IBM's

SYSTEM NETWORK ARCHITECTURE

AND

TELEPROCESSING ACCESS METHODS

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UNIT 1

INTRODUCTION

SNA OVERVIEW

A THREE DAY SEMINAR ON AN OVERVIEW OF SNA WITH A REVIEW OF LIMITATIONS OF PRE-SNA SOLUTIONS AND AN OVERVIEW OF ADVANCED COMMUNICATIONS FUNCTION FOR VIRTUAL TELECOMMUNICATIONS ACCESS METHOD (ACF/VTAM), ADVANCED COMMUNICATIONS FUNCTION FOR TELECOMMUNICATIONS ACCESS METHOD (ACF/TCAM), AND ADVANCED COMMUNICATIONS FUNCTION FOR NETWORK CONTROL PROGRAM (ACF/NCP)

SEMINAR IS SUITABLE FOR SOME ONE STARTING IN SNA AND IS MEANT TO BE USED AS THE FIRST INTRODUCTORY COURSE

NOT SUITABLE FOR PEOPLE WITH PRIOR SNA KNOWLEDGE OR EXPERIENCE

SOME RELEVENT QUESTIONS:

WHY IS SNA RELEVENT TO OUR PARTICULAR NETWORK?

WHAT MAKES A NETWORK SNA? BSC IN SNA?

WHAT DO I NEED TO KNOW ABOUT SNA TO OPERATE IN THIS ENVIRONMENT EFFECTIVELY

BACKGROUND THAT WILL BE HELPFUL

1. FAMILIARITY WITH COMPONENTS OF A DATA COMMUNICATIONS SYSTEM

2. AT LEAST CONCEPTUAL FAMILIARITY WITH IBM SYSTEM SOFTWARE COMPONENTS SUCH AS OPERATING SYSTEM, ACCESS METHODS, AND TELEPROCESSING MONITORS

4. MORE THAN SUPERFICIAL FAMILIARITY WITH BTAM, EP, AND TELEPROCESSING MONITORS

3. GENERAL AWARENESS OF CURRENT TRENDS IN IN DATA COMMUNICATIONS TECHNOLOGY

SOME OBSERVATIONS:

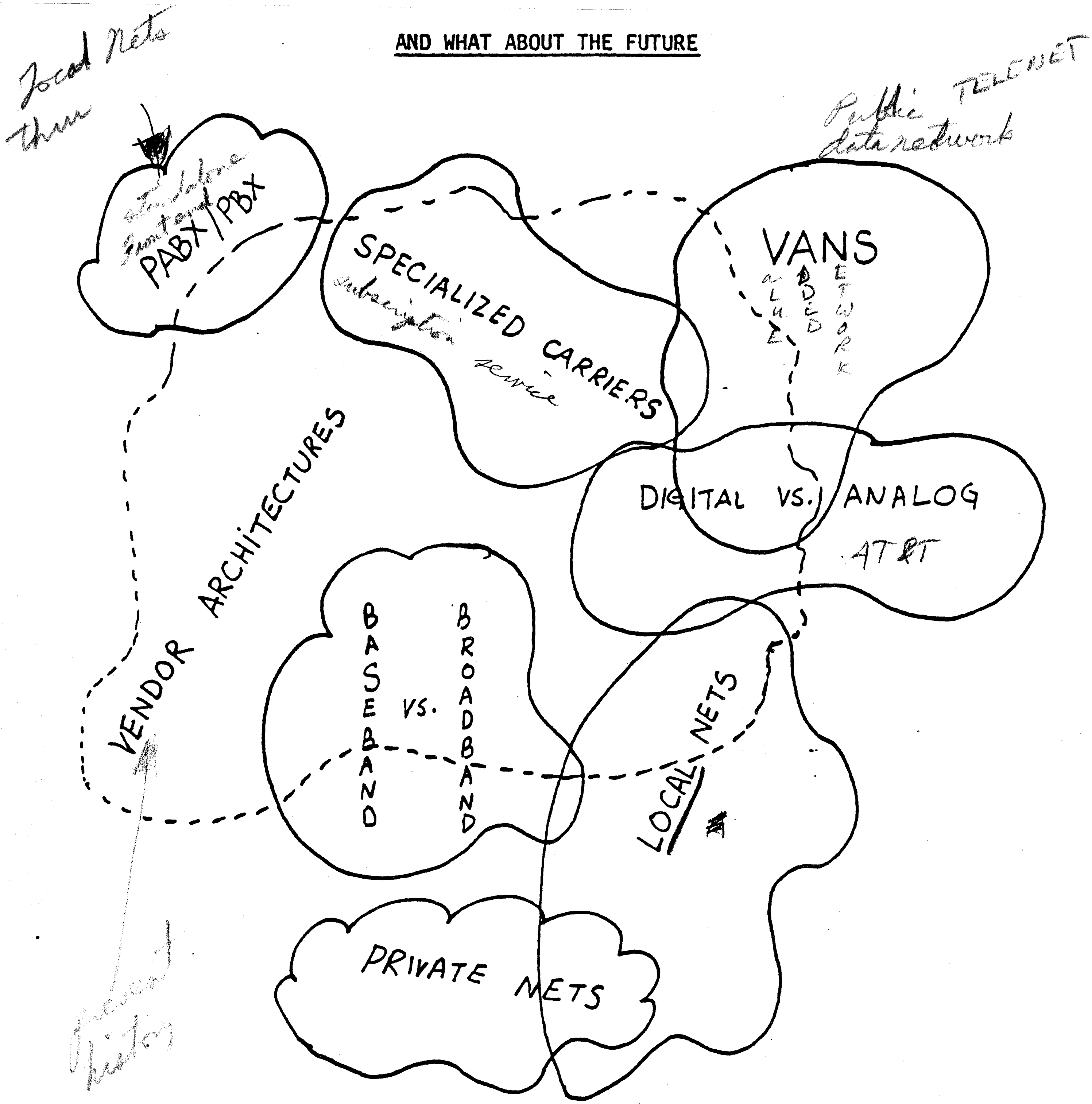
1. DIVERSITY OF EXPECTED AUDIENCE; DIFFERENT AREAS AND LEVELS OF EXPERTISE

2. INHERENT PROBLEMS IN PRESENTING INFORMATION TO A DIVERSE GROUP SUCH AS ABOVE

TTY TO TTY →	TTY TO COMPUTER →	TTY SOME CRT →	MULTIPLICITY: NETWORKS DEVICES APPLICATIONS
NO COMPUTERS	SPECIAL HARDWARE/ SOFTWARE	STILL SPECIALIZED BUT WITHIN REACH	T.P. MONITORS, EVERYONE IS GETTING INTO THE ACT
			↑
			MID 70s TO PRESENT

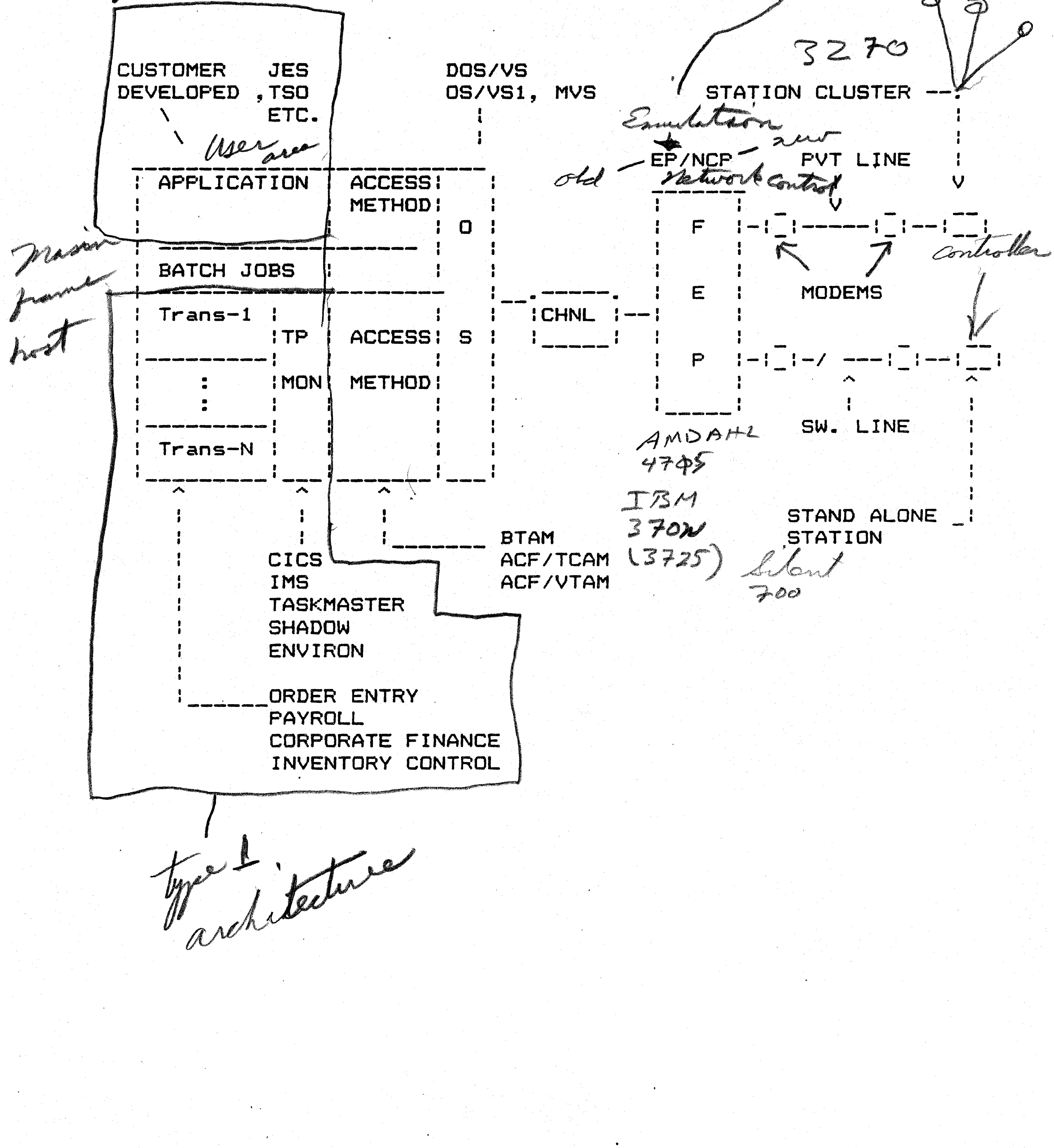
WHERE WE ARE

AND WHAT ABOUT THE FUTURE



CONFUSION REIGNS

IBM ENVIRONMENT: WHERE EVERYTHING FITS



TP_ACCESS_METHODS_FROM_IBM

1. BASIC TELECOMMUNICATIONS ACCESS METHOD (BTAM)

   - OLDEST (SINCE MID 60s)
   - SIMPLEST
   - STILL THE MOST COMMON

   No Bugs reliable

2. ADVANCED COMMUNICATIONS FUNCTION FOR VIRTUAL TELECOMMUNICATIONS ACCESS METHOD (ACF/VTAM)

   - LATEST (SINCE MID 70s)
   - VERY COMPLEX
   - PRIMARY VEHICLE FOR SNA

3. ADVANCED COMMUNICATIONS FUNCTION FOR TELECOMMUNICATIONS ACCESS METHOD (ACF/TCAM)

   - SINCE EARLY 70s
   - MOST COMPLEX
   - SNA SUPPORT, ALTERNATIVE TO VTAM

ACCESS METHODS, FEP SOFTWARE, AND PROTOCOLS

WHAT GOES WITH WHAT

370 Host	3705 (FEP	Link Protocols
BTAM	EP	SS, BSC
TCAM	EP OR NCP	SS, BSC (EP) SS, BSC, SDLC (NCP)
VTAM	NCP	SDLC, 3270 BSC

ACF: ADVANCED COMMUNICATION FUNCTION

1. PART OF SNA CAPABILITIES, STEP IN EVOLUTION.

2. ANNOUNCED 1977, MOST SIGNIFICANT NEW FEATURE: MULTIPLE HOSTS ON A COMMON NETWORK.

3. ALL PRODUCT RELEASES (VTAM, TCAM, AND NCP) WITH THESE NEW CAPABILITIES HAD THE "ACF" PREFIXES WITH THEIR NAMES.

4. TODAY ALL CURRENT RELEASES ARE "ACF" RELEASES AND HAVE BEEN FOR A FEW YEARS. SO THE ACF DESIGNATION HAS, IN A SENSE, BECOME MEANINGLESS.

5. ALL REFERENCES TO VTAM, TCAM, AND NCP IN THIS LECTURE ARE TO THEIR "ACF" RELEASES EVEN THOUGH "ACF" IS NOT SHOWN.

<u>WHAT'S THE STORY ON "ACF"</u>

THE ROAD MAP

1. **THE STONE AGE:**

   - OVERVIEW OF BTAM/EP
   - ASYNCHRONOUS AND BINARY SYNCHRONOUS COMMUNICATIONS (BSC) PROTOCOLS
   - TELEPROCESSING MONITORS

2. **THE RENNAISANCE:**

   - LIMITATIONS OF PREVAILING IBM TECNOLOGY
   - CUSTOMER NEEDS FOR NEW SOLUTIONS

3. **THE GREAT LEAP FORWARD**

   - NEW ANSWERS, NETWORKING ARCHITECTURES
   - SNA OVERVIEW, SINGLE DOMAIN AND SDLC

4. **DOING IT VIRTUALLY**

   - SNA IMPLEMENTATION WITH VTAM AND NCP

5. **SO WHAT'S AN 'MCP'?**

   - DOING IT WITH ACF/TCAM

6. **HOW IS YOUR INTERNODAL AWARENESS?**

   - SELECTED TOPICS IN MULTIPLE SYSTEMS NETWORKING FACILITY (MSNF)

UNIT 2

HOST CONTROL SOFTWARE REVIEW

OBJECTIVES

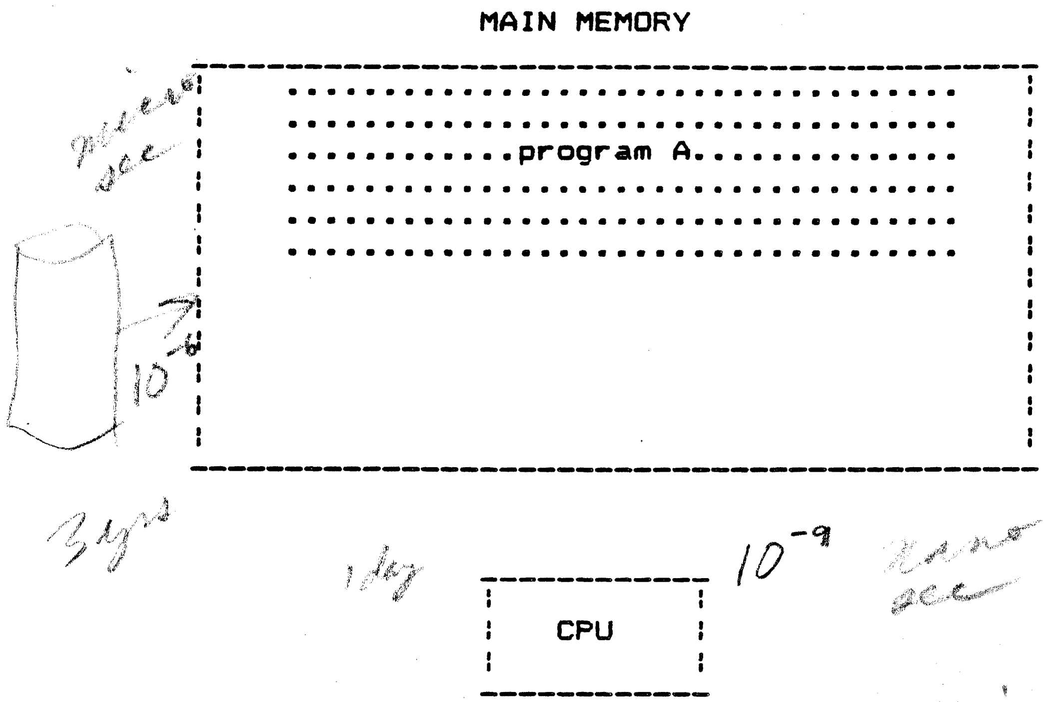
TO REVIEW FUNCTIONS/DEFINITIONS OF:

IO SUBSYSTEM AND RELATIONSHIP TO MULTIPROGRAMMING

JOB MANAGER AND RESOURCE ALLOCATION (TP LINES)

IO OPERATION, ACCESS METHODS, AND CHANNEL PROGRAMS

DESCRIBING LINES TO THE OPERATING SYSTEM, IODEVICE



The speed relationship. If it takes one day to read data in main memory it would take 3 yrs to read from the disk

QUESTIONS:

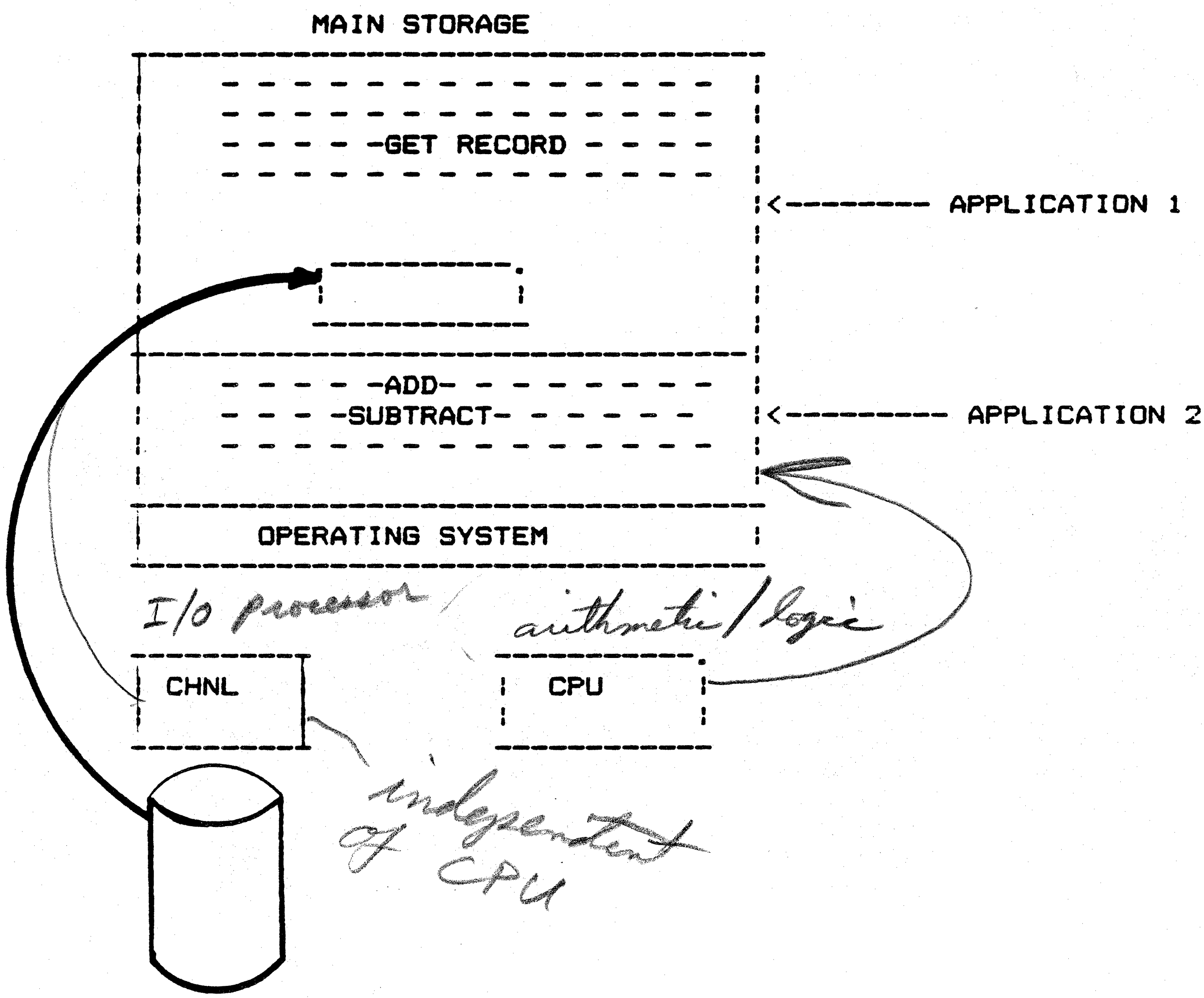
1. WOULD DATA FILES NEEDED BY THE PROGRAM BE CONTAINED WITHIN THE BODY OF PROGRAM 'A'?

2. WHAT ARE THE IMPLICATIONS FOR THE PROGRAM IF THE DATA IS NOT IN MAIN STORAGE?

3. WHAT IS A COMMON APPROACH TO IMPROVE CPU UTILIZATION BECAUSE OF MAIN STORAGE LIMITATIONS?

THE_HISTORIC_CPU_VS._MAIN_STORAGE_LIMITATIONS_DILEMMA

TRANSFERRING CONTROL FROM ONE ONE APPLICATION TO ANOTHER DURING AN I/O OPERATION

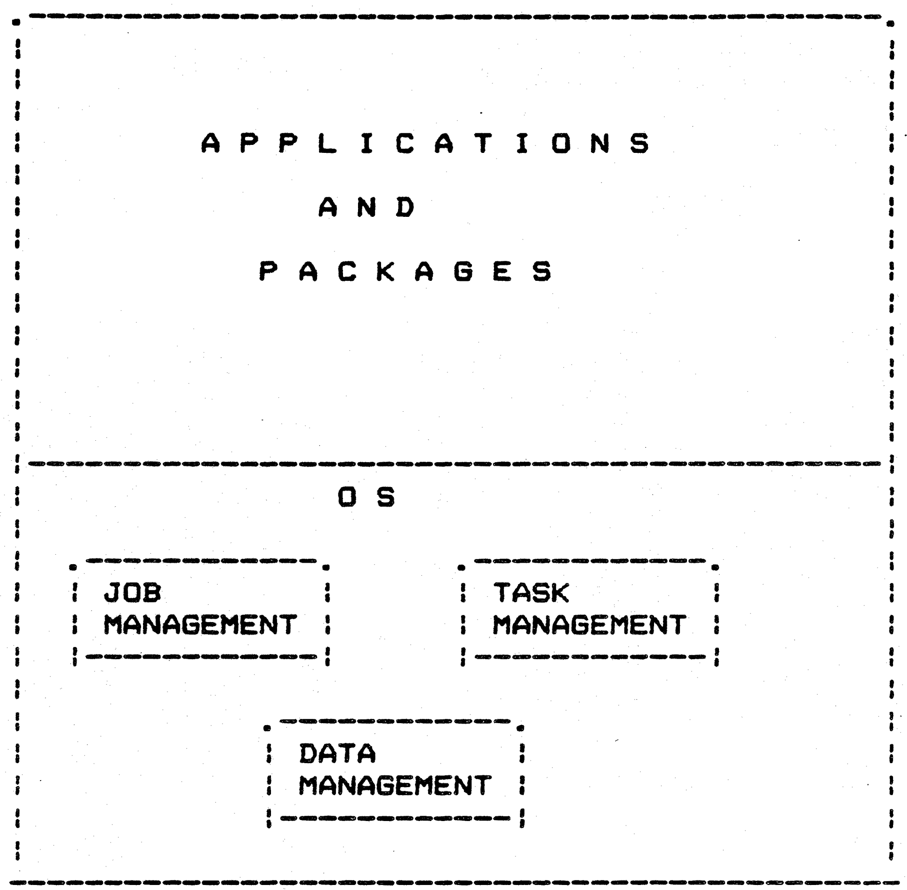


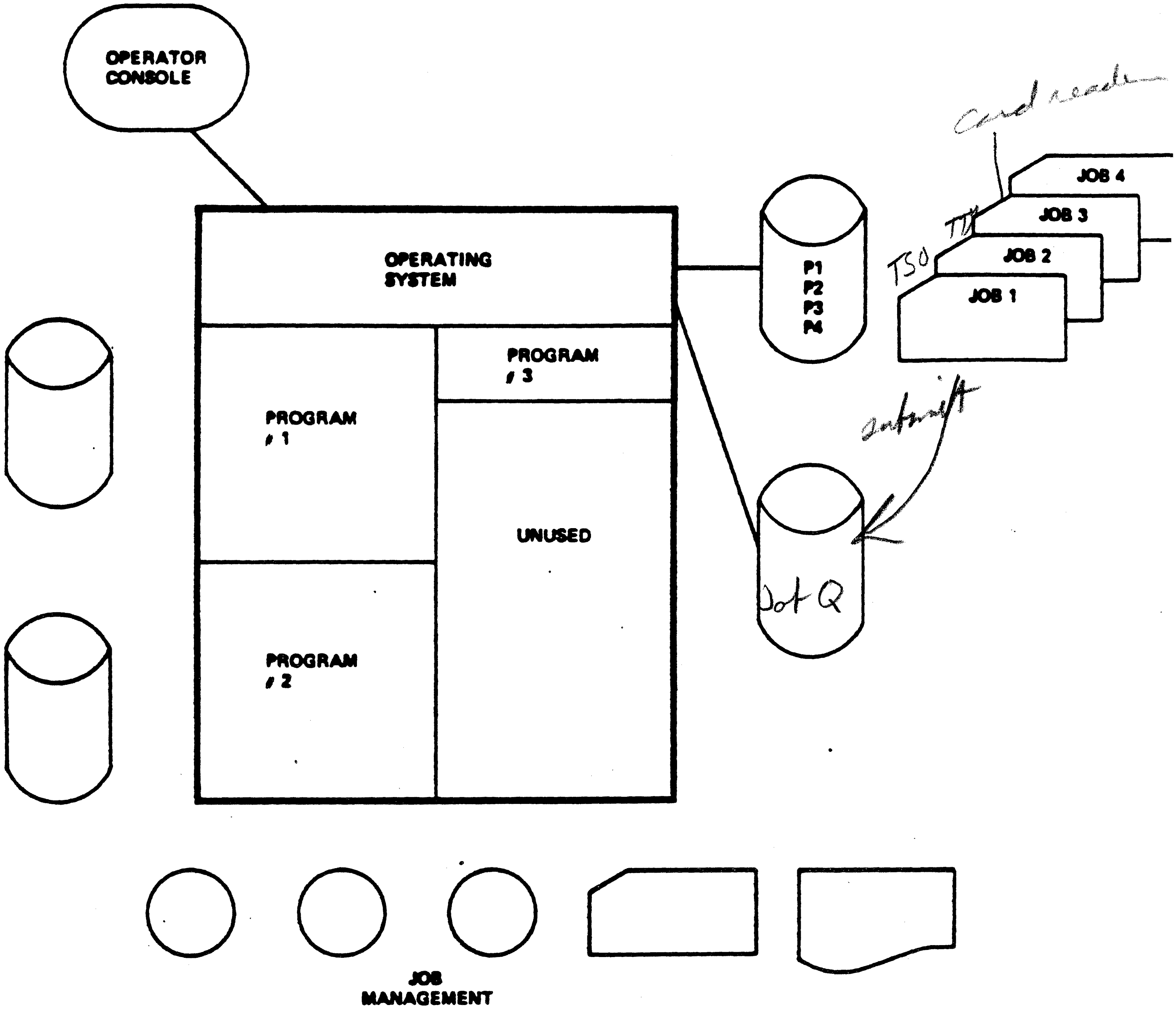
WHILE I/O CHANNEL EXECUTES CHANNEL COMMANDS, THE CPU CAN EXECUTE INSTRUCTIONS FROM ANOTHER PROGRAM

M U L T I P R O G R A M M I N G

- ABILITY TO RUN MORE THAN ONE PROGRAM CONCURRENTLY ON THE MACHINE
- AN ATTRIBUTE OF THE OPERATING SYSTEM AND NOT OF THE CPU
- PRIMARY PURPOSE: TO INCREASE CPU UTILIZATION
- NOT POSSIBLE WITHOUT AN INDEPENDENT I/O CHANNEL CAPABLE OF EXECUTING COMMANDS (INSTRUCTIONS)

OPERATING SYSTEM COMPONENTS OF INTEREST FOR TELEPROCESSING





ALLOCATING RESOURCES TO A JOB

DESCRIBING IO RESOURCES TO THE OPERATING SYSTEM

SUBCHANNELS:

1. EACH SUBCHANNEL REPRESENTS A UNIQUE DATA PATH THROUGH A CHANNEL 256 subchannel to a channel

2. FOR OS PURPOSES EACH LINE (EP) OR EACH COMPLETE 370X (NCP) IS ASSIGNED A UNIQUE SUBCHANNEL

3. FOR EACH SUBCHANNEL, THE PROFILE OF THE DEVICE ASSIGNED TO IT IS KEPT IN A TABLE CALLED UNIT CONTROL BLOCK (UCB). CONVERSELY, THERE IS ONE UCB PER DEVICE

4. STANDARD IBM PROVIDED SYSTEM GENERATION PROCEDURES ARE USED CREATE UCB TABLES

ILLUSTRATIVE_MACROS_FOR_DESCRIBING_TP_LINES

TO_AN_OS_TYPE_OPERATING_SYSTEM_IN_AN_EP/BTAM_ENVIRONMENT

IODEVICE	ADDRESS=0FF, UNIT=3705, :	NATIVE SUBCHANNEL FOR 3705
IODEVICE	ADDRESS=0F0, UNIT=BSC1	SUBCH 0F0 ASSIGNED TO A BSC1 LINE
IODEVICE	ADDRESS=0F2, UNIT=BSC1	SUBCH 0F2, ONE MORE BSC1 LINE
IODEVICE	ADDRESS=0F3, UNIT=BSC3	SUBCH 0F3 ASSIGNED TO A BSC3 LINE
IODEVICE	ADDRESS=(0F8,6), UNIT=TWX, FEATURE=AUTOANSR	6 TWX LINES SUBCHNLS 0F8-0FD HOST TO AUTO-ANSWER
IODEVICE	ADDRESS=0F5, UNIT=BSC2, FEATURE=AUTOCALL	SUBCH 0F5 ASSIGNED FOR BSC2 LINE HOST IS TO DIAL OUT

NOTE: BSC1=POINT TO POINT, PRIVATE
BSC2=POINT TO POINT, SWITCHED
BSC3=MULTIPOINT, PRIVATE — 3270

(FOR NCP ENVIRONMENT ONE SUBCHANNEL WOULD SUFFICE FOR THE WHOLE NETWORK)

JOB CONTROL LANGUAGE (JCL) AND JOB MANAGEMENT

OS OR JOB MANAGER KNOWS THE TOTAL UNIVERSE OF IO DEVICES IN THE SYSTEM VIA UCBs DEFINED DURING SYSTEM GENERATION

EACH PROGRAM, AS IT ENTERS THE SYSTEM FOR EXECUTION, MUST DECLARE RESOURCES NEEDED BY IT SO THAT THE JOB MANAGER CAN DETERMINE WHETHER RESOURCES NEEDED ARE AVAILABLE OR NOT

JOB CONTROL LANGUAGE IS THE MEANS BY WHICH A PROGRAMMER INFORMS THE JOB MANAGER AT EXECUTION TIME THE RESOURCES NEEDED TO RUN THE PROGRAM

THREE MAJOR TYPES JCL STATEMENTS USED ARE:

- JOB STATEMENT
- EXEC STATEMENT
- DATA DEFINITION (DD) STATEMENT

COMMON JCL STATEMENT TYPES

JOB STATEMENT

- o JOB NAME
- o JOB ACCOUNTING INFORMATION
- o STORAGE, PRIORITY, ...

EXEC STATEMENT

- o NAME OF PROGRAM TO BE RUN
- o OTHER OPTIONAL INFORMATION

DATA DEFINITION (DD) STATEMENT

- o DECLARES IO RESOURCES (FILES, NETWORK) NEEDED BY THE PROGRAM
- o ONE DD STATEMENT PER FILE AND LINE (EP) OR PER 370X (NCP)
- o TELLS THE OPERATING SYSTEM WHETHER THE RESOURCE BEING IDENTIFIED IS TO BE EXCLUSIVELY OWNED BY THIS JOB OR CAN IT BE SHARED WITH OTHER JOBS IN THE SYSTEM

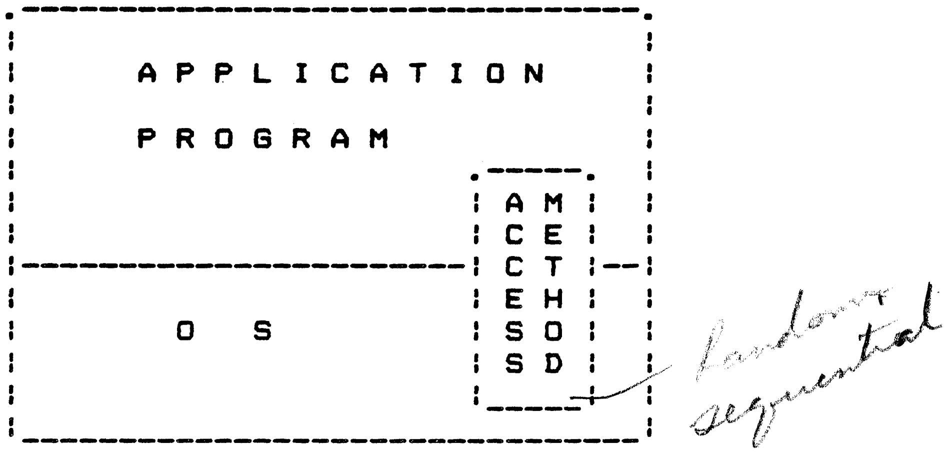
TASK MANAGEMENT

```
 ------------------------------------.
 :                                   :
 :        J O B   1                  :<-----  WAITING  FOR  AN
 :                                   :
 :                                   :        IO  TO  COMPLETE
 :-----------------------------------:
 :                                   :
 :                                   :
 :         J O B   2                 :<-----  CAN USE THE CPU
 :                                   :        BUT JOB 3 HAS A
 :-----------------------------------:        HIGHER PRIORITY
 :                                   :
 :                                   :
 :         J O B   3                 :<-----  CURRENTLY  USING
 :                                   :        CPU (i.e. ACTIVE)
 :-----------------------------------:
 :          O S                      :
 :                                   :
 :    .------------------.           :
 :    :     TASK         :           :
 :    :     MANAGEMENT   :           :
 :    :------------------:           :
 -------------------------------------
```

- o WHO USES THE CPU NEXT ?
- o WHERE IS A PROGRAM TO BE RESTARTED AFTER COMPLETION OF ITS REQUESTED OPERATION?

DATA MANAGEMENT

A COLLECTIVE NAME FOR ALL ACCESS METHODS AVAILABLE WITH AN OPRATING SYSTEM



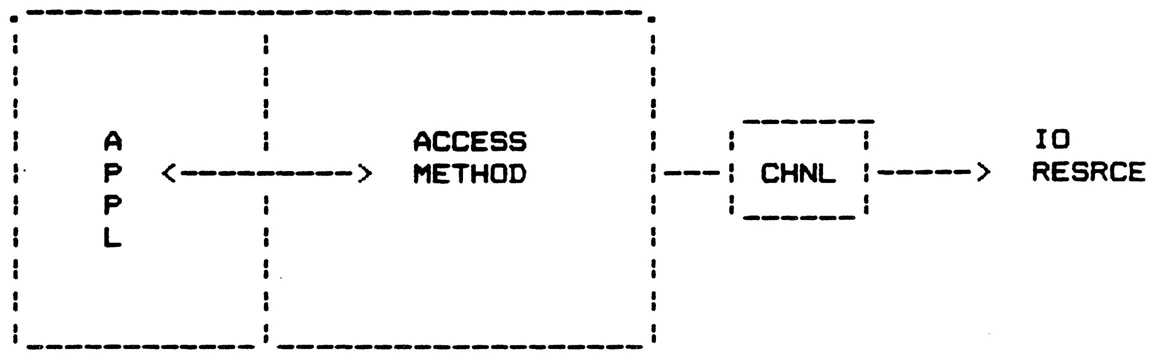
ACCESS METHOD:

A DISCIPLINE FOR ORGANIZING, STORING AND RETRIEVING INFORMATION FROM IO DEVICES

A MAJOR FUNCTION: TO PROVIDE INSTRUCTIONS FOR THE CHANNEL TO AFFECT DATA TRANSFER

WHAT MUST A PROGRAM TELL THE ACCESS METHOD

TO REQUEST DATA TRANSFER



1. WHERE IS THE DATA TO BE MOVED FROM OR PLACED AT IN MAIN STORAGE

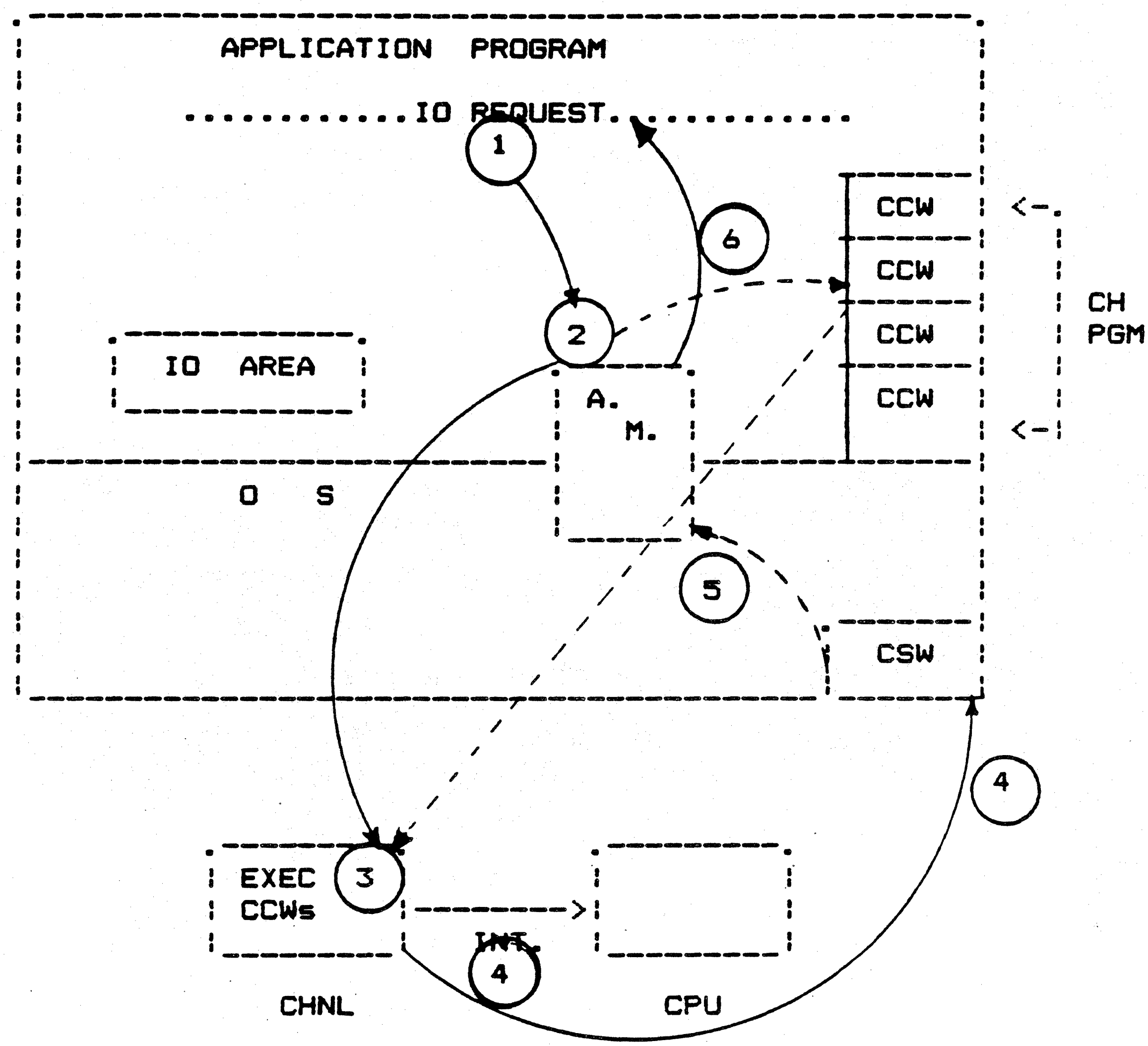
2. WHETHER DATA IS TO BE MOVED FROM OR TO MAIN STORAGE

3. HOW MUCH DATA IS TO BE MOVED

4. DESCRIPTION OF DATA ON THE IO MEDIUM AND WHERE TO PLACE DATA ON IO DEVICE

:

FLOW OF CONTROL DURING AN OPERATION: (MAJOR ACTIVITIES)



NOTES:

1. NOT ALL DETAILS SHOWN
2. CCW: CHANNEL COMMAND WORD
3. CSW: CHANNEL STATUS WORD

I/O OPERATION: FLOW OF CONTROL

1. Application program sends a request for an IO to the access method.

2. Access method validates the request and builds a channel program.

3. Channel executes the channel program thereby transferring data to/from main storage.

4. Channel places the status of the I/O operation at a predetermined location called the Channel Status Word, CSW, and interrupts the CPU.

5. Access method analyzes the CSW, may try error recovery if appropriate.

6. Access method returns control to the application program with an indication of whether the IO completed successfully or not.

UNIT 3

IBM 3705/EMULATION PROGRAM (EP)

OBJECTIVES:

TO DESCRIBE THE FUNCTION OF MAJOR 3705 HARDWARE COMPONENTS

TO DESCRIBE THE FUNCTION OF MAJOR EP GENERATION MACROS

WHAT IS THE 370X:

- o A SPECIALIZED MINICOMPUTER

  PROCESSOR (CENTRAL CONTROL UNIT)
  MEMORY
  NO SECONDARY STORAGE
  NO CONSOLE EXCEPT MODEL 3725

- o VARIOUS MODELS AS DISCUSSED EARLIER

WHAT IS THE EMULATION PROGRAM:

- o CONTROL SOFTWARE FOR 370X
- o MAKES THE 370X APPEAR LIKE THE OLD, NON-PROGRAMMABLE IBM 270X
- o PREPARED IN THE HOST AND DOWN-LOADED IN TO THE FRONT END BEFORE FEP CAN BE USED

FUNCTIONS_OF_370X_IN_EP_MODE

1. MAKES UP FOR THE SPEED MISMATCH BETWEEN NETWORK AND THE SYSTEM 370

2. PROVIDES STANDARD INTERFACE REQUIRED BY 370 CHANNEL ON BEHALF OF THE NETWORK

3. PROVIDES PAD AND SYN CHARACTERS FOR BSC AND START/STOP BITS FOR ASYNCH LINE PROTOCOLS

4. EXECUTES CHANNEL COMMANDS ORIGINALLY PROVIDED BY THE ACCESS METHOD

5. COMPUTES AND CHECKS BCC FOR BSC LINES

6. PROVIDES STATUS INFORMATION TO HOST IN RESPONSE TO CERTAIN CONTROL CHARACTERS AND NETWORK CONDITIONS

7. CONTAINS NO TERMINAL IDs AND INITIATES NO ACTION WITHOUT HOST COMMANDS

3705 HARDWARE COMPONENTS

```
                                                           COMMN
  H O S T              |        F E P                      SCANNER
                       |                                 <-------------->
                       |                 .-------.      .--------------.
 -------               |                 | C     |      |      | LS1   |
       |     .-----.   |    .-----.      |       |      |      |-------|
  SYS  |<->|CHNL  |<------>| C.   |<-->|   C   |<-->|      | LS2   |
       |     |     |   |    |  A. |      |       |      |      |-------|
  370  |     |_____|   |    |_____|      |   U   |      |      |   :   |
       |               |                 |       |      |      |   :   |
 ------|               |                 |       |      |      |   :   |
                       |                 |_______|      |______|_______|
                       |                                           ^
                                                                   |
                                                                  LIB
```

1. BASIC MACHINE: CCU, MAIN STORAGE, CONTROL PANEL

2. CHANNEL ADAPTER: CONNECTS 3705 TO HOST CHNL, FOUR TYPES, 1-4. ONLY 1 AND 4 FOR EP

3. COMMN. SCANNER: BUFFERS LINE DATA, PROVIDES CLOCKS, MANAGES LIBs AND LINE SETS

4. LINE INTERFACE BASE (LIB): PROVIDES HOUSING FOR MAX 8 LINE SETS

5. LINE SETS: PROVIDES MAX 2 HDX PORTS WITH EIA INTERFACE FOR EACH PORT

MUST HAVE AT LEAST ONE OF EACH OF THE ABOVE COMPONENTS IN A WORKING 370X

CREATING_AN_EMULATION_PROGRAM

- 3705 DERIVES ALL ITS INTELLIGENCE FROM EP WHICH MUST BE CREATED BY THE CUSTOMER

- GENERATION OF EP REQUIRES CREATING VARIOUS TABLES CONTAINING INFORMATION SUCH AS

  - GENERAL CHARACTERISTICS OF THE 370X AND THE EP ITSELF
  - TYPES OF CHNL. ADAPTERS, SCANNERS, AND CLOCKS
  - CHARACTERISTICS OF EACH LINE ATTACHED TO THE 370X

- IBM PROVIDES CODING AIDS (MACROS) TO EASE THE TASK OF CREATING THE ABOVE TABLES

- SINCE 370X DOES NOT HAVE ENOUGH 'HORSE-POWER' ACTUAL CREATION OF THE EP PROGRAM TAKES PLACE IN SYS 370

MACROS_AVAILABLE_TO_DEFINE_EP_PROFILES

BUILD

ONE AND ONLY ONE BUILD MACRO PER EP GENERATION, DESCRIBES THE 'SYSTEM' ITSELF

CSB

DESCRIBES A COMMN. SCANNER, ONE/SCANNER

GROUP

DESCRIBES COMMON CHARACTERISTICS OF A GROUP OF SIMILAR LINES

LINE

DESCRIBES CHRACTERISTICS OF LINE, ONE/LINE

GENEND

INDICATES END OF TABLES, MUST BE THE VERY LAST MACRO.

AN_EXAMPLE_OF_EP_MACRO_SEQUENCE

A 370X WITH 2 SCANNERS, 2 LINES USING ONE TYPE OF PROTOCOL AND A THIRD LINE WITH A DIFFERENT PROTOCOL

	BUILD	THE 'BOX' ITSELF
	CSB	1ST SCANNER
	CSB	2ND SCANNER
GRP1	GROUP	1ST GROUP WITH 2 LINES
G1L1	LINE	1ST LINE IN THIS GROUP
G1L2	LINE	2ND LINE IN THIS GROUP
GRP2	GROUP	BEGIN NEXT GROUP
G2L1	LINE	THE ONLY LINE IN THIS GROUP
	GENEND	END OF GENERATION TABLES

EP_MACROS:_ILLUSTRATIVE_VALUES

```
        MACRO NAME    VALUE                      COMMENTS
            :           :                            :
            :           :                            :
            v           v                            v

            BUILD       TYPGEN=EP,                 TYPE OF GENERATION
                        TYPSYS=OS,                 TYPE OF HOST OP SYS
                        MODEL=3705-2,              TYPE 2 3705
                          :

            CSB         TYPE=TYPE2,                TYPE OF SCANNER
                          :

GRPX        GROUP       LNCTL=BSC,                 A BSC GROUP
                        DIAL=NO,                   PRIVATE/DEDICATED LINE
                          :

LINE1       LINE        SPEED=9600,                LINE SPEED IN BPS
                        ADDRESS=.....,             PORT AND SUB CH ADDR
                        TERM=3271,                 TYPE OF TERMS ON LINE
                          :

GRPY        GROUP       LNCTL=SS,                  AN ASYNCH GROUP
                        DIAL=YES,                  SWITCHED LINES
                          :

LINE2       LINE        SPEED=110,                 LINE SPEED IN BPS
                        ADDRESS=....,              PORT AND SUB CH ADDR
                        TERM=TWX,                  TWX TYPE TERMS
                          :

            GENEND
```

3705 EP EXERCISE

```
                SYSTEM 370
          .--------------------.
          :        BTAM        :
          :   BASED SOFTWARE   :
          :--------------------:
          :       O.   S.      :
           --------------------
                     :
                .-----.
                :     :   I/O CHNL
                 -----
                     :
             .---------------.
             :   :_C.A._:    :
             :               :
          ^  :---------------:
SCANNER   :  :...............:
          v  :_____:__:_____:<-----   LIB

                           LINE SET
```

BSC3 @4800 BPS SS, AUTOANSWER @300BPS

For the configuration above, code appropriate EP macros in the correct order. Where applicable, code those values that were discussed in the class.

3705 MODEL 80

- o DESIGNED AND PRICED FOR ENTRY LEVEL CUSTOMERS
- o FUNCTIONALLY NO DIFFERENT THAN EARLIER MODELS
- o NO DIFFERENCE AS FAR AS SYSGENS AND INTERFACES ARE CONCERNED
- o BETTER PRICE OERFORMANCE THAN OLDER MODELS

SOFTWARE CONFIGURATIONS:

EP, NCP, AND PEP

HARDWARE CONFIGURATIONS:

THREE SUB-MODELS:

4 LINES 10 LINES 16 LINES

19.2 KBPS HIGHEST LINE SPEED FOR BSC AND SDLC,
9600 BPS FOR S/S

50 KBPS FOR DIGITAL CIRCUITS

ONLY TYPE 2 SCANNERS

TYPE 1 AND 4 CHANNEL ADAPTERS (TYPE 1 ONLY ON BYTE MUX CHANNELS)

CAN OPERATE AS A REMOTE

TOTAL CAPACITY SENSITIVE TO MESSAGE SIZES AND LINE SPEEDS

3725 MODELS 1 AND 2

- o LONG AWAITED AND SPECULATED MACHINES
- o DISAPPOINTING IN TERMS OF WHAT WAS ANTICIPATED
- o BETTER PRICE PERFORMANCE THAN OLDR MODELS BUT NO NEW MAJOR FUNCTIONS EXCEPT THE CONSOLE
- o SOME LONG STANDING SHORTCOMINGS:

    NO SECONDARY STORAGE

    NO MESSAGE SWITCHING

    MOST OF THE CONTROL STILL IN HOST (WOULD REMAIN SO TILL NEW ACCESS METHODS ARE AVAILABLE)

    STILL NO TRUE "AUTO BAUD RATE DETECT"

    DIAL DIGITS IN HOST

    :

    :

3725 MODELS 1 AND 2 (CONTD.)

BOTH SUPPORT:

CONSOLE TERMINAL
EP, NCP, PEP
ACF/NCP AT LEASET VERSION 2
MODULO 128 ACKNOWLEDGEMENTS ON NCP-NCP LINKS
SEPARATE PROCESSOR AND DISKETTE FOR THE OPERATOR SUBSYSTEM
MICROPROCESSOT BASED SCANNERS

NEW MODELS DO NOT SUPPORT OLD LIBS, LINE SETS, SCANNERS AND CHANNEL ADAPTERS

NEW HARDWARE HAS NEW NAMES

MODEL 1:

MAX 256 LINES
MAX 2M STORAGE (1M WITH EP)
UP TO FOUR 3725s CAN SHARE THE SAME CONSOLE WITH A SPECIAL OPTION

MODEL 2:

MAX 24 LINES
MAX 512 K

EXPANSION BOX: 3726

SYSTEM CONSOLE: 3727

UNIT 7

BASIC TELECOMMUNICATIONS ACCESS METHOD

(BTAM)

OBJECTIVES:

AT THE CONCLUSION OF THIS UNIT, THE ATTENDEE SHOULD BE ABLE TO:

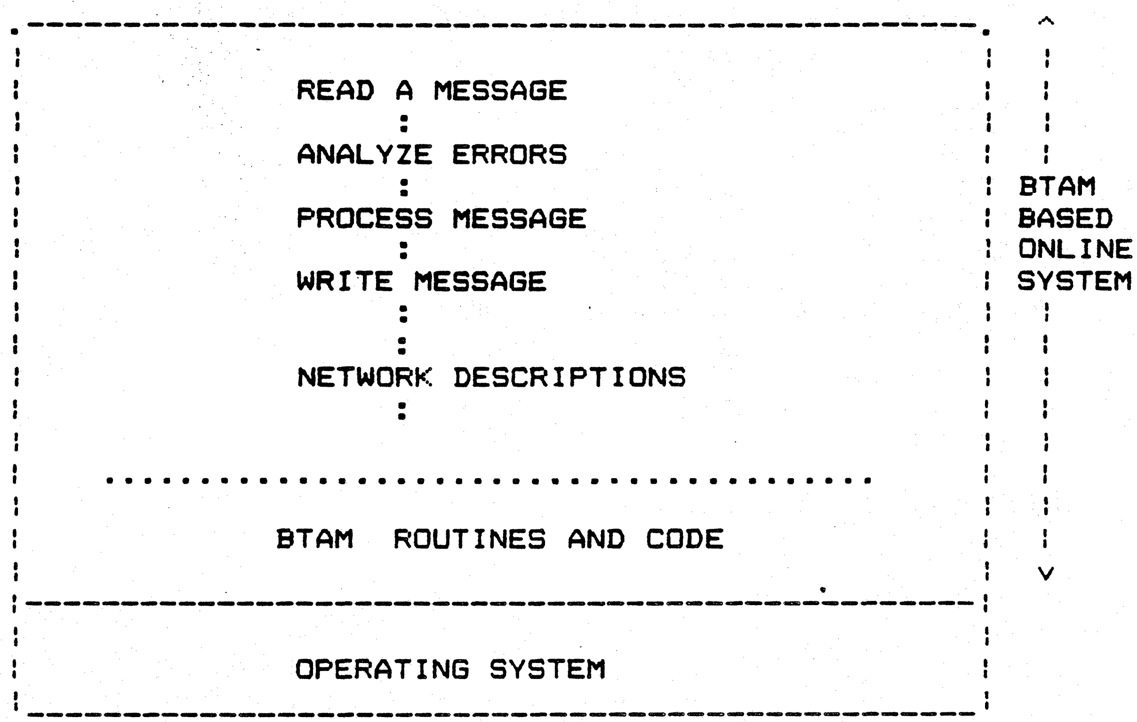
1. DESCRIBE MAJOR FUNCTIONS PERFORMED BY BTAM

2. IDENTIFY MAJOR MACROS AND FACILTIES AVAILABLE WITH BTAM

3. DESCRIBE THE LOGICAL FLOW A BTAM PROGRAM AT A HIGH LEVEL

4. DESCRIBE HOW POLLING AND SELECTION LISTS ARE CODED FOR IBM 3270s

WHAT BTAM DOES



- PROVIDES MACROS FOR APPLICATION PROGRAM TO:

  SPECIFY I/O (READ/WRITE) REQUESTS
  SPECIFY NETWORK DESCRIPTIONS

- CREATES CHANNEL PROGRAMS BASED UPON APPLICATION REQUEST

- INITIATES CERTAIN ERROR RECOVERY PROCEDURES

BTAM APPLICATION PROGRAM
(COMMUNICATIONS FUNCTIONS)

EXECUTABLE CODE:

1. ACTIVATE (OPEN) LINES
2. ISSUE I/O REQUESTS TO RECEIVE AND SEND MESSAGES
3. SYNCHRONIZE CPU OPERATIONS WITH I/O OPERATIONS
4. ANALYZE BTAM REPORTED ERROR

TABLES AND PROFILES:

1. NETWORK DESCRIPTIONS:

   LINES, TERMINALS, DIAL OUT NUMBERS, ...

2. INPUT/OUTPUT AREAS TO RECEIVE OR SEND MESSAGES
3. PARAMETER LIST FOR BTAM AND APPLICATION TO TALK TO EACH OTHER

WHAT MUST YOU KNOW 'BEFORE' CODING A BTAM PROGRAM

1. LINK PROTOCOLS

2. YOUR DEVICE

   - o BSC/SS
   - o BUFFER SIZE
   - o CONTROL CHARACTERS, COMMANDS, ORDERS
   - o DATA FLOW SEQUENCES

3. SOURCES OF INFORMATION

   - o BTAM REF. MANUAL
     - o GENERAL INFO. P. 1-52
     - o SPECIFIC DEVICES, SEE TABLE OF CONTENTS
   - o DEVICE TECHNICAL REFERENCE PROVIDED BY THE VENDOR FOR DEVICES IN YOUR NETWORK

MAJOR BTAM MACROS

EXECUTABLE:

OPEN	OPENS A GROUP OF LINES AND LOADS BTAM
CLOSE	CLOSES A GROUP OF LINES AND REMOVES BTAM
READ	REQUESTS DATA FROM THE NETWORK
WRITE	SENDS DATA TO THE NETWORK
WAIT	SUSPENDS THE PROGRAM PENDING I/O COMPLETION

TABLE AND PROFILES:

DCB	DATA CONTROL BLOCK, DESCRIBES A GROUP OF SIMILAR LINES
DFTRMLST	DESCRIBES TERMINALS ON A LINE
DECB	PARAMETER LIST FOR APPLICATION AND BTAM TO TALK TO EACH OTHER (THIS IS NOT A MACRO)

A_BTAM_PROGRAM_LOGIC_FLOW

```
BTAMPGM   START
            :
        program initialization
          code
            :
            :
          OPEN       GROUP1                     LOAD  BTAM
            :
          READD      ....,AREA ADDRESS,LENGTH,.....

          WAIT
            :
  process  message  received and
  create   an  output  message
            :
          WRITE      ....,MSG ADDR,MSG LENGTH,.....

          WAIT

     loop  back  to  READ  next
     message,  end  of  day  the
     following  logic
            :
          CLOSE      GROUP1                 CLOSE NETWORK

          BR         14                     TERMINATE  PGM

*    MESSAGE  AREAS  AND  TABLES  NEEDED  IN  THE  PROGRAM
*    FOLLOW

     GROUP1    DCB       .....,DEVD=BS,.....

     POLLST    DFTRMLST  .......C1C140402D.....

               decb  area

     INAREA    DS        CL??

     MSGOUT    DC        C'WRITE  ME  TO  CRT'

               END
```

DESCRIBING_NETWORK_IN_A_BTAM_PROGRAM

- PRIMARY TABLES

  DATA CONTROL BLOCK (DCB)

  TERMINAL LIST DEFINININITIONS (DFTRMLST)

- INFORMATION CODED

  LINES: PRIVATE / SWITCHED

  BSC / SS

  FOR PRIVATE LINES: POLLING SEQUENCES

  SELECTION SEQUENCES

  FOR SWITCHED LINES: HOST ID

  DEVICE ID

  DIAL DIGITS

DATA CONTROL BLOCK (DCB) MACRO

(name)   DCB   DSORG=CX,DDNAME=.....,.......

1. DCB DESCRIBES A GROUP OF SIMILAR LINES
2. DSORG=CX INDICATES A GROUP TP LINES SUPPORTED VIA BTAM
3. DDNAME= IDENTIFIES THE NAME OF THE JCL DD STATEMENTS THAT IDENTIFY PHYSICAL LINES REPRESENTED BY THIS DCB

RELATIONSHIP BETWEEN UCB, DCB, AND JCL

1. OS SYSTEM PROGRAMMER DEFINES UCBs DURING OS SYSGEN TO ASSIGN LINES TO SPECIFIC SUBCHANNELS

UCB	UCB	UCB	UCB	UCB	UCB
010	011	012	013	014	015

....

2. APPLICATION PROGRAMMER DESCRIBES GENERAL CHARACTERISTICS OF THE LINES VIA A DCB AND THE DCB IDENTIFIES THE JCL VIA 'DDNAME'

```
BSCDCB    DCB       ....,DDNAME=BSLINES,....
```

....

3. AT PROGRAM EXECUTION TIME PROGRAMMER MUST ENSURE THAT JCL CONTAINS A SET OF DD STATEMENTS THAT BEGIN WITH THE NAME BSLINES (IN OUR EXAMPLE) AND THAT THESE STATEMENTS IDENTIFY THE CORRECT UCBs

```
        //ONLINE        JOB   (PAYROLL),......,REGION=......
                         :
        //              EXEC PGM=PAYRL123
                         :
-----> //BSLINES       DD    UNIT=011
        //              DD    UNIT=012
        //              DD    UNIT=013
        //PAYMSTR       DD    .....,UNIT=DISK,.......
                         :
```

IN THE ABOVE EXAMPLE GROUP1 DCB DEFINES THREE LINES WHOSE SUBCHNL ASSIGNMENTS ARE 011,012, AND 013 RESPECTIVELY

DATA EVENT CONTROL BLOCK (DECB)

- DECBs ARE AREAS IN APPLICATION PROGRAM USED TO SPECIFY THE DETAILS OF THE OPERATION THAT BTAM IS TO PERFORM

- EACH READ OR WRITE OPERATION USES A DECB

- AT MOST, NEED AS MANY DECBs AS THE NUMBER OF LINES IN THE NETWORK

- UPON COMPLETION OF THE OPERATION BTAM RETURNS THE COMPLETION STATUS OF THE OPERATION IN THE DECB AREA

```
      APPL                   BTAM                   O S
 .----------------------------------------------------------.
 :                :                  :                      :
 :    READ        :       EXCP       :         SIO          :
 :                :                  :                      :
 :                :                  :                      :
 :                :                  :                      :
 :                :                  :                      :
 :----------------------------------------------------------:
             :          :       :           :
             :   DECB   :       :   CHNL    :
             :          :       :    PGM    :
             ------------       -------------
```

BTAM CONSIDERATIONS FOR IBM 3270

THE IBM 3270 FAMILY

- FAMILY OF DEVICES: CONTROLLERS, CRTs, AND PRINTERS
- MULTIPLE DEVICES, CRTs AND PRINTERS, ON ONE CONTROLLER
- THE MOST COMMON DEVICE IN IBM MAINFRAME ENVIRONMENT FOR HIGH PERFORMANCE APPLICATIONS
- EXTENSIVE CAPABILITIES IN CRTS AND PRINTERS FOR MESSAGE FORMMATING AND FORMS CONTROL
- VERY COMPLEX FROM SOFTWARE POINT OF VIEW

IBM 3270 CONTROLLERS MODEL NUMBERS

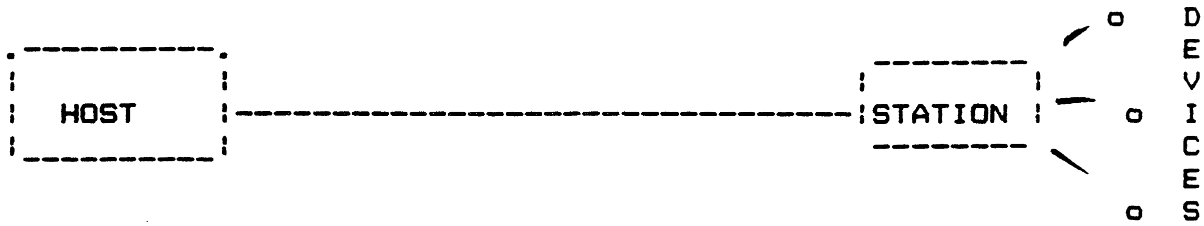
WITHIN THE 3270 FAMILY, DIFFERENT PROTOCOLS SUPPORTED BY DIFFERENT CONTROLLERS

VARIOUS MODELS ARE:

3271 MODELS 1 AND 2:	BSC CONTROLLERS
3271 MODELS 11 AND 12:	SDLC, PU TYPE 1 CONTROLLERS
3274, 3276:	SDLC, PU TYPE 2 CONTROLLERS

NOTE: SDLC CONTROLLERS CAN BE EQUIPPED WITH A BSC SWITCH WHICH ENABLES THEM TO OPERATE IN EITHER MODE.

REVIEW OF MULTIPOINT OPERATION



EOT ----------------------------->

POLL (WITH ID) ----------------------------->

<----------------------------- RESPONSE FROM THE POLLED STATION

1. ID IN THE POLL COMMAND IDENTIFIES WHICH STATION ON THE LINE IS PERMITTED TO RESPOND TO THE POLL

2. EACH CONTROLLER ON THE LINE AND EACH OF ITS ASSOCIATED CRTs AND PRINTERS ASSIGNED 1 BYTE HEX ID

3. PRE-ASSIGNED RANGE OF IDs

IDENTIFYING CONTROLLERS AND DEVICES

CONTROLLER ID:

2 TYPES

POLLING ID: ID USED WHEN HOST WISHES TO RECEIVE.

PERMISSIBLE IDs DOCUMENTED IN 3270 MANUAL .

SELECTION ID: ID USED WHEN HOST WANTS TO SEND (ALSO KNOWN AS ADDRESSING ID).

FOR EVERY VALID POLLING ID A PRE-DESIGNATED SELECTION ID - SEE TABLE IN 3270 MANUAL.

POLL EXAMPLE

```
EOT             ---------------------------->

POLL ID         ---------------------------->

                <---------------------------->      MSG OR EOT
```

SELECTION (ADDRESSING) EXAMPLE

```
EOT              ---------------------->

SELECTION ID     ---------------------->
(ADDRESSING)

                 <---------------------   ACK0/1

MESSAGE          ---------------------->
```

ID CODE IMPLICITELY INDICATES WHETHER THE OPERATION IS A POLL OR SELECT.

CONTROLLER AND DEVICE IDENTIFICATION

DEVICE ID:

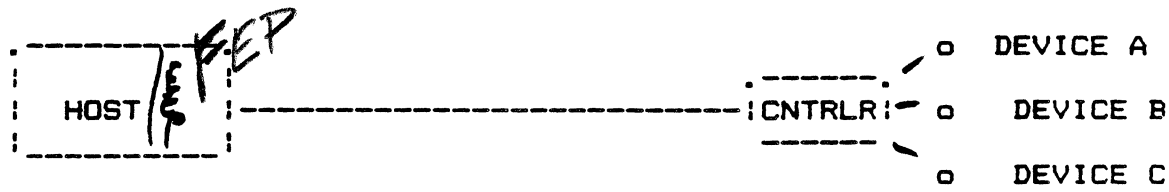
2 TYPES

GENERAL ID: USED WITH POLL OPERATIONS ONLY

ANY DEVICE ON THE CONTROLLER MAY SEND DATA

DEVICE ID X'7F' RESERVED TO SPECIFY GENERAL POLL

SPECIFIC ID: ONLY THE SPECIFIC DEVICE IDENTIFIED MAY RESPOND OR RECEIV



GENERAL POLL

EOT -------------------------->

(CNTRLR ID, X'7F') -------------------->

<------------------------- DEVICE A, B, OR C MAY SEND

SPECIFIC POLL

EOT -------------------------->

(CNTRLR ID, DEVICE A ID) -------------->

<------------------------- ONLY DEVICE A MAY SEND DATA

TERMINAL LIST

A LIST CONTAINING IDs OF VARIOUS DEVICES THAT HAVE TO BE POLLED OR SELECTED BY THE HOST SOFTWARE

DIFFERENT LIST USED FOR POLLING AND SELECTION OPERATIONS

DIFFERENT OPTIONS OFFER DIFFERENT DEGREES OF CONTROL AND EFFICIENCY

AUTO VS. MANUAL LIST
(BTAM)

WITH A MULTIPLE ENTRY TERMINAL LIST:

AUTO LIST:

- o AUTOMATICALLY SERVES EACH ENTRY IN THE LIST
- o USED WITH POLLING (READING) OPERATIONS
- o REDUCES CPU OVERHEAD

MANUAL LIST:

- o SERVES ONLY ONE ENTRY IN THE LIST IN ONE OPERATION. (SOFTWARE SPECIFIES WHICH ENTRY)
- o USED WITH SELECTION/ADDRESSING (WRITE) OPERATIONS

OPEN VS WRAP LIST

(APPLIES TO AUTO LISTS FOR POLL)

OPEN LIST:

STOP POLLING UPON RECEIVING A MESSAGE OR UPON REACHING END OF LIST

WRAP LIST:

UPON REACHING END OF LIST RESTART THE POLL AT THE BEGINNING OF THE LIST (WRAPAROUND) IF NO MESSAGE HAS BEEN RECEIVED

DESCRIBING_TERMINAL_INFORMATION_IN_BTAM_PROGRAM

```
(name)     DFTRMLST   value1,value2,.....,value-n
```

DFTRMLST: DESCRIBES TERMINALS ON LINE AND INFORMATION INFORMATION NEEDED BY BTAM TO MANAGE A SWITCHED LINE

value1,value2,....,value-n: THERE ARE NO UNIVERSAL RULES FOR THESE VALUES WHICH ARE LINE AND DEVICE DEPENDENT. BTAM MANUAL PROVIDES PRECISE DETAILS FOR WHAT SHOULD BE CODED FOR EACH SUPPORTED DEVICE

ONE OR MORE DFTRMLST DEFINITIONS ARE NEEDED FOR EACH LINE

EXAMPLES FOR TWO COMMON DEVICE TYPES FOLLOW

TERMINAL LISTS FOR BSC 3270

EXAMPLE 1: AUTO-OPEN POLL LIST

```
LIST01     DFTRMLST   AUTOLST,(404040402D,40407F7F2D,C1C17F7F2D,3737373737)
                                 -- -- -
                                  ^  ^  ^
                      CNTRLR ID__|  |  |__ ENQ
                                     |
                                DEVICE ID
```

EXAMPLE 2: AUTO-WRAP POLL LIST

```
LIST2     DFTRMLST   AUTOWLST,(404040402D,40407F7F2D,C1C17F7F2D,3737373737)
                                 -- -- -
                                  ^  ^  ^
                      CNTRLR ID__|  |  |_ ENQ
                                     |
                                DEVICE ID
```

EXAMPLE 3: SELECTION LIST

```
LIST03     DFTRMLST OPENLST,(606040402D)
                                 -- -- -
                                  ^  ^  ^
                      CNTRLR ID__|  |  |_  ENQ
                                     |
                                DEVICE ID
```

INFORMATION IN THE FOLLOWING PAGES CONTAINS ADDITIONAL DETAILS ABOUT BTAM MACROS AND CODING ORIENTED TOPICS

IT IS INCLUDED IN HERE AS A FURTHER REFERENCE FOR THOSE INTERESTED IN THESE DETAILS

BTAM INITIALIZATION AND TERMINATION MACROS

OPEN dcb name

- OPENS A GROUP OF LINES REPRESENTED BY THE DCB IDENTIFIED
- CAUSES A COPY OF BTAM TO BE LOADED IN TO THE APPLICATION PARTITION
- ADDRESS OF WHERE BTAM IS LOADED IS PLACED IN THE DCB ITSELF

CLOSE dcb name

- TERMINATES AVAILABILITY OF BTAM FOR THE GROUP OF LINES IDENTIFIED BY THE DCB
- DISABLES LINES IN THE GROUP

READ MACRO: ACCEPTING DATA FROM A DEVICE

```
(name)    READ    DECB, OP TYPE, DCB, INAREA, MSGSIZE,
                  TERM-LIST, REL. LINE, MF=E
```

8 OPERANDS:

DECB	ADDRESS OF THE DECB TO BE USED WITH THIS READ OPERATION
OPTYPE	CHANNEL PROGRAM ID FOR THIS IO
DCB	NAME OF THE DCB ASSOCIATED WITH THIS LINE
INAREA	ADDRESS OF THE AREA WHERE APPLICATION WANTS BTAM TO PLACE THE INCOMING MESSAGE
MSG SIZE	SIZE OF THE LARGEST POSSIBLE MESSAGE THAT CAN BE RECEIVED IN THIS OPERATION
TERM .LIST	ADRRESS OF THE POLL LIST TO BE USED WITH THIS READ
REL. LINE	WHICH LINE WITHIN THIS DCB GROUP IS BTAM TO READ FROM
MF=E	MACRO CODING REQUIREMENT, CODE IT AS SHOWN

WRITE MACRO: SENDING DATA TO A DEVICE

```
(name)    WRITE   DECB, OP TYPE, DCB, MSGADDR, MSGSIZE,
                  TERM-LIST, REL. LINE, MF=E
```

8 OPERANDS:

DECB	SAME AS READ MACRO
OPTYPE	" " " "
DCB	" " " "
MSGADDR	ADDRESS OF THE MSG TO BE SENT
MSGSIZE	EXACT LENGTH OF THE MSG TO BE SENT
TERM LIST	ADRRESS OF THE SELECTION LIST FOR THE DEVICE TO WHICH THIS MSG IS ADDRESSED
REL. LINE	SAME AS READ MACRO
MF=E	" " " "

WAIT MACRO: WAITING FOR AN IO TO COMPLETE

1. APPLICATION PROGRAM RESPONSIBLE FOR TELLING OS TO PUT IT TO SLEEP WHILE AN EVENT IS BEING COMPLETED

2. EVENT BEING WAITED UPON IS IDENTIFIED VIA AN EVENT CONTROL BLOCK (ECB) WHICH IS IN THE DECB ITSELF

3. APPLICATION CAN WAIT ON SINGLE OR MULTIPLE EVENTS

4. APPLICATION MUST ENSURE THAT AN IO GOT STARTED SUCCESSFULLY BEFORE ISSUING A WAIT

EXAMPLE 1: SINGLE EVENT WAIT

```
WAIT       ecb name
```

WHERE ecb name IS THE SAME AS DECB NAME

EXAMPLE 2: MULTIPLE EVENT WAIT

```
WAIT       count,ECBLIST= address of a list
                          of ECBs
```

count IN THIS CASE SPECIFIES HOW MANY OF THE EVENTS IN THE LIST MUST COMPLETE BEFORE THE APPLICATION IS TO BE 'WOKEN' UP

ERROR_ANALYSIS_IN_BTAM_APPLICATION

1. ON CERTAIN TYPES OF ERRORS BTAM WILL RETRY AN OPERATION MULTIPLE TIMES AND IF THE ERROR STILL PERSISTS IT WILL REPORT IT TO THE APPLICATION

2. IT IS THE APPLICATION RESPONSIBILITY TO INITIATE ANY FURTHER RECOVERY

3. ALL INFORMATION PERTAINING TO THE ERROR IS RETURNED IN THE DECB

4. ERROR ANALYSIS AND RECOVERY PROCEDURES CAN BECOME FAIRLY COMPLEX AND HIGHLY DEVICE DEPENDENT AND GENERALLY SEPERATE ROUTINES ARE CODED FOR DIFFERENT TYPES OF DEVICES

BTAM REVIEW QUIZ

1. (TRUE/FALSE) THE DCB CONTAINS THE ADDRESS OF BTAM AFTER IT HAS BEEN LOADED IN THE APPLICATION PARTITION.

2. WHICH INSTRUCTION (MACRO) IN THE APPLICATION PROGRAM CAUSES BTAM TO BE LOADED IN ITS PARTITION?

3. A CONTROL BLOCK USED TO PASS INFORMATION BETWEEN BTAM AND APPLICATION IS CALLED THE ________________ .

4. THE MACRO (TABLE) USED TO DESCRIBE THE TERMINAL OR SWITCHED LINE INFORMATION IN BTAM IS CALLED THE ________________ .

5. (TRUE/FALSE) THE INFORMATION CONTAINED IN THE TERMINAL LIST IS DEPENDENT ON THE TERMINAL TYPE.

6. IN A BTAM ENVIRONMENT THE APPLICATION PROGRAM MUST ENSURE WHETHER AN I/O WAS STARTED AND COMPLETED SUCCESSFULLY BEFORE TRYING TO PROCESS INFORMATION ASSOCIATED WITH THE I/O.
   AFTER ISSUING A READ/WRITE MACRO, REGISTER 15 INDICATES WHETHER THE I/O WAS ______________________ AND VARIOUS FIELDS IN THE DECB INDICATE WHETHER THE I/O WAS __________________________________ .

7. WITH REFERENCE TO QUESTION 6 ABOVE, WOULD ONE TEST REGISTER 15 FIRST OR THE CONTENTS OF DECB TO PROPERLY CHECK I/O OPERATION STATUS?

8. (TRUE/FALSE) AN APPLICATION MUST WAIT FOR AN I/O OPERATION TO FINISH COMPLETELY BEFORE IT MAY START ANY FURTHER I/Os ON OTHER LINES IN THE NETWORK.

UNIT 4

TELEPROCESSING MONITORS AND BTAM

OBJECTIVES

TO IDENTIFY MAJOR COMPONENTS OF A TELEPROCESSING MONITOR

TO IDENTIFY REASONS WHY AN MIS ORGANIZATION WOULD NEED A GENERAL PURPOSE TELEPROCESSING MONITOR

TO EXPLAIN DIFFERENCES BETWEEN OPERATING SYSTEM, ACCESS METHOD, AND TELEPROCESSING MONITOR FUNCTIONS

TO IDENTIFY TRADE-OFFS BETWEEN DEVELOPING YOUR OWN TELEPROCESSING MONITOR VS. LEASING OR BUYING A PACKAGE

TO DISTINGUISH BETWEEN 'MULTIPROGRAMMING', 'MULTITASKING', AND 'MULTITHREADING' AS USED IN IBM PUBLICATIONS

W H Y   T P   M O N I T O R S ?

THE REASONS THEN

- BTAM, 3705 / EP

THE REASONS NOW

- SNA PROTOCOLS

Why TP Monitors?

The software technology has evolved at a very rapid pace. Thus, before one answers a question such as the above one almost has to know the point in time when the question is being answered.

Some of the major reasons why TP monitors came about during the days of BTAM have since disappeared and, yet, TP monitors are still very much around ! Well, the old problems have been replaced by new problems - SNA protocols. More on that later.

In any case, to answer this question in the context of BTAM one has to go back in history (yes in this industry a 15 years lapse qualifies as history) and look at the state of the art in software technology in existence then.

What were the constraints under which a customer developed communications software on an IBM mainframe in those days ?

Let us next review the environment in existence then.

BTAM

THE REASONS THEN: CIRCA MID 60s

- o ADVENT OF THE FIRST GENERATION OF GENERAL PURPOSE COMPUTING MACHINES- IBM SYSTEM 360
- o A NEW GENERATION OF SYSTEM SOFTWARE- OS/360
- o NEW FAMILY OF COMMUNICATIONS FRONT END CONTROLLERS- IBM 270X FAMILY
- o A "COMPREHENSIVE" NEW ACCESS METHOD FOR COMMUNICATIONS- BTAM
- o INCREASING PRESSURES ON TECHNOLOGY TO PRODUCE MORE TIMELY INFORMATION
- o IBM 3270 AND BSC PROTOCOLS ARE STILL A FEW YEARS AWAY

WHAT
DID AN END USER DO
IN SUCH AN ENVIRONMENT
PRIOR TO TP MONITORS?

XYZ,_INC.:__AN_END_USER_SCENARIO_(LATE_60s)

XYZ, Inc is a relatively enlightened D. P. user. While the top management does not fully understand the technology, they have given a free hand to their Director of Data Processing Systems who in turn reports to the V. P., Corporate Finance.

Because of the rising popularity of their main products, Widgets and Gizmos, XYZ has been opening various regional offices and distribution centers.

Corporate headquarters are located in St. Louis with regional locations in New York, Chicago, Dallas, Houston, Los Angeles, and San Fransisco.

Because of an accelarated growth rate a few things got out of hand. One of the major problems was managing the inventory at regional locations. While they were carrying excessive inventories in large number of items and, therefore, paying high interest payments, paradoxically, they were consistently running short on other items in demand causing shipping delays and order cancellations.

That is when they did it for the first time.

Their first on-line system using TTY33 teleprinters!

Each regional distribution center was installed with a TTY33 machine and the centers could dial into the central computer at St. Louis two or three times a day and report critical inventories.

Results were satisfactory and directors of Data Processing and Operations were promoted to newly created positons of Corporate Assistant Vice Presidents.

And then it happened !

x x x x x x

VP Marketing felt that sales force was spending too much time doing the paperwork and had no way of tracking the orders within the corporation. He demanded an on-line capability.

VP Corporate Finance was still smarting over the fact that she was the one to discover the inventory problems but the credit had gone to the operations people. She wanted more timely information on cash flows, short term borrowings and surplus cash that could be invested in short term commercial paper. She too wanted an on-line capability.

Manufacturing managers wanted a direct access to Marketing and Distribution data so that they could schedule production more accurately. Why not an on-line system for them too?

AVP Data Processing, while happy at the potential increase in the size of his corporate domain, was also concerned about his ability to fulfill all the requested requirements. On-line technology was still too new for him.

So, after due consideration, or at least the appearance of it, he made the following recommendations:

1. Corporate Finance would be provided with an on-line access to corporate financial data bases. This would enable the finance people to make on-line inquiries against the data base and also provide certain on-line reports on request.

2. Marketing would have an on-line order entry and inquiry/response system to track orders.

3. Manufacturing Department needs could be met via more timely batch reports and, for now at least they did not have a real case for an on-line system

To make it all happen, AVP, D P proposed that:

1. Given the reliability requirements and sensitive nature of data, the system would consist of private lines only.

2. XYZ would use a new family of terminals from IBM called 3270s that had recently been announced.

3. Since terminals were going to be located in the same cities, the cost of private lines could be reduced by connecting terminals for various applications on the same private line (3270s could be 'clustered' on a line).

4. To keep the system simple and maintain data security and integrity each application will be a seperate, independent job in the system.

5. All software development, as always, would be done in-house to ensure a high quality, tailor-made, and high performance system.

6. To do all this the current machine would have to be upgraded from IBM System 360 Model 40 to Model 55 and with additional personnel requirements the DP budget would have to be increased by at least 50%.

But for a few objections regarding the high cost and lack of need analysis from the Manufacturing Department, the plans for the new system were quickly approved by the corporate Policy Committee.

Design and analysis work was started by the design team.

A few programmers were sent for BTAM and 3270 training and the first substantial report from the system design team was presented to the AVP Data Processing about six months later.

Once the team members were done with all the nice features of BTAM and 3270s they had one little surprise for the AVP/DP.

The system could not be implemented to support the exact configuration as approved by the policy committee. They assured him that there was no major problem - they would just need a few more private lines.

And then the system design team provided the explanation as to why the configuration could not be implemented precisely as approved.

XYZ, INC. PROBLEM ANALYSIS

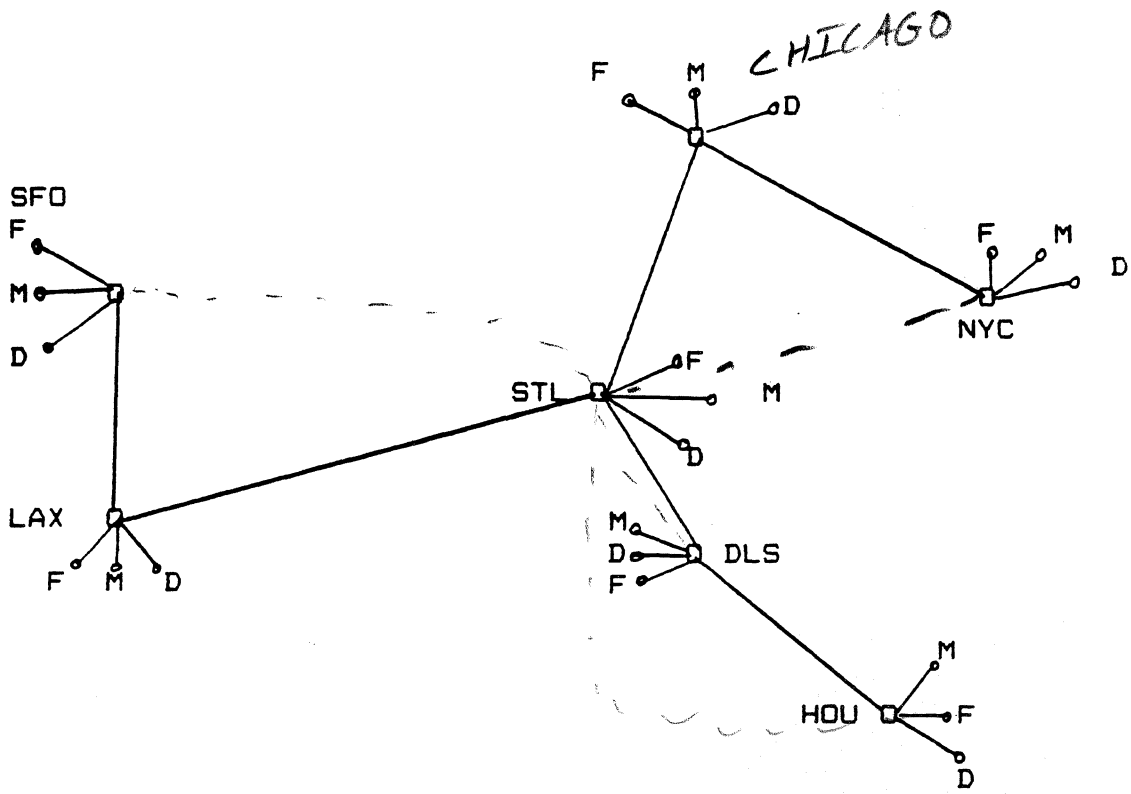
The network and host configurations as approved by the XYZ Policy Committee for the 3 on-line applications are shown on the next two pages.

Analyze the configurations and see if you can identify the reasons why it cannot be implemented precisely as shown.

Once you discover the reason you should probably be able to state it in less than 5 sentences.

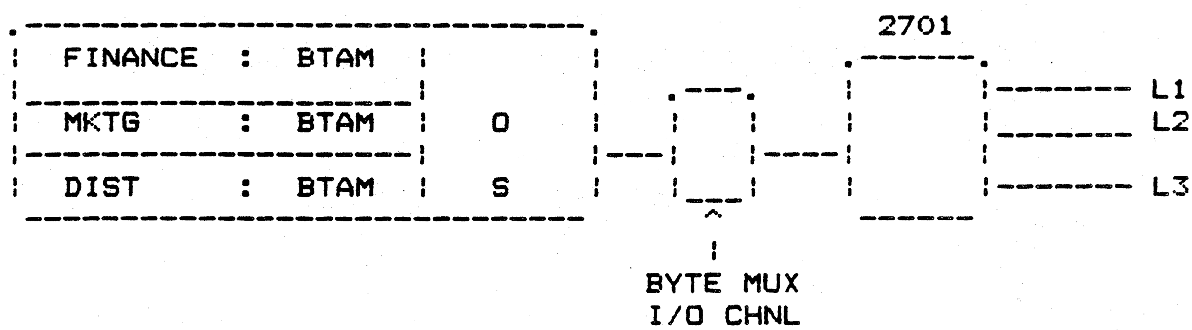
We shall discuss your answer in a few minutes.

NETWORK CONFIGURATION APPROVED BY XYZ, INC



D: DISTRIBUTION
F: FINANCE
M: MARKETING

PROPOSED HOST CONFIGURATION



IBM SYSTEM 360/50

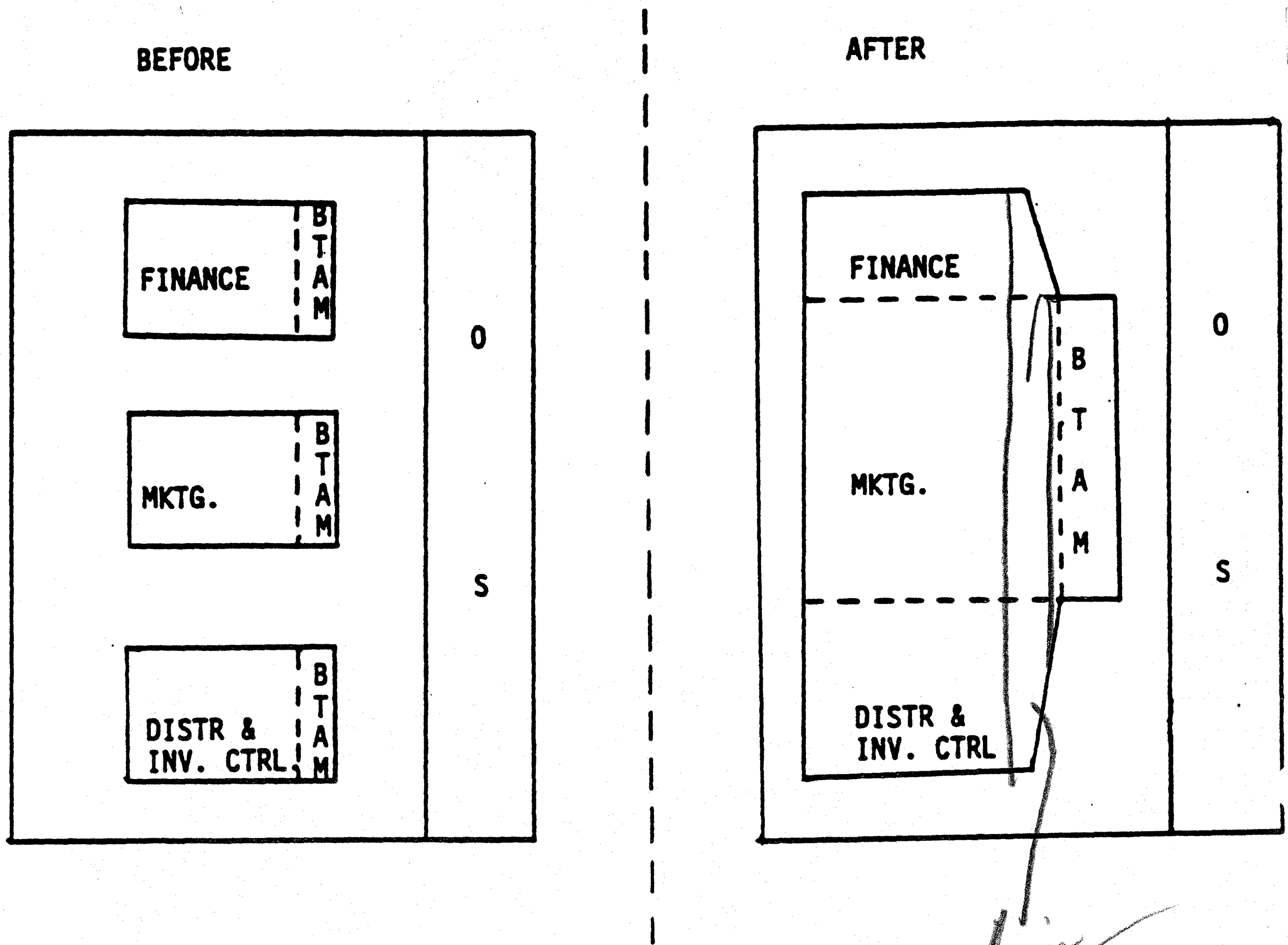
OS / MVT

Not shared comm lines

ALTERNATIVES FOR XYZ

?

1. Separate lines for ea application system - triple line costs
2. Fool the system to believe that all is one
   a. 'LOAD' application
   b. Security (based on logon/password)



COMBINING THREE PROGRAMS INTO A SINGLE JOB

admin pgm to control from which called TRANSCNTR

COMBINING THREE PROGRAMS INTO A SINGLE JOB:

Questions that must be answered:

1. How do you bring three programs in the same partition?

2. When a message comes in, how do you know who is going to process it and who is this 'you' who is going to do the figuring?

3. Are all operators authorized to access all available programs or are there to be any restrictions?

   If restrictions, who is going to enforce them?

4. OTHER ISSUES... ?

INPUT MESSAGE FORMAT

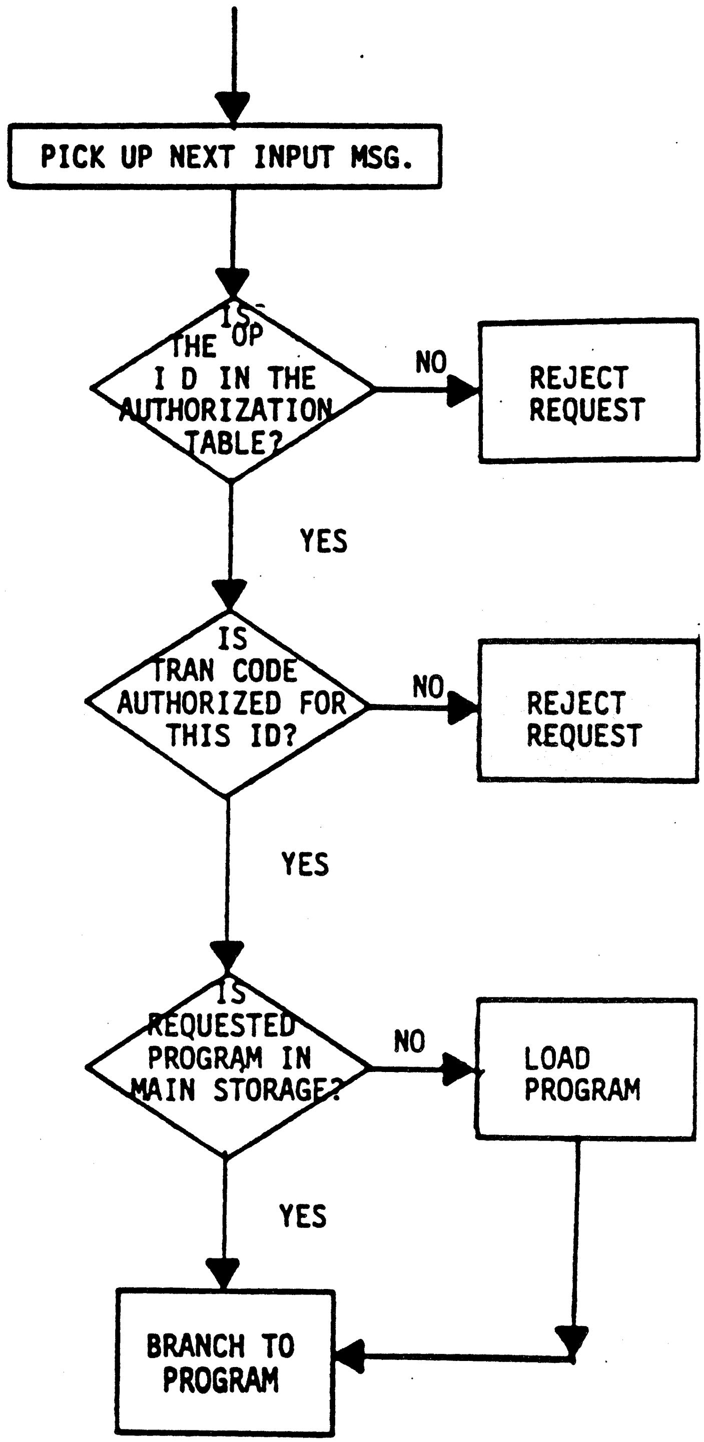
II	TTTT	data
ID	TRANS. CODE	

SYSTEM AUTHORIZATION TABLE

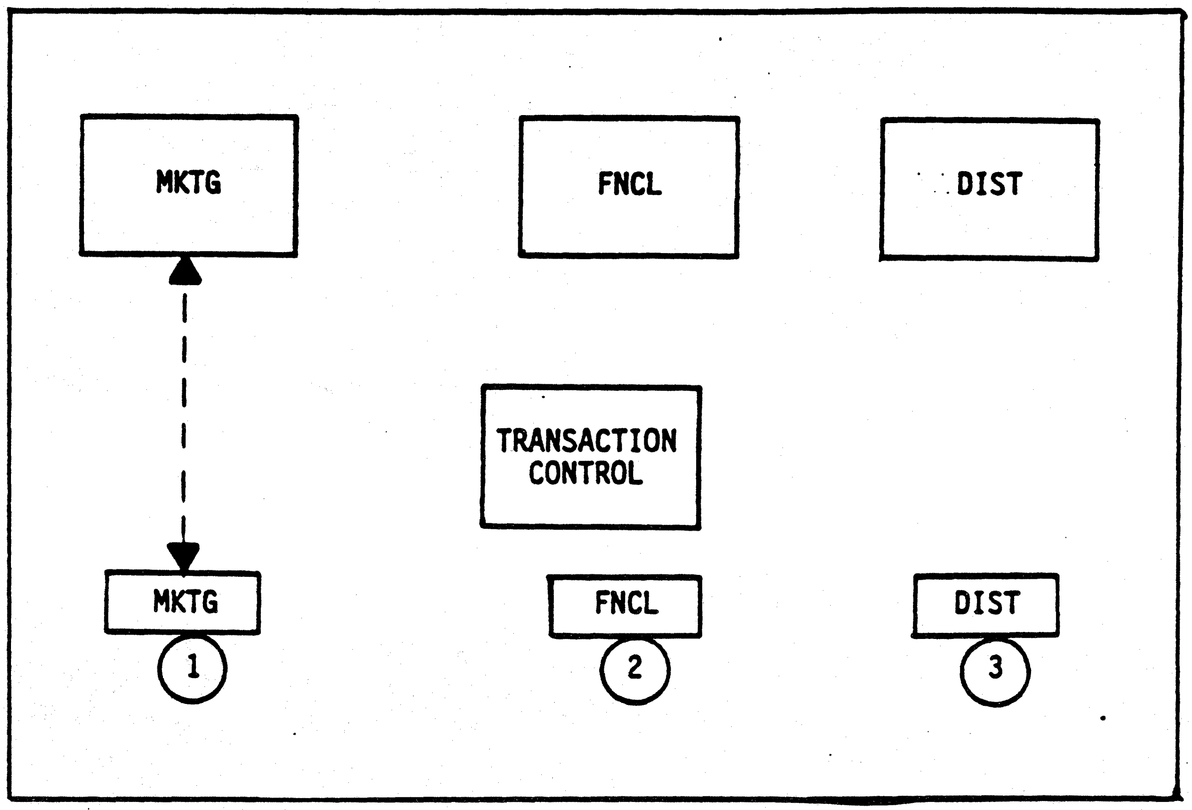
ID	CODE
AA	01
AB	01
AC	03
AD	02
AE	07
:	:
:	:
etc.	etc.

TRANSACTION CONTROL PROGRAM

(FUNCTIONAL DESCRIPTION)



SWITCHING CONTROL FROM ONE TRANSACTION TO ANOTHER



GIVEN: 3 MESSAGES IN THE HOST

MESSAGE 1 IS CURRENTLY BEING PROCESSED

MESSAGES 2 AND 3 ARE AWAITING PROCESSING

QUESTION: WHAT IS THE EARLIEST TIME THAT MESSAGE 2 CAN BE PASSED TO FNCL?

Switching control from one transaction to another:

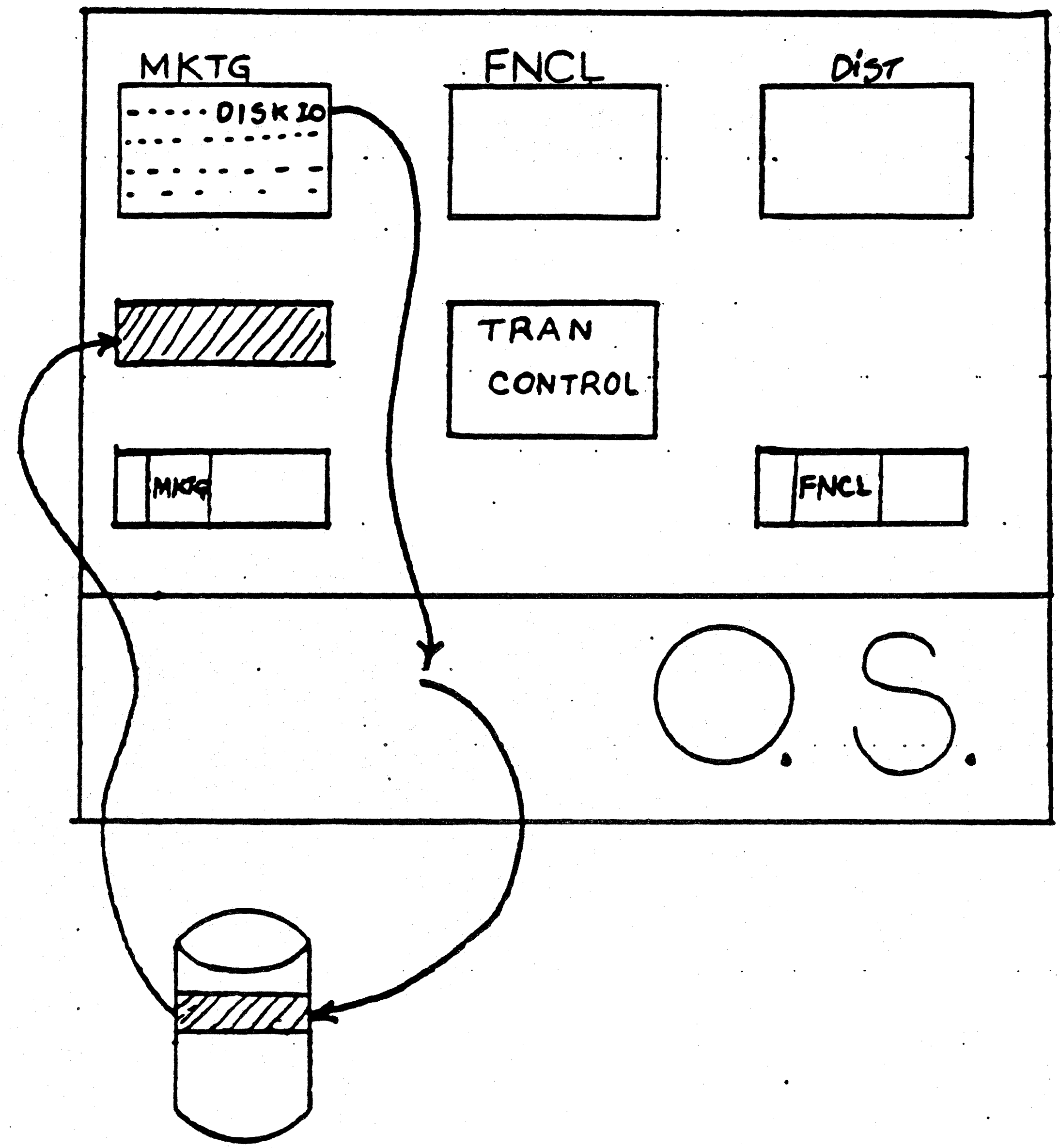
In the example shown here we have currently 3 messages in the host machine.

Message 1 is for MKTG transaction. It was the 1st one to arrive and is currently being processed by the MKTG program.

Messages 2 and 3 arrived next in that order.

Question is -
What is the earliest that we can start processing message 2 without unduly disrupting message 1 processing?

IO OPERATIONS AS CRITERIA FOR SWITCHING TRANSACTIONS:



I/O as a criterion for switching Transactions:

As a starting point it may be worthwhile to borrow a concept from the Operating System that it uses to implement multiprogramming i.e. switching from one job to another during an IO operation.

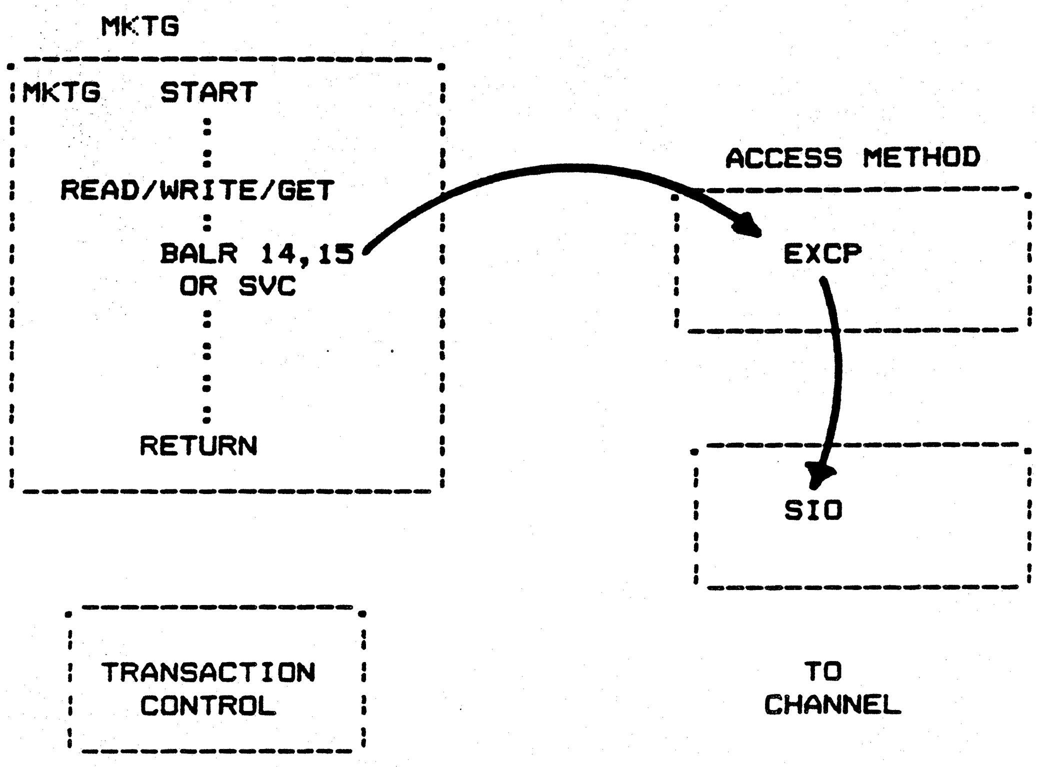
We want to switch from MKTG to FNCL during an IO operation for MKTG.

Except that instead of the Operating System it is the Transaction Control who would have to make the switch.

How is the Transaction Control going to do it?

Let us review again some of the facts about flow of control in an I/O operation next to help us determine the Transaction Control logic.

APPLICATION IO REQUEST: FLOW OF CONTROL



Application I/O Request: Flow of Control:

The diagram on the opposite page shows the relevant part of the flow when an application issues an IO request.

There are three major transitions of interest:

1. Application issues an OS access method macro. The macro generated code causes a branch to the access method.

2. The access method eventually issues an EXCP instruction, which in turn transfers control to the IO Supervisor in the Operating System.

3. The IO Supervisor issues SIO, thereby, starting the Channel operation.

The interesting fact about this flow is that it completely bypasses our Transaction Control.

If the Transaction Control is to do any program switching, it has to know when one of our transactions is doing an IO operation.

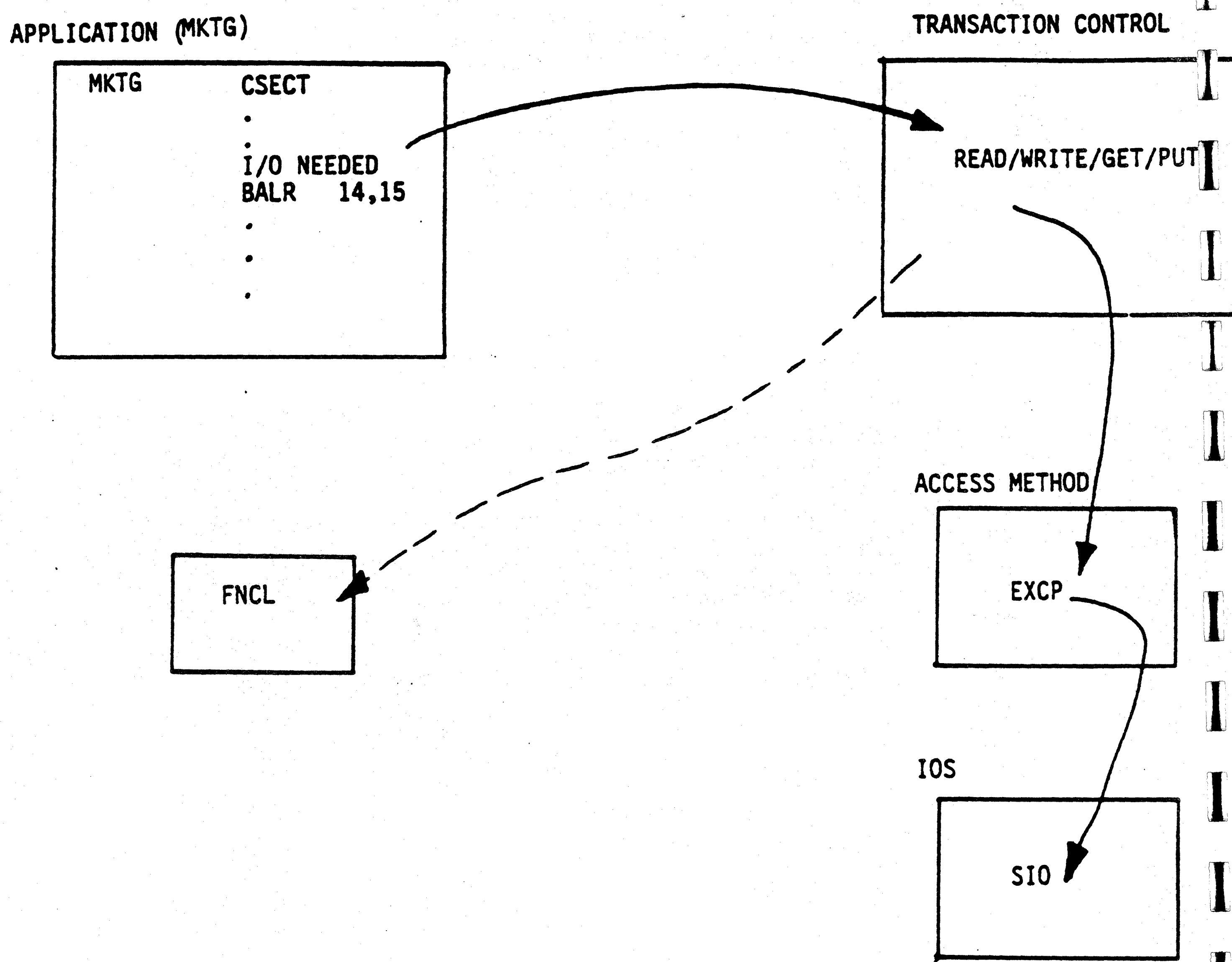
Worse yet, if any of the transactions were to request OS to be put in a WAIT state, it would cause the whole partition to be put in a WAIT state including the Transaction Control and all the other transactions - a highly undesirable situation.

One way to get around our problems is not to let the transactions make direct IO requests or issue any WAIT requests.

Any time a transaction needs an IO operation, the transaction will inform the Transaction Control of its requirements, and only the Transaction Control will issue actual IO requests and any WAIT requests. Only then can the Transaction Control transfer control from one transaction to another during an IO operation.

APPLICATION I/O REQUEST: FLOW OF CONTROL

(USING TRANSACTION CONTROL PROGRAM)



Application IO request: Flow of control with Transaction Control

1. The transaction MKTG sets up details of the IO operation - name of the file, record ID, and whether or not it can do more processing while the IO is taking place and goes to the Transaction control.

2. Transaction Control formats an access method request based upon transaction provided data. Transaction Control also indicates to the OS that it not be put in a WAIT state while the IO is progressing.

3. After initiating the IO request for MKTG the Transaction Control also goes through its internal tables to see if any transaction can do any processing (new messages may have arrived or some prior IOs may have been completed).

4. If any other transaction can proceed at this time, say FNCL in this case, Transaction Control would transfer control to such a transaction.

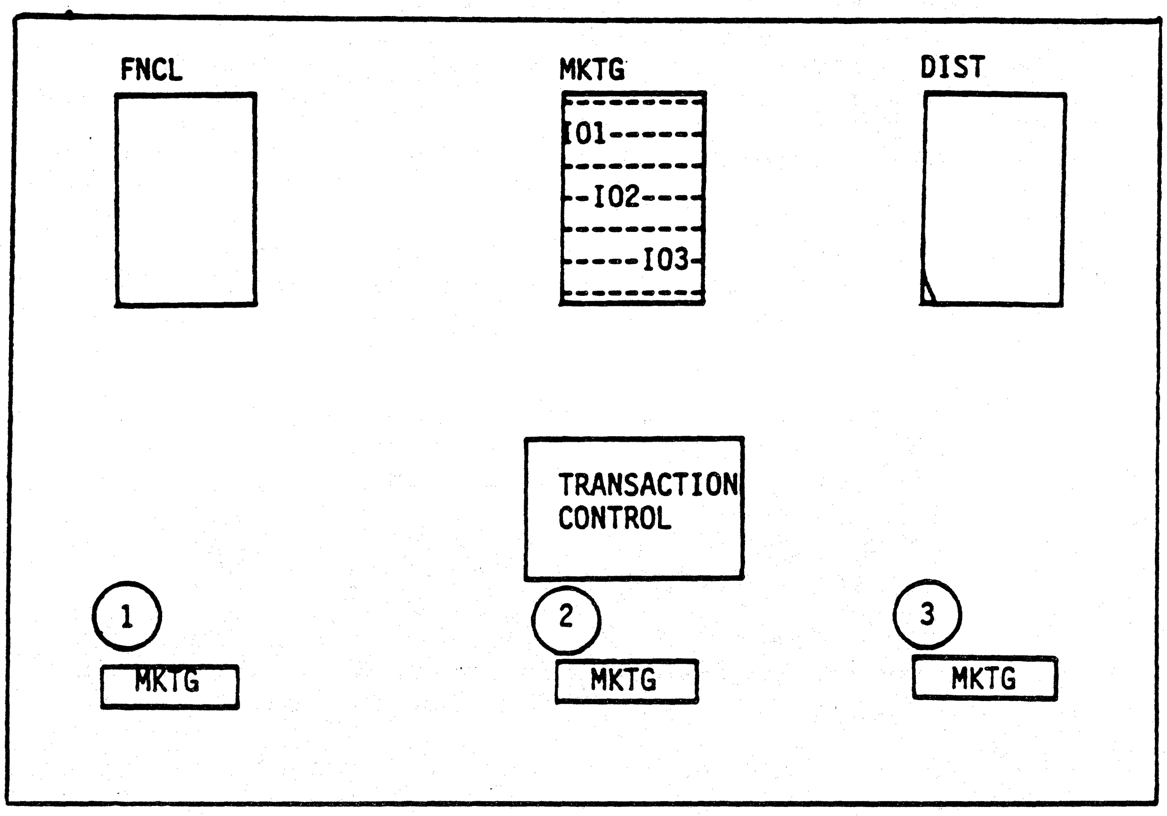
   This step is the very essence of managing multiple transactions in a single job.

5. If, however, no further work can be dispatched at this time, the Transaction Control would issue a WAIT request to the Operating System.

An ability such as above whereby Transaction Control can run multiple programs (tasks) concurrently within a partition/job/region/address space is called multitasking.

XYZ, Inc. would have to develop a multitasking Transaction Control program if they want to run the three transactions concurrently over a shared network as they proposed to do.

MULTIPLE MESSAGES FOR THE SAME TRANSACTION



Multiple_concurrent_messages_for_the_same_transaction:

Take a situation in our on-line system where we have three messages in the system:

1. As Transaction Control comes through its next pass to check for dispatchable work it discovers message 1.

   Based upon our system design, the Transaction Control looks at the transaction ID and determines that MKTG transaction is to process this message.

2. Message 1 is dispatched to MKTG and that transaction starts running.

3. MKTG starts processing message 1 and ultimately needs a record from one of its files and sends a request for an IO, IO1, to the Transaction Control.

4. Transaction Control notes down the the location within MKTG where the program is to be restarted when IO1 completes and sets up the IO request for MKTG.

5. Transaction Control now looks for additional work that can be dispatched and discovers that message 2 is ready for processing and that this too is for MKTG.

6. Transaction Control interrogates the status of the MKTG transaction and finds that MKTG is awaiting an I/O completion and, thus, temporarily idle.

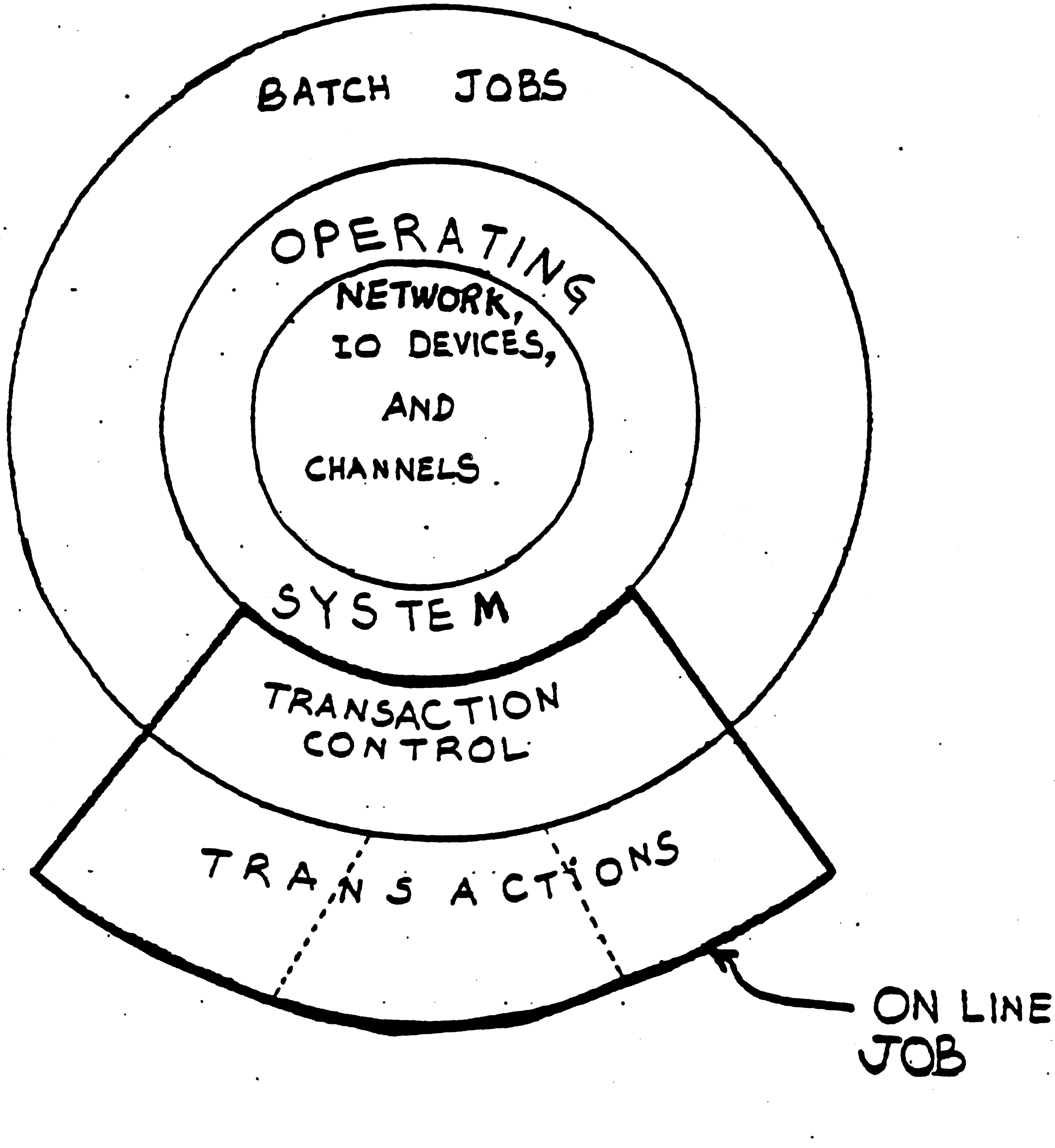
7. Transaction Control transfers control to the beginning of the MKTG transaction passes it message 2 for processing.

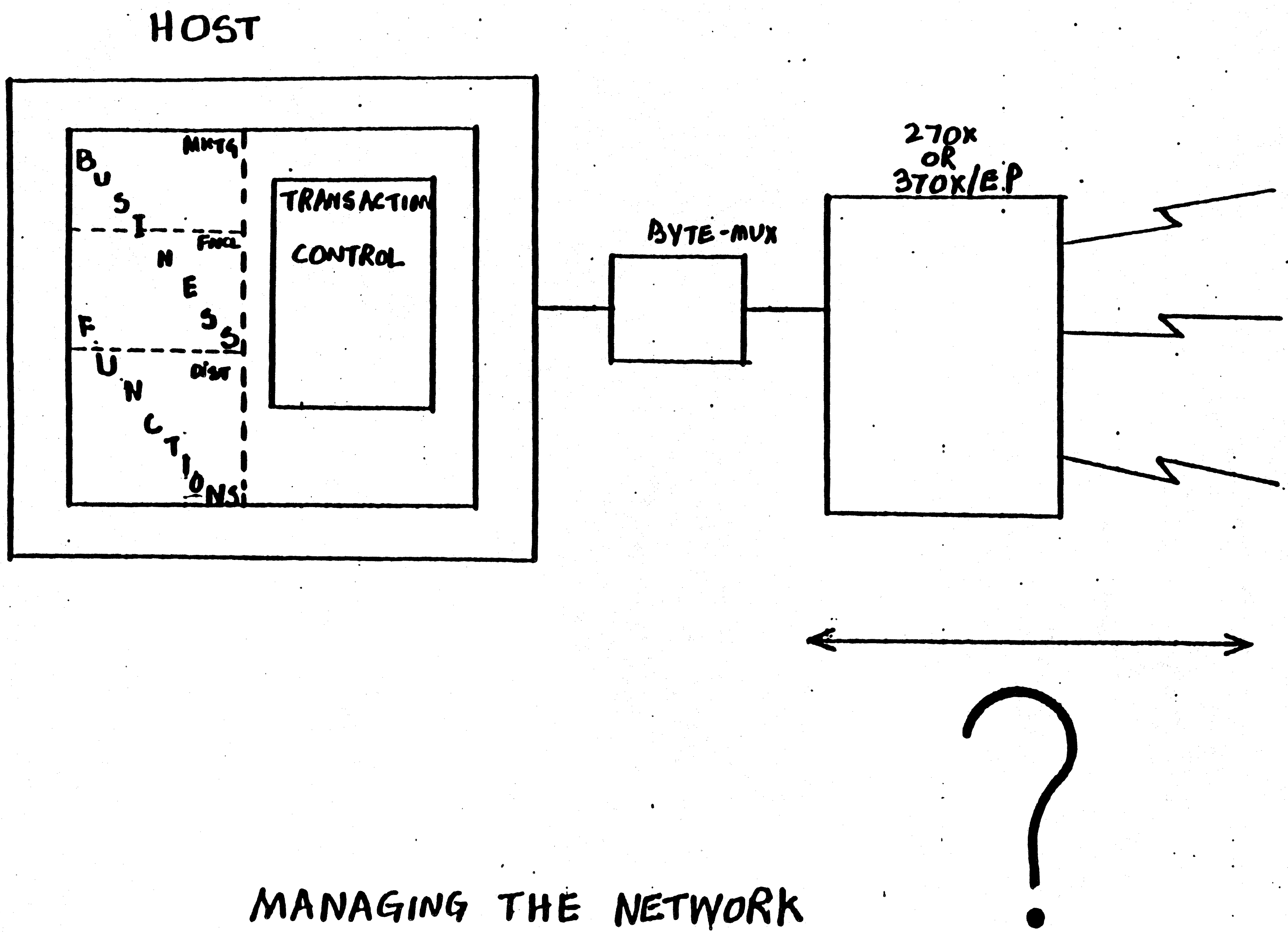
   At this time the MKTG program is in effect processing two messages 'concurrently' or, in other words, we have two seperate processing threads running through the same program.

This process whereby a single program can process multiple messages concurrently is called multithreading.

Programs that can multithread are also called reenterant programs because they can be 'entered' again while they are still processing a previous message.

SUMMARY OF MODULAR STRUCTURE WITH TRANSACTION CONTROL





MANAGING THE NETWORK

MANAGING THE NETWORK

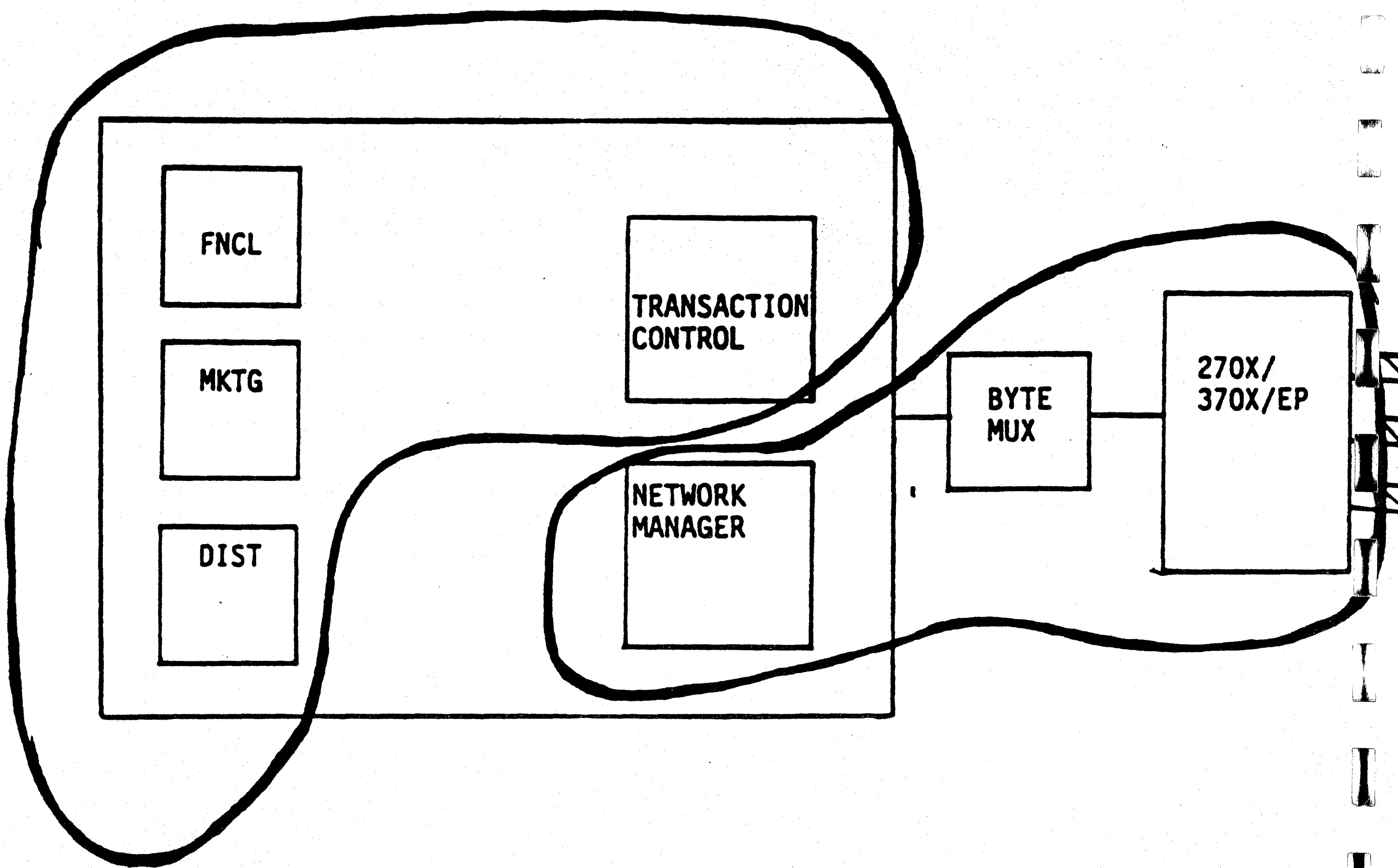
So far our discussions have focussed primarily on activities within the host. We shall next take a look at functions that have to be performed to manage the network.

These functions would involve tasks such as activating/deactivating lines, responding to incoming calls on switched lines, starting polls on private lines and functions such as were discussed in the BTAM lecture.

First question, irrespective of the details, is one pertaining to the overall structure of our system.

Should these additional functions be performed by the Transaction Control module or do we have a better idea?

TRANSACTION CONTROL AND NETWORK MANAGER



TRANSACTION CONTROL MANAGES TRANSACTIONS

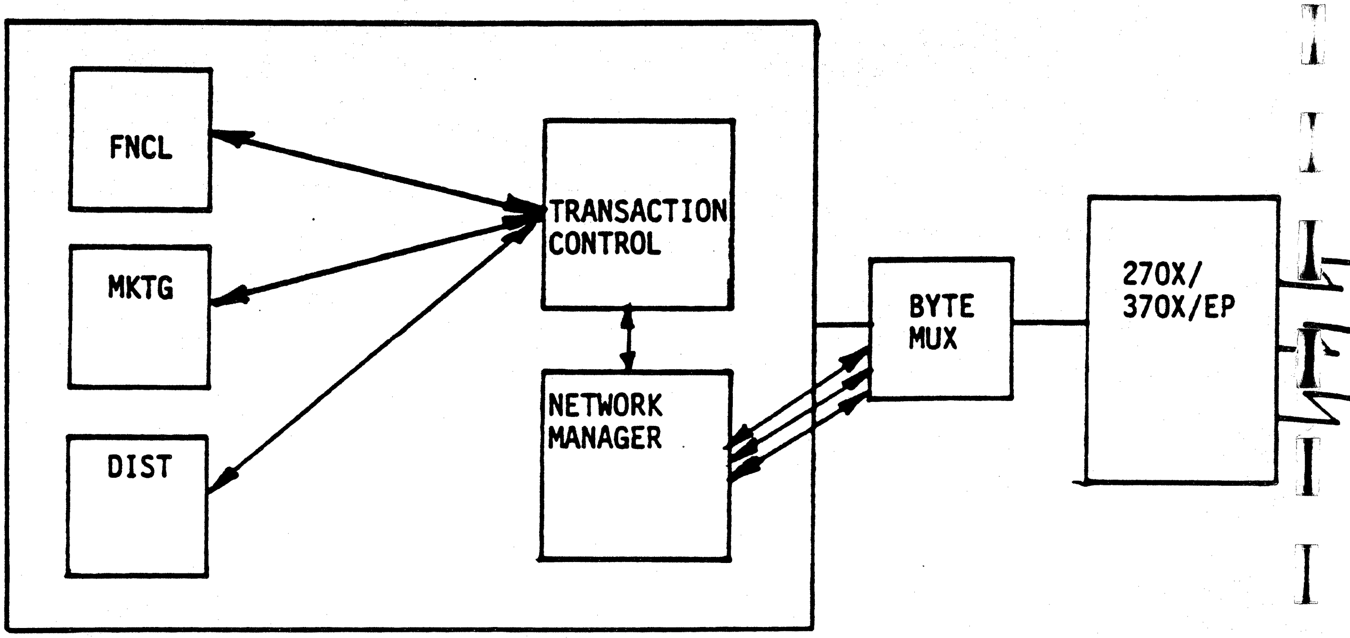
NETWORK MANAGER MANAGES NETWORK

Transaction Control and Network Management Program

Our on-line system has so far evolved to two major system components:

Transaction Control:	For managing the transactions
Network Management Program:	For managing the network, for brevity, we would refer to it as the Network Manager.

Next we would explore how communications take place between the Network Manager and the rest of the system.



COMMUNICATIONS BETWEEN NETWORK MANAGER AND SYSTEM COMPONENTS

Communications between Network Manager and other system components:

Earlier in this unit we discussed reasons why transactions must not issue requests directly to the Operating System - but rather route their requests to the Transaction Control.

For similar reasons we would also require that there be no direct communications between transactions and the Network Manager. The requests for network services from transactions would also be routed through the Transaction Control.

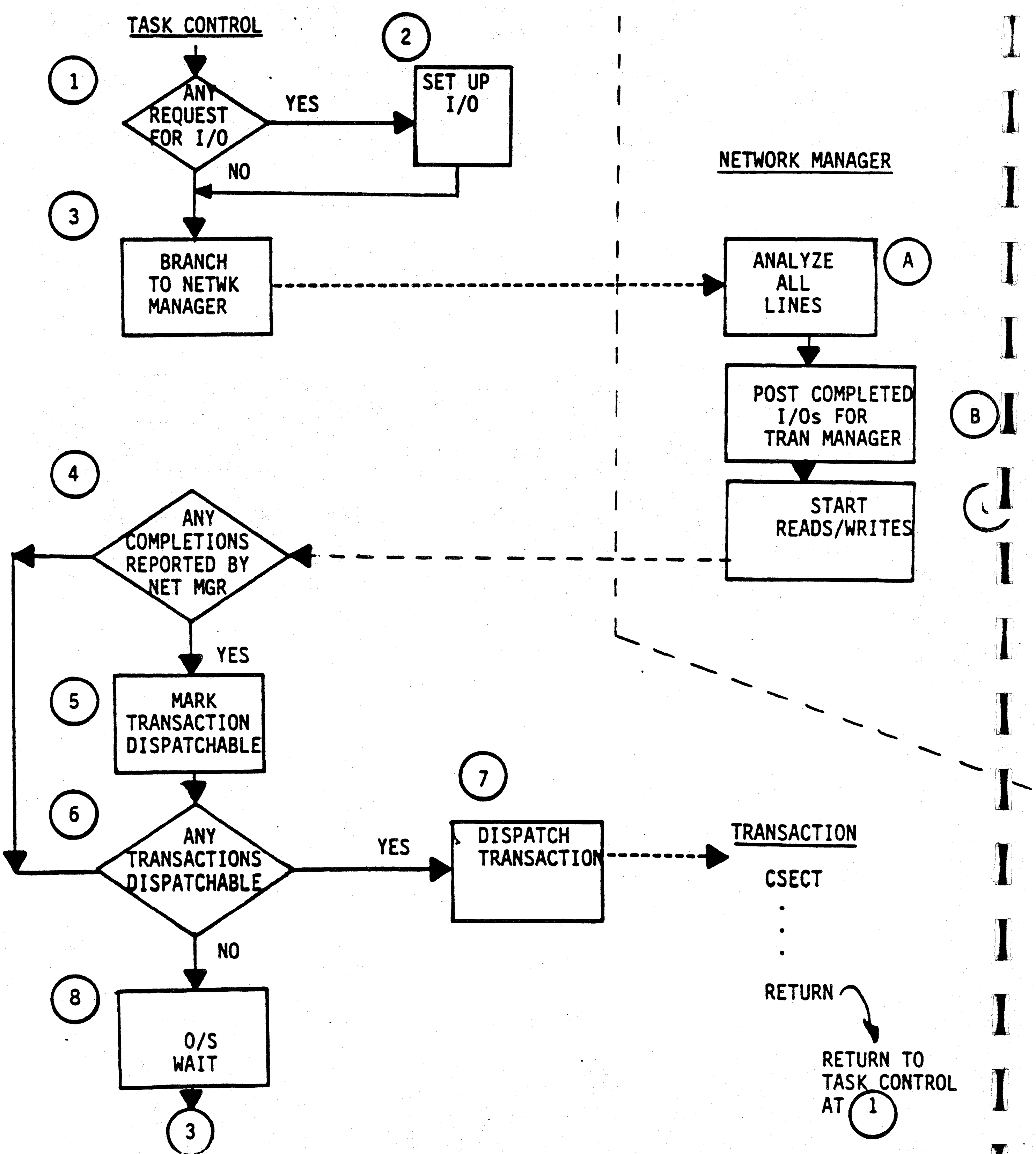
The two major advantages of such an approach are:

1. The Transaction Control has total control over the system and can keep track of each transaction's progress and put transactions in a WAIT state if they are awaiting completion of pending events.

2. The fact that there is a Network Manager is totally transparent to the transactions. The transactions need a single interface to the Transaction Control program irrespective of the type of service needed. The Transaction Control would take care of routing the request to the appropriate system component.

We shall next take a look at the overall flow of the system as it has evolved so far.

FLOW OF CONTROL BETWEEN TASK CONTROL AND NETWORK MANAGER



Overall System Flow:

Transaction Control is basically a cyclical program that runs in a big logical loop and keeps dispatching transactions as messages arrive in the system or IO activities complete. It must also periodically dispatch the Network Manager to send or receive messages from the network.

Because of this circular logic we can pick up the Transaction Control logic anywhere in the cycle and complete the circle. In the flow chart shown here we pick up the logic at a point where the Transaction Control has just received control back from a transaction.

1. Transaction Control takes transaction request, if any, along with any other pending requests from before,

    2. sets up IOs

3. At this point the transaction Control branches to the Network Manager so that the Network Manager may report completions on previously started I/Os and start new IOs,

    Network Manager:

    a. Scans control blocks for each line.
    b. As completed IOs are discovered posts them in appropriate control blocks for the Transaction Control.
    c. Starts new READ/WRITE operations on idle lines.

4. Transaction Control scans the control blocks posted by the Network Manager to check if completions were posted and

    5. Marks those transactions dispatchable that can start processing.

6. Transaction control now scans the list of dispatchable tasks in priority order and

    either, 7. Dispatches a transaction

    or, 8. Requests an OS WAIT with an ECB list of all activities pending completion.

ISSUES FOR SYSTEM PROGRAMMER

HOW AND WHERE TO MAINTAIN:

LINE STATUS:	ACTIVE / INACTIVE
LINE TYPE:	PVT / SW / SS / BSC1, 2, 3
TERMINAL LISTS:	POLLING / SELECTION
DECBs	
IO ARAES	

:

:

:

BTAM PROVIDED MACROS (TABLES)

DCB

DECB

DFTRMLST

NEED FOR USER PROVIDED CONTROL BLOCKS?

Issues_for System_Designer

To manage the network in a manner as shown in the system flow diagram we would need information in the program that goes beyond what is provided via standard BTAM tables.

For example, while terminal lists can be defined using DFTRMLST macro, a mechanism is needed to determine which list is to be used when and with which line.

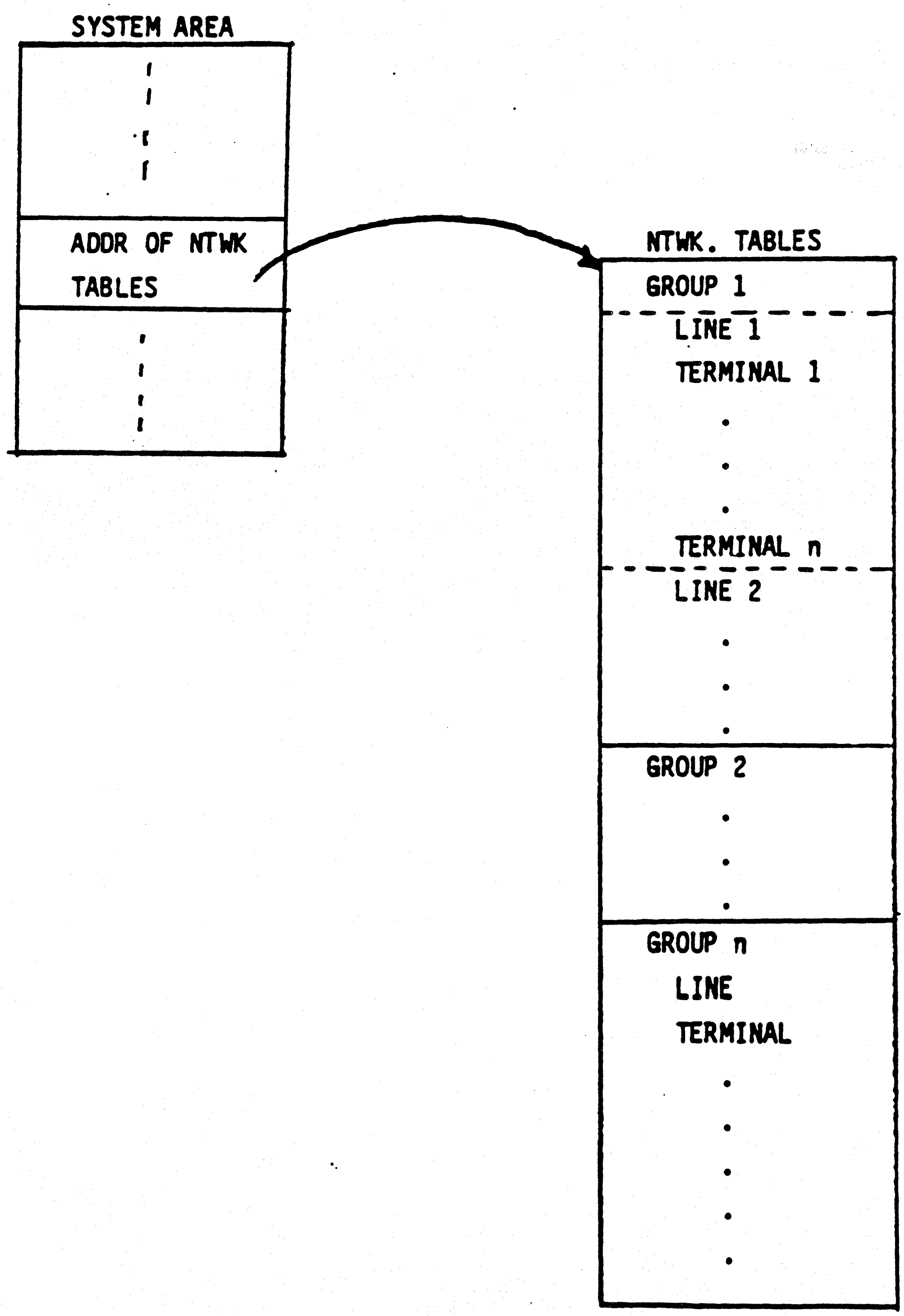
It is important to identify the types of information that would be needed and how various inter-related data would be linked together.

One way to put together such information is to put it in user defined tables or control blocks. The names, size, and contents of such tables are entirely upto the system designer.

As an example of how information could be organized to implement a system such as here some illustrative tables are shown in the following pages. It should be borne in mind that this is just one of several ways tables could be organized i.e., there is no 'THE WAY'.

Generally speaking, though, it is a good idea to organize your tables in a heirarchical manner should there be natural heirarchical relationship among the resources being defined

Overview of Control Blocks:

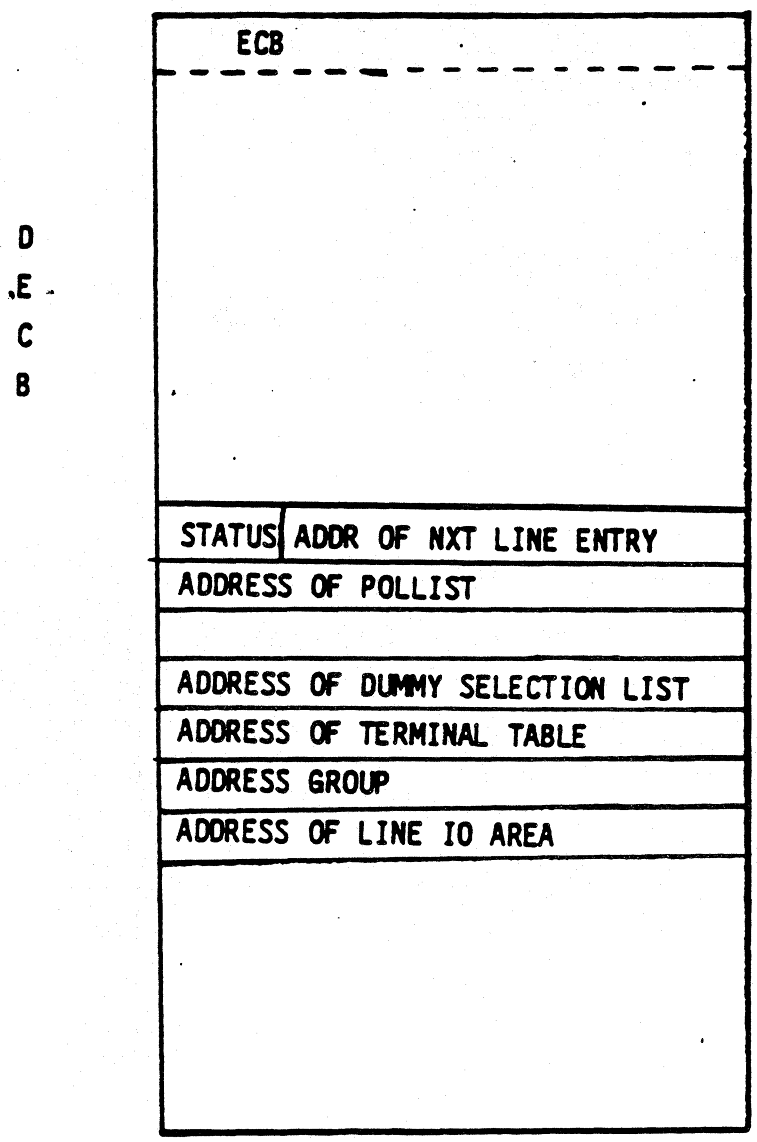


GROUP ENTRY

4 BYTES

ID	ADDRESS OF NXT GRP ENTRY
ADDRESS LINE TABLE, THIS GROUP	
ADDRESS OF DCB	
ADDRESS OF READ RTN	
ADDRESS OF WRITE RTN	
ADDRESS OF IO COMPLETION RTN	
ADDRESS OF LAST LINE ENTRY	

Line Entry


ECB
D
E
C
B
STATUS
ADDR OF NXT LINE ENTRY
ADDRESS OF POLLIST
ADDRESS OF DUMMY SELECTION LIST
ADDRESS OF TERMINAL TABLE
ADDRESS GROUP
ADDRESS OF LINE IO AREA

TERMINAL ENTRY

SYMBOLIC NAME
CURRENT TRANSACTION
SELECTION SEQUENCE
LINE ENTRY ADDRESS

Teleprocessing Monitors

We just designed one! The concepts that we have developed so far in this unit, Transaction Control and Network Manager, in effect from the heart of real life TP Monitors such as CICS, Taskmaster, etc.

The real life TP Monitors, of course, go far beyond our primitive model here.

For example, we did not touch upon the data base handling at all in our model. In a real monitor this would be a major component.

Other issues relate to storage management, high level language interfaces, handling application program errors, and system restart and recovery. These issues go beyond the scope of this course and cannot be covered here in any detail. However, we would discuss two monitors at an overview level later in this seminar.

network control
task management

<u>XYZ, Inc.:</u> Chapter II, Circa 1976

Rich Star, V.P. Data Processing, is a respected executive of XYZ, Inc. Ever since he provided on-line systems for the Marketing, Corporate Finance and Distribution departments, his star has been rising at XYZ. His promotion to V. P. came in late 1974 and Rich felt that it was well deserved.

Since XYZ was a dominant vendor by now, its executives were often invited to present keynote addresses by various trade groups and societies.

One of such invitations was received by Jack Grouch, V. P. , Manufacturing, to be the keynote speaker at the annual convention of National Union of Retail Distributors, otherwise known as NURDS.

While attending that convention at Hilton Head, South Carolina, Mr. Grouch heard a presentation by an independent consultant, Jane Smart, on use of computers in business.

What especially caught Mr. Grouch's attention was Ms. Smart's assertion that it was becoming increasingly easier to develop on-line systems using pre-packaged software called Teleprocessing Monitors. Ms. Smart also talked about some rather complicated technologies using terms such as System Network Architecture, universal protocols, and machine-to-machine interfaces.

Mr. Grouch was quite convinced after Ms. Smart's presentation that Manufacturing had been denied their on-line system unfairly and invited Ms. Smart to make a presentation to XYZ, Inc.'s Executive Committee the following month.

Ms. Smart's presentation to the XYZ Executive Committee went rather well and the high point came when Ms. Smart disclosed that she had recently helped install a truly state of the art on-line system for XYZ's main competitor, We Do It Better, Inc. Ms. Smart explained how Better's system was developed using far less manpower and talent than XYZ using a package called Customer Information Control System (CICS), and how this system gave a tremendous advantage to 'Better' over their competition.

Around the same period, unknown to DP staff, the CEO of XYZ was also approached by the Regional Marketing Director of IBM about the use of their latest software and hardware for XYZ. Their specific recommendation was to do a complete study of XYZ operations and to come up with a comprehensive solution for XYZ needs.

Such a study was undertaken and it was recommended that, looking into the future, XYZ must consider migration to SNA and that IBM would provide software such as CICS to ease the pains of such a migration.

Rich Star tried to point out how XYZ had one of the most efficient and reliable systems by industry standards. He also felt that migrating to SNA was premature. No one really understood the implications of such a move. However, Star was unable to provide any firm estimates of cost and time to migrate his current system to SNA other than to say that it would be almost like designing a whole new system.

In 1975 XYZ migrated to CICS. The response time was less than desirable. When the system went down, it took much longer to bring it up because system programmers were not familiar with the system. But a whole new group of application programmers was very happy. They could write new transactions using Cobol.

Rich Star had opposed the move to packaged software rather strenuously. But it did not really matter any more.

Last we heard, Rich was running a computer store selling, among other things, packaged software for micro-computers.

Epilogue

1977: Things were much better - but they had to migrate to the new release of CICS, 1.1.3, so that they could take advantage of the new features.

1979: Things were much better. Release 1.1.3 was stable enough but they had to migrate to release 1.1.4.

1981: Things were much better - but all the new exciting things were happening in SNA - perhaps it was time to consider ACF/VTAM version of CICS.

1983: Things must be much better, after all they were running SNA!! But who could be sure anymore. The largest communications company in the USA had just announced their new Value Added Public Network and there was talk of 'peanuts' and 'popcorn' from IBM- they just had to look into it.

1987: Things were much better, but .....

XYZ, INC.

LESSONS TO BE LEARNED

Build vs Lease

HP Monitor

UNIT 10

CUSTOMER INFORMATION CONTROL SYSTEM
(C I C S)

OBJECTIVES

TO IDENTIFY MAJOR MODULES IN CICS

TO IDENTIFY MAJOR TABLES IN CICS WITH MAJOR EMPHASIS ON TERMINAL CONTROL TABLE (TCT)

TO PROVIDE OVERVIEW OF APPLICATION PROGRAM AND CICS COMMUNICATIONS

CICS_INTRODUCTION

- A GENERAL PURPOSE TELEPROCESSING MONITOR
- AN IBM SOFTWARE PACKAGE (PROGRAM PRODUCT) THAT SIMPLIFIES THE TASK OF DEVELOPING SOFTWARE FOR ON-LINE APPLICATIONS
- OTHER PACKAGES THAT PROVIDE SIMILAR CAPABILITIES: ENVIRON, SHADOW, TASKMASTER, IMS/DC
- CICS, THROUGH ITS TASK MANAGEMENT CAPABILITIES, ALLOWS MULTIPLE APPLICATIONS (TRANSACTIONS) TO SHARE A COMMON NETWORK
- APPLICATIONS MAY BE WRITTEN IN HIGH LEVEL LANGUAGES
- BESIDES REGULAR FILES ALSO POSSIBLE TO ACCESS DATA-BASES DEFINED UNDER PACKAGES SUCH AS IMS/DB (DL/I), IDMS, ADABAS, TOTAL ETC.
- ERROR HANDLING, RECOVERY, SECURITY, PRIORITIES BY TERMINAL, TRANSACTION OR OPERATOR ARE SOME OTHER HIGHLIGHTS

SELECTED MANAGEMENT MODULES IN CICS

TASK CONTROL:	DISPATCHES AND MANAGES PROGRAMS.
TERMINAL CONTROL:	MANAGES THE NETWORK AND TERMINALS.
FILE CONTROL:	MANAGES THE FILES, INTERFACE TO ACCESS METHODS AND DATABASE MANAGEMENT SYSTEMS.
STORAGE CONTROL:	MANAGEMENT OF STORAGE IN THE POOL BOTH FOR CICS OWN USAGE AND APPLICATIONS.
TEMPORARY STORAGE:	"SCRATCH PAD" AREA, TO SAVE INTERMIDIATE RESULTS, DATA.
PROGRAM CONTROL:	LOADING OF PROGRAMS, LANGUAGE INTERFACE
JOURNAL CONTROL:	RECOVERY
DUMP/TRACE CONTROL:	GENERATION OF DUMPS AND TRACES

adabas interface

:
:

MAJOR TABLES IN CICS

PROGRAM CONTROL TABLE (PCT):

IDENTIFIES VARIOUS TRANSACTION CODES AND PROGRAM ASSOCIATED WITH EACH TRANSACTION CODE.

PROCESSING PROGRAM TABLE (PPT):

NAMES OF ALL PROGRAMS THAT ARE TO RUN UNDER CICS, ONE ENTRY PER PROGRAM.
PROGRAM ATTRIBUTES - LANGUAGE, SIZE, LOCATION ON DISK.

TERMINAL CONTROL TABLE (TCT):

DESCRIPTION OF NETWORK RESOURCES - LINES AND TERMINALS

FILE CONTROL TABLE (FCT):

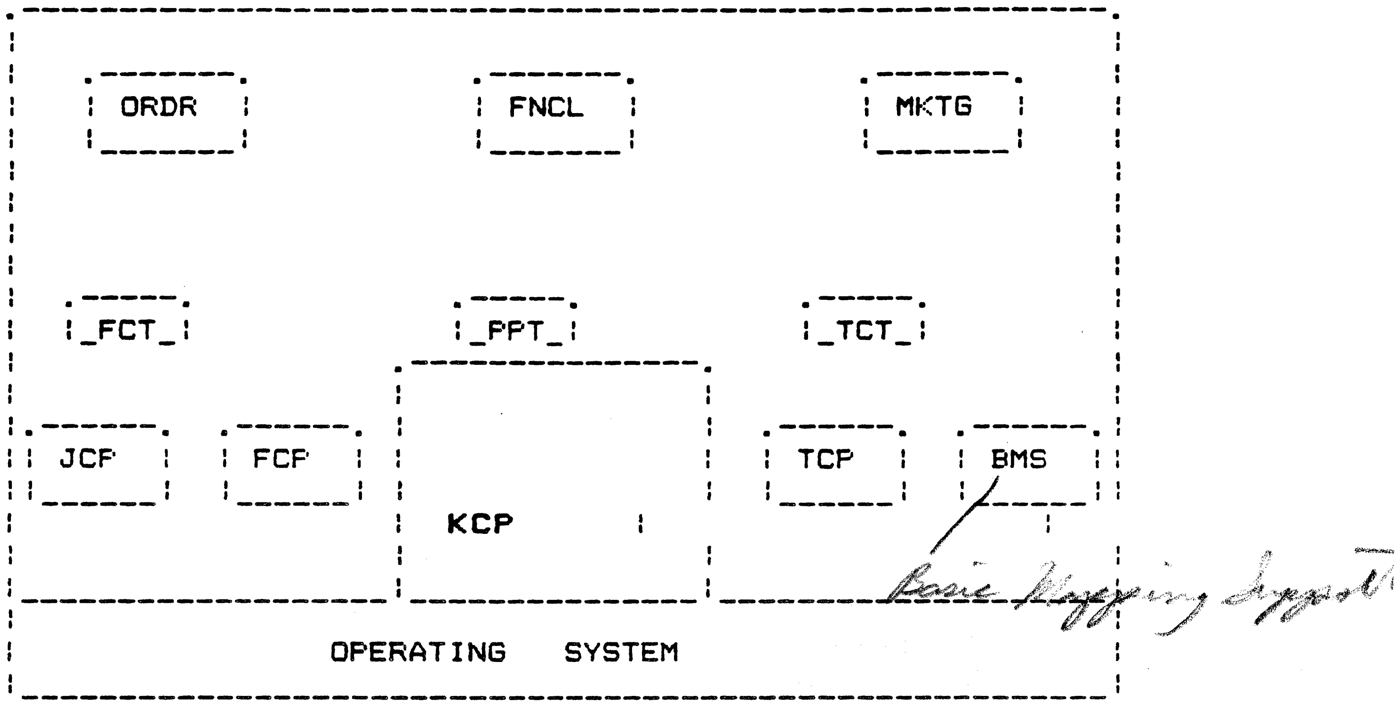
DESCRIPTION OF FILES NEEDED BY PROGRAMS THAT ARE TO RUN UNDER CICS.

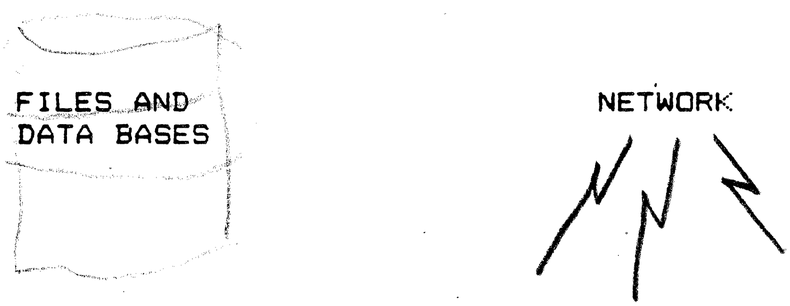
SIGN ON TABLE (SNT):

USER NAMES, PASSWORDS, PRIORITIES, SECURITY KEYS.

:
:
:

CICS STRUCTURE





CICS SYSTEM MODULES AND TRANSACTIONS RUN AS ONE JOB IN THE SAME ADDRESS SPACE (PARTITION)

THE TASK CONTROL PROGRAM (KCP) ACTS AS THE INTERFACE BETWEEN APPLICATIONS AND CICS INTERNAL MODULES

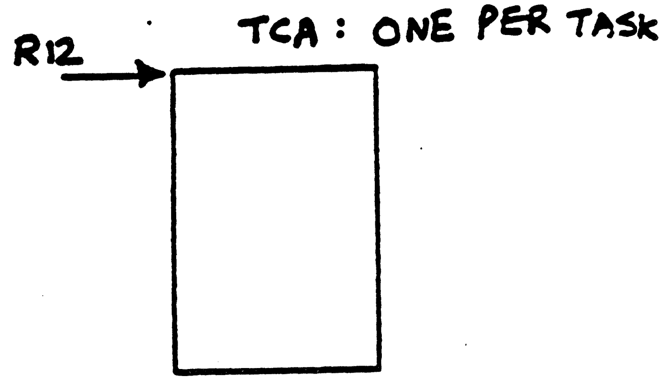
KCP: TASK CONTROL PROGRAM, FCP: FILE CONTROL PROGRAM, TCP: TERMINAL CONTROL PROGRAM , BMS: BASIC MAPPING SUPPORT
JCP: JOURNAL CONTROL PROGRAM.

APPLICATION AND CICS COMMUNIACTIONS

APPLICATION

What user does

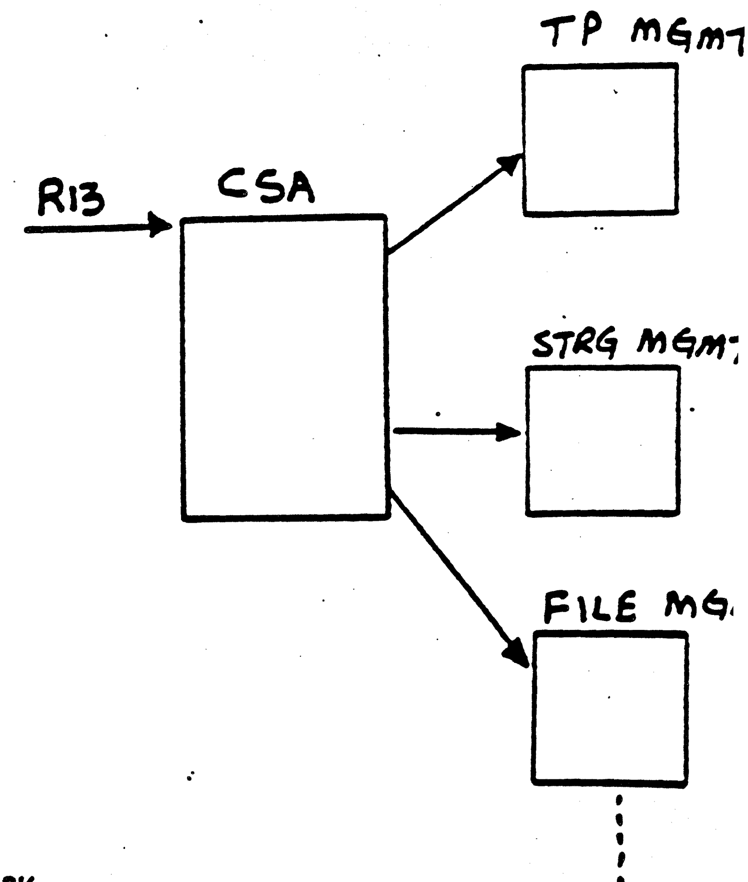
MOVE "GET" REQUEST TO TCA
MOVE REC NUMB TO TCA
MOVE FILENAME TO TCA
GO TO CICS



CICS

does

DECODE APPLICATION RQST IN THE TCA
PICK UP ADDRESS OF THE APPROPRIATE MODULE FROM CSA.
GO TO THE MGMT. MODULE



TCA: TASK CONTROL AREA, ONE PER CICS TASK

CSA: COMMON SYSTEM AREA, ONE PER CICS

BTAM AND CICS

TERMINAL CONTRO TABLE (TCT)

CONTAINS PROFILES OF ALL NETWORK RESOURCES, TABLES (DCB, DECB,..) NEEDED BY BTAM

CICS MACROS INTERNALLY GENERATE BTAM MACROS

Group / lines then sub to terminals

```
DFHTCT     TYPE=SDSCI,........
DFHTCT     TYPE=LINE,..........
DFHTCT     TYPE=TERMINAL,.....
   :
   :
DFHTCT     TYPE=LINE,..........

   :

DFTRMLST

DFTRMLST
```

Under TCAM/VTAM only terminals are in no need in CICS to include Group and lines

BTAM AND CICS

Terminal Control Table (TCT):

All network definitions are defined in the Terminal Control Table (TCT). The TCT contains information not only neede ny CICS but also information that it would need to communicate with BTAM. BTAM macros DCB and DECB are not coded directly by the system programmer but are generated internally by CICS.

The same macro, DFHTCT, is used to describe all types of network resources. TYPE= operand identifies the resource being described.

TYPE = SDSCI: Describes a group of similar lines, and generates the BTAM DCB table. Needed one per group of similar lines.

TYPE= LINE: Describes the profile of one line in the group. Coded as many times as the number of lines in the system. Also generates the DECB for the line .

TYPE= TERMINAL: Describes a controller or device on the line. Coded once for each or controller or device in the network.

DFHTCT: This is the standard BTAM macro and coded as discussed earlier in this course.

ILLUSTRATIVE OPERANDS FOR TERMINAL CONTROL TABLE IN CICS

```
         DFHTCT     TYPE=INITIAL,            BEGIN TABLE
                    ACCMETH=NONVTAM,         NON-VTAM SYSTEM
                    :
                    :
                    :
POLLST1  DFTRMLST   AUTOWLST,(...poll list..)

SELLST1  DFTRMLST   OPENLST,(...sel list..)  ONE PER DEVICE
           :
           :
           :
         DFHTCT     TYPE=SDSCI,          GROUP ENTRY
                    DEVICE=3277,            FOR 3270 TYPE
                    DDNAME=.....              JCL CONNECTION
                    :
                    :

         DFHTCT     TYPE=LINE,           BEGIN LINE DESCRPN
                    BTAMRLN=...,         WHICH LINE IN JCL
                    LISTADDR=POLLST1     POLL LST THIS LINE
                    :
                    :

         DFHTCT     TYPE=TERMINAL,       BEGIN TERM DESCRPN
                    TERMID=T001,         LETS CHRISTEN IT
                    TRANSID=ACCT,        OPTIONAL DEFAULT
                    TRMADDR=SELLST1,     TERM SEL LST NAME
                    :
                    :
         :
         :
         :
         DFHTCT     TYPE=FINAL           END TABLE
```

All tp monitors have a mapping support

CICS AND BASIC MAPPING SUPPORT (BMS)

MOST TELEPROCESSING MONITORS TODAY OFFER AN APPLICATION CODING AID OFTEN REFERRED TO AS 'MAPPING SUPPORT' EXAMPLES OF SUCH FEATURES ARE:

- BASIC MAPPING SUPPORT (BMS): CICS
- MESSAGE FORMATTING SERVICES (MFS): IMS
- TERMINAL INDEPENDENCE MODULES (TIMS): TASKMASTER ETC.

PRIMARILY A CODING AID TO EXPLOIT 3270 CAPABILITIES WITHOUT REQUIRING AN APPLICATION PROGRAMMER TO KNOW ABOUT COMMAND AND DEVICE LEVEL DETAILS OF 3270. in other words it keeps track of the HEX instructions in pseudo code translations

A VERY USEFUL TOOL WHICH REMOVES LARGE AMOUNTS OF CLERICAL AND ERROR PRONE DETAILS FROM THE APPLICATION PROGRAM CODING.

LACK OF DEVICE FAMILIARITY CAN ALSO GIVE RISE TO SOME VERY POORLY DESIGNED APPLICATIONS WITH RESPECT TO 3270 DEVICES

FOR APPLICATIONS DEALING WITH A VARIETY OF DEVICES MULTIPLE 'MAPS' CAN DEFINED, ONE FOR EACH DEVICE AND CAN BE GROUPED TOGETHER AS A 'MAP-SET' FOR CONVENIENT REFERENCE IN THE APPLICATION.

C I C S   E X E R C I S E

FOR THE NETWORK CONFIGURATION USED IN THE BTAM EXERCISE, CODE THE APPROPRIATE CICS/TCT MACROS IN THE RIGHT ORDER. CODE ONLY THOSE VALUES THAT WERE SHOWN ON THE ILLUSTRATIVE TCT VALUES.

(NOTE: FOR TTY-43 TERMINAL DEVICE CODE

CODE TRMTYPE=TWX ON TERMINAL DESCRIPTION)

UNIT

INFORMATION MANAGEMENT SYSTEM, DATA COMMUNICATIONS

(IMS / DC)

OBJECTIVES:

AT THE CONCLUSION OF THIS UNIT, THE ATTENDEE SHOULD BE ABLE TO :

1. DESCRIBE THE STRUCTURE OF NETWORK TABLES IN IMS
2. COMPARE IMS ARCHITECTURE WITH CICS AT A HIGH LEVEL

IMS DATA BASE/DATA COMMUNICATIONS

- PRIMARILY A DATA BASE PACKAGE independent of

- DATA COMMUNICATIONS: AS IF AN AFTERTHOUGHT

- APPROPRIATE WHEN DATA BASE INTEGRITY TAKES PRCEDENCE OVER PERFORMANCE AND RESPONSE TIME

- COMMUNICATIONS NOT AVAILABLE WITH DOS

IMS TERMINAL SUPPORT
(COMMON TYPES)

- IBM 2260
- IBM 2740
- IBM 2741
- IBM 2780/2770
- IBM 3270
- IBM 3600
- IBM 3614
- IBM 3630
- IBM 3767
- IBM 3770
- IBM 7770 AUDIO RESPONSE UNIT
- IBM SYSTEM 3
- IBM SYSTEMS 32/34, SERIES 1
- TTY(TWX) 33/35 DEVICES

BATCH_VS._ONLINE_PROCESSING_UNDER_IMS

BATCH_APPLICATIONS

- o SEPARATE PRIVATE/LOCAL REGION CONTROLLER FOR EACH BATCH APPLICATION
- o EACH BATCH APPL IS AN INDEPENDENT JOB
- o OFF LINE, TRADITIONAL, BATCH PROCESSING ONLY
- o THESE WILL NOT BE DISCUSSED FURTHER

ONLINE_SYSTEM

- o RUNS UNDER THE CONTROL OF SINGLE CONTROL REGION
- o MULTIPLE APPLS (ONE /REGION) RUN WITH ONE CONTROL REGION
- o ONLINE ACCESS TO APPLCATIONS FROM TERMINALS
- o CAN NOT ACCESS OS FILES

NOTE: PRIOR TO RELEASE 1.2, BATCH IMS SYSTEMS COULD NOT ACCESS ONLINE DATABASES

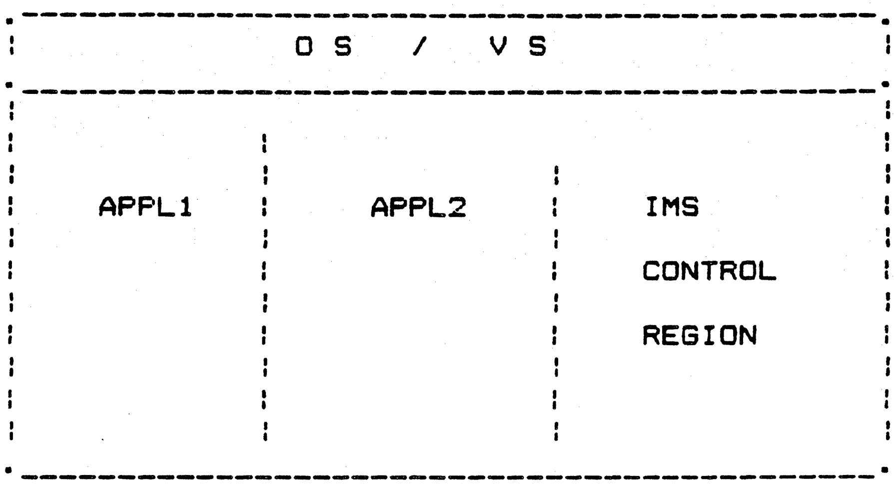
IMS ONLINE CONTROL REGION: INTRODUCTION

```
.----------------------------------------------------------------.
:                        O S  /  V S                             :
:----------------------------------------------------------------:
:              :              :              :                   :
:              :      A       :      A       :       A           :
:   CONTROL    :      P       :      P       :       P           :
:              :      P       :      P       :       P           :
:   REGION     :      L       :      L       :       L           :
:              :      1       :      2       :       3           :
:              :              :              :                   :
:    C R       :    M P P     :    M P P     :     M P P         :
:______________:______________:______________:___________________:
```

IMS CONTROL REGION:

- o CONTAINS IMS SYSTEM ROUTINES, CODE, AND TABLES
- o MANAGES AND CONTROLS THE NETWORK AND ONLINE APPLICATIONS
- o PROVIDES ACCESS TO MESSAGE QUEUES FOR ONLINE APPLICATIONS AND MANAGES OUTGOING MESSAGES TO TERMINALS
- o WORKS INDEPENDENT OF IMS BATCH SYSTEMS

IMS ONLINE SYSTEM ORGANIZATION



- UNLIKE CICS APPLICATIONS (TRANSACTIONS) ARE NOT A PART OF THE TP MONITOR JOB
- NEED INTER-REGIONAL MOVEMENT OF DATA BETWEEN APPLS AND IMS
- ONLINE APPLICATIONS MAY ACCESS ONLY IMS DEFINED DATA BASE AND NO OTHER FILES

a little more secure. Partitions better seperated

BATCH PROCESSING WITH ONLINE IMS

```
.------------------------------------------------.
:             O S   /   V S                      :
.------------------------------------------------.
:                                                :
:    ONLINE                                      :
:    APPL                                        :
:                               IMS              :
:                                                :
:                               CONTROL          :
:    ONLINE                                      :
:    APPL                       REGION           :
:                                                :
:                                                :
:                                                :
:           BATCH                                :
:           PROCESSING                           :
:           JOB                                  :
:                                                :
.------------------------------------------------.
```

- BATCH APPLICATIONS CAN ALSO RUN UNDER THE CONTROL OF IMS ONLINE CONTROL REGION.

- SUCH BATCH APPLICATIONS ARE CALLED 'BATCH MESSAGE PROCESSING PROGRAMS' OR BMPs

- ONLINE APPLICATIONS BY CONTRAST ARE CALLED 'MESSAGE PROCESSING PROGRAMS' OR MPPs

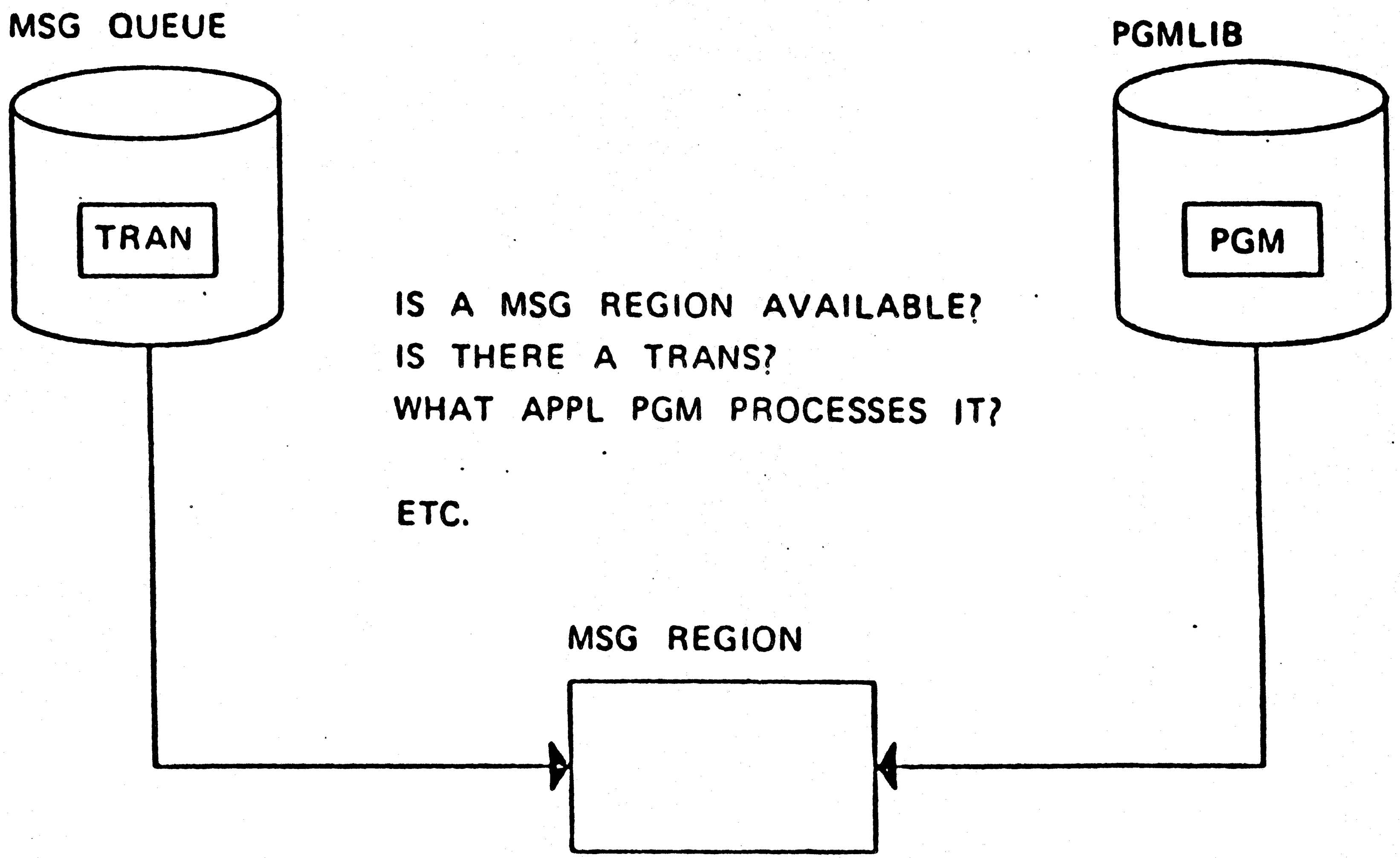
- MPPs ARE AUTOMATICALLY SCHEDULED BY IMS ON ARRIVAL OF INPUT MESSAGES.
  BMPs HAVE TO BE STARTED VIA JOB CONTROL LANGUAGE (JCL)

- IF NEEDED, BMPs CAN ACCESS ONLINE RESOURCES INCLUDING MESSAGE QUEUES AND TERMINALS AND ALSO OS FILES

- BMPs ARE BURDENSOME FOR THE ONLINE PROCESSING AND SHOULD BE USED JUDICIOUSLY

MESSAGE SCHEDULING

"THE PROCESS BY WHICH A COMPLETELY RECEIVED INPUT TRANSACTION IS UNITED WITH ITS ASSOCIATED APPLICATION PROGRAM"



HOW IS IT DONE?

IMS USES A 'DOUBLE' ALGORITHM TO SELECT TRANSACTIONS FOR PROCESSING – CLASS FIRST, THEN PRIORITY WITHIN CLASS.

MESSAGE CLASS SCHEDULING

- ASSIGN A CLASS TO EACH TRANSACTION CODE
- ASSIGN ONE TO FOUR CLASSES TO EACH MESSAGE REGION
- CAUSE IMS TO SCHEDULE TRANSACTIONS OF A CERTAIN CLASS IN MESSAGE REGIONS HAVING A CORRESPONDING CLASS

PRIORITY

- ASSIGN A PRIORITY TO EACH TRAN
  - 0 – LOWEST
  - 14 – HIGHEST
- OPTIONAL AUTOMATIC PRIORITY INCREASE WHEN THERE IS A LARGE QUEUE BUILDUP

DEFINING NETWORK RESOURCES TO IMS (BTAM)

COMMUNICATIONS NAME TABLE: CNM

```
LINEGRP
LINE
CTLUNIT
TERMINAL
NAME
TERMINAL
NAME
CTLUNIT
  :
  :
LINE
  :
  :
LINEGRP
LINE
  :
  :
```

MACROS MUST BE CODDED IN THE ORDER SHOWN

COMMUNICATION NAME TABLE (CNT):

Network resource definitions are collectively referred to as the Communication Resource Table. Five different macros are used to describe the network.

LINEGRP: One per group of similar lines, macro automatically generates the BTAM DCB table for the line group.

LINE: One per line within the group, LINE macro also generates the BTAM DECB table for the line.

CTLUNIT: For BSC3 lines, one per cluster controller, contains, among other information, the polling id of the controller.

TEMINAL: One per terminal in the cluster. Contains terminal selection id among other information.

NAME: Atleast One per terminal, assigns a symbolic name to the terminal immediately preceeding the NAME macro.

Unlike CICS, no DFTRMLST tables are defined for BTAM amd IMS bulds them direcltly from the information provided on the CTLUNIT and TERMINAL macros.

ILLUSTRATIVE OPERANDS FOR IMS/BTAM

BTAM DEFINITIONS

```
LINEGRP    DDNAME=BTAMLN01,UNITYPE=3270,CODE=EBCDIC

LINE       ADDR=040

CTLUNIT    ADDR=40,MODEL=2

TERMINAL   ADDR=40,UNIT=3277,MODEL=2,
           OPTIONS=(TRANRESP), FEAT=IGNORE
NAME       LA101AB

TERMINAL   ADDR=C1,UNIT=3277,
           OPTIONS=(TRANRESP),FEAT=IGNORE
NAME       LA102AB
```

UNIT 5

EVOLUTION OF TELEPROCESSING SOFTWARE AND SNA

OBJECTIVES:

UPON COMPLETION OF THIS UNIT, THE ATTENDEE SHOULD BE ABLE TO:

1. IDENTIFY THE LIMITATIONS OF PRE-SNA ACCESS METHODS AND FRONT ENDS.
2. IDENTIFY THE ROLE AND ADVANTAGES OF TELEPROCESSING MONITORS IN A PRE-SNA ENVIRONMENT.
3. IDENTIFY MAJOR STRUCTURAL AND FUNCTIONAL DIFFERENCES BETWEEN BTAM, ACF/VTAM, AND ACF/TCAM.
4. IDENTIFY MAJOR CAPABILITIES OF EMULATION PROGRAM (EP), PARTITIONED EMULATION PROGRAM (PEP), AND NETWORK CONTROL PROGRAM (NCP) AS FRONT END SOFTWARE.
5. DEFINE THE TERM "COMPUTER NETWORKING"
6. DESCRIBE THE DIFFERENCE BETWEEN PRIVATE AND SHARED PUBLIC NETWORKS.

EVOLUTION OF TELEPROCESSING SOFTWARE IN IBM ENVIRONMENT

SYSTEM 360

↓

BTAM, 270X, TWX

↓

BTAM, 270X, MULTIPLE DEVICES

↓

BTAM, 270X, MULTIPLE DEVICES, MULTIPLE APPLICATIONS

↓

BTAM, 370X EP, TELEPROCESSING MONITORS
(SYSTEM AND APPLICATION SOFTWARE PACKAGES)

↓

VTAM, TCAM, AND NCP

↓

ACF PRODUCTS AND NETWORKING

← Prior to this lecture all these were discussed

EARLY SYSTEMS (PRE-MONITORS): 1

SINGLE APPLICATION SINGLE DEVICE

```
.------------------------------.   ^
:     APPLICATION CODE         :   :
:..............................:   :
:     CODE TO HANDLE TWX       :   :    TP JOB
:..............................:   :
:     BTAM     CODE            :   v
:------------------------------:
:           O S                :
:                              :
 ------------------------------
              :
              :
              :
      .---------.
      :         :    IBM 270X HARDWARE FEP
      :_________:

      SWITCHED
      NETWORK
```

Low speed
Assembler code

EARLY_SYSTEMS_-1: Single Application / Single Device

The very early commercial applications of teleprocessing technology were often simple systems using low speed TTY devices (those were the only ones easily available in those days). The physical networks generally used switched facilities as IBM did not support TTY compatible devices in a leased line environment.

These were generally single device single application systems with BTAM and the hardware 270X as the front end.

Application programmer was responsible for all aspects of the system and, thus, had to be knowledgeable not only in the business functions but also in BTAM and network devices.

Also, because of the limitations imposed by BTAM, the software had to be all written in Assembler Language, one of the more difficult languages for writing software.

EARLY SYSTEMS (PRE-MONITORS): 2

SINGLE APPLICATION MULTIPLE DEVICES

```
.---------------------------------------.   ^
!          APPLICATION CODE             !   !
!.......................................!   !
!    TWX CODE      !     3270 CODE      !   !   TP JOB
!..................!....................!   !
!            BTAM     CODE              !   v
!---------------------------------------!
!                  O S                  !
!---------------------------------------!
                   !
                   !
                   !
              .---------.
              !         !     IBM 270X HARDWARE FEP
              !---------!
```

SWITCHED AND PRIVATE LINES

sensitive to maintenance

Early Systems - 2: Single Application / Multiple Devices

Basic environment still consisted of BTAM and 270x with assembler still being the primary language.

With the availabilty of CRT devices (e. g. IBM 3270) that could be multidropped on higher speed private lines it became possible to achieve higher performance without a disproportionate increase in the facilities cost.

However, that meant that application programmers had to learn multiple protocols and be able to handle various types of line connections in their programs.

Major software changes were needed to support these newer devices. Applications became increasingly more complex and difficult to maintain and grow.

EARLY SYSTEMS (PRE-MONITORS): 3

MULTIPLE APPLICATIONS, MULTIPLE DEVICES

```
.---------------------------------------------------------------.
|        APPL-1 CODE             |       APPL-2 CODE            |
|................................|..............................|
| DEV-1 CODE |     | DEV-n CODE  | DEV-1 CODE |     | DEV-n CODE|
|................................|..............................|
|       BTAM   CODE              |       BTAM   CODE            |
|---------------------------------------------------------------|
|                             O   S                             |
|---------------------------------------------------------------|
                                 |
                                 |
                                 |
                     .----------------------.
                     |                      |   IBM 370X EP
                     |----------------------|
                                 |
   NETWORK FOR                   |                 NETWORK FOR
   APPL-1                        |                 APPL-2
                                 |
                                 |
                                 |
```

help!

Early Systems - 3: Multiple Applications/Multiple Devices

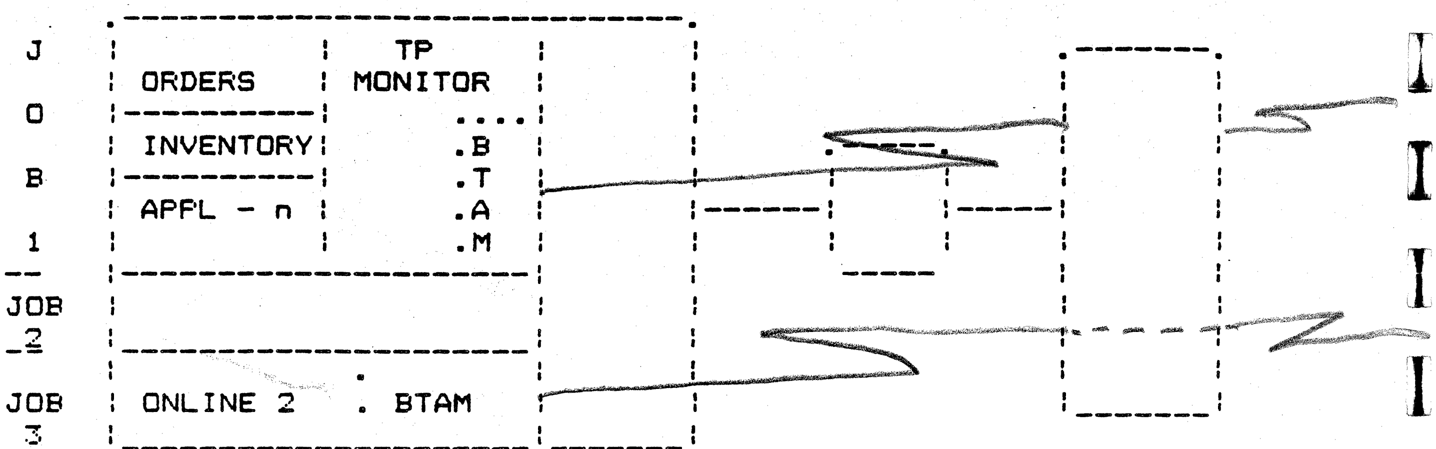
As more and more systems were being converted to on-line environments, we had all the problems of the earlier systems with the additional problem now of a separate network for each application - a very expensive proposition. From communications point of view, this problem of having a dedicated network for each on-line system was probabaly the most serious one and ITS root cause was in the system software itself.

Also, not only did programming teams for each system need advanced level knowledge of data communications, BTAM, and business functions, each team was also firmly convinced that they had the 'better mouse trap'.

Thus arose systems in each shop with their own message formats, coding conventions, and unique operational considerations.

Result was: Inefficient, expensive networks;
high software development cost;
high maintenence overhead; and
incompatible systems.

TELEPROCESSING MONITORS



Emergence of Teleprocessing Monitors:

With the advent of TP monitors it was now possible to run multiple applications in a single partition over a shared network. This gave rise to significantly improved resource utilization.

Additional benefits included separation of communications and business functions in the software. Communication functions were implemented within the monitor and applications (transactions) had to handle primarily business functions.

With most popular monitors it was also possible to write application code in high level languages.

Some of the secondary benefits were:

- o Low cost, low risk entry into teleprocessing.
- o Community of interest and user groups, vendor incentive to keep current.
- o Availability of trained personnel 'off the street'.
- o Better standardization

Examples of some of the common TP monitors are CICS, IMS/DC, SHADOW, ENVIRON, and TASKMASTER.

However, it was not necessary nor desirable to run all applications under the control of the TP monitor. But applications that ran outside the control of the TP monitor still needed <u>separate networks</u>.

Thus, the problem of dedicated networks was not entirely alleviated. Also, first generation TP monitors were not capable of allowing network sharing across hosts.

74

EMERGENCE OF NEW ACCESS METHODS

```
     BTAM                    TCAM                     VTAM
 .------------.          .------------.          .------------.
 ! A .   !    !          ! A !   !    !          ! A !   !    !
 ! P . B !    !          ! P !   !    !          ! P !   !    !
 ! P . T !    !          ! P ! T !    !          ! P ! V !    !
 ! L . A ! O  !          ! L !   ! O  !          ! L !   ! O  !
 ! 1 . M !    !          ! 1 ! C !    !          ! 1 ! T !    !
 !-------!    !          !---!   !    !          !---!   !    !
 ! A . B !    !          ! A ! A !    !          ! A ! A !    !
 ! P . T ! S  !          ! P !   ! S  !          ! P !   ! S  !
 ! P . A !    !          ! P ! M !    !          ! P ! M !    !
 ! L . M !    !          ! L !   !    !          ! L !   !    !
 !_2_.___!____!          !_2_!___!____!          !_2_!___!____!
```

PART OF APPL JOB

MUTIPLE COPIES

DEDICATED NETWORK FOR
EACH ONLINE JOB

INDEPENDENT JOBS

ONLY ONE COPY SUFFICIENT

NETWORK SHARED AMONG
ALL ONLINE JOBS

Yeah!

Emergence of new access methods:

BTAM: BTAM, of course, is not a new access method and its limitations and those of systems built around it were discussed earlier in this unit. ACF/VTAM and ACF/TCAM are the two new access methods that can help in getting around some of the limitations imposed by BTAM based systems.

ACF/VTAM and ACF/TCAM:

Similarities:

1. Each runs as a separate OS job from the application programs.

2. The network is "owned" by the access method and not the applications.

3. Applications sharing the access method can share the network.

4. Both support all major SNA functions.

5. Both are very complex.

No more dedicated hosts

A FUNCTIONAL COMPARISON OF IBM ACCESS METHODS

	BTAM	ACF/VTAM	ACF/TCAM
LINK PROTOCOLS	BSC, S/S	3270 BSC SDLC	BSC, S/S SDLC
FEP SOFTWARE	EP	NCP	EP, NCP
DIAGNOSTIC CAPABILITIES	SIMPLE	EXTENSIVE	EXTENSIVE
COMPLEXITY	SIMPLEST	VERY COMPLEX	MOST COMPLEX
OPERATOR COMMANDS	NONE	EXTENSIVE	EXTENSIVE
MSG Q'ING *storage*	NONE	NONE	YES
MSG SWITCHING *+ process out of CPU*	NONE	NONE	YES
MULTIPLE HOSTS	NO SUPPORT	YES	YES
SNA	NO	YES	YES
SYSGEN	SIMPLEST	VERY COMPLEX	MOST COMPLEX
OP. SYS SUPPORT	OS, DOS	OS, DOS	OS ONLY
3270 SUPPORT	*3270* BSC	ALL MODELS	ALL MODELS

not precise compare

PARALLEL DEVELOPMENTS

FEP EVOLUTION:

HARDWARE FEPs: IBM 270X FAMILY

PROGRAMMABLE: IBM 370X FAMILY

- EMULATION PROGRAM (EP) MODE
- EP+ MODE (NON-IBM FEPs)
- NETWORK CONTROL PROGRAM (NCP) MODE

Parallel developments: FEP Evolution

Hardware FEPs:

When 270x-like, non-programmable front ends first became available, they fulfilled the following needs:

a) Provide a standard interface to the host I/O channel on behalf of the network.
b) Partially make up for the speed mis-match between host channel and the network.
c) Provide EIA (or equivalent) interface for each line and buffer line data.
d) Provide some DLC control characters and check for transmission errors.

Some of the major limitations, above and beyond capacity, were:

Lack of flexibilty, needed vendor personnel to make changes to network configuration- expensive for both vendor and the customer, and centralization of network management, control, and protocols in the host.

Programmable FEP with Emulation Program (EP) and EP+:

The advent of solid state technology made possible the creation of larger and programmable front ends at a less than prohibitive cost.

Initially, however, these programmable machines did not takeover any of the existing host functions as that would have required changes in the host system software which most of the customers did not want to make. So while programmable, these machines still emulated the old hardware FEPs in their functional capabilities. Thus, these machines came to be known as Emulation Program (EP) machines

Some of the non-IBM front ends not only provided complete EP capabilities, but also additional features, such as speed/code conversion, not available on IBM3705/EP. Such non-IBM oferrings were sometimes also referred to as the EP+ machines.

Some examples of such vendors are COMTEN (now part of NCR), CCI, and Memorex (Burroughs).

Programmable FEP with Network Control Program (NCP):
(VTAM and TCAM only)

With SNA came the need to off-load network management and control functions out of the host and, thus, the NCP. Link protocol (SDLC), activation/deactvation of network resources, tracking status are done by the front end with NCP. NCP is also capable of staying operational even when the owning host is lost- a critical requirement in a multiple-host, networking environment.

FEP SOFTWARE AND SUBCHANNEL REQUIREMENTS

E P:

ONE SUBCHANNEL PER LINE

ONLY BYTE MULTIPLEXER CHANNEL (SLOWEST)

N C P:

ONE SUBCHANNEL FOR THE WHOLE NCP (OR PER CHNL ADAPTER)

CAN CONNECT WITH BLOCK MUX OR SELECTOR CHANNEL

WHAT ABOUT PARTITIONED EMULATION PROGRAM (PEP)

CURRENT CONFIGURATION:

```
     BTAM/TCAM                    EP
 .--------------.          .----------.
 :              :          :          :          ASYNCH,
 :              :          :          :
 :              :          :          :          BSC
 :______________:          :__________:
```

TRANSITION CONFIGURATION:

```
                                  PEP
  .--------------.          .-----------.
  :              :          :           :        ASYNCH
  :              :          :    EP     :        BSC
  :______________:          :___________:
  :              :          :           :
  :              :          :   NCP     :        SDLC,
  :______________:          :___________:        BSC 3270
```

FINAL OBJECTIVE

```
     VTAM/TCAM                    NCP
  .-------------.          .----------.
  :             :          :          :
  :             :          :          :          SDLC
  :             :          :          :          BSC 3270
  :_____________:          :__________:
```

ASSEMBLER

Early_Technology:_Review_Quiz

1. Identify major limitations/disadvantages of teleprocessing environment prior to TP Monitors. Application programmers acting as systems programmers when teleprocessing / application / network (dedicated network)

2. Identify major advantages of TP Monitors over earlier environments. SHR application,

3. One of the major advantages of TP monitors is the ability to share the network among multiple applications. What then is meant by the "dedicated networks" problem in a TP Monitor environment? If not in TP monitor treated as seperate network

4. What advantages do programmable front ends offer over non-programmable front ends even while emulating the non-programmable front ends? Easier to maintain. Machine speed increase

5. What are the benifits of NCP over EP?

6. What is meant by the PEP configuration and when is its use appropriate? Transition from EP to NCP

7. For each of the link protocols shown below, identify the access methods and front end software with which they can be supported:

	ACCESS METHODS	FEP SOFTWARE
Start/Stop	BTAM TCAM	EP EP/NCP
BSC (FULL SUPPORT)	BTAM TCAM	EP EP/NCP
SDLC	VTAM TCAM	NCP
BSC (3270 ONLY)	TCAM BTAM VTAM	EP, NCP EP NCP

UNIT 2B

WHY FORMAL ARCHITECTURES AND SNA

EMERGING TRENDS AND ISSUES
(LATE 60s EARLY 70s)

"IN THE WORLD OF THE FUTURE, WILL THE INFORMATION SYSTEMS BE CENTRALIZED OR DISTRIBUTED, MAXI OR MINI, TOP DOWN OR BOTTOM UP?"

"YES !!".

DR. LEWIS M. BRANSCOMB
VICE-PRESIDENT, CHIEF SCIENTIST
IBM, 1979.

The Evolution of the New Issues and Architectures: A Tutorial

When discussing teleprocesing or data communications systems there are often implied assumptions about what is called a network. Obviously, a collection of transmission facilities alone without additional protocols is not a network.

A set of "locally" interconnected terminals (consoles) and machines (disks, tapes, printers, etc.) within one computer center can be called a network, but are not included in teleprocessing discussions since they do not involve telecommunications.

Sometimes networks are classified based upon whether they are fixed in place (using leased lines) or transitory (using dial up lines). In some cases it is possible to identify a network in terms of applications using the network e.g., Inquiry/Response, Remote Job Entry, Time Sharing, Data Entry, etc. In any significant system a simultaneous mix of several of these functions will be found.

However, one critical characteristic of these systems by which they may be distinguished is the manner in which the host machine exerts control over the system. In the more traditional "teleprocessing" or strictly terminal-oriented systems, there is only one host and it supports many terminals in a hierarchical way. There may be only two levels in the hierarchy, host and terminal, or more. A four level hierarchy may involve host, front-end, cluster controller, and terminals.

But in any case, the system control resides in ONE host.

As the number of single host systems grew, it became desirable to consolidate communications networks. There were many situations within the same community of users in which different hosts (often different types) provided different application programs and services to different types of terminals over non-shared communication lines often operating well below capacity.

Consolidation of single host networks gave rise to networks with multiple coequal hosts, none of which was single-handedly in control of the total network. Each of these hosts could interact with the other to provide resources to its applications and terminals on demand.

This latter type of environment with multiple hosts is often referred to as a "computer networking" or simply "networking" environment to distinguish it from traditional, terminal oriented (i.e., single host) systems.

Once the concept of computer networking took hold, it became obvious fairly quickly that advantages of such an environment far surpassed the reduction in line costs. Performing code conversions, providing alternate routing for backup became natural extensions of such a system. As viewed by the user community (or more accurately, the "potential" user community), a networking environment can provide more powerful options such as a complete freedom for any terminal to access any CPU or any CPU to access any other CPU.

Such a set of general objectives gives rise to a generalized definition of computer networking as "a set of autonomous, independent computer systems, interconnected so as to permit interactive resource sharing between any pair of end-points."

However, such a generalized objective of sharing resources raises communications issues far more extensive and complex than those of achieving increased utilization at a lower cost.

These issues also involve complex regulatory matters that infringe upon the scope of the Bell System's and other regulated carriers' involvement in the networking solutions.

There is the need for common definitions, message formats and protocols between different data-processing systems communicating with each other and between data-processing systems and remote devices.

The network management itself presents a whole new set of problems. Some of the questions that come up are - which operational center is going to be responsible for which part of the network? How are the back-ups to be provided? How do various hosts coordinate their activities with each other?

Distribution of data bases is a whole new area which needs a separate discussion. There is a great amount of research and development effort being spent in this area. The rewards of such efforts still seem a few years away.

So, while networking environments with resource sharing and distributed processing have an attractive set of advantages, their design and installation is complex enough to put them out of the reach of an average potential user today. But, for those who do want to explore the implementation of such an environment, there are two basic approaches available - Private Networks and Shared Public Networks. These two approaches are discussed next.

Private_Networks_for_Computer_Communications

First of all, a private network in this context does not mean a private or leased lines network- switched lines are very much a part of it. These networks are private in the sense that they are deployed, managed, used, and controlled by a customer for its own purposes. The network still consists of predominantly common carrier facilities.

In this context, most existing customer networks today are private networks.

In a networking environment a customer may use an architecture such as SNA to build such a private system. In a sense, all that SNA would provide in this case would be the guildlines to build such a system.

It would be the customer's responsibility to select appropriate SNA compatible terminals, proper hardware and software for the front- end, appropriate host system software and applications.

Customer would also be responsible for physical network design (number of private and switched lines, use of satelites, speeds, location and number of drops, etc.), modem selection, attaining response time objectives, and backup and recovery of network failures.

Somewhere along the way the customer would also have to understand what SNA formats and protocols mean, which in itself may cause some problems.

Shared_Public_Networks_for_Computer_Communications

An increasingly attractive option for a number of customers may be not to do any development on their own but, rather, connect into existing data networks available for public access for a fee.

Such networks, called the shared public networks, are being provided by certain vendors who use common carrier facilities for actual transportation of data. Billing to customers is primarily based upon usage and not the distance that data has to travel.

Some other names for such networks are Public Data Networks (PDNs) and Value Added Networks (VANs).

Currently some of the available offerings in the U.S.A. are Tymnet from Tymshare, Telenet from GTE and NET/1000 from AT&T Information Systems.

A customer using a public network does not have to worry about network management, operation and recovery. Most of these networks also provide features (called "values" and, thus, the name VANs) such as code, protocol, and speed conversions which make it possible for an end user to communicate with a diverse range of terminals without requiring the support software in the host.

Value added networks, because of their complexity, provide a big challange to potential vendors. Maintaining security and message integrity are two of the major concerns of the VAN users. But on the other hand, VANs also provide ready made data networks that one can use with minimal effort in a manner similar to using voice networks. While the VAN concept is here along with a few basic offerings, it would probably be a few years before VANs become an ubiquitous force in the data marketplace.

It should also be noted that private and public networks are not mutually exclusive. It is quite likely that the comprehensive solutions of the future would include a combination of both public and private networks along with emerging technologies such as local area networks (LANs).

NEW_ISSUES

MAJOR THEMES HERE ARE:

- DISTRIBUTON OF FUNCTIONS
- RESOURCE SHARING / COMPUTER NETWORKING
- GROWTH: DATA VOLUMES, APPLICATIONS, HOSTS
- MIGRATION: ABILITY TO ACCOMODATE NEW TECHNOLOGIES

NEW ANSWER: COMPUTER NETWORKING SYSTEMS

- THE PROCESS OF INTERCONNECTING HOST COMPUTERS SO THAT THEY CAN COMMUNICATE AUTOMATICALLY
- ANY APPLICATION/TERMINAL IN THE NETWORK SHOULD BE ABLE TO ACCESS ANY OTHER APPLICATION/TERMINAL WITHOUT ANY REGARD TO ITS LOCATION
- IMPLEMENTATION OF NETWORKING SOLUTIONS THROUGH FORMALLY DEFINED ARCHITECTURES SO THAT FUNCTIONS OF VARIOUS COMPONENTS ARE PRECISELY DEFINED AND, THUS, THERE IS NO AMBIGUITY WITH RESPECT TO COMPATIBILITY ISSUES AND FUTURE MIGRATIONS
- SNA IS ONE SPECIFIC EXAMPLE OF THE ABOVE CONCEPT

EVOLUTION OF NEW ISSUES AND ARCHITECTURES

1. As defined in this tutorial, what is the difference between a "terminal oriented" and "computer networking" environments?

   Terminal oriented single host / host w/ many terminals
   computer network environ is 2 computer hosts
   w/o regard to terminals

2. What potential advantages does a customer have in a networking environment? Complete freedom of the user to access any computer or any CPU to access another

3. What are some of the major problems in developing a networking system? Very complex from communications standpoint, and complex standardization for each machine to talk to each other

4. What is the major difference between a private network and a shared public network ?

   Private network - customer responsible for pgm and data, hardware, software

   shared - Vendor responsible for pgm and data

5. What are some of the problems for a customer considering a shared public network today?

   availability, security, message integrity, response delay.

74 - avail
77 - major implement

UNIT 6

SNA FUNDAMENTALS

OBJECTIVES:

UPON SUCCESSFULLY COMPLETING THIS UNIT THE ATTENDEE SHOULD BE ABLE TO DEFINE THE FUNCTION OF:

NETWORK ADDRESSABLE UNIT (NAU)
SYSTEM SERVICES CONTROL POINT (SSCP)
PHYSICAL UNIT (PU)
SNA SESSIONS
ACTPU, ACTLU, BIND, AND SDT COMMANDS
LOGICAL UNIT (LU)
REQUEST/RESPONSE UNIT (RU)
REQUEST/RESPONSE HEADER (RH)
TRANSMISSION HEADER (TH)
PATH INFORMATION UNIT (PIU)
DOMAINS
SUBAREAS

Standardization

SNA: INTRODUCTION

1. ".....ARCHITECTURE FOR BUILDING COMPLEX MULTIPLE HOST NETWORKS WITH DISTRIBUTED PROCESSING AND RESOURCE SHARING..."

2. IBM's ARCHITECTURE

3. A METHODOLOGY/PHILOSOPHY, A SET OF RULES

4. ALL IBM COMMUNICATIONS PRODUCTS, HARDWARE AND SOFTWARE, IN THE FUTURE WILL CONFORM TO SNA SPECIFICATIONS

5. SNA ADDRESSES SELECTED COMMUNICATIONS ISSUES ONLY AND NOT APPLICATION ORIENTED FUNCTIONS

6. CAN IMPLEMENT SNA NETWORKS WITH NON-IBM PRODUCTS SUCH AS DATASPEED 4540E, COMTEN, AND AMDAHL AND NUMEROUS OTHER VENDORS

AT&T answer to IBM 3270

WHAT SNA IS NOT

1. A SPECIFIC PRODUCT - i.e., A PIECE OF HARDWARE/SOFTWARE

2. A LINK PROTOCOL - IT IS MORE THAN SDLC

3. A SPECIFIC ACCESS METHOD

4. A FRONT END

SNA ENCOMPASSES ALL OF THE ABOVE AND PROVIDES SPECIFIC RULES AND PROTOCOLS FOR ALL OF THE ABOVE

WHAT SNA SPECIFIES

traditional def too narrow

1. PROTOCOLS:

    LINK LEVEL

    FEP TO CLUSTER CONTROLLERS

    FEP TO DEVICES

    ACCESS METHODS TO FEP/CONTROLLERS/~~STATIONS~~ DEVICES

    HOST APPLICATION TO DEVICES

2. COMMANDS:

    ACTIVATION/DEACTIVATION *sequence*

    INTERROGATION *of status*

    STATISTICS/DIAGNOSTICS

3. CONTROL AND DATA FLOW SEQUENCES

4. MESSAGE FORMATS:

    HEADERS/USER DATA

    DETAILED BIT SPECIFICATIONS

GETTING A HANDLE ON SNA: THREE VIEWS

1. OPERATIONAL (STRUCTURAL) VIEW

   - NETWORK ADDRESSABLE UNITS (NAUs), DOMAINS, SUBAREAS, ...

2. LAYERED VIEW

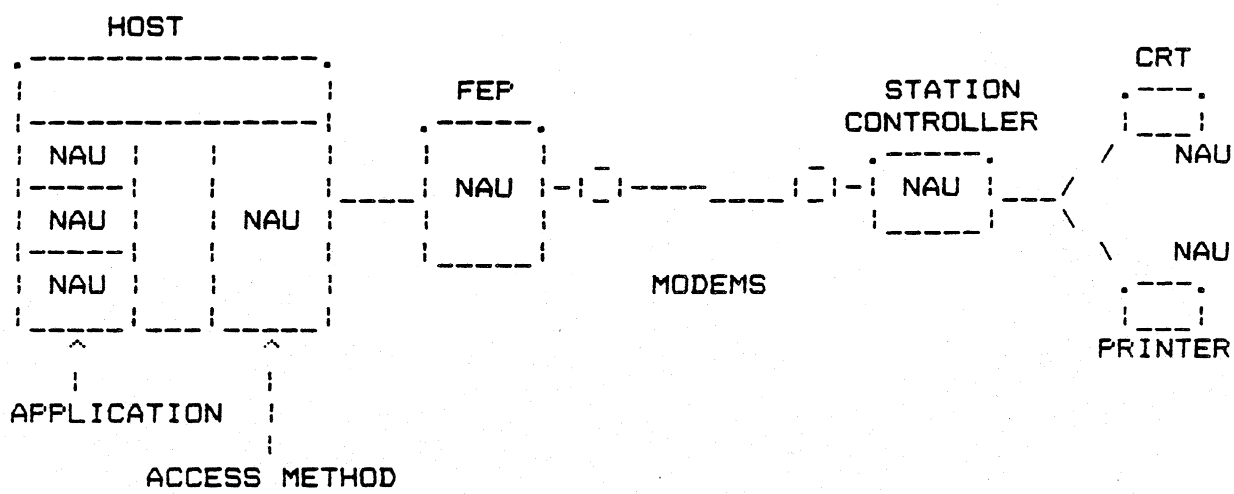
   - SNA LAYERS

3. PRODUCT VIEW

   - VTAM, TCAM, NCP, IBM 3270 . . . .

NETWORK ADDRESSABLE UNITS: NAUs

SOURCES & SINKS



NETWORK ADDRESSABLE UNITS (NAU):

Each network element that can be a source or destination of data must have a unique network address and is known as an NAU.

NAUs include:

- Host Access Method
- FEP Control Program (NCP)
- Cluster Controllers
- Terminals
- Applications

While communications lines also have SNA network addresses associated with them, they are not SNA NAUs since lines cannot be the ultimate sources or destinations of messages.

THREE TYPES OF NETWORK ADDRESSABLE UNITS (NAUs)

SYSTEM SERVICES CONTROL POINT:	SSCP
PHYSICAL UNIT:	PU
LOGICAL UNIT:	LU

```
      HOST
.---------------.                                                    CRT
|               |       FEP                                        .---.
|---------------|     .-----.                        CONTROLLER    |___|
| LU  |    |    |     |     |  _                _    .-----.      /  LU
|-----|    | S  |_____| PU  |-|_|-------_____|_|-|  PU   |___/
| LU  |    | S  |     |     |                         |_____|   \
|-----|    | C  |     |_____|                                    \  LU
| LU  |    | P  |                     MODEMS                     .---.
|_____|____|____|                                                |___|
    ^        ^                                                  PRINTER
    |        |
    |        |___ ACCESS METHOD
    |
APPLICATION
```

Three types of NAUs defined in SNA:

SNA formally defines capabilities and functions for its network addressable units. There are three types of NAUs defined with different capabilities:

System Services Control Point (SSCP)

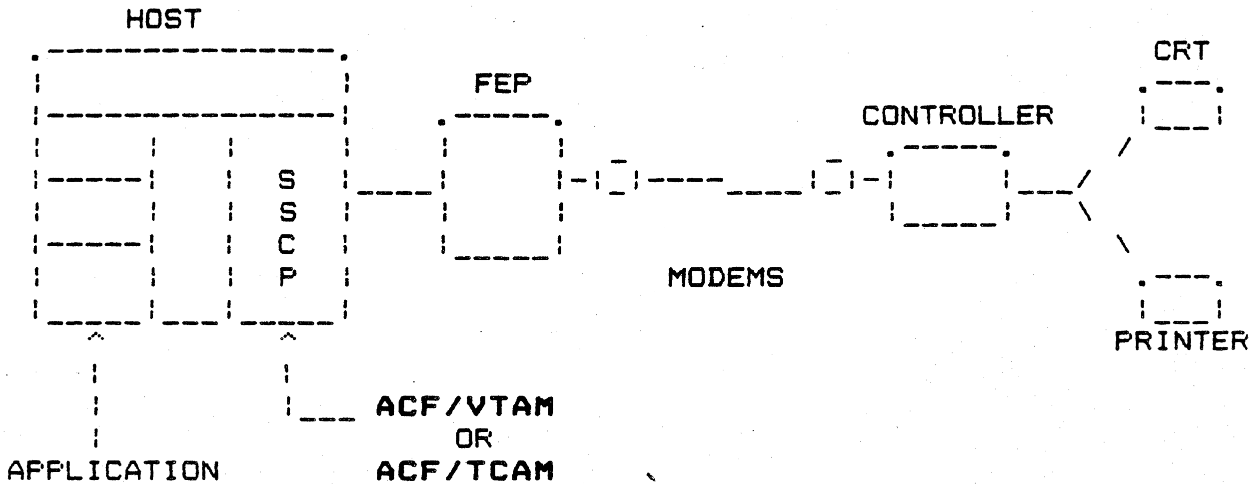
Physical Unit (PU)

Logical Unit (LU)

These NAUs will be discussed next.

SYSTEM SERVICES CONTROL POINT: SSCP

OVERALL CONTROL AND MANAGEMENT



IBM 8100 series has SSCP contained in VTAM/TCAM

SYSTEM SERVICES CONTROL POINT (SSCP)

Special purpose NAU which is used for network management and control.

SSCP resides within the host access method and manages that portion of the network that is assigned to this access method.

Functions of SSCP include

- Brings up/down the network
- Helps in setting up sessions
- Schedules error recovery
- Executes operator commands
- Keeps track of the status of network resources.

While a host access method contains all the SSCP functions, it is not limited to the SSCP functions only. An access method, typically, also performs functions other than the SSCP.

Master

Performs overall manage/control

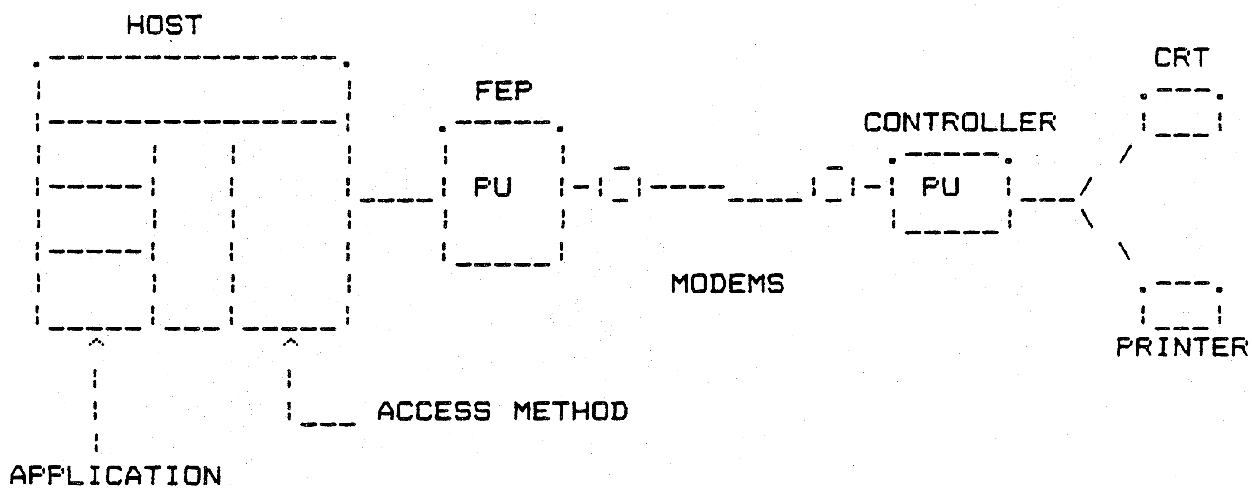
PHYSICAL UNIT: PU

REGIONAL CONTROL

CONTAINS A SUBSET OF SSCP CAPABILITIES

INITIATES ACTIONS BASED UPON COMMANDS FROM SSCP

PU TYPES: 1, 2, 4, AND 5



PHYSICAL UNIT (PU)

A PU is an NAU which acts as a companion to the SSCP in network management and control functions. It contains a subset of the SSCP capabilities.

Typically, with each PU there is associated a PUCP, Physical Unit Control Point.

Functions of a PU include:

- Activation and deactivation of data links (NCP PU)
- Assistance in recovery procedures during network communication failure (NCP PU)
- Providing control functions for a local operator (cluster controller PU)
- Providing control and management of stations directly connected to it (cluster controller PU)

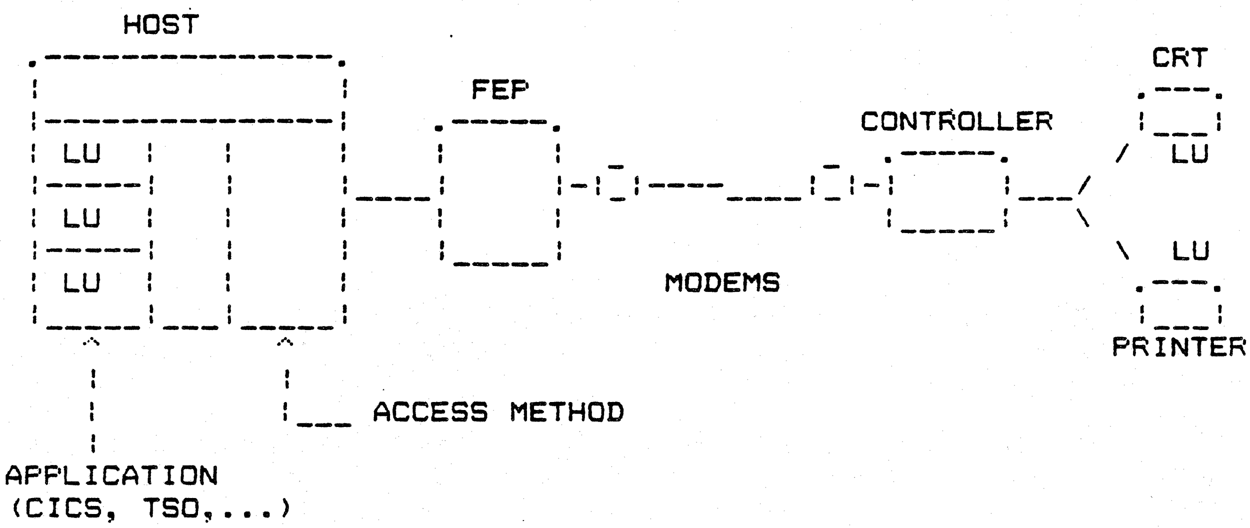
SNA defines four classes of PUs:

TYPE 5 - Host node (PU_T5)
TYPE 4 - NCP node (PU_T4)
TYPE 2 - Cluster Controller node (PU_T2)
TYPE 1 - Cluster Controller node (has less capabilities than type 2 PU) (PU_T1)

It should be noted about the PU_T5 that it is NOT the same as the SSCP even though it is contained within the the access method.

LOGICAL UNIT: LU

USER DATA



LOGICAL UNIT

An LU is an NAU which provides "ports" or "windows" through which end-users access the SNA network.

Typically LUs are associated with devices behind a cluster controller and with host applications.

Functions for an LU may include:

- Data conversion for an end-user
- Local editing
- Correlating SNA responses with requests
- Providing Data Flow Control Signals
- Originating session initiation and termination requests.

Examples of typical LUs would be:

Network LUs:	CRTs and printers on a controller (such as 4540E or 4540 ADCCP), each CRT or printer being one LU.
Host LUs:	Online systems such as TSO, IMS, CICS, and JES etc. each would constitute one LU. All of CICS, with all of its programs, would count as one LU.

AN SNA SESSION

A TEMPORARY LOGICAL CONNECTION BETWEEN TWO NAUs

SESSION MANAGEMENT

- NAU LOCATION
- SESSION AUTHORIZATION
- NAU CAPABILITIES
  - DIFFERENT LEVELS OF INTELLIGENCE IN DIFFERENT DEVICES
  - ARE WE TALKING AT THE SAME LEVEL?

SNA Sessions:

SNA uses the term 'session' to denote communications between two Network Addressable Units (NAUs). A session by definition is a temporary logical connection in place by agreement of the participating NAUs.

Management of sessions is one of the major functions of an SNA network. In older, pre-SNA, systems such as CICS/BTAM there used be only one destination in the host and all sessions belonged to it (CICS).

When there are multiple applications in one host or spread over multiple hosts, one of the problems is to find the location of the application itself.

Also, it has to be determined if the terminal user is authorized to access that host (access method) and its applications.

Host application LUs are allowed multiple concurrent sessions with other LUs. It is important that session data for separate sessions be kept separate from each other.

Different devices in the network have different levels of intelligence and capabilities. Therefore, one also has to know which data formats, SNA commands, and protocols are valid for a given device.

All such issues are part of the session establishment and management procedures and are discussed later in this course.

TYPES OF SESSIONS IN SNA

```
 HOST            ACCESS         NCP        CLUSTER          DEVICE
APPLICATION      METHOD                    CONTROLLER

 --------        ------       ------      --------        -------
 :      :       :  S   :      :    :      :      :        :     :
 :      :       :  S   :      :    :      :      :        :     :
 : L U  :       :  C   :      : PU :      : P U  :        : LU  :
 :      :       :  P   :      :    :      :      :        :     :
 :______:       :______:      :____:      :______:        :_____:

                  <-- SSCP-PU -->

                  <-------- SSCP-PU --------->

                  <--------------- SSCP-LU --------------->

    <------------------- LU-LU ------------------------>
```

Types of sessions in SNA: (Single Access Method)

SNA defines the following classes of sessions:

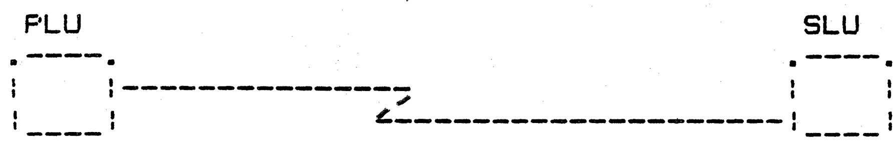
SSCP - PU Sessions
SSCP - LU Sessions
LU - LU Sessions

Sessions involving SSCP are basically "hand-shake" activities that occur when an access method brings up an NCP, cluster controller, or a device on a controller. A session with SSCP, when established successfully, means that the particular resource is "up", available and, usable.

The session types have a hierarchical relationship, i.e. before an LU-LU session can take place, the following sessions must be in place in the order shown:

SSCP - PU (NCP) Session
SSCP - PU (Cluster Controller) Session
SSCP - LU (Device) Session

LU-LU SESSIONS: INTRODUCTION



PRIMARY	SECONDARY
ALWAYS IN HOST	NETWORK DEVICES ALWAYS SECONDARY
IN TP MONITOR (IF VTAM) IN ACCESS METHOD (IF TCAM)	HOST SOFTWARE CAN BE SECONDARY WHEN IN SESSION WITH ANOTHER PROGRAM
MULTIPLE CONCURRENT LU-LU SESSIONS PERMISSIBLE	ONLY ONE LU-LU SESSION ALLOWED AT A TIME

LU-LU Sessions Introduction:

LU-LU sessions are, of course, where all application data is carried in SNA.

There are several additional considerations unique to such sessions and some of them are discussed here.

In an LU-LU session one the LUs must be designated as the Primary LU, PLU, and the other the secondary LU, SLU. Network devices by definition are always SLUs. The primary LU has more responsibilities in SNA. In an application to application session, one of the two applications must act as the secondary LU.

In a VTAM environment, examples of host LUs (PLUs) would be subsystems such as CICS, IMS, JES, and TSO.

In case of TCAM, the host LUs are contained entilrely within TCAM.

While PLUs are allowed to support multiple concurrent sessions with several SLUs, an SLU is not permitted to have more than one session at any time.

SESSION TYPE AND USER INFORMATION LINE

THE USER INFORMATION LINE (LINE 25) INDICATES THE SESSION STATUS OF A 3270

```
.-------------------------------------------------------------------.
|                                                                   |
|                                                                   |
|                                                                   |
|                                                                   |
|                                                                   |
|                                                                   |
|                                                                   |
|-------------------------------------------------------------------|
|  #1    |    #2    |    #3    |    #4    |    #5    |    #6        |
|-------------------------------------------------------------------|
```

SESSION TYPE	SYMBOLS ON LINE 25
SSCP - PU (NCP)	BLANK
SSCP - PU (CONTROLLER)	BLANK
SSCP - LU	SYSTEM
LU - LU	STICKMAN

(DURING THE CHANGE-OVER FROM SSCP-LU TO LU-LU, FIELD 1 WOULD SHOW "?" FOR A BRIEF DURATION)

OVERVIEW OF SESSION ESTABLISHMENT PROCESS

(ONLY MAJOR DETAILS SHOWN)

```
 HOST            ACCESS          NCP         CONTROLLER       CRT OR
APPLICATION      METHOD                                       PRINTER

 --------        ------         ------        --------        -------
 :      :       :  S   :       :    :       :        :       :     :
 :      :       :  S   :       :    :       :        :       :     :
 : L U  :       :  C   :       : PU :       :  P U   :       : LU  :
 :      :       :  P   :       :    :       :        :       :     :
 :______:       :______:       :____:       :________:       :_____:

                 ACTPU  -------->

                     <-------- + RESP (SSCP-PU SESSION)

                 ACTLINK -------->

                     <-------- + RESP

        (EXCHANGES ABOVE DO NOT GO BEYOND FEP MODEM)

        *********************************************

        (EXCHANGES BELOW CAN BE SEEN ON THE LINE)

                 ACTPU  --------------------->

                     <--------------------- + RESP (SSCP-PU SESSION)

                 ACTLU  ------------------------------------->

                     <------------------------------------- + RESP
                                                             (SSCP-LU SESSION)

   <---------------------------------------------------  LOGON

  LOGON ACCEPTED ------------------------------------------->

                                                             (LU-LU SESSION)
```

Unit 3: Review Quiz A

1. What is an NAU in SNA?
   Network addressable Unit

2. Name 3 types of NAUs in SNA:
   SSCP
   PU
   LU

3. Which NAU causes the control to be centralized in the host in an SNA network?
   SSCP

4. What is the function of a PU?
   subset of SSCP between FEP and controller

5. Where may an LU be located in an SNA network?
   host application and I/O device
   access method network device

6. Identify various SNA sessions, in the right sequence, that must take place before an LU-LU session can take place:

SNA MESSAGE FORMATS AND HEADERS

HDRS	MSGS	HDRS

1. PRECISE RULES FOR MESSAGE FORMATS

2. DIFFERENT TYPES OF HEADERS CARRY DIFFERENT TYPES OF INTELLIGENCE

3. SOME EXAMPLES OF TYPE OF INFORMATION IN HEADERS:

   - LINK CONTROL INFORMATION
   - ROUTING INFORMATION
   - DATA FLOW MANAGEMENT INDICATORS
   - WHETHER THE MESSAGE IS TEXT, SENSE/STATUS INFORMATION, (e.g., PAPER JAM IN PRINTER), OR SNA COMMAND

MESSAGE FORMATS AND HEADERS: REQUEST RESPONSE UNIT, RU

```
.------------------------------------------------------------------------.
|             |             |             | R U     |                    |
|------------------------------------------------------------------------|
                                              ^
                                              |
                                              |
```

USER DATA (REQUEST)

OR

RESPONSE TO A REQUEST (RESPONSE)

OR

SNA COMMAND

REQUESTS:

OPERATOR ENTERED DATA
MESSAGES FROM HOST FOR THE DEVICE

RESPONSES:

1. SENSE/STATUS INFORMATION:
   INDICATE NON-TRANSMISSION TYPE ERRORS
   EXAMPLES: PAPER JAM, BAD ATTRIBUTES TO CRT
   PROTCOL VIOLATIONS

2. NULL RU:
   ERROR CONDITION REQUIRES NO FURTHER EXPLANATION
   ANOTHER HEADER CONTAINS GLOBAL RESPONSE

COMMANDS:

SNA COMMANDS
ACTPU, ACTLU, ACTLINK.......
COMMANDS MAY ALSO REQUIRE RESPONSES

Message formats and headers: Request/Response Unit (RU)

An SNA network not only has the end-user data flowing through it, but also the SNA commands and control information. In any case, each entity flowing through the network is either a request or a response.

Requests: All messages that contain user data or SNA commands are called "requests". Thus, the operator entered data at a device is a "request" from the remote device to the host application - even though the message may not request the host to do anything. Similarily, an application generated message, e.g., customer information in response to an operator inquiry, is a "request" from application to the remote device.

In simple English - what have been called messages between end users traditionally - are now called requests.

Responses: A "response" is an acknowledgement from the receiving LU to a "request". Not all requests require responses.

Request/Response Unit (RU): An RU is end-user data or response or an SNA command before any headers have been attached to it.

MESSAGE FORMATS AND HEADERS: REQUEST/RESPONSE HEADER (RH)

```
.-----------------------------------------------------.
!         !         ! R  H   !  R  U  !               !
!-----------------------------------------------------!
                       ^
                       !
                       !
```

A DESCRIPTION OF THE PERSONALITY
OF THE RU THAT FOLLOWS ME

WHETHER THE RU IS A:

- REQUEST (USER DATA)

  INDICATORS WHETHER A RESPONSE IS REQUIRED FROM RECEIVER
  DATA FLOW CONTROL BITS

- RESPONSE (SOFTWARE OR DEVICE MICROCODE GENERATED)

  NON-TRANSMISSION ERRORS

  INDICATOR FOR GLOBAL + OR - RESPONSE TO A REQUEST OR SNA COMMAND
  IF - RESPONSE, RU MAY HAVE SENSE/STATUS INFO

- SNA COMMANDS

  ACTPU, ACTLU, BIND, ...
  MORE COMPREHENSIVE LIST LATER

Message formats and headers: Request/Response Header (RH)

Request/Response Header (RH): An RH is added to each RU to indicate whether:

RU is a request or response (and the actual Response type, if response)

RU contains control information and the category of control information.

Combination of RH and RU is also called the Basic Information Unit or BIU.

MESSGAE FORMATS AND HEADERS: TRANSMISSION HEADER (TH)

```
              <--------  PIU  ------------->
.---------------------------------------------------------.
!          ! T  H   ! R  H   ! R  U   !                    !
!__________________________________________________________!
                ^
                !
                !

          ROUTING INFO
```

- MESSAGE ORIGINATION AND DESTINATION ADDRESSES

- OTHER INFORMATION TO BE DISCUSSED LATER

PATH INFORMATION UNIT (PIU)

TH + RH + RU COMBINATION IS REFERRED TO AS THE PATH INFORMATION UNIT (PIU) IN SNA

Message formats and headers: Transmission Header (TH)

Transmission Header (TH): A TH is added to RH by Path Control.

TH contains the address of the message origin and destination points and indicates the type of PU the message is destined for.

The combination of TH, RH, and RU is called the Path Information Unit, PIU.

MESSAGE FORMATS AND HEADERS: SDLC HEADER AND TRAILER

```
          <--------  PIU  ------------->
.-----------------------------------------------------.
!SDLC HDR !  T  H   !  R  H   !  R  U   ! SDLC TRLR   !
!-----------------------------------------------------!
    \                                        /
      \                                    /
        \                                /
          \                            /
            \                        /
              \                    /

                  SDLC
            HEADER AND TRAILER
```

LINK MANAGEMENT INFORMATION

PARITY INFORMATION FOR DETERMINING LINK ERRORS

```
          !    PIU PART OFTEN SHOWN     !
          !    AS "USER DATA" IN SDLC   !
          !    DOCUMENTATION            !
```

TRANSMISSION HEADER: INTRODUCTION

SNA ALLOWS MULTIPLE TYPES OF TRANSMISSION HEADERS

EACH TH IS IDENTIFIED BY ITS FORMAT ID (FID)

TH OVERVIEW

```
BYTE 0
.-----------------------------------------------------------------------.
|         |   |   O T H E R    I N F O R M A T I O N                     |
|_________|___|____________|___________|_____________|____________|

.------------------.                           ^
| 0 1 2 3 | 4 5 6 7 |            |              |
                                                |___   ROUTING AND OTHER
 BITS 0-3    BITS 4-7                                  INFORMATION
    |           |
    |           v
    |       IGNORE FOR NOW
    |
    |
    v
FID TYPE
```

USED WITH NETWORK STATIONS:

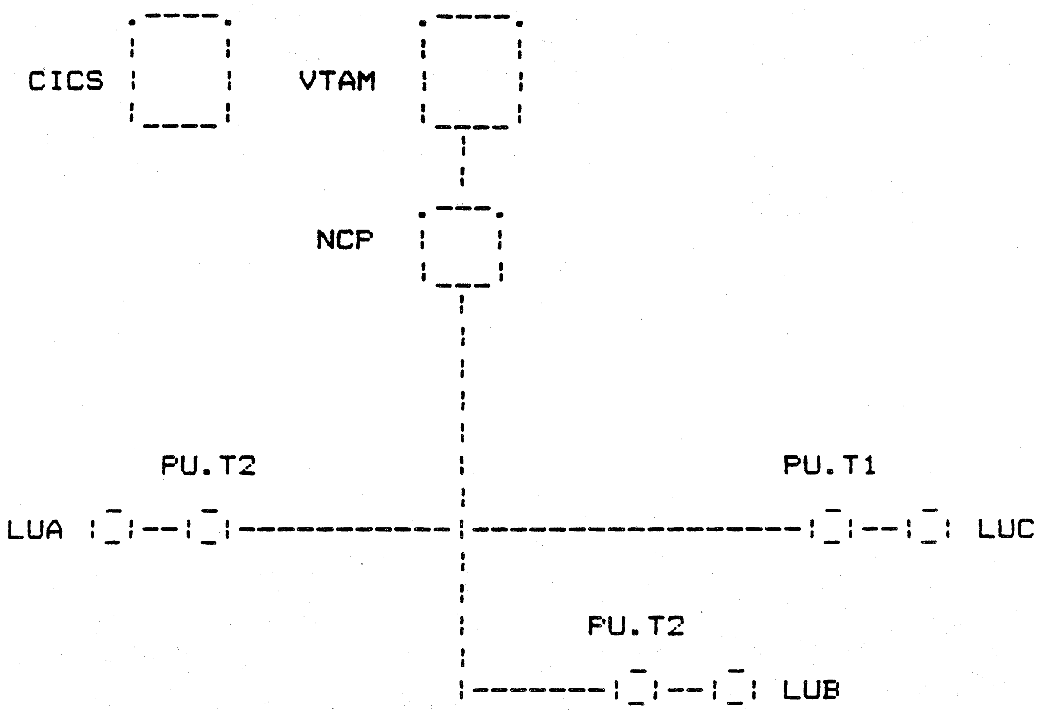
0010	FID2	6 BYTES	USED WITH PU.T2
0011	FID3	2 BYTES	USED WITH PU.T1

USED INTERNALLY BETWEEN NCPs AND HOSTS:

0000	FID0	10 BYTES	HOST-NCP, NCP-NCP, FOR NON-SNA DATA
0001	FID1	10 BYTES	HOST-NCP, NCP-NCP
0100	FID4	26 BYTES	REPLACES FID 1 AS OF RELSE 3
1111	FIDF	26 BYTES	INTERNAL TO SYSTEM, RELSE 3

NOTE: VTAM DOES NOT SUPPORT FID 0

FID USAGE REVIEW



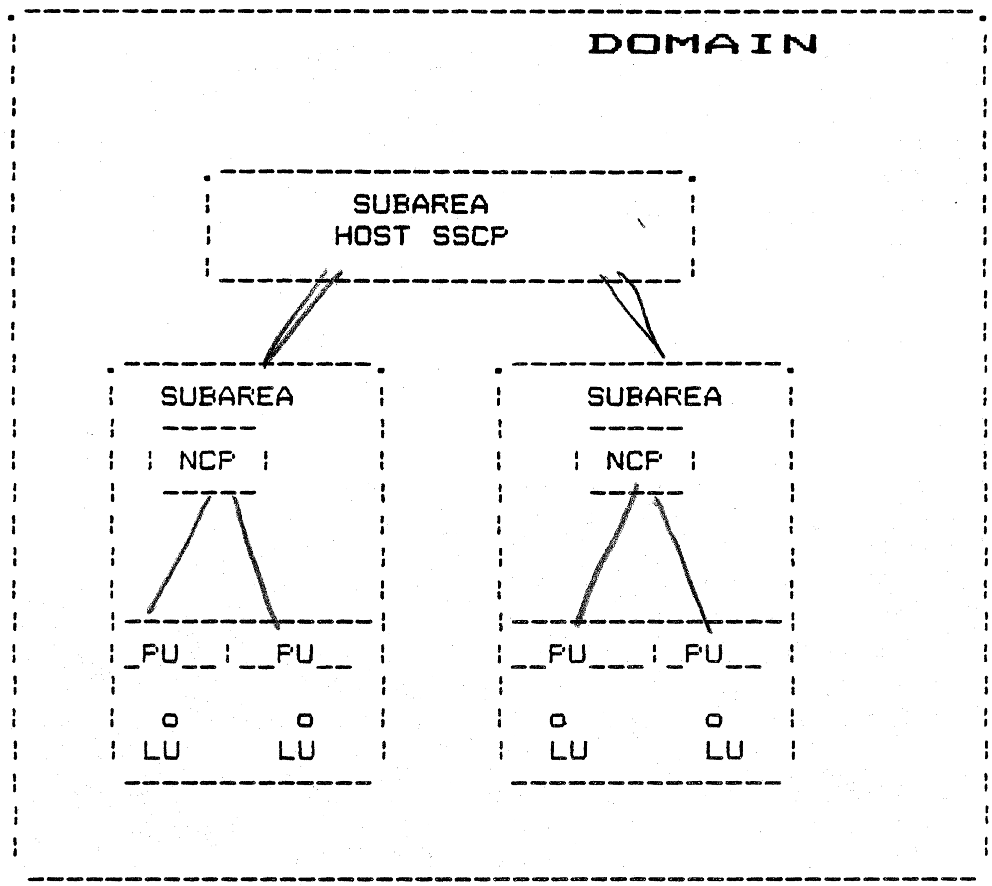
FOR THE CONFIGURATION SHOWN ABOVE, SHOW TH FID TYPE FOR MESSAGES FOR EACH OF THE LINKS. ASSUME PRE-RELEASE 3 SOFTWARE, NO FIDs 4 IN USE.

SNA HEADERS AND HOST COMPONENTS

HEADER/DATA	HOST COMPONENT RESPONSIBLE
R U	APPL TP MONITOR ACCESS METHOD
R H*	ACCESS METHOD
T H	ACCESS METHOD (NCP)
S D L C	NCP

* EVEN THOUGH APPLICATION AND TP MONITOR MAY SPECIFY THEIR REQUIREMENTS FOR RH, THEIR REQUIREMENTS ARE PASSED TO THE ACCESS METHOD AND THE ACTUAL RH IS ALWAYS BUILT BY THE ACCESS METHOD

DOMAINS AND SUBAREAS



Domains and Subareas:

For the purposes of controlling resources (FEPs, links, PUs, and LUs) and routing messages through an SNA network, all resources are viewd as belonging to domains and subareas.

Domains: Each SSCP in an SNA network is assigned the ownership of a part of the network. All resources that belong to the same SSCP constitute the domain of that SSCP.

Only the owning SSCP can activate or deactivate a resource.

Subarae: The concept of subarea exists strictly for providing route definitions and not for control purposes.

Each SSCP and NCP must be assigned a unique number, called the subarea number during the sysgen. Subarea numbers have to be unique not only within the domain but also across domains in multiple host environments in order to ensure unambiguous paths through the network.

SUBAREA NUMBER, NETWORK ADDRESS, AND TH

SNA NETWORK ADDRESS:

```
<------- 16 BITS (2 BYTES) ---------->
.-------------------------------------.
|     SUBAREA     |      ELEMENT       |
 -------------------------------------
                  ^
                  |__ BOUNDARY FIXED BY SYSTEM PROGRAMMER
```

NETWORK ADDRESS AND TH: FID 1 AS AN EXAMPLE

```
                         FID 1
BYTE ----->
  0          1     2     3     4    5      6     7     8     9
.------------------------------------------------------------.
|       |   |    D A F    | O A F   |            |           |
|_______|___|_____________|_________|____________|___________|
    |                ^          ^
    |                |__________|
    |                     |
    v                     |_____  SUBAREA/ELEMENT OF MSG
.-------------------.             DESTINATION AND ORIGIN
| 0 1 2 3 | 4 5 6 7 |         DAF: DEST ADDRESS FIELD
 BITS 0-3   BITS 4-7              OAF: ORIG ADDRESS FIELD
   |           |
   |           v
   |        IGNORE FOR NOW
   v
FID TYPE
  0001   FID1
```

SUBAREA NUMBER, NETWORK ADDRESS, AND TH:

As mentioned earlier, subarea numbers are used to generate network addresses for the network resources (NAUs). All NAUs connected to the same subarea have a common subarea address and each resource has a unique element number within the subarea.

The network addresses in SNA are 2 bytes (16 bits) long. The first (left) part of the address contains the subarea number and the second part contains the element number.

SNA does not require any particular boundary between subarea and element parts. It is the responsibility of the system programmer to specify the subarea/element boundary as a part of the system generation procedures.

The network addresses are ultimately plugged into the Transmission Header (TH) and are used as a basis for routing messages through the network.

Example on the opposing page shows a FID 1 TH and the locations of message origination and destination addresses within the TH.

Other TH types will be discussed in more detail later in the course.

Unit 3: Review Quiz 2

1. What is the purpose of TH?

2. Which host software component provides the TH?

3. What type of information is carried in an RH? (give any three examples)

4. What is an SNA domain?

5. What are subarea numbers associated with in an SNA network?

6. For the PIU shown below, answer the questions below:

   1E00C0002000D0050008 0B8000010201C002

   (PIU is host to NCP, the system is generated to accomomodate no more than 15 subareas)

a) What FID type TH is being transmitted?

b) What is the subarea number of the host?

c) What is the subarea number of the NCP?

d) How many bytes are contained in the RH/RU part of the PIU?

e) Does the RU contain an SNA command or user data? If SNA command, which one?

7. 1F00060E020000010006 6B8000 110101

For the PIU above, indicate the following:

TH FID type:

RU is: Request or Response

RU contains: Data or SNA command

If SNA command, name of the command:

UNIT 7

HIGHER LEVEL SNA PROTOCOLS - I

OBJECTIVES:

AT THE CONCLUSION OF THIS UNIT, THE ATTENDEE SHOULD BE ABLE TO DEFINE THE MEANING AND APPLICATION OF THE FOLLOWING SNA PROTOCOLS:

- SEGMENTATION
- CHAINING
- PACING / VPACING
- SEQUENCE NUMBERS

NEED FOR HIGHER LEVEL PROTOCOLS

```
  ONLINE        ACCESS                             CLUSTER      PRINTER
 APPL SYS       METHOD        FEP                  CONTROLLER   OR CRT
 .-------.    .-------.    .------.             .------.     .-----.
 |       |    |       |    |      |-------      |      |     |     |
 |  LU   |---|  SSCP  |----|  PU  |      <--------|  PU  |--|  LU  |
 |_______|    |_______|    |______|             |______|     |_____|

   25K          250K        100K                  0.2K         1K
```

FINITE AMOUNT OF STORAGE IN:

VTAM BUFFERS
NCP BUFFERS
DEVICE PU BUFFER
STATION CLUSTER BUFFER

NEED TO GUARD AGAINST SENDING MORE DATA THAN CAN BE HANDLED BY A GIVEN ENTITY:

- SHOULD THE MESSAGE BE DIVIDED IN TO SMALLER PIECES?
- HOW BIG SHOULD BE THE "PIECES"?
- GIVEN PROPER SIZED "PIECES", CAN WE RELEASE THEM ALL AT THE SAME TIME?

ASSUMING A SYSTEM TO BE CONFIGURED AS ABOVE, HOW SHOULD AN APLLICATION GENERATED 2K LONG MESSAGE BE HANDLED?

SNA PROTOCOLS TO PREVENT FLOODING OF BUFFERS

```
 ONLINE        ACCESS                                         PRINTER
 APPL SYS      METHOD          FEP              CONTROLLER    OR CRT
.--------.    .--------.    .-------.           .-------.    .------.
|        |    |        |    |       |-------                |       |    |      |
|   LU   |----|  SSCP  |----|  PU   |       /---------|  PU   |--|  LU  |
|________|    |________|    |_______|           |_______|    |______|
```

SOME OF THE PROTOCOLS UNDER SNA THAT HELP IN MANAGING THE FLOW OF DATA WITHOUT EXCEEDING / FLOODING VARIOUS BUFFERS:

SEGMENTATION:	CONTROLLER (PU) BUFFERS
CHAINING:	PRINTER/CRT (LU) BUFFERS
SEQUENCE NUMBERS:	TO RECOVER CHAINS
PACING:	PRINTER/CRT (LU) BUFFERS
VPACING:	NCP / VTAM BUFFERS

NOTE: NOT ALL DEVICES SUPPORT ALL OF THE ABOVE

SEGMENTATION

"TO ENSURE THAT NO SINGLE PIU EXCEEDS THE PHYSICAL UNIT (PU) BUFFER "

```
 PLU       AM       .----------.                   .---------.    SLU
.----.   .----.     |          |                   |         |   .----.
|    |---|    |-----|          |---------->        |         |---|    |
|____|   |____|     |          |       <-----------|         |   |____|
                    |          |                   |         |
                    |__________|                   |_________|
                       N C P                           P U

                          <-----SEGMENTATION------>
```

1. USED BETWEEN NCP AND PU (A PU-PU PROTOCOL)

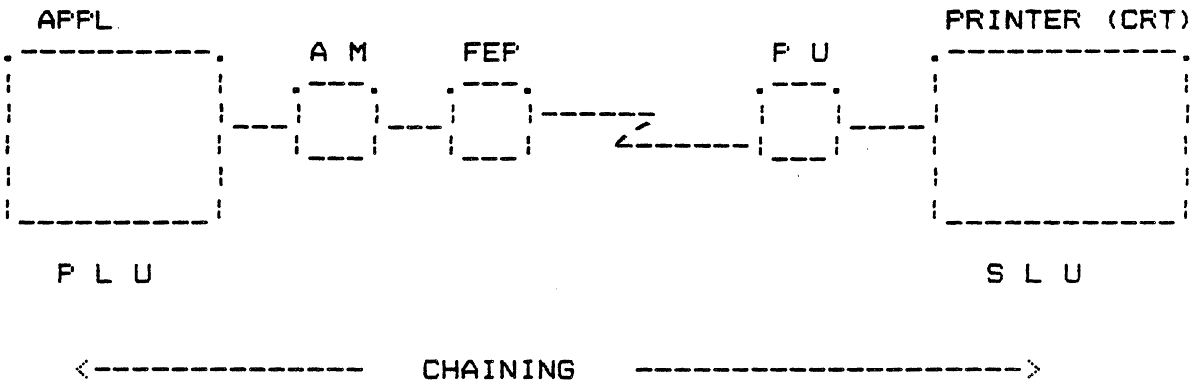
2. ANY PIU THAT EXCEEDS THE PU BUFFER SIZE WILL BE "SEGMENTED" INTO MULTIPLE PIUs BY THE NCP

3. FOR EACH PU IN THE NETWORK, ITS BUFFER SIZE IS SPECIFIED DURING THE NCP SYSGEN

```
<-----------    PIU    ----------------->
.----------------------------------------.
|___TH__|__RH___|_____RU_________________|
    ^
    |____    SEGMENTATION INDICATORS ARE CARRIED
             IN THE TRANSMISSION HEADER
```

CHAINING

"TO ENSURE THAT NO SINGLE PIU EXCEEDS THE LOGICAL UNIT (LU) BUFFER"

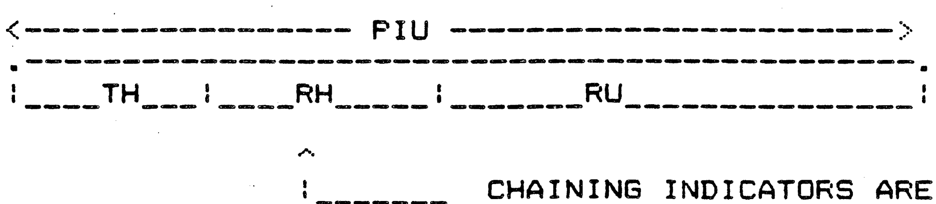


1. USED BETWEEN PLU AND SLU. (AN LU-LU PROTOCOL)

2. ANY PIU THAT EXCEEDS THE RECEIVING LU's BUFFER MAY BE CHAINED INTO MULTIPLE ELEMENTS BY THE SENDING LU

3. FOR CHAINING, THE SENDING LU MUST KNOW THE SIZE OF THE RECEIVING LU's BUFFER SIZE

4. EVEN THOUGH USED WITH IBM CRTs ALSO, PRIMARILY USEFUL WITH LONG REPORTS FOR PRINTERS



CHAINING INDICATORS ARE CARRIED IN THE REQUEST/RESPONSE HEADER

SEQUENCE NUMBERS

"TO KEEP TRACK OF CHAINS AND CHAIN-ELEMENTS IN AN LU-LU SESSION"

```
                                                                  PRINTER (CRT)
.----------.     A M      FEP                     P U          .------------.
|          |    .---.    .---.                   .---.         |            |
|          |----|   |----|   |-----              |   |---------|            |
|          |    |___|    |___|     /_____________|___|         |            |
|          |                                                   |            |
|__________|                                                   |____________|

  P L U                                                            S L U

    <--------------- SEQUENCE NUMBERS --------------->
```

1. ALL PIUs IN A SESSION ARE ASSIGNED SEQUENCE NUMBERS, EACH NEW PIU BEING ONE HIGHER THAN THE PREVIOUS ONE

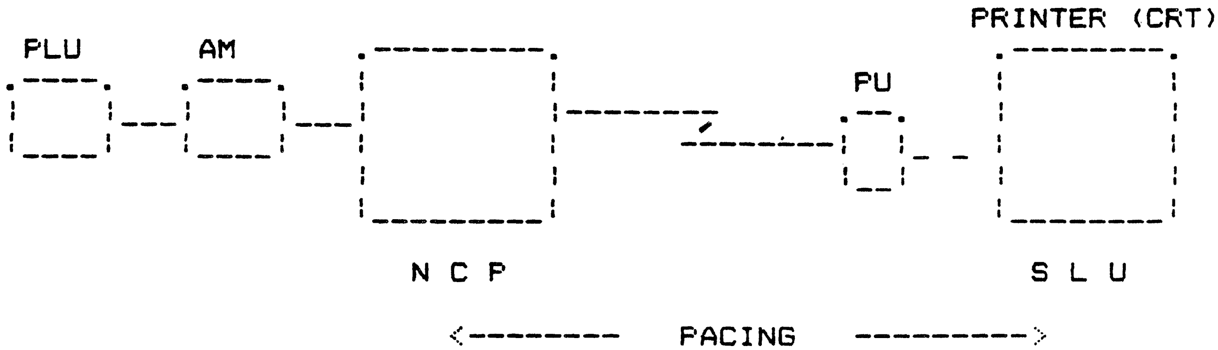
2. SEQUENCE NUMBERS ARE USED FOR RECOVERY PURPOSES

3. WHEN CHAINING IS IN USE, EACH ELEMENT IN A CHAIN IS ASSIGNED A NEW SEQUENCE NUMBER

```
<----------------- PIU ----------------------->
.---------------------------------------------.
|____TH___|____RH_____|_______RU______________|
      ^
      |_______   SEQUENCE NUMBERS ARE CARRIED
                 IN THE TRANSMISSION HEADER
```

PACING

"TO LIMIT THE MAXIMUM NUMBER OF PIUs RELEASED TO A SPECIFIC LU AT ANY GIVEN TIME SO THAT THE LU BUFFER IS NOT EXCEEDED"



1. USED BETWEEN NCP AND SLU (NCP-LU PROTOCOL)

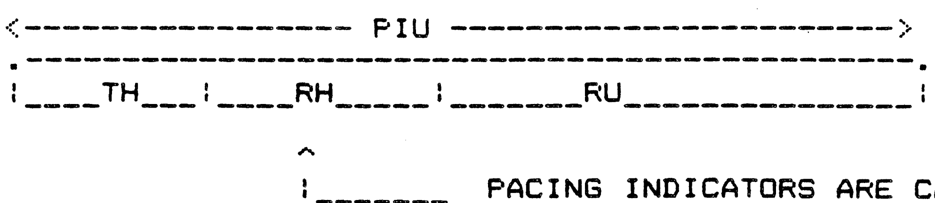
2. SPECIFIED AS A NUMBER, e.g., PACING=n, AND NCP WILL NOT SEND MORE THAN "n" PIUs TO THIS LU. NCP WILL THEN REQUEST AND WAIT FOR A "PACING RESPONSE" FROM THE LU.

   NCP WILL SEND "n" MORE PIUs AFTER RECEIVING THE PACING RESPONSE

   PACING COUNTS FOR EACH LU ARE SPECIFIED DURING THE NCP SYSGEN

3. IF CHAINING IS IN USE, EACH CHAIN ELEMENT IS COUNTED AS A PIU FOR PACING. SEGMENTS ARE NOT COUNTED

4. VERY USEFUL PROTOCOL FOR PRINTERS



PACING INDICATORS ARE CARRIED IN THE REQUEST/RESPONSE HEADER

SEGMENTATION VS CHAINING

SEGMENTATION	CHAINING
BASED UPON PU BUFFER SIZE	BASED UPON LU BUFFER SIZE
DONE BY THE NCP OR CONTROLLER (PU)	DONE BY APPLICATION OR DEVICE (LU)
HAS NO EFFECT ON SEQUENCE NUMBERS	CAUSES SEQUENCE NUMBERS TO BE INCREMENTED
SEGMENTS DO NOT COUNT TOWARDS PACING	EACH CHAIN ELEMENT IS COUNTED TOWARDS PACING

EXERCISE: CHAINING, SEGMENTING, PACING, AND
SEQUENCE NUMBERS

GIVEN: CLUSTER (PU) BUFFER = 256 BYTE
PRINTER (SLU) BUFFER= 2K

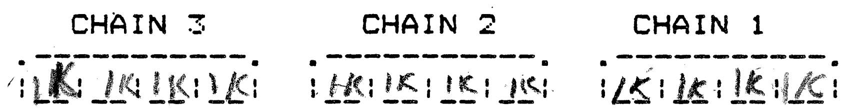
AN APPLICATION PROGRAM HAS THREE REPORTS FOR THIS PRINTER, MONTHLY, WEEKLY, AND DAILY CUSTOMER TROUBLE REPORTS.

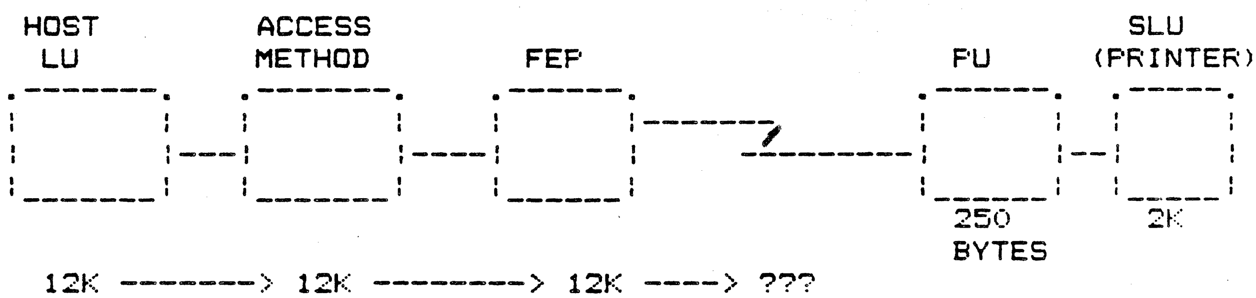
EACH REPORT = 4 PAGES, EACH PAGE = 1K

EACH REPORT IS TO BE TRANSMITTED AS A SEPARATE CHAIN AND EACH PAGE IS A SEPARATE ELEMENT IN THE CHAIN.

i.e., THREE CHAINS, 4 ELEMENTS EACH, EACH ELEMENT = 1 K
TOTAL DATA = 12 K

LAST SEQUENCE NUMBER USED = 1000





WHAT SHOULD THE NCP DO ?

RECOMMEND A PACING COUNT. 2 because SLU = 2K
SHOW ALL INSTANCES OF SEGMENTATION. 48 seg 250/1K * 4 e
SHOW THE FINAL SEQUENCE NUMBER FOR THE REPORTS. 1012

Not include Head/Trailer

VPACING

"TO PREVENT FLOODING OF NCP BUFFERS WHEN NCP IS RECEIVING PIUs FROM THE HOST FASTER THAN IT CAN RELEASE THEM TO THE NETWORK"

```
  HOST        ACCESS                                           SLU
   LU         METHOD         FEP                       PU    (PRINTER)
 .-------.   .-------.   .------.                  .------.  .-----.
 |       |   |       |   |      |-------           |      |  |     |
 |       |---|       |---|      |       /----------|      |--|     |
 |_______|   |_______|   |______|                  |______|  |_____|

             <---VPACING--->
```

1. USED BETWEEN VTAM AND NCP. (SSCP-PU PROTOCOL)
   (CAN ALSO BE USED BETWEEN VTAM AND PLU)

2. NCP MAY NOT BE ABLE TO RELEASE PIUs AS FAST AS IT RECEIVES THEM DUE TO SLOWER DEVICES OR PACING, AND MAY RUN OUT OF OR LOW ON BUFFERS

3. BY SPECIFYING VPACING, CAN LIMIT THE NUMBER OF PIUs THAT VTAM RELEASE TO NCP AT ANY GIVEN TIME FOR A GIVEN LU

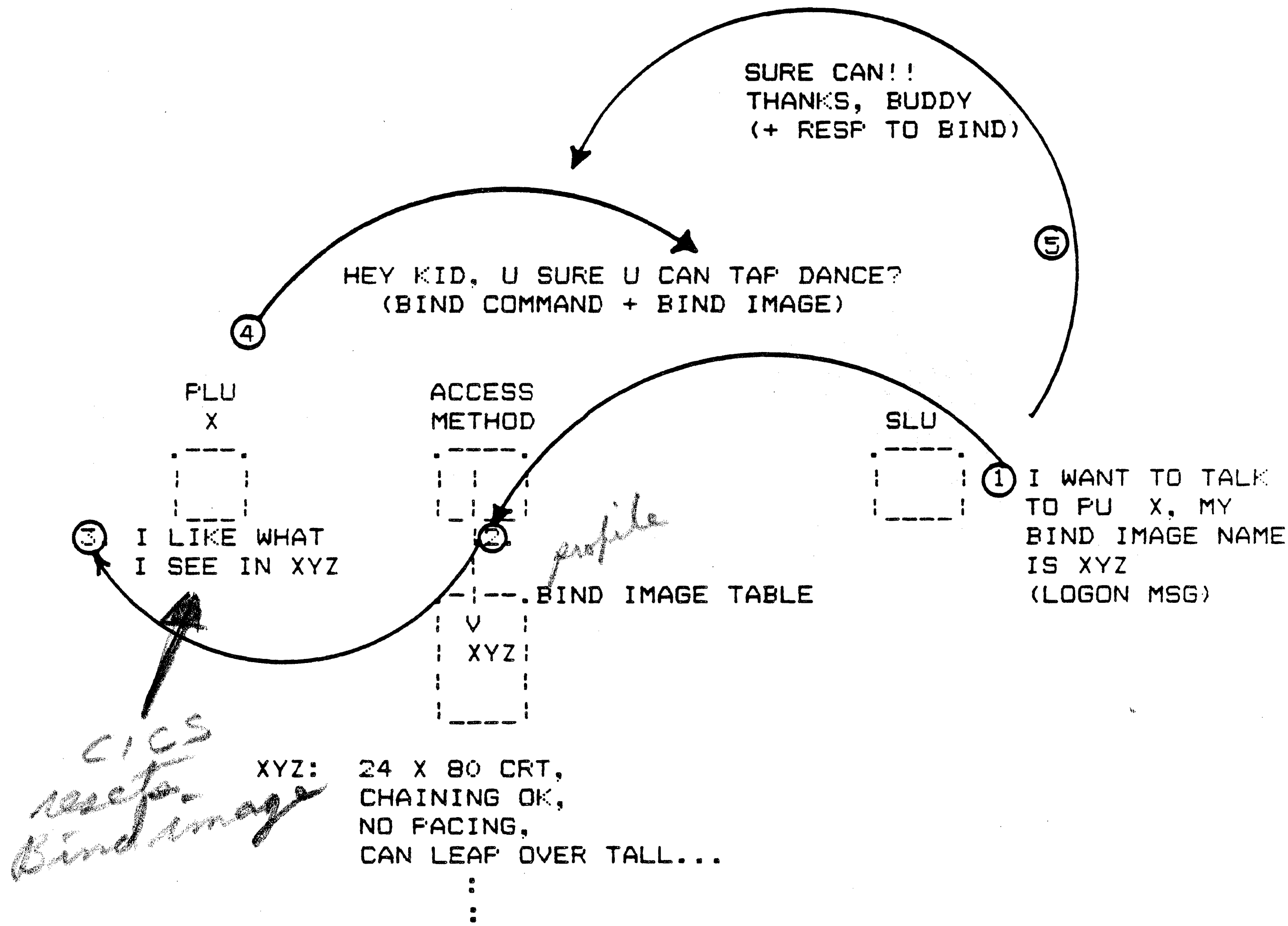
4. VPACING VALUE TO VTAM FOR AN LU IS, GENERALLY, SPECIFIED THE SAME AS THE PACING VALUE FOR THAT LU TO THE NCP

5. USEFUL WITH PRINTERS

HIGHER LEVEL PROTOCOLS, LU-LU SESSIONS AND BIND IMAGE

1. SESSION PARTNERS MUST AGREE UPON THE HIGHER LEVEL PROTOCOLS TO BE USED DURING THE SESSION

2. PROTOCOLS SUPPORTED BY REMOTE DEVICES DEFINED IN THE HOST DURIN THE SYSGEN BASED UPON DEVICE SPECIFICATIONS AND ARE CALLED THE BIND_IMAGE OF THE DEVICE



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CONSIDERATIONS FOR IBM 3270

IBM 3270 SUPPORTS ALL OF THE FOLLOWING:

- SEGMENTATION
- CHAINING
- PACING
- SEQUENCE NUMBERS

SEGMENTATION CONSIDERATIONS FOR PU.T2:

PU BUFFER SIZE MUST BE SPECIFIED = 265
NCP WILL SEGMENT ALL PIUs (TH+RH+RU) > 265 BYTES
3270 CONTROLLER WILL ALSO SEGMENT PIUs > 265 BYTES

CHAINING CONSIDERATIONS FOR 3270:

HOST MAY CHAIN ELEMENTS TO ANY SIZE LESS THAN 2048

3270 DEVICES CAN CHAIN AT 1024 (SOME COMPATIBLES CAN GO UPTO 2048), BIND IMAGE TELLS THE DEVICES WHICH SIZE TO USE.

PACING CONSIDERATIONS:

CRTs: NO PACING RESTRICTIONS FOR CRTs, FROM A PRACTICAL POINT OF VIEW, THERE SHOULD BE NO NEED TO PACE THE CRTs.

PRINTERS:

LU TYPE3: DO NOT SUPPORT PACING, NONE IS NEEDED SINCE THEY SUPPORT SINGLE ELEMENT CHAINS WITH DEFINITE RESPONSE

LU TYPE1: COMPUTE PACING VALUE ASSUMING PRINTER BUFFER ABOUT 3K, i.e., DO NOT RELEASE PIUs COLLECTIVELY LARGER THAN 3K AT ANY TIME.

Unit 5: Review Quiz

1. Which SNA protocol(s) can be used to help prevent messages from exceeding the:

   a) LU buffers

   b) PU buffers

2. What are the similarities and differences between chaining and segmentation?

   Similarities:

   Differences:

3. What are the similarities and differences between Pacing and Vpacing?

   Similarities:

   Differences:

4. Among the Application, the Access Method, and the NCP, who is responsible for each of the protocols shown below?

   Pacing:

   Chaining:

   Segmentation:

   Vpacing:

UNIT 17

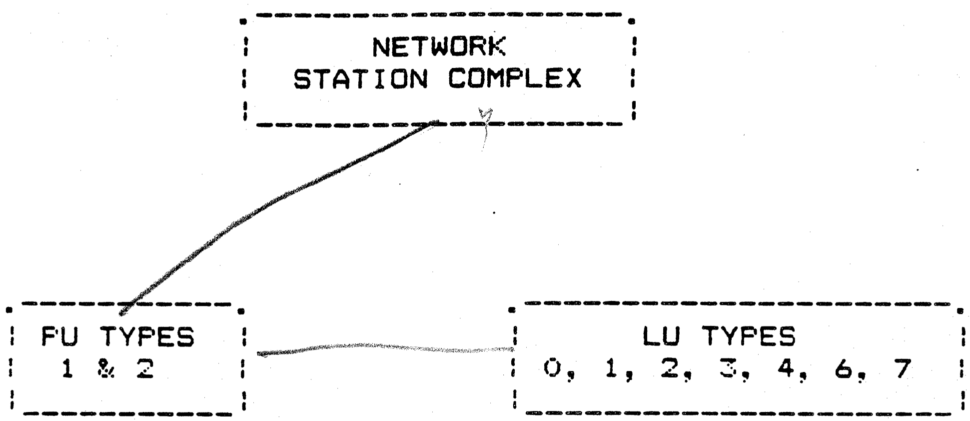
PU AND LU TYPES FOR NETWORK STATIONS

OBJECTIVES:

AT THE CONCLUSION OF THIS UNIT, THE ATTENDEE SHOULD BE ABLE TO:

1. DESCRIBE THE DIFFERENCE BETWEEN PUs TYPE 1 AND 2
2. IDENTIFY THE TRANSMISSION HEADER (TH) TYPES USED WITH DIFFERENT PU TYPES
3. DEFINE THE TERMS FM AND TS PROFILES AS THEY RELATE TO DIFFERENT LU TYPES
4. DESCRIBE THE LAYOUT OF THE BIND IMAGE

MAPPING DEVICE CHARACTERISTICS INTO SNA PROTOCOLS



Mapping Device Characteristics into SNA Protocols

SNA defines a very large set of functions for remote devices. However, not all functions are required nor necessary for all devices. For each device in an SNA network there must be identified a set of SNA functions that the device is capable of performing.

To provide a systematic methodology for specifying a potentially very large number of permutations and combinations, SNA defines classes of PUs and LUs. Each SNA device must conform to capabilities defined in these classes to be a proper SNA device.

A PU or LU type is, in effect, a grouping of logically compatible functions.

Physical Units:

For network devices two types of PUs are defined, types 1 and 2. Besides the degree of 'SNA intelligence', the major difference occurs in the way Transmission Header (TH) is built and the way Path Control sends information to the PU.

Logical Units:

SNA defines 7 types of LUs: 0, 1, 2, 3, 4, 6, and 7. Each LU type represents a set of LU-LU protocols that are supported by that LU.

Note that there is no type 5 Logical Unit.

The capabilities and restrictions associated with a given type of Logical Unit pertain to functions associated with the following layers:

Function Management Data Services, Data Flow Control, and Transmission Control.

Each class supports a different subset of the above layers.

DEVICE AND PU TYPE

- o PU TYPE 2 HAS MORE CAPABILITIES
  - USES FID 2 TH

- o PU TYPE 1
  - USES FID 3 TH (2 bytes)
  - DOES NOT SUPPORT SEQUENCE NUMBERS
  - REQUIRES SPECIAL SHORT FORM OF DEVICE ADDRESSING
  - CANNOT HANDLE ALL SNA COMMANDS

NOTES:

1. PU TYPE DETERMINES THE TYPE OF TH TO BE USED IN COMMUNICATIONS WITH A GIVEN DEVICE

2. IBM DOES NOT PROVIDE ANY FORMAL DEFINITION OF DIFFERENCES BETWEEN TYPE 1 AND TYPE 2 PUs WITH THE EXCEPTION OF THE TH FORMAT

3. NOT ALL DEVICES WITHIN THE SAME PU CLASS NEED HAVE THE SAME SET OF SNA CAPABILITIES. IMPORTANT TO KNOW PRECISE TECHNICAL SPECIFICATIONS OF THE DEVICE

ADDRESSING NETWORK COMPONENTS AND TH

- o PROPER SNA ADDRESS
  - SUBAREA / ELEMENT FORMAT
  - USED IN FID 1 THs, FID 4 THs ALSO CONTAIN THE NETWORK ADDRESS BUT IN AN EXPANDED FORMAT

- o LU LOCAL ADDRESS internal to the controller
  - 1 BYTE HEX ID OF THE CRT/PRINTER WITHIN THE CLUSTER
  - USED IN FID 2 AND FID 3 THs

- o PU ADDRESS
  - 1 BYTE HEX ID OF THE CLUSTER CONTROLLER
  - USED IN SDLC HEADER AND NOT IN ANY OF THs

(LINES ARE ALSO ASSIGNED ADDRESSES INTERNALLY BY THE NCP)

Addressing Network Components and TH:

There are several forms of addresses that are used in an SNA network. Some of these addresses are specified in the TH and, therefore, affect the size of the TH. Various types of addresses are:

NAU Network Address:

This is the 'proper' SNA resource ID. It is two bytes long and consists of subarea and element components as discussed earlier in this course. These addresse are computed during the NCP system generation. All network addresses must be unique across the SNA network.

FID0 and FID1 THs use this form of addressing.

LU Local address:

This is a 1 byte address that is assigned to each LU behind a PU. These are generally assigned in a sequential order, 1, 2, 3,... etc. Each LU on a PU must have a unique local address. LU local addresses are specified during the NCP system generation and are generally hardwired within the LU.

FID 2 THs use this form addressing which in turn are used with LUs (CRTs and printers) connected to a PU.T2 controller.

FID3 THs use slightly modified form of this address which in turn are used with LUs (CRTs and printers) on a PU.T1.

PU Address:

This is a 1 byte device ID that is hardwired in each PU. This address is used in the SDLC header as the destination address and has no effect on the TH.

Line Address:

Each line in the network is assigned a unique network address by the NCP. Line addressing has no effect on the TH.

TH REVIEW FOR PU.T1 AND PU.T2

1 byte LU id

```
     FID2:          FOR PU.T2, 6 BYTES LONG

     0        1       2       3       4     5
.--------------------------------------------------.
|         |    |  DAF'  |  OAF'  |      SNF        |
|_________|____|________|________|_________________|
     |
     |                                 sequence number
     |
     |
     |
     |
     |       FID 3:            PU.T1, 2 BYTES LONG
     V
     0        1
.-------------------.
|         |   DAF   |<---- ONLY 6 BITS USED FOR ADDRESSING
|_________|_________|

.---------------|-----------.
| 0   1   2   3 |4   5   6   7|-----> EFI: 0=NORMAL FLOW,
 ---------------|-----------               1=EXPEDITED FLOW
  FID TYPE       |_|   |

FID2: 0010       |     |
                 |     |----> NOT USED
FID3: 0011       |
                 |----> SEGMENTATION: 00=MIDDLE, 01=LAST
                                      10=FIRST, 11=ONLY
```

DAF': DEST LU ID (PU ID IS IN SDLC HDR)

OAF': ORIG ADDRESS FIELD, DOES NOT CONTAIN ANY ADDRESS

SNF: SEQ. NUMBR FIELD

EFI: EXPEDITED FLOW INDICATOR

DEVICE CAPABILITIES AND LU TYPE

Transmission Control

Function management

1. LU CATEGORIES BASED UPON FM (FMDS AND DFC) AND TC SUBSETS IMPLEMENTED IN A DEVICE

2. CAPABILITIES PROFILES

   - TWO TYPES OF PROFILES FOR EACH LU:

     FM PROFILE NUMBER

     DEVICE CAPABILITIES AS PER FMDS AND DFC LAYERS

     TS PROFILE NUMBER

     DEVICE CAPABILITIES AS PER TC LAYER

   - IBM DEFINED PROFILE NUMBERS, EACH REPRESENTING IBM SELECTED SET OF CAPABILITIES

3. PROFILES OF EACH UNIQUE LU PROVIDED TO THE HOST ACCESS METHOD (SSCP) DURING SYSGEN

   - BIND IMAGE TABLE

Device and LU Type:

Secondary Logical Units are assigned classes depending upon their capabilities with respect to Function Management Data Services (FMDS), Data Flow Control (DFC), and Transmission Control (TC) Layers.

There are two types of profiles defined for each class of LU:

Function Management (FM) Profile: This profile defines the LU capabilities associated with FMDS and DFC layers. Currently 9 types of FM profiles are defined in SNA.

Transmission Services (TS) Profile: (Formerly known as Transmission Subsystem Profile).
This profile defines the LU capabilities associated with the TC Layer. Currently SNA defines 7 types of TS profiles.

These profile numbers are IBM defined and each number represents an IBM defined set of capabilities. The end user cannot create new profile numbers.

Since IBM defined profile numbers are not very precise in what they represent, the end user is allowed to qualify the profile numbers through additional statements.

Bind Image: The FM profile, TS profile and the qualifiers for a device are called its Bind Image and are described in a table called the Bind Image Table. Bind images are defined as a part of the access method system generation. As many Bind images may be defined in the system as is appropriate. Alike LUs may use the same Bind image.

PROFILES FOR SOME COMMONLY KNOWN DEVICES

LU TYPE	0	1	2	3	~~4~~ 6.2
PRODUCT NAME	IBM 3271 MODS 11, 12	3770 PRNTRS (SCS) IBM 3274 RJE	CRTs 3278s	PRNTRS (NO SCS) IBM 3274 RJE	SOFTWARE SYSTEMS CICS IMS TSO
FM PROFILE	2,3,4	3,4	3	3	7
TS PROFILE	2,3,4	3,4	3	3	7

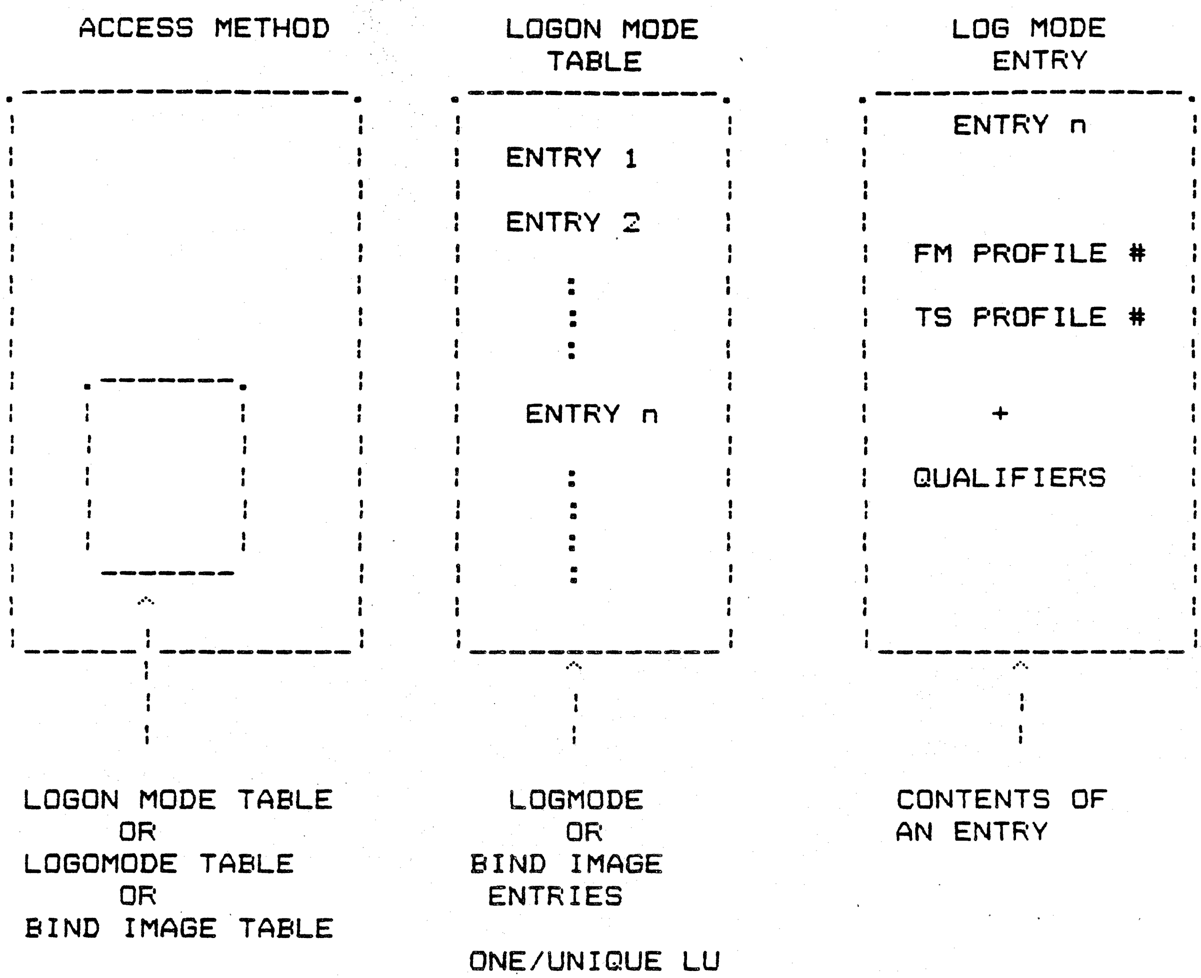
Support SNA char string

Teletype

most intel

IBM 6670 type 4 profile

WHERE ARE LU PROTOCOLS KEPT IN THE ACCESS METHOD



LU Protocols and Access Method:

One of the important tables coded as a part of the access method system generation is the so called Logon_Mode_Table (or the Bind Image Table).

This table defines the session protocols supported by each LU in the SNA network. These protocol definitions are called the Bind Images. There must be a bind image defined for each LU in the system. Similar devices (e.g., 3270 and all its non-IBM compatibles) can use the same bind image.

Each bind image in the table is assigned a unique name and this name must be provided to the SSCP as a part of the logon (LU-LU session) establishment procedures.

IBM provides a standard bind image table with each access method and it contains bind images for most IBM devices. The IBM provided table can be replaced or modified by the customer to meet customer's specific needs.

A TYPICAL BIND IMAGE (IBM 3270)

BYTE #	CONTENTS		
0	X'31'	BIND COMMAND	
1		RESERVED	
2	X'03'	FM PROFILE	**PROFILES**
3	X'03'	TS PROFILE	
4	X'B1'	PRIMARY PROTOCOL PLU	**QUALIFIERS**
5	X'90'	SECONDARY PROTOCOL SLU	
6,7	X'3080'	COMMON PROTOCOLS	
8	n	3270-HOST PACING COUNT	
9	n	HOST-3270 PACING COUNT	
10	MAX. RU SIZE FROM 3270, CHAINING CRITERINON FOR SLU		
11	MAX. RU SIZE FROM HOST, CHAINING CRITERION FO HOST		
12,13	NOT APPLICABLE		
14	DATA STREAM TYPE X'01'-LU1, X'02'-LU2, X'03'-LU3		
15-19	NOT APPLICABLE		
20,23	SCREEN/BUFFER SIZE, LU TYPES 2 & 3, USED IN CONJUNCTION WITH BYTE 24		
24	SCREEN/BUFFER SIZE		

DESCRIPTION OF BIND IMAGE FIELDS

BYTE 2: FM PROFILE - X'03'

PLU/SLU USE DELAYED CONTROL MODE
PLU/SLU USE IMMEDIATE RESPONSE MODE

BYTE3: TS PROFILE - X'03'

PACING ALLOWED BOTH WAYS   SEQ #s ALLOWED   CLEAR, SDT REQUIRED
RQR, STSN NOT ALLOWED

BYTE 4: PRIMARY PROTOCOLS - X'B1'

SINGLE/MULTIPLE ELEMENT CHAINS ALLOWED   IMMEDIATE REQST MODE
DR/ER BOTH ALLOWED   PLU TO END BRACKETS   NO COMPRESSION

BYTE 5: SECONDARY PROTOCOL - X'90'

SINGLE/MULTIPLE ELEMENT CHAINS ALLOWED   IMMEDIATE REQST MODE
ONLY ERs MAY BE REQUESTED   SLU DOES NOT EB   NO COMPRESSION

BYTES 6,7: COMMON PROTOCOLS - X'3080'

NO FMHs   BRACKETS ALLOWED   HOST TO END BRACKET   HDX/FF
PLU/SLU BOTH USE EBCDIC   PLU RESPONSIBLE FOR RECOVERY
SLU 1ST SPEAKER   SLU WINS CONTENTION

BYTES 20,24: SCREEN/BUFFER SIZES
(BYTES 20-23 USED BASED UPON BYTE 24 CONTENTS)

BYTE 24: BASIC SIZE (LU TYPE 2 OR 3)
X'01': 12 ROWS X 40 COLS   X'02': 24 X 80
X'7E': SIZE IN BYTES 20-21
X'7F': SIZE IN BYTES 22-23

BYTE 20 - # OF ROWS
X'0C': 12 ROWS   X'18: 24 ROWS   X'20': 32 ROWS
X'2B': 43 ROWS

BYTE 21 - # OF COLUMNS
X'1C': 28 COLUMNS   X'32': 50 COLUMNS

BYTE 22 - # OF ALTERNATE ROWS
VALUES ALLOWED SAME AS 20

BYTE 23 - # OF ALTERNATE COLUMNS
VALUES ALLOWED SAME AS BYTE 21

Unit 8: Review Quiz

1. Which header format in the PIU is determined based upon the PU type of a given device?

2. How long is the TH header for a PU type 2 device?

   6

3. Which SNA layer generates the TH?

4. Which host software component builds the TH?

   Access Method

5. Name the profiles used to describe SNA protocols for an SLU?

   2 profiles FM TS

6. Which table in the host contains the profile numbers for Logical Units? BIND TABLE

7. Which SNA layer(s) functions are covered by:
   a). an FM profile?

   b). a TS profile?

8. Having captured a bind image being sent to a 3270 on a line monitor, which byte in the bind image would you look at to determine:
   a) Whether the host can ask for definite responses? Which bit in the byte?

   b) Whether the 3270 can ask for definite and exception reponses? Which bit(s)?

   c) Whether the use of Bracket protocol is mandatory? Which bit(s)?

UNIT 8

SNA LAYERS

OBJECTIVES:

AT THE CONCLUSION OF THIS UNIT, THE ATTENDEE SHOULD BE ABLE TO:

1. DESCRIBE THE FUNCTION OF MAJOR SNA LAYERS

2. DESCRIBE THE RELATIONSHIP BETWEEN SNA LAYERS AND NAUs

3. MAKE A HIGH LEVEL COMPARISON BETWEEN SNA AND OPEN SYSTEM INTERCONNECT (OSI) MODEL

INTRODUCTION TO SNA LAYERS

```
                         Storm in Utah, transmission no good

D    Make sure to insert attribute characters
I
D                 But, what is the optimum route from here to there

U    S    D    D    C    H    I
      L    O    E    A    A    T
A      O    W    V    N    N
C       W    N    I    T    D
 T                   C         L
  I                   E         E
   V      COMPUTE  PAYROLL
    A
      T  E   T H E   S T A T I O N

     So U got data, but do U have CTS?

  WILL IT FIT IN THE PRINTER BUFFER?
```

COMPUTE PAYROLL
STN. ACTIVE?
ATTRIBUTES
PRNTR BUF SIZE?
SLOW DOWN
ROUTING INFO?
STORM IN UTAH
CTS?

module

THE LAYERS

- FORMAL SPECIFICATION OF "SELECTED" FUNCTIONS IN A COMMUNICATIONS SYSTEM
- SIMILAR FUNCTIONS GROUPED TOGETHER IN "LAYERS"
- WHEN GROUPING FOR LAYERS, CONSIDER ONLY THE FUNCTIONAL SIMILARITIES AND NOT THE PRODUCTS THAT PERFORM THOSE FUNCTIONS
- AN "ABSTRACT" VIEW OF AN ARCHITECTURE, LAYERS MAY NOT EQUATE WITH REAL PRODUCTS PRECISELY
- ARCHITECTS MAY DISAGREE ABOUT THE PLACEMENT OF CERTAIN FUNCTIONS IN IN CERTAIN SNA LAYERS

Some selected functions peformed in a communications network:

1. Making sure that the next timing pulse is received before next data bit is presented on the line.

2. Making sure that there are no logical errors in the contents of data (e.g. bad attribute or row, column address for 3270)

3. Making sure that there are no 'transmission errors' as data passes through each link.

4. Figuring out optimum routing between points A and B, where A and B are separated by >1 link.

5. Making sure that message is compatible with the end user medium, e.g. do not use attributes for a TWX device.

6. Ensuring that message will not exceed the device_buffer and thereby end up in the 'bit bucket'.

7. If a message exceeds device buffer, break it up into smaller blocks. Before sending the next block make sure to wait for an acknowledgement from the device indicating that it has processed the previous message.

8. Make sure that the message is not too long for a given link quality (too high an error probability), if too long divide it into blocks, receive 'no transmissions errors' notification before sending the next block.

9. Encrypt data for highly secure applications before sending it over the network.

:
:
:
etc.

EXERCISE:

Assume that the functions identified above would not all be performed in a single software component. Since it is generally desirable to perform similar functions in the same program, divide the functions identified above into categories of related functions such that each category can be implemented in one program (or logic in hardware).

SNA LAYERS: INTRODUCTION

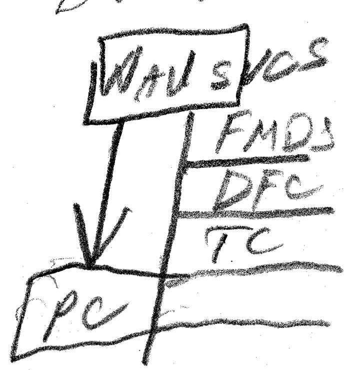
END USER (8)	END USERS: HOST APPLICATIONS, TERMINAL OPERATORS, MICROCODE IN A DEVICE
NAU.SVCS.MGR (9)	NETWORK MANAGEMENT AND CONTROL, SESSION INITIATION/TERMINATION SUPPORT *Normally inactive*
FMDS (6 Presentation Service)	MAKE MESSGES COMPATIBLE WITH DEVICE MEDIUM OR APPLICATION NEEDS, MANAGING SCS AND OLDER FORMATTING CHARACTERS
DFC (5 Data Flow Control)	MANAGING MSG FLOW IN A SESSION, CHAINING LONG MSGS INTO SMALLER ELEMENTS, ASSIGNING SEQ NUMBERS TO MSGS, LU-LU ACKS *LU-LU session* *acknowledge*
TC (4 Transmission Control)	CHECKING MSG SEQ NUMBERS, 'PACING', EXEPEDITE/NORMAL FLOWS, ENCRYPTION/DECRYPTION
PC (3 Path Control)	ROUTING, SEGMENTATION
DLC (2)	LINK MGMT, EST/MAINT/RELSE LINKS, LINK LEVEL ERROR RECOVERY, SDLC IN SNA *BSYNC) — not protocol* *EP*
PHYSICAL (1)	ELECTRICAL INTERFACE WITH THE MODEM, RS232C, X.21 ETC.

(IBM has formal rules)

1st industry standard *(DSU)*

During activation

many sublayers



Layers in an SNA environment:

1. Physical Control: Data Terminal Equipment (DTE) to Data Communications Equipment (DCE) interface. SNA does not define protocols for this layer and accepts the already existing standards for modems such as EIA RS232c. The new ANSII standard x.21 is not yet very prevalent.

2. Link Control (DLC): This layer provides protocols for exchange of information between two points of a transmission link. SNA defines Data Link Control (DLC) protocols only between end points of common carrier communications links or equivalents via the Synchronous Data Link Control (SDLC). Channel protocols, for example, for exchange of information between the host and the local NCP or other local devices are not defined by SNA and are implementation dependent.

3. Path Control (PC): This layer provides protocols for routing information through an SNA network. This layer keeps track of message paths between nodes, Transmission Groups (multiple links between two adjacent nodes for backup and throughput). It also provides segmenting (as against "chainining", see DFC) of messages to keep them compatible with the receiver buffer requirements and translates SNA network addresses to addresses that are recognized by remote devices.

4. Transmission Control (TC): Provides protocols for checking sequence numbers (number generation is part of DFC), separating expedited flow from normal flow of data, "pacing" data transmissions so that the receiver is not flooded, and for encryption/decryption of data.

5. Data Flow Control (DFC): Provides protocols to specify which of two end-users should transmit next, ability to divide long messages into a chain of smaller elements; assigns sequence numbers to messages for recovery purposes; prevents unsolicited messages in the middle of a transaction. Also provides protocols to verify that the message was processed correctly.

6. Function Management Data Services (FMDS): This layer provides a convenient means to perform any special processing unique for a given end user medium. While the architecture defines the location of this layer, the specific functions are implementation defined. Basic Mapping Support in CICS or Message Formatting Services in IMS are two examples of FMDS.

7. <u>NAU Services Manager:</u> This layer provides functions that are invoked primarily for non-end user sessions. These sessions pertain to special functions associated with an SNA defined control point called the Systems Services Control Point which by definition is in the host access method. This layer is primarily concerned with monitoring, control, and maintenance functions for the network resources.

8. <u>End User:</u> End user functions are not defined by the SNA. This layer includes application programs, terminal operators, and firmware in remote devices etc.

<u>Note:</u> The SNA architecture is still evolving. Related publications allude to certain functions which are not otherwise defined. Thus, it is to be expected that focus and emphasis of layer-functions will change as architecture matures.

SNA LAYERS DURING NORMAL FLOWS

END USER
FMDS
DFC
TC
PC
DLC
PHYSICAL

NOTES

1. NOT ALL SNA LAYERS ARE ACTIVE NOR NEEDED FOR EVERY OPERATION IN THE NETWORK

2. NAU_SVCS_MGR LAYER, FOR EXAMPLE, PLAYS NO ROLE DURING NORMAL DATA FLOWS AS SHOWN IN THE DIAGRAM HERE

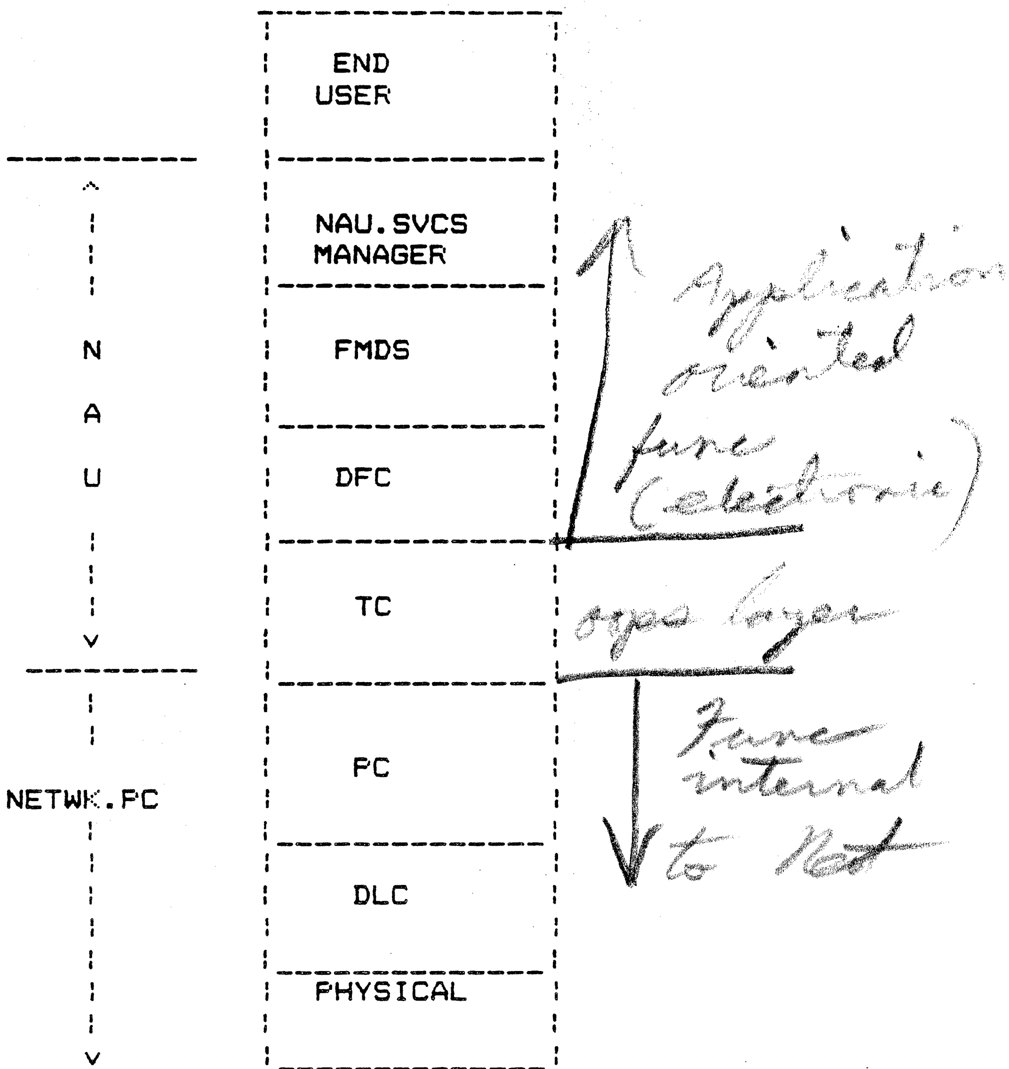
3. CONVERSELY, DURING THE SESSION ESTABLISHMENT/TERMINATION PHASE NAU_SVCS_MGR HAS A DIRECT INTERFACE WITH PC LAYER AND OTHER LAYERS IN BETWEEN ARE ABSENT

SNA HEADERS AND LAYERS

HEADER/DATA	LAYER RESPONSIBLE	HOST COMPONENT RESPONSIBLE
R U	END-USER FMDS DFC TC	CUSTOMER SOFTWARE TP MONITOR ACCESS METHOD
R H *	FMDS DFC TC	CUSTOMER SOFTWARE TP MONITOR ACCESS METHOD
T H	PC	ACCESS METHOD NCP
S D L C	DLC	NCP

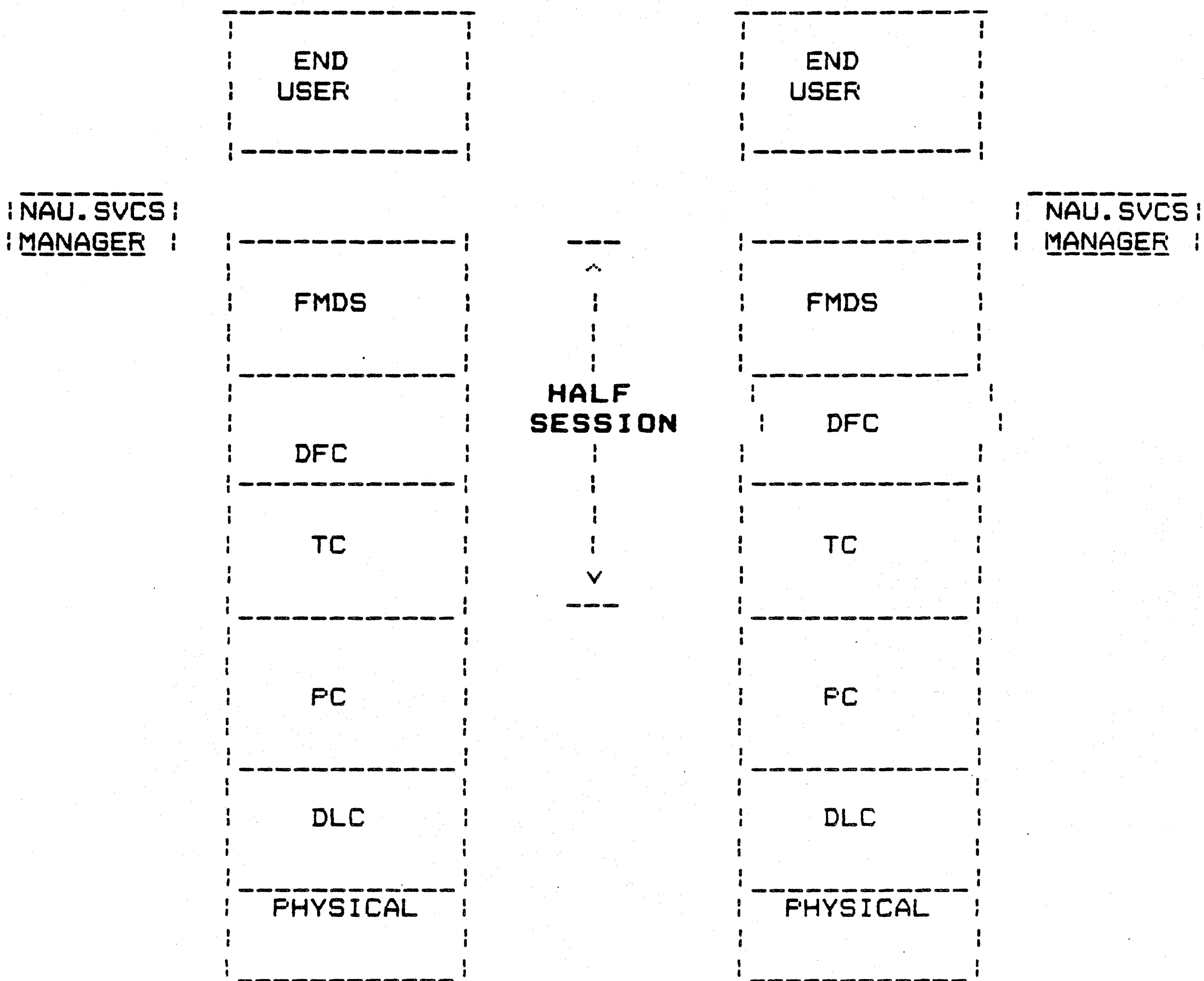
* FMDS AND DFC PASS THEIR REQUIREMENTS TO TC, THE ACTUAL CONSTRUCTION OF RH IS DONE IN THE TC LAYER.

LAYERS, NAUs, AND PATH CONTROL NETWORK



"SNA IS A SET OF NAUs INTECONNECTED VIA A PATH CONTROL NETWORK"

HALF SESSIONS

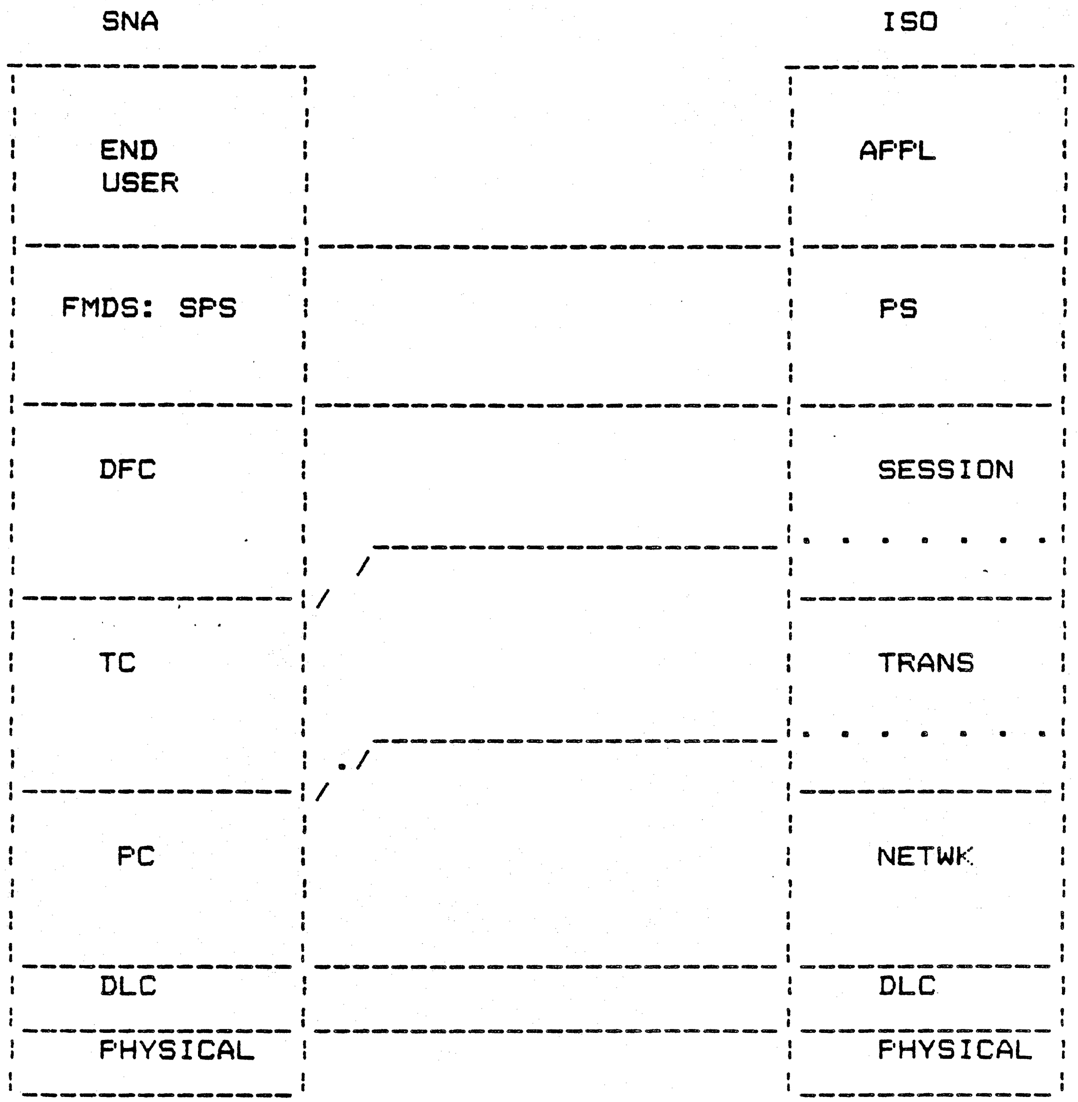


APPL	END USER NEEDS, ULTIMATE SOURCE/DEST OF USER DATA, AND SESSION REQUESTS
PS (PRESENT)	PRESENT INFO PRESERVING MEANING YET RESOLVE SYNTAX DIFFERENCES, OR MAKE DATA COMPATIBLE WITH APPL LAYER NEEDS
SC (SESSION)	ESTABLISH/TERM SESSIONS, MGMT OF FLOW CTL, DIALOGUE MGMT,QUARANTINE, EXP/NORM FLO
TC (TRANSPORT)	OPTMUM NET SVC. AND QUALITY OF SVC CHOICE, SYMB TO NET ADDR TRANS, FLO CTL, END TO END ACKS, SEGMENTING/BLOCKING
NC (NETWORK)	ROUTING/PATH, MASK DIFFERENCS IN TRANS AND NET TECHNOLOGIES, GEN NET ADDRESSES, DELIVER MSGS IN CORRECT SEQ, SEG/BLOCK
DLC	LINK MGMT, EST/MAINT/RELSE LINKS, LINK LEVEL ERROR RECOVERY
PHYSICAL	BIT TRANS BETWEEN LINK ENTITIES, SERIALIZATION, e.g. RS232C, X.21

NOTE: OSI IS THE NAME OF THE ARCHITECTURE BEING DEVELOPED INTERNATIONAL STANDARDS ORGANIZATION

OPEN_SYSTEM_INTERCONNECT_(OSI)_REFERENCE_MODEL

SNA VS. OSI: PASS I



SPS = SESSION PRESENTATION SERVICES

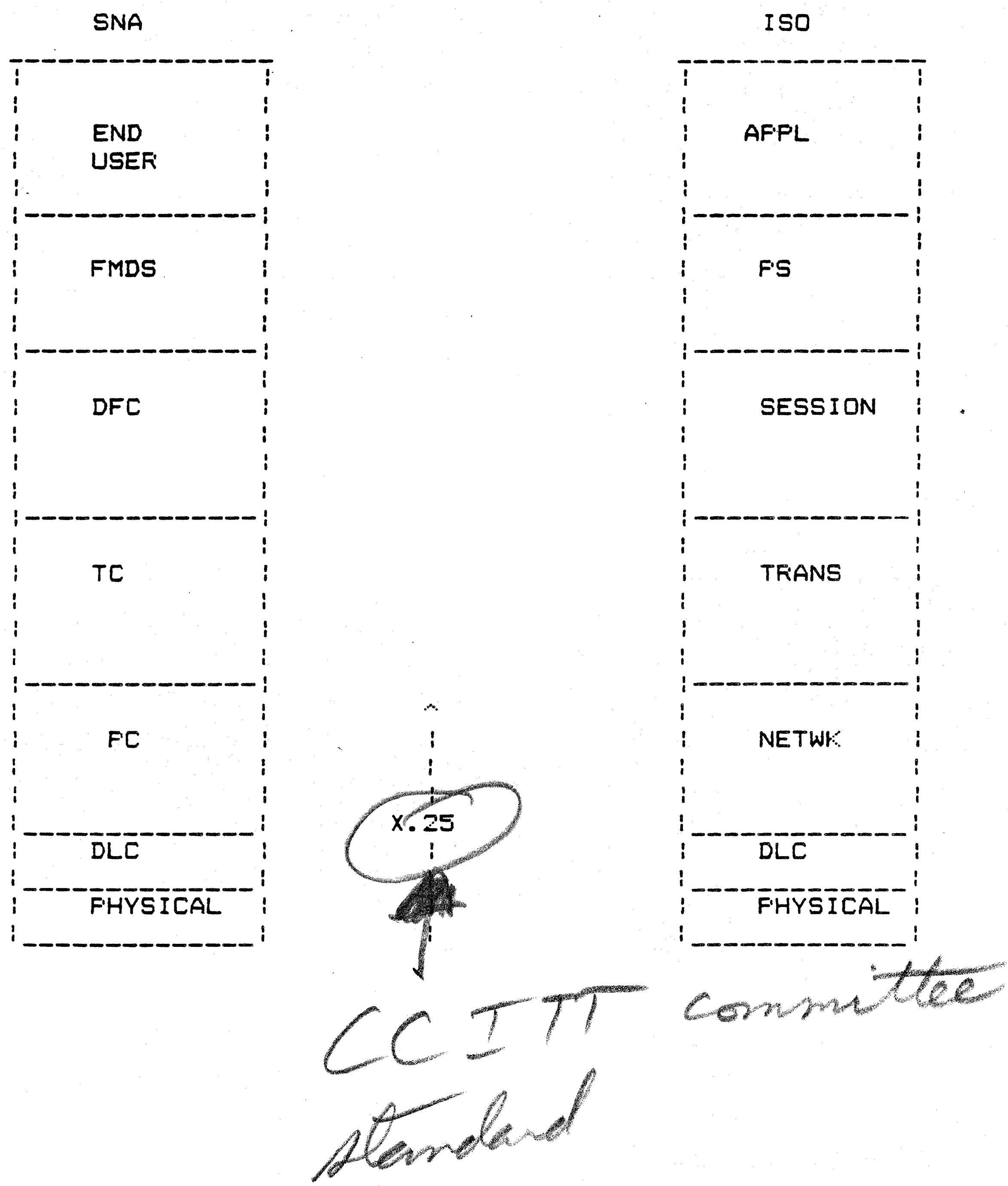
SNA VS. OSI: PASS II

```
              SNA                                              ISO
          ----------------                                 --------------
         |                |                               |              |
         |     END        |                               |    APPL      |
         |     USER       |                               |              |
         |                |                               |              |
         | -------------- |                               | ------------ |
     ?   | NAU.SVC.MGR    |                               |              |
         |                |                               |              |
         | -------------- | ----------------------------- |              |
         |     FMDS       |                               |              |
         |       :        |                               |              |
     ?   | SNS   :  SPS --| ----------------------------- |--> PS        |
         |       :        |                               |              |
         | -------------- | ----------------------------- | ------------ |
         |                |                               |              |
         |     DFC        |                               |   SESSION    |
         |                |                               |              |
         |                |    -------------------------- | . . . . . . .|
         |                | ./                            |              |
         | -------------- |/                               | ------------ |
         |                |                               |              |
         |     TC         |                               |   TRANS      |
         |                |                               |              |
         |                |    -------------------------- | . . . . . . .|
         |                | ./                            |              |
         | -------------- |/                               | ------------ |
         |                |                               |              |
         |      PC        |                               |   NETWK      |
         |                |                               |              |
         |                |                               |              |
         | -------------- | ----------------------------- | ------------ |
         |     DLC        |                               |   DLC        |
         | -------------- | ----------------------------- | ------------ |
         |     PHYSICAL   |                               |   PHYSICAL   |
         | -------------- |                               | ------------ |
```

SNS = SESSION NETWORK SERVICES

X.25: A DE FACTO INTERCONNECT PROTOCOL?

OSI



SNA LAYERS REVIEW QUIZ:

For each of the functions described below, identify the SNA layer in which it is implemented:

a). Routing information through the network.

____

b). Ensuring data integrity across a transmission link.______________

c). Monitoring the status of a network resource from the host access method. ________________

d). Checking sequence numbers on messages received to ensure that none are lost. ________________

e). Generating sequence numbers on messages transmitted.______________

f). Ensuring that data is not transmitted on the link unless the modem is ready. ______________

g). A totally confused human being on how to use an allegedly "user friendly" device. ____________________

h). Inserting special control characters in a message depending upon whether it is destined for a CRT or a printer. ________________

UNIT 9

SYSTEM GENERATION CONSIDERATIONS FOR SNA IN AN NCP/VTAM ENVIRONMENT

OBJECTIVES:

AT THE CONCLUSION OF THIS UNIT, THE ATTENDEE SHOULD BE ABLE TO:

1. DESCRIBE MAJOR SYSTEM GENERATION ACTIVITIES TO BE PERFORMED BY A CUSTOMER TO GENERATE AN SNA NETWORK

2. IDENTIFY SELECTED VALUES CODED ON THE NCP SYSTEM GENERATION MACROS

3. DESCRIBE THE ROLE OF MAJOR AND MINOR NODES IN VTAM

4. DESCRIBE PROCEDURES FOR AUTOMATIC ACTIVATION OF NETWORK RESOURCES DURING SYSTEM

OVERVIEW OF SYSTEM GENERATION ACTIVITIES

1. NCP DEFINITIONS:

TABLES THAT CONTAIN PROFILES OF LINES, CLUSTER CONTROLLERS, CRTs, AND PRINTERS CONNECTED TO THE FEP

2. VTAM DEFINITIONS:

NETWORK PROFILES AS CODED FOR THE NCP ABOVE. VTAM NEEDS THIS INFORMATION BECAUSE IT IS THE SSCP AND HAS TO MANAGE THE TOTAL NETWORK

ADDITIONAL DESCRIPTIONS NEEDED BY VTAM INCLUDE HOST APPLICATIONS (HOST LUs), LOCALLY ATTACHED DEVICES, BIND IMAGE TABLE, LOGON TRANSLATION TABLES

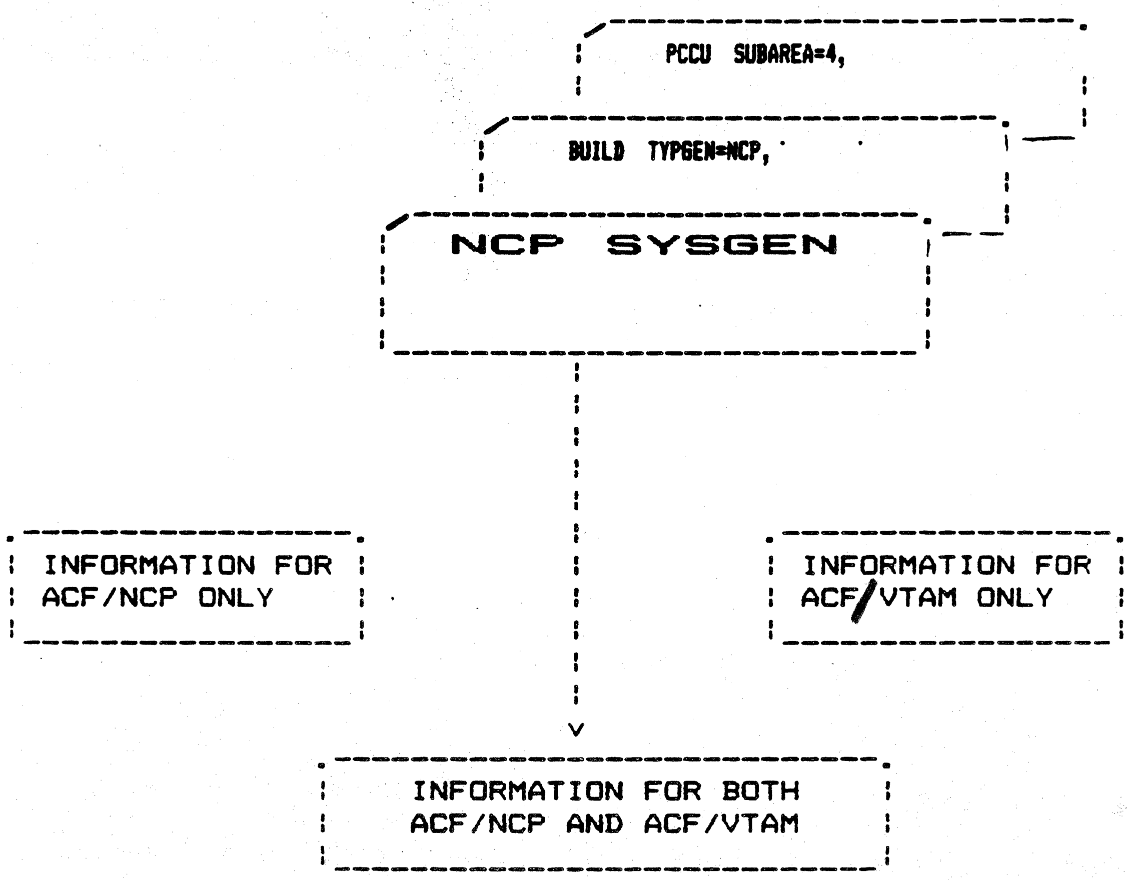
3. OPERATING SYSTEM DEFINITIONS

OPERATING SYSTEM ALSO NEEDS TO KNOW THE FACT THAT VTAM WOULD BE USED IN THIS HOST. Network subchannels

[redacted]

4. CICS

ACF/NCP SYSGEN AND ACF/VTAM



partial SSCP sysgen

NCP system generation and VTAM:

As in all system generations (SYSGENs), NCP generation involves creation of various tables that describe each resource that the NCP would be communicating with.

However, information described in the tables is actually more than what the NCP needs to know. The tables also include information that is needed by VTAM only. Any information in the tables not applicable to NCP is ignored by it.

Thus, the tables coded to create an NCP are coded once but filed twice:

Once as part of the NCP and this goes to the front end.

Second, as part of VTAM and this stays in the host.

One of the easier ways to generate a malignant system is for a customer to file a different set of definitions for NCP than the one for VTAM.

SELECTED NCP SYSTEM GENERATION MACROS

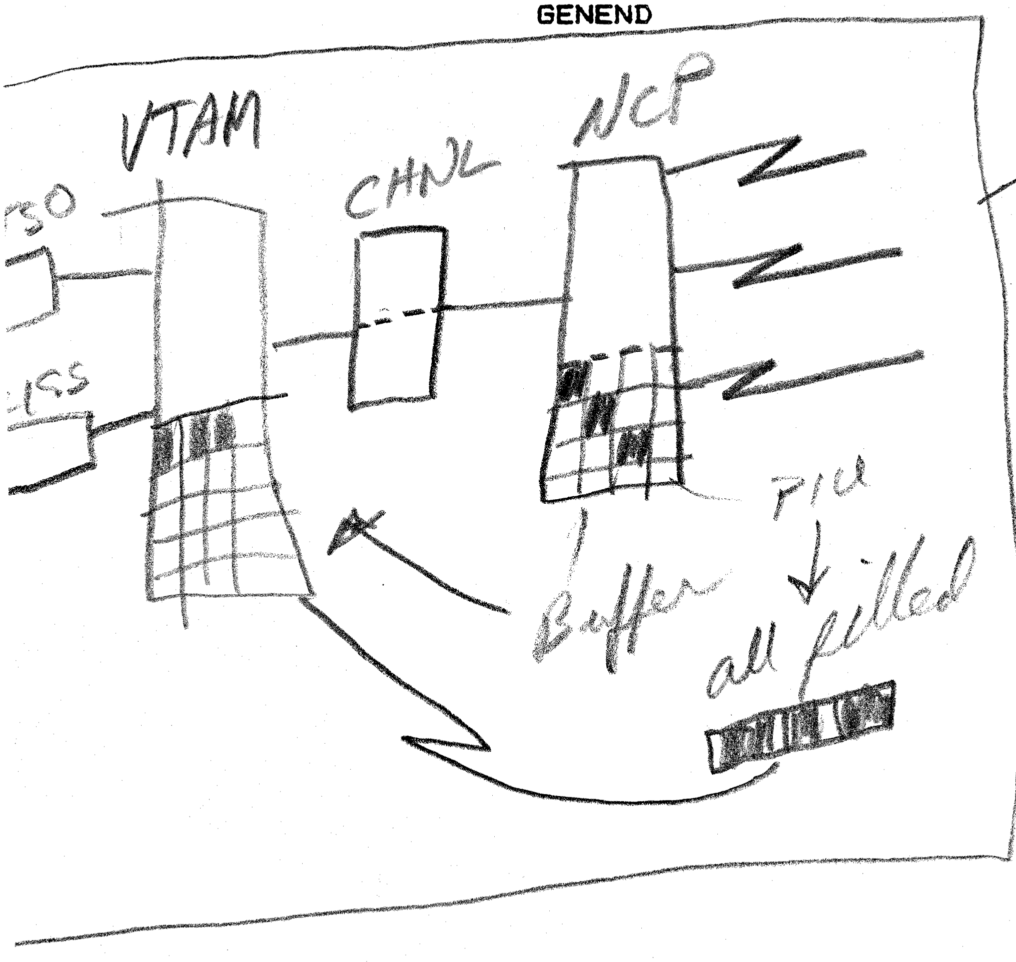
PCCU

BUILD

HOST

SNA STATIONS	BSC 3270
GROUP	GROUP
LINE	LINE
SERVICE	SERVICE
PU	CLUSTER
LU	TERMINAL

GENEND



NCP/VTAM MACROS:

PCCU: (Programmed Communications Control Unit).
This macro is used to describe the NCP attributes to VTAM. PCCU macro contains information such as:

The subchannel number connecting this NCP to the VTAM host, the subarea number of the VTAM controlling this NCP.

BUILD:
BUILD macro describes features and capabilities of the 370X hardware and the NCP being generated. It provides information such as:

Subarea number of the NCP, buffer size of the NCP buffers, highest subarea number assigned to any node in this SNA network, etc.

HOST:
Host macro describes the characteristics of a host access method to the NCP. It contains information such as:

Largest message size that this host access method can accept form the NCP, subarea number of this host access method, how many NCP buffers would be generally sufficient to receive messages from this access method.

GROUP:
GROUP macro describes a group of similar lines. Lines are considered alike if they all use the same link protocol and are all switched or all private. Common attributes of lines in the group need be coded only on the GROUP macro.

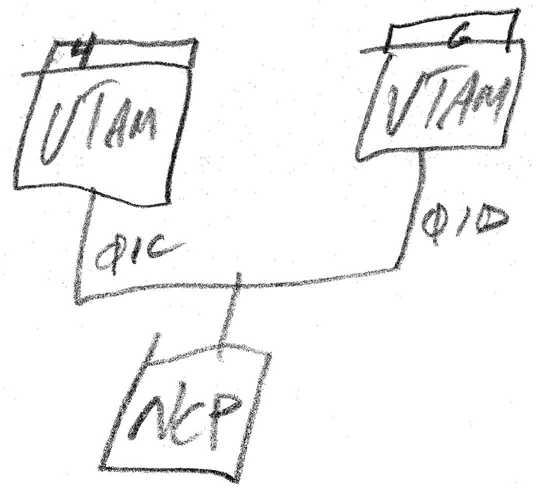
LINE:
LINE describes unique attributes of a line that are not defined on the GROUP definition. May contain values such as line speed, port address, etc.

SERVICE:
SERVICE macro specifies the order in which PUs (controllers) on the line are to be serviced.

PU (CLUSTER):
PU (CLUSTER) macro describes the profile of a physical unit (cluster controller) on the LINE above.

LU (TERMINAL):
LU (TERMINAL macro describes the profile a logical unit (device) on the PU above.

GENEND:
GENEND indicates the end of generation and provides some performar related option.



CUADDR=ØIC
CUADDR=ØID

ILLUSTRATIVE_SEQUENCE_OF_NCP/VTAM_MACROS:

	PCCU	DESCRIBE FEP TO VTAM per VTAM
	BUILD	DESCRIBE NCP FEATURES
	SYSCNTRL	OPTIONAL DYNAMIC FEATURES per host
	HOST	DESCRIBE A. M. TO NCP
	CSB	DESCRIBE SCANNER ON 370X
	CSB	IF ADDITIONAL SCANNER
GRP1	GROUP	BEGIN DESCRIPTION SIMILAR LINES
GRP1L1	LINE	UNIQUE FEATURES THIS LINE
	SERVICE	ORDER IN WHICH STNS SERVICED
PU1	PU	DESCRIBE A PU ON THE LINE
LU1	LU	LU PROFILE FOR ABOVE PU
LU2	LU	IF MORE LUs, ONE / LU
	:	
PU2	PU	IF MULT. POINT LINE
	:	
LUs	for above PU	
	:	
GRP1L2	LINE	NEXT LINE IN GROUP, IF ANY
	:	
	:	
GRP2	GROUP	START NEXT GROUP OF LINES
	:	
	LINE	
	:	
	GENEND	

NCP Major Node

max # of Buffers AC would receive from NCP

ILLUSTRATIVE_OPERANDS_FOR_NCP/VTAM_GENERATION:

```
NCP1H1      PCCU        CUADDR=01C,SUBAREA=2,....

NCP1        BUILD       TYPGEN=NCP,SUBAREA=3,
                        MAXSUBA=12,......

VTAM1       HOST        SUBAREA=2,UNITSZ=100,MAXBFRU=10,....

GROUP1      GROUP       LNCTL = SDLC,
                        DIAL = YES/NO,
                        TYPE = NCP,
                         :
                         :

SOT1        SERVICE   ORDER = (----,----)

LINE1       LINE        ADDRESS = 3705 port address,
                        SPEED = 2400,               LINE SPEED
                        AUTO = YES,                 IF AUTO DIAL
                        MAXPU = # OF PUs,
                        TRANSFER = largest msg size,
                         :
                         :

PU1         PU          ADDR = Hex Id of PU,
                        BNNSUP = 3270,              FOR 3270 PU_T1
                        MAXDATA = bytes,            LRGST POSS MSG
                        MAXOUT = 7,                 MAX SDLC FRAMES
                        PUTYPE = ..,                THIS PU TYP 1,2,OR 4
                         :
                         :
            VTAM ONLY VALUES:

                        ISTATUS = ACTIVE,           STRTUP STATUS OF PU
                         :
                         :

LU1         LU          LOCADDR=01,PACING=(2,2),...

            VTAM ONLY VALUES:

                        DLOGMOD = ..,       BIND IMAGE NAME
                        ISTATUS = ACTIVE,   LU STRTUP STATUS
                        LOGAPPL = CICS,     AUTO LOGON TO CICS
                         :
```

100*10 = LARGEST PIU From NCP to VTAM

BSC / SNA

Description of selected values from VTAM/NCP generation tables:

PCCU Table:

CUADDR: Subchannel number of the subchannel connecting FEP to the host.

SUBAREA: Subarea number of the VTAM connected to this NCP over the subchannel identified above.

BUILD Table:

SUBAREA: Subarea assigned to the NCP being created.

MAXSUBA: Highest subarea number that will ever be encountered by the NCP in this network. NCP uses this value to compute the SUBAREA/ELEMENT boundary in network addresses.

HOST Table:

SUBAREA: Subarea number of the host access method that this NCP is connected with.

GROUP Table:

LNCTL: Indicates the link protocol for lines in this group, 4540e lines must be in an SDLC group.

DIAL: Indicates whether lines in this group are private (= NO) or swithced (= YES).

LINE Table:

ADDRESS: Port number assined to this line on the FEP.

MAXPU: Approximate maximum number of controllers on this line.

TRANSFER: Largest message (PIU, chain element, or segment) that will ever be received by the NCP from any device on this line.

PU Table:

name: Symbolic name ("PU1" in our example) assigned to this PU.

ADDR: 1 byte hex ID of this controller, this ID goes in the address field in the SDLC header.

MAXDATA: Buffer size of this controller, any messages exceeding this number would be segmented by the NCP. This number should be 265 for 4540E

PUTYPE: PU type of the controller being described, 2 for 4540E.

ISTATUS: Whether VTAM should automatically activate (=ACTIVE) this resource when it comes up.

LU Table:

name: Symbolic name ("LU1" in our example) assigned to the LU being described.

LOCADDR: 1 byte hex ID of this LU (CRT/Printer) within this controller.

PACING: Pacing number for this LU, a parasite, BIND value would override it.

DLOGMODE: Name of the Bind image for this LU in the Bind table. A value here alleviates the need for a Bind entry name in the Logon message.

ISTATUS: Whether VTAM should automatically activate (=ACTIVE) this resource when it comes up.

LOGAPPL: Name of host application, e.g. CICS, with which VTAM would set up an LU-LU session for LU1 automatically when VTAM comes up.

ADDITIONAL VTAM TABLES

1. MAJOR/MINOR NODES: FIVE TYPES

   APPLICATIONS: EACH SUBSYSTEM (IMS, CICS, ..) A MINOR

   NCPS: EACH PU AND LU ON THE NCP A MINOR

   SNA LOCAL: EACH PU AND LU A MINOR

   NON-SNA LOCAL: EACH CONTROLLER AND DEVICE A MINOR (3270)

   SWITCHED PORTS: ASSOCIATED PU AND LU ARE MINORS

2. BIND IMAGE TABLES

3. USS TABLES

   Unformatted system service

   LOGON MESSAGES

   CUSTOMIZED ERROR MESSAGES

4. START AND CONFIGURATION LISTS

EXAMPLE: APPLICATIONS MAJOR NODE

```
          VBUILD    TYPE=APPL            BEGIN APPL MAJOR

CICS03    APPL      PRTCT=SECRET,..      1ST APPL MINOR
IMS01     APPL      PRTCT=SECURE,..      IMS IS NXT MINOR
            :          (password)
            :
            :
            :
```

NOTES:

1. MAJOR NODE CONTAINING CICS OR IMS MUST BE ACTIVATED BEFORE THE SUBSYSTEM CAN BE ACTIVATED UNDER VTAM
2. TRANSACTIONS UNDER IMS OR CICS ARE UNKNOWN TO VTAM
3. NAME CODED TO THE LEFT OF THE 'APPL' KEYWORD BECOMES THE NAME OF THE MINOR NODE BY WHICH THE APPLICATION WILL BE KNOWN TO THE SYSTEM

All nodes description are kept on VTAM system file called SYS1.VTAMLIST

START AND CONFIGURATION LISTS

START LIST: ATCSTRXX (XX=00-99)

1. CONTAINS STARTUP INITIALIZATION INFORMATION FOR VTAM

   SIZE OF VTAM BUFFERS, NUMBER OF BUFFERS

   SUBAREA NUMBER ASSIGNED TO VTAM

   HIGHEST SUBAREA NUMBER IN THIS SNA NETWORK

   :

   :

   OTHER INFORMATION

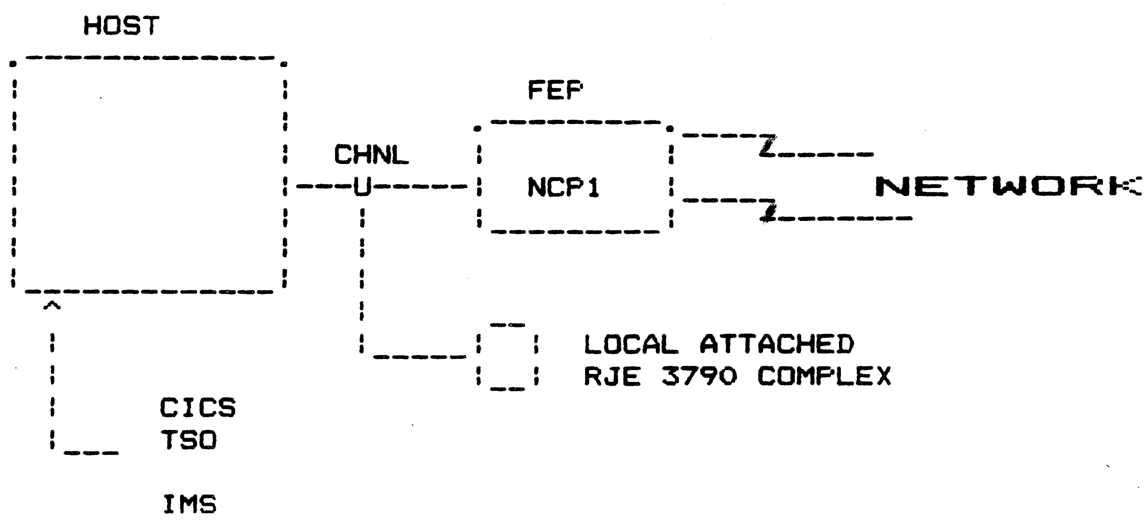
2. THE ABOVE CAN BE PROVIDED ALTERNATIVELY ON VTAM START COMMAND

CONFIGURATION LIST: ATCCONXX (XX=00-99)

1. A MEANS TO CONTROL ACTIVATION OF NETWORK IN PARTS

2. CONTAINS NAMES OF MAJOR NODES TO BE ACTIVATED AUTOMATICALLY WHEN VTAM COMES UP

AN EXAMPLE OF VTAM STARTUP



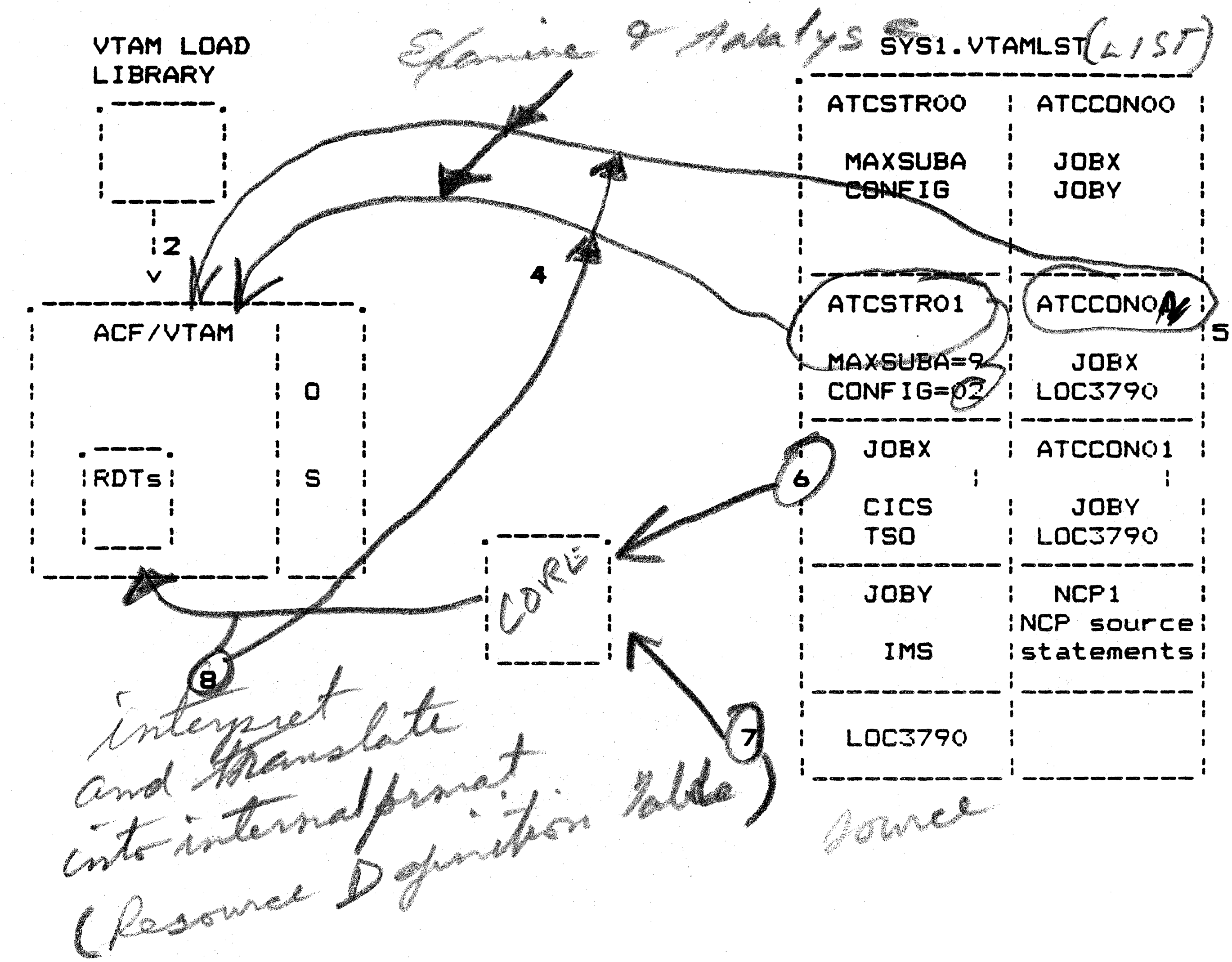
VTAM NODES OF INTEREST

MAJOR	ASSOCIATED MINORS
JOBX	CICS, TSO
JOBY	IMS
LOC3790	RJE COMPLEX, 1 PU AND 3 LUs (ASSUME 3 COMPONENTS)
NCP1	LINKS, PUs, AND LUs CONNECTED TO THE NCP. (SPECIFIC NUMBERS NOT IMPORTANT FOR THIS EXAMPLE)

Build Group

WHAT HAPPENS DURING VTAM STARTUP

```
          1
START  VTAMNET,,,(LIST=01)
                       3
```



NOTE: FOR DOS/VS, ATCSTRXX AND ATCCONXX ARE APPENDED TO B, GIVING B.ATCSTRXX AND B.ATTCONXX.

What_Happens_During_ACF/VTAM_Startup:

Diagram on the opposite page shows some of the major activities that take place when the system operator starts ACF/VTAM.

1. Operator enters the START command indentifying NETATT as the procedure that contains the JCL. Also note the option LIST=01. This identifies which start list to use. More of this in a moment.

2. The operating system receives the START command loads the appropriate ACF/VTAM modules from the disk to the main storage.

3. As ACF/VTAM initialization routine gets control, it looks at the set of options specified by the operator, LIST=01 in this case.

   Or in other words, we want to bring up ACF/VTAM in this case using the start list ATCSTR01.

4. ACF/VTAM loads ATCSTR01 list into main storage and discovers that network configuration to be brought up in CONFIG=02 or ATCCN02.

5. VTAM reads configuration list, ATCCON02, into main storage. In this case we have two major nodes in the configuration JOBX and LOC3790.

6. ACF/VTAM reads JOBX major node statements and builds RDT entries for JOBX.

7. ACF/VTAM reads LOC3790 major node statements and builds RDT entries for LOC3790.

The following page shows the ACF/VTAM view of the network at this point.

ACF/VTAM'S VIEW OF THE NETWORK USING LIST=01

```
.----------------------------.
:    :         :            :                        CICS
:    :         :            :-------- JOBX
: O  :  APPLS  :     V      :                        TSO
:    :         :     T      :
: S  :         :     A      :
:    :         :     M      :-------- LOCAL          3709
:    :         :            :
:____:_________:____________:                          PU1
                                                       LU1
                                                       LU2
                                                       LU3
```

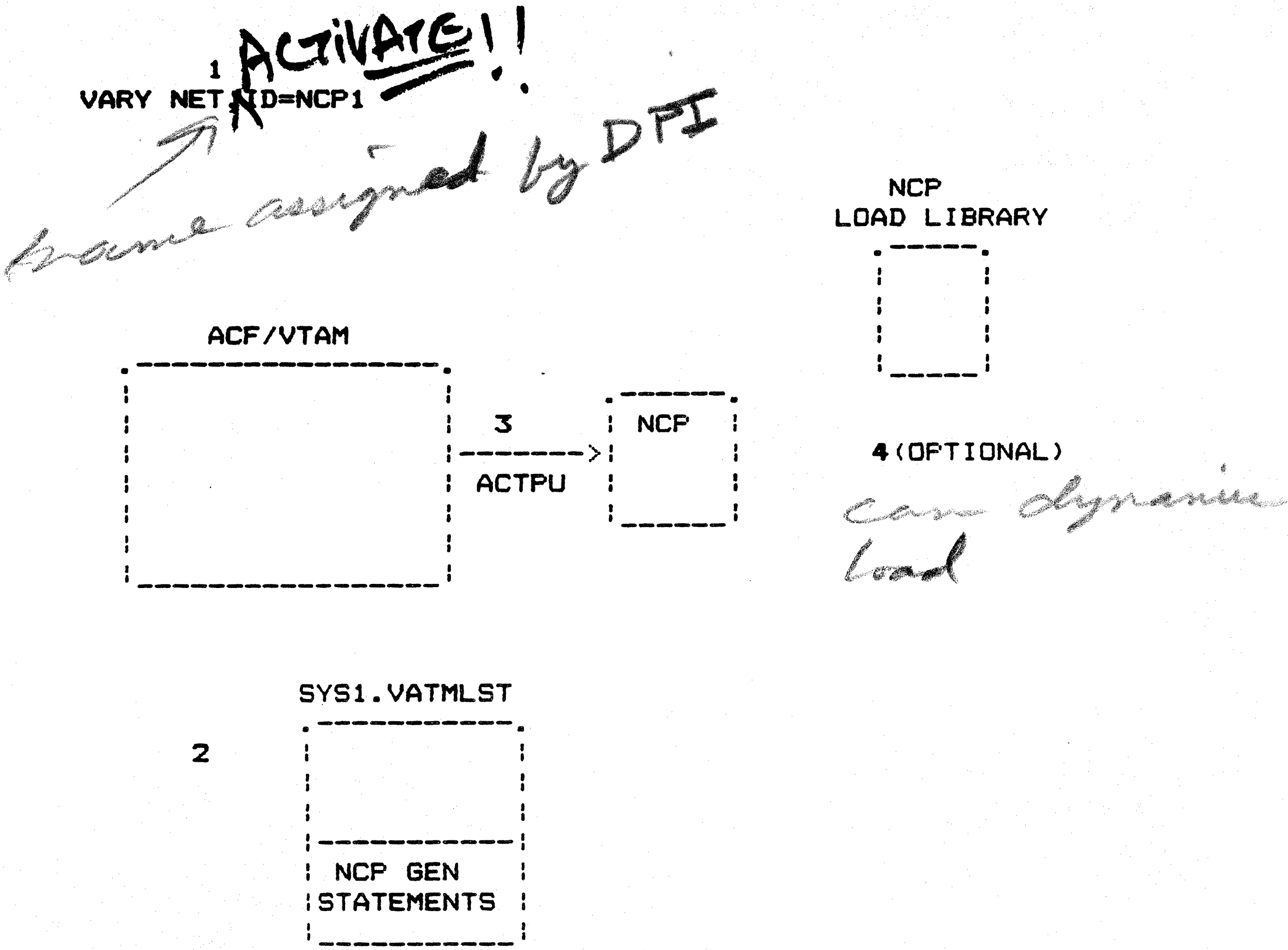
Figure here shows ACF/VTAM's view of system at this time.

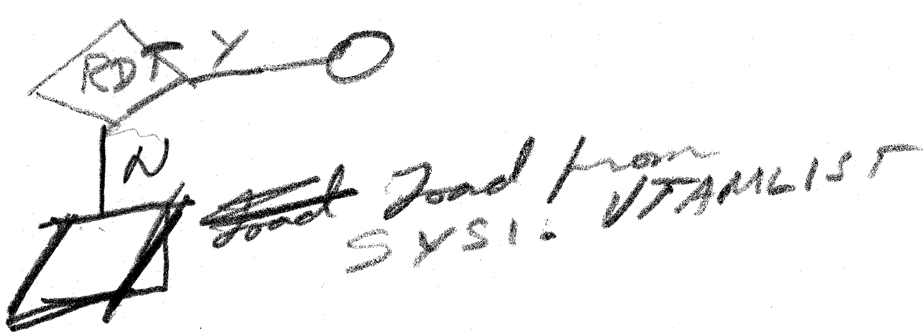
RDTs at this time should contain:

```
JOBX
     CICS
     TSO
LOCAL 3790
     PU1
     LU1
     LU2
     LU3
```

This does not, however, mean that these PUs and LUs are active (i.e., they have SSCP-PU and SSCP-LU sessions). That would depend upon their ISTATUS specification in the PU and LU macros.

MODIFYING THE NETWORK





Modifying Network Configuration:

Once the network has been brought up using the start list, modifications can be made to the network using the ACF/VTAM operator command VARY.

For example, in the first example in this module (with LIST=01) we did not bring up NCP or any of the associated network.

Say, at this point we now want to activate the NCP and rest of the network. To be able to do that we have to know the name of the NCP major node - which in this case is NCP1. The command in this case is:

```
VARY      NET, ACT, ID=NCP1
```

VARY:	command code
NET:	Identifies this command is for VTAM
ACT:	For "activate"
ID:	The resource ID, NCP1.

Unit: Review Quiz

1. A VTAM user with a large network is unhappy because:

a). It takes a very long time to bring up the network since operator has to activate all controllers and devices one at a time (100 devices). Operator errors make an already bad problem worse.

Can anything be done to help the customer?

b). Terminal operators in the field (end users) make too many mistakes in entering required logon messages in the right format. It causes loss of productive time, bad public relations, and unnecessary calls to AT&T for trouble shooting when it was really an operator error.

Can anything be done to help the customer?

2. On a new customer site, a 3270 clusters work fine except for one application where the operator is required to enter full screen messages. Any time such a message is entered, the NCP rejects it with an exception response. Line monitor shows that NCP sent an SNA sense code of x'8010' ("PIU too long") to the 3270 [redacted]. You have checked that the segmentation is being performed properly by the [redacted] 3270.

A customer error was the cause of the problem. Can you identify the customer error?

3. Customer is unable to activate one of the 3270 [redacted] controllers on a line (other 3270 [redacted] controllers work fine on the same line). Host sends the ACTPU command to the controller (activation command can be seen on the system log) but no response is returned by the controller. At the same time, the line monitoring equipment shows no ACTPU commands coming down the line for the controller in question.

A customer error was causing the problem. Can you identify the error?

UNIT 10

ACF/TCAM_OVERVIEW

OBJECTIVES:

TO IDENTIFY VARIOUS SOFTWARE COMPONENTS OF ACF/TCAM

TO DESCRIBE THE FUNCTION OF MESSAGE CONTROL PROGRAM (MCP) AND MESSAGE HANDLERS (MHs)

TO DESCRIBE VARIOUS NAUs IN A TCAM ENVIRONMENT

TO DESCRIBE VARIOUS DEFINITIONS NEEDED TO SUPPORT A GIVEN NETWORK IN A TCAM ENVIRONMENT

HIGHLIGHTS OF ACF/TCAM

- NETWORK CONFIGURATION TRANSPARENCY

  - APPLICATIONS DEAL WITH SEQUENTIAL AND NOT WITH NETWORK DEVICES

- RELATIVELY GREATER DEVICE INDEPENDENCE

  - POSSIBLE TO DO CERTAIN AMOUNT OF EDITING WITHIN TCAM, INSERT/STRIP CONTROL CHARACTERS

- SUPPORTS VARIETY OF OLD AND NEW PROTOCOLS

  - ALSO WORKS WITH BOTH NCP AND EP

- AS A QUEUED ACCESS METHOD, ALLOWS:

  - ASYNCHRONOUS INPUT/PROCESSING/OUTPUT

  - WARM RESTART AFTER SYSTEM FAILURE

  - BATCH TESTING OF APPLICATIONS

- HAS BUILT IN MESSAGE SWITCHING CAPABILITY

- VERY COMPLEX, HIGH DISK QUEUING OVERHEAD

- WITH THE NEW SUBSYSTEM INTERFACE, IT CAN EMULATE ACF/VTAM

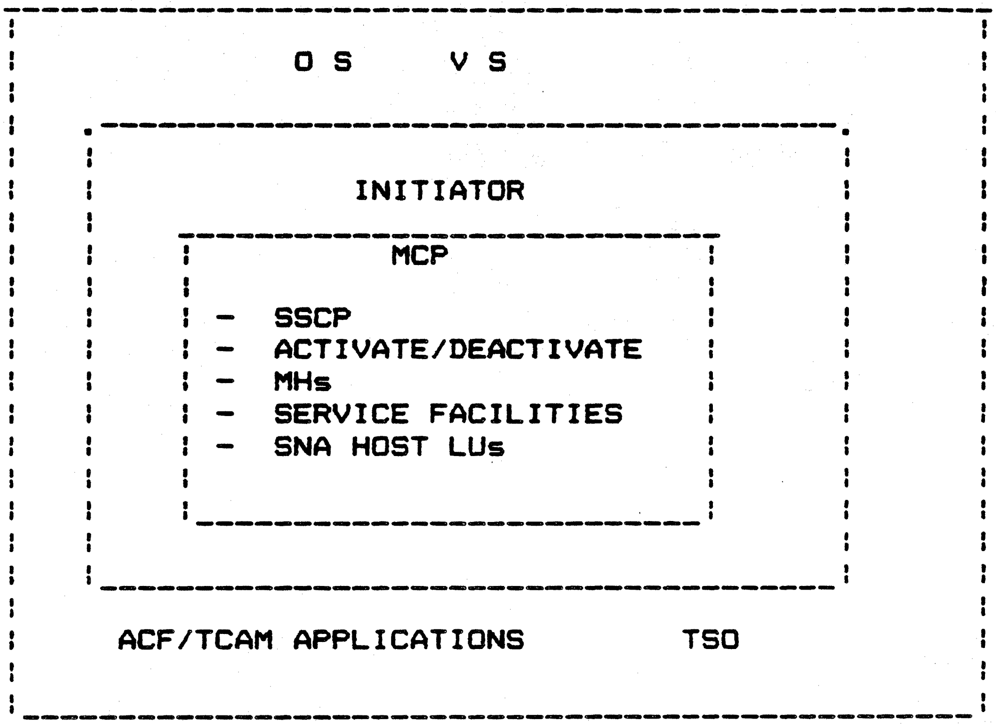
ACF/TCAM TERMINAL SUPPORT

- WITH EMULATION PROGRAM
  - SS
  - BSC

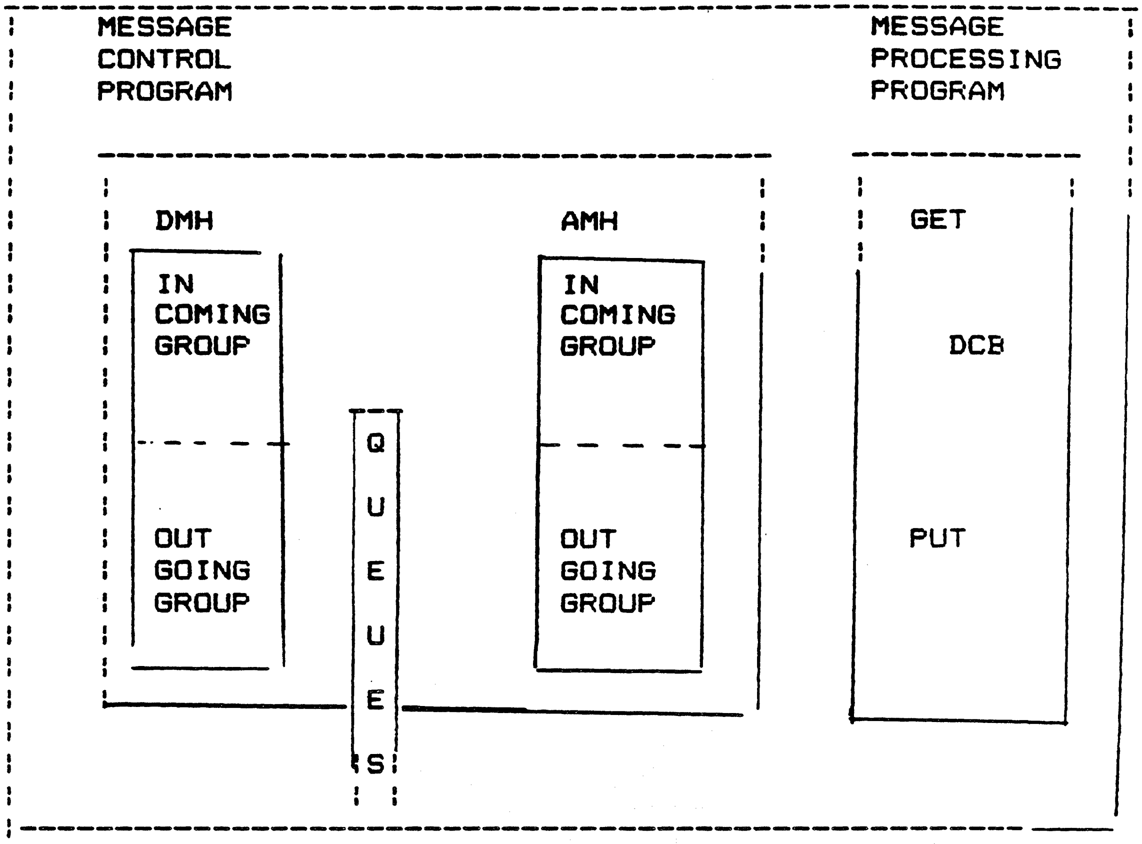
- WITH NETWORK CONTROL PROGRAM
  - SS
  - BSC
  - SNA

- LOCAL ATTACHMENT

ACF/TCAM SOFTWARE COMPONENTS



ACF/TCAM MESSAGE HANDLERS



ACF/TCAM QUEUES

- WHY QUEUE:

  UNPREDICTABLE ARRIVALS

  TEMPORARY CONGESTIONS

- CRITERION FOR COMMON ELEMENTS ON A QUEUE:

  Q BY DESTINATION

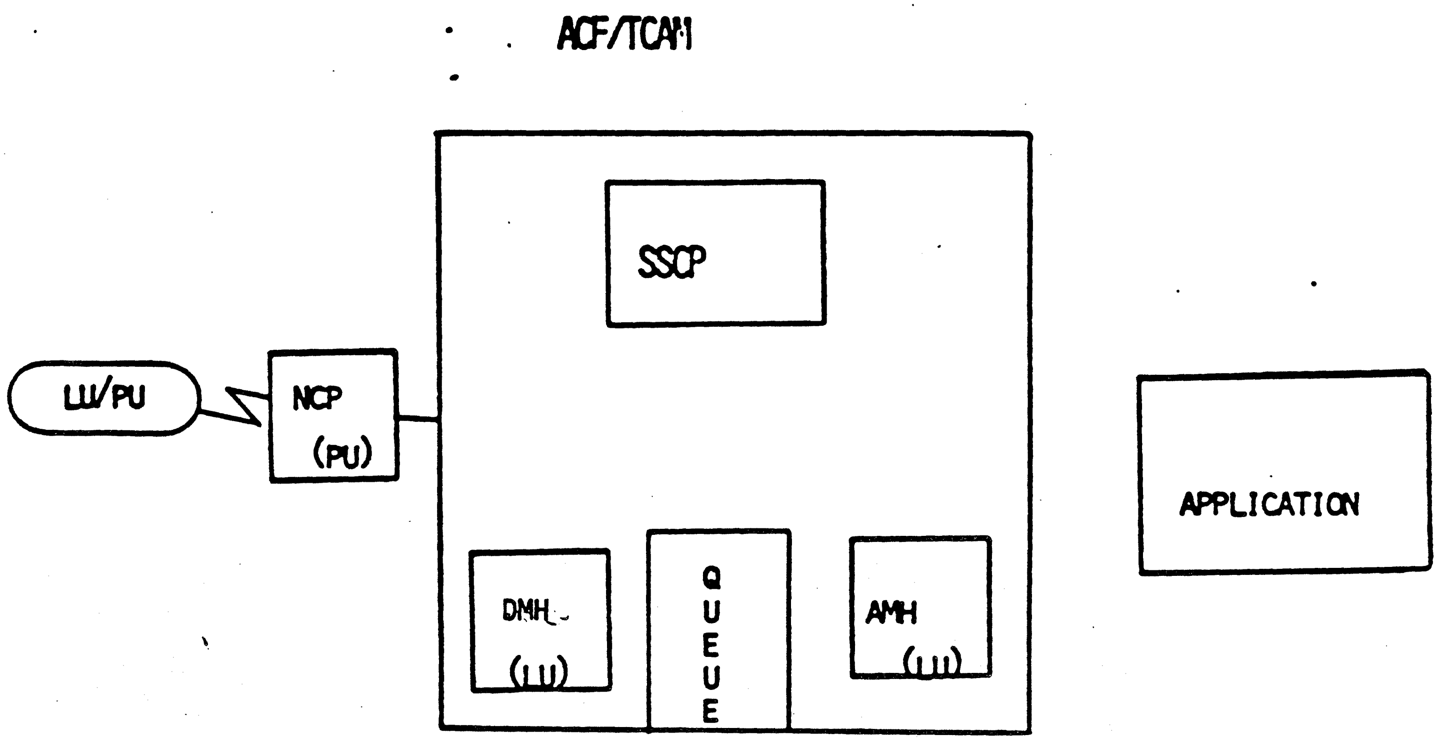
- QUEUING OPTIONS:

  MAIN STORAGE QUEUE

  DISK QUEUE
  NON-REUSABLE
  REUSABLE

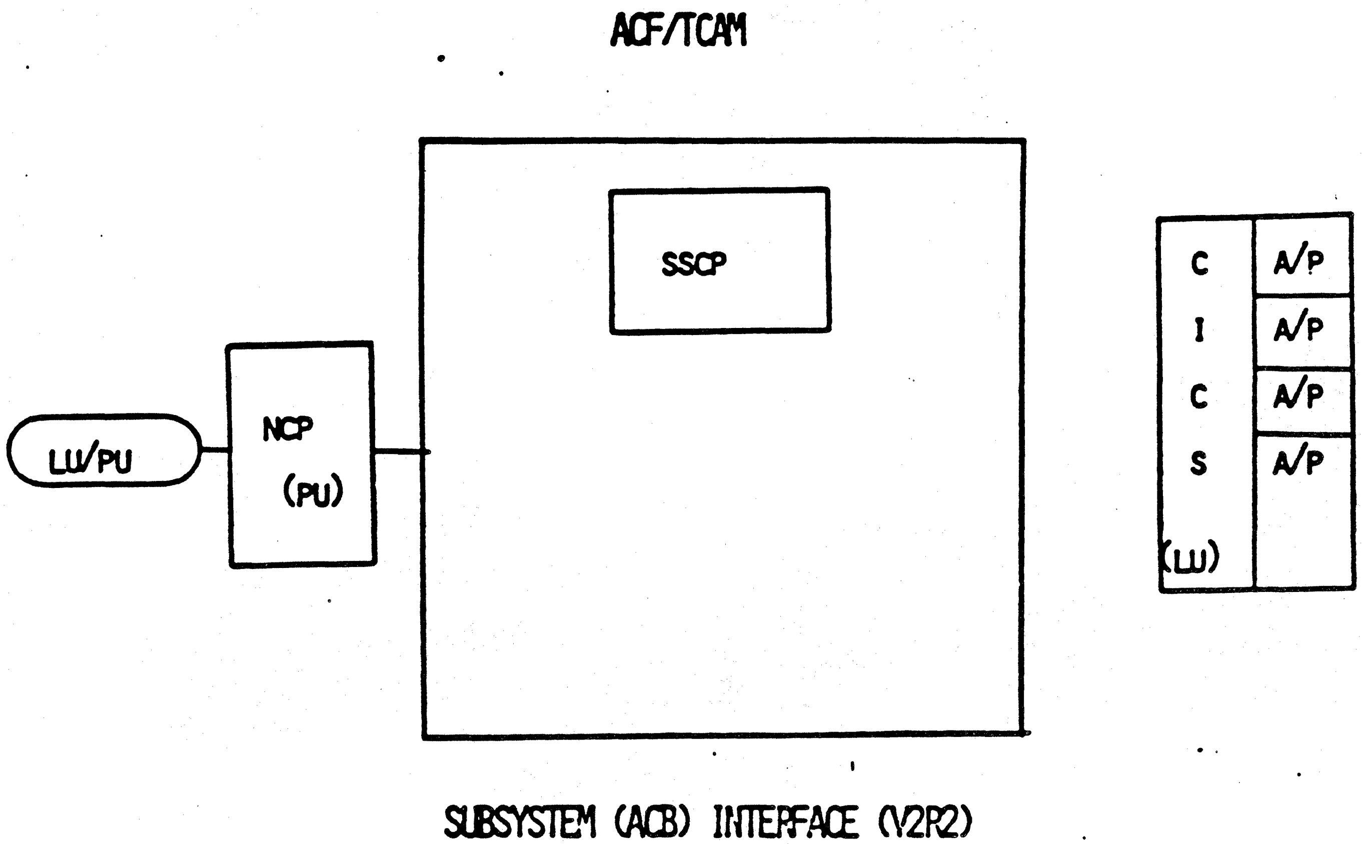
  MAIN STORAGE WITH DISK BACKUP
  NON-REUSABLE AND USABLE

LOGICAL UNITS IN ACF/TCAM - 1



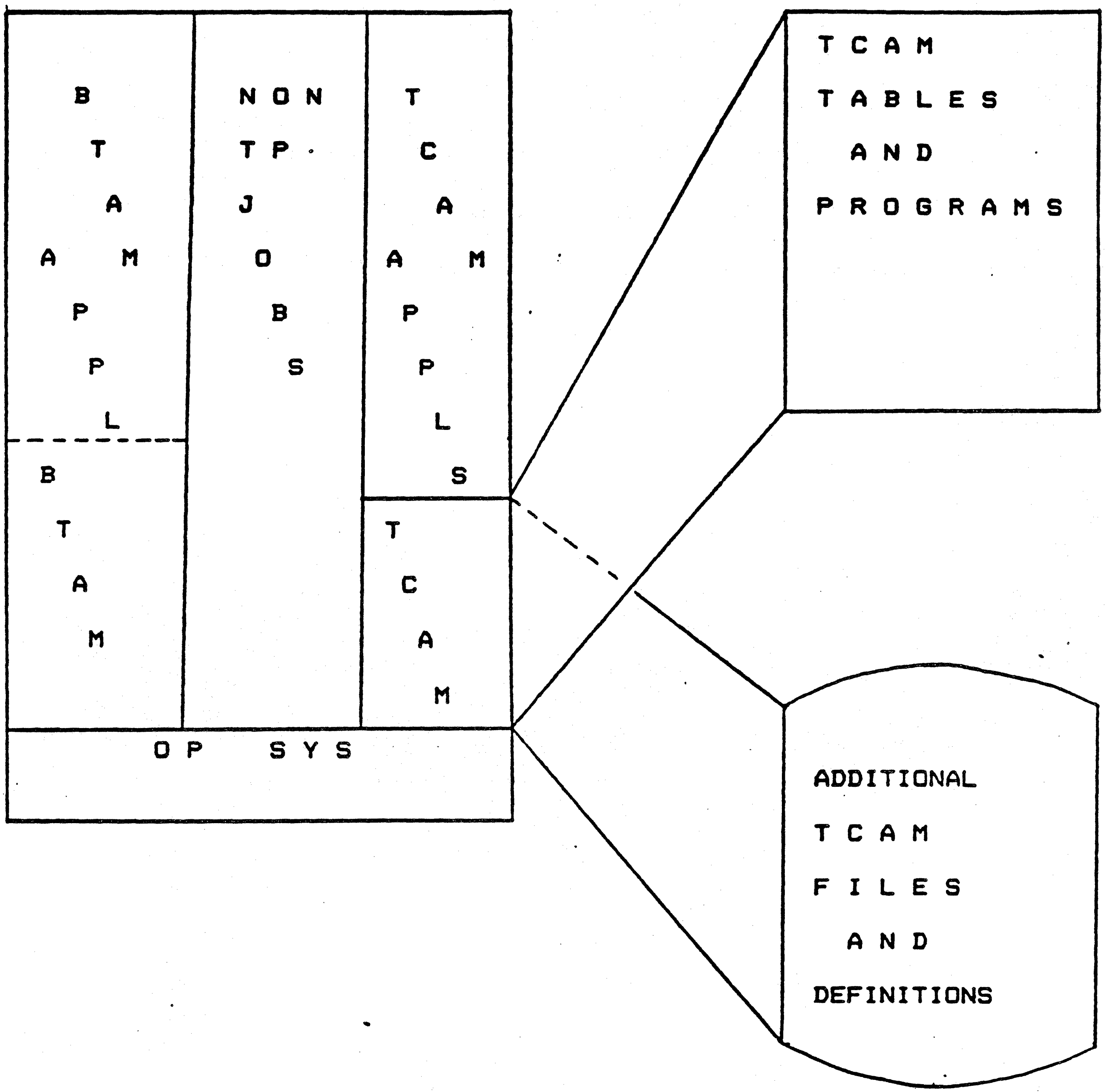
TRADITIONAL (DCB) INTERFACE

LOGICAL UNITS IN ACF/TCAM - II

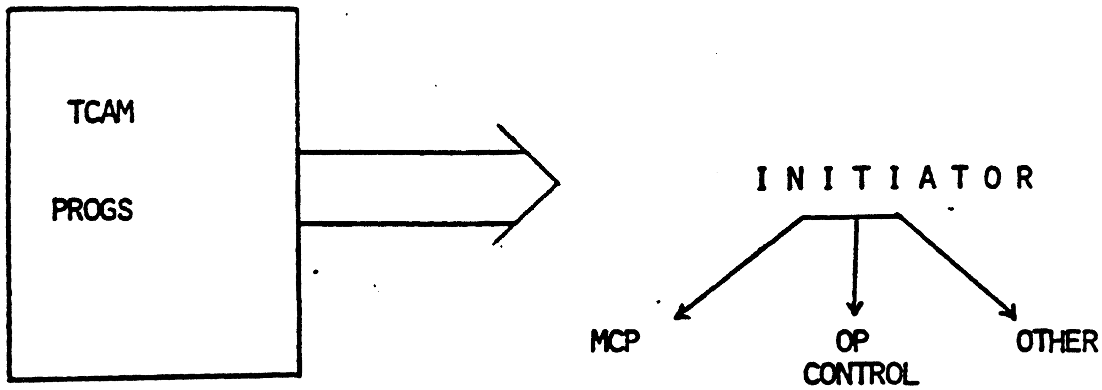


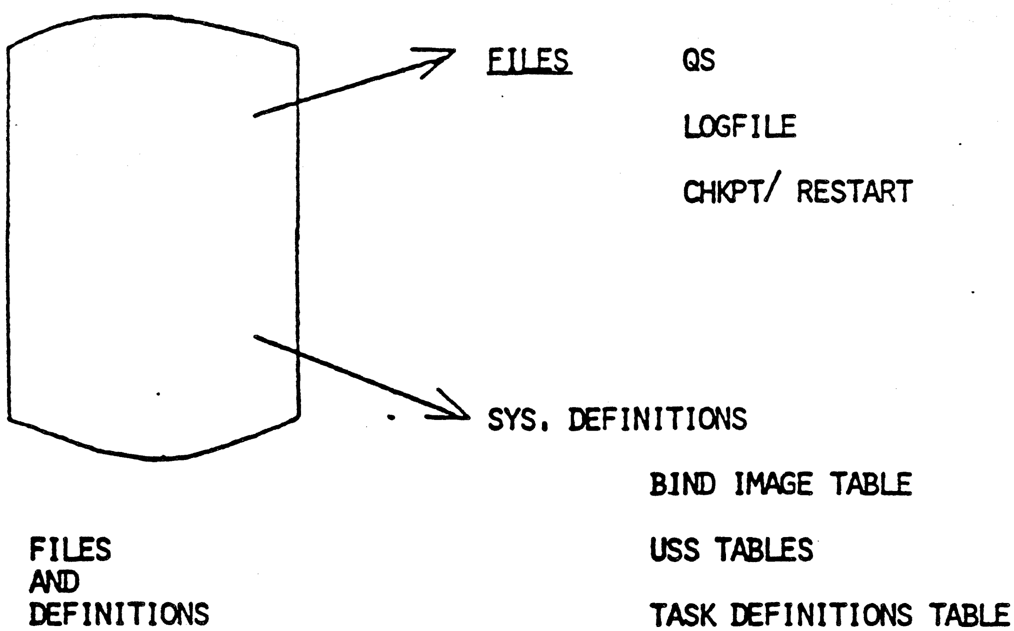
DEFINING A MESSAGE CONTROL PROGRAM

- ACF/TCAM PROVIDED MACROS
- OPTIONAL CUSTOMIZATION WITH ASSEMBLER CODE
- MACROS GENERATE CONTROL PROGRAMMING AND TABLES
- ASSEMBLED AND LINK EDITED AS AUTHORIZED PROGRAM

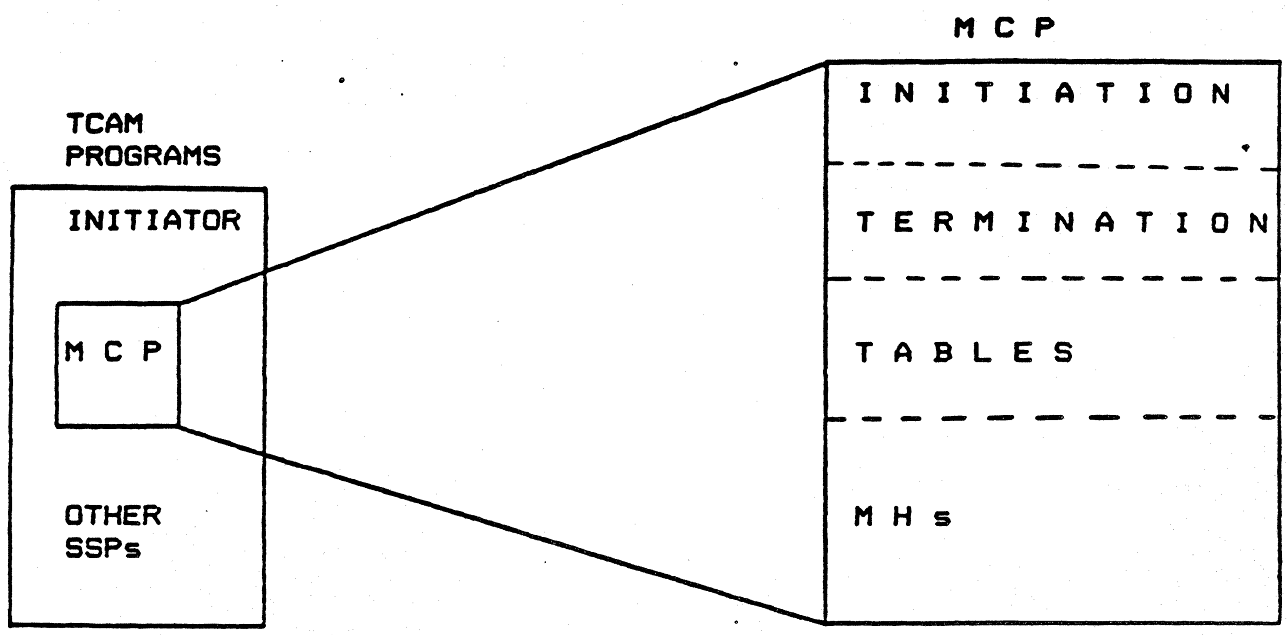


ACF/TCAM AND REST OF THE SYSTEM

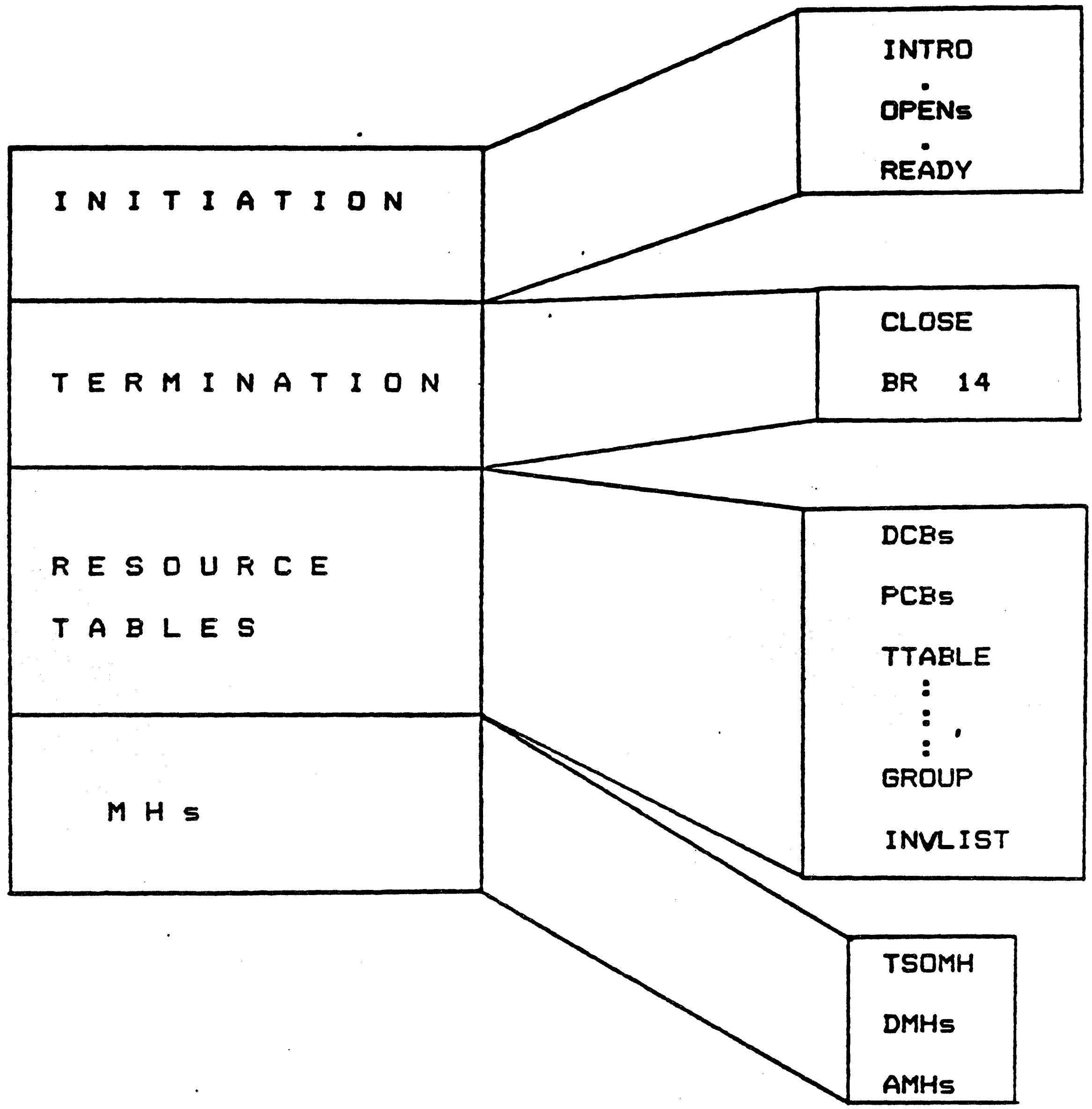




TCAM: PROGRAMS, FILES, DEFINITIONS



TCAM: MCP AND OTHER PROGRAMS



TCAM: MCP STRUCTURE

```
DCB         DSORG=....              ONE/FILE

DCB         DSORG=TX,....           ONE/LINE VIA EP

DCB         DSORG=TR,...            ONE/3705(NCP)

PCB         MH=---,....             ONE/APPLICATION

TTABLE                              BEGIN NETWORK DEFINITIONS

OPTION                              OPTIONAL CTRL, EDIT INFO
  :
  :
  :
GROUP       MH=....                 NON-SNA LINES VIA NCP

TERMINAL    TERM=LINE,...           NON-SNA LINE, ONE/LINE

   |        TERM=327C,GROUP=..      3270 BSC CLUSTER
   |
   |        TERM=327R,GROUP=..      3270 DEVICE
   |
   |        TERM=327C,....          CONTINUE
   |
   v        TERM=327R,....                 EP DEFINITIONS...
   .
   :
   .
GROUP       MH=.....                START SNA DEFINITIONS

TERMINAL    TERM=LINE,...           SNA LINE
   |
   |        TERM=PUNT,...           ONE/PU ON THIS LINE
   |
   v        TERM=LUNT,...           ONE/LU ON THIS PU
   .
   :
   .
TPROCESS    ......                  ONE/APPL MSG Q
   :
   :
INVLIST     ......                  POLLING LISTS (EP)
                                    SWITCHED LISTS
```

TCAM_MCP:_RESOURCE_DEFINITION_TABLES

- ALL DEFINITIONS AS IN SAME DOMAIN RESOURCES ARE IN THE MCP

- TO INDICATE THAT THIS IS AN MSNF ENVIRONMENT MUST CODE FEATURE = NETWORK ON THE INTRO MACRO IN THE MCP

- CROSS DOMAIN RESOURCES MANAGER AND CROSS DOMAIN RESOURCES ARE DEFINED IN THE TERMINAL TABLE IN A MANNER SIMILAR TO THE SAME DOMAIN RESOURCES.

- CROSS DOMAIN DEFINITIONS MUST BE CODED AFTER ALL SAME-DOMAIN DEFINTIONS IN THE TERMINAL TABLE.

- TCAM MAINTAINS A CROSS DOMAIN RESOURCE VECTOR TABLE (CDRVT) FOR CROSS DOMAIN RESOURCES. CDRVT OPERAND ON THE INTRO MACRO SPECIFIE THE NUMBER OF CROSS DOMAIN RESOURCES TO BE SUPPORTED.

- FOR DESCRIBING NETWORK ROUTES TCAM DOES NOT HAVE A PATH MACRO. THE MACRO USED IN THIS CASE IS CALLED IEDRTDEF.

(NOTE: TCAM DOCUMENTATION REFERS TO SECONDARY LOGICAL UNITS AS OUTBOARD LOGICAL UNITS (OBUs))

```
INTRO          .....,FEATURE=NETWORK,....,CDRVT=n,....
  :
  :
S A M E

D O M A I N

D E F I N T T I O N S
  :
  :
TERMINAL     TERM=LINE,...              LINK TO ADJ NCP

TERMINAL     TERM=ANCP,...              ADJACENT NCP

TERMINAL     TERM=CDRM,...              CROSS DOMAIN CDRM

GROUP        .....                      DUMMY  GROUP

TERMINAL     TERM=LINK,...              ONLY IF THIS TCAM..

TERMINAL     TERM=PUNT,....                ..IS BACKUP HOST

TERMINAL     TERM=LUNT,....             CROSS DOMAIN LU

IETRTDEF     ....                       CROSS DOMAIN ROUTE
   .
   :
   :
```

NOTES:

1. DUMMY GROUP MACRO HAS NO EFFECT ON CD LINKS AND PUs. CD LU-LU FLOWS ARE AFFECTED.

2. ALL RESOURCES BELONGING TO THE SAME CROSS DOMAIN MUST FOLLOW BELOW THE TERM=CDRM MACRO FOR THAT DOMAIN.

3. IF BOTH THE PARTICIPATING DOMAINS ARE RUNNING ACF/TCAM, IT IS POSSIBLE TO HAVE PSEUDO CROSS-DOMAIN SESSIONS FOR SNA DEVICES ALSO.

TCAM_CROSS_DOMAIN_DEFINITIONS:_OVERVIEW

MULTIPLE SYSTEMS NETWORKING FACILITY

(M S N F)

OBJECTIVES

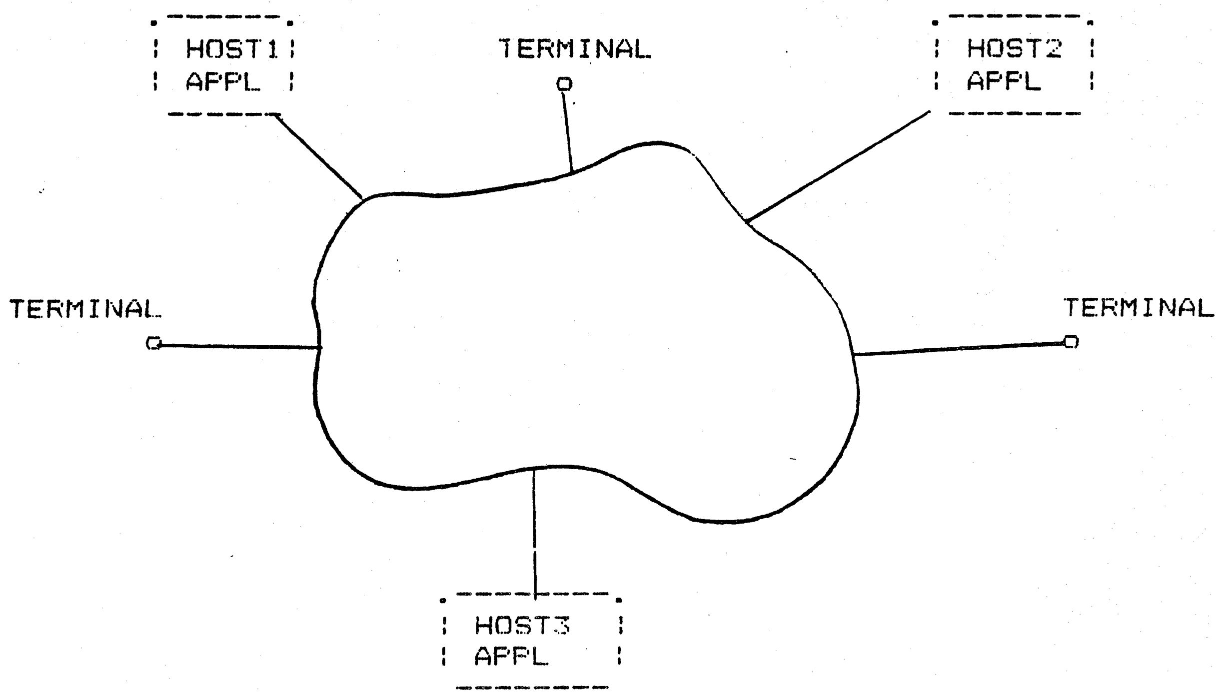
TO DESCRIBE THE FOLLOWING DEFINITIONS NEEDED IN AN MSNF ENVIRONMENT:

1. CROSS DOMAIN RESOURCE MANAGER MAJOR NODE

2. CROSS DOMAIN RESOURCES MAJOR NODE

3. PATH TABLES

MULTIPLE SYSTEMS NETWORKING FACILTY (MSNF): DEFINITION



AN ABILITY TO ACCESS ANY APPLICATION IN ANY HOST FROM ANY TERMINAL AND VICE VERSA USING A COMMON NETWORK

SNA Multiple Systems Networking Facility (MSNF):

MSNF protocols let you connect multiple hosts on a common network. These hosts do not have to have the same operating systems, access methods or control programs (CICS, IMS etc.) so long as each location can support MSNF protocols.

Some of the major resons for MSNF are:

- Resources sharing extended over multiple systems.
- Greater flexibility and possible reductions in network cost.
- Increased availability and reliability.

MSNF: KEY TERMS AND CONCEPTS

- SSCP/DOMAIN/OWNERSHIP
- SUBAREA/ROUTING
- SSCP/CDRM/NON-OWNED RESOURCES

MSNF: Key terms and Concepts

1. SSCP/Domain/Ownership: One of the first questions to be resolved in a multiple host environment is deciding which host is responsible for which part of the network. For this purpose each resource in the network will be "owned" by an SSCP who will be responsible for its management. All resources (lines, PUs, LUs, remote NCPs) owned by the same SSCP constitute the "domain" of that SSCP.

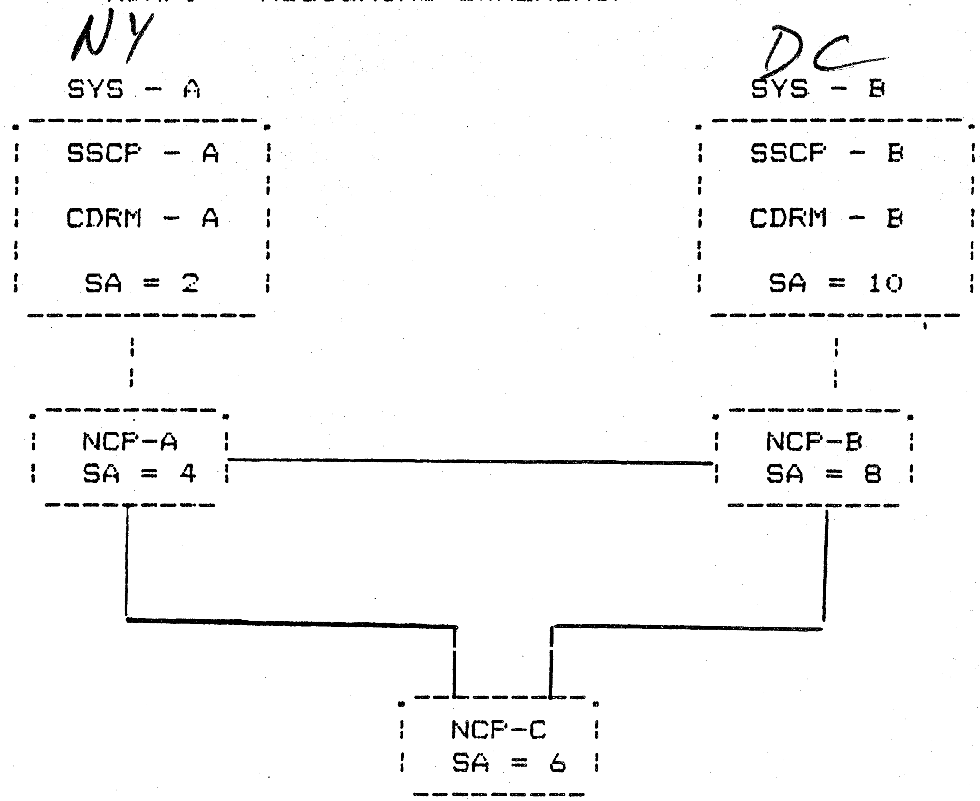
2. Subarea/Routing: To determine routing paths through the network each SSCP and NCP is assigned a unique number called its "subarea" number. Network paths between two end points are then specified via the subarea numbers of the intervening NCPs/SSCPs.

3. SSCP/CDRM/Non-Owned Resources: What about resources that are not owned by a given SSCP?

   First of all, to distinguish them from the owned (i.e. same-domain) resources they are called cross-domain resources.

   To manage communications with cross-domain resources each SSCP has a special component called the Cross Domain Resource Manager (CDRM).

MSNF: ASSIGNING OWNERSHIP



OWNER'S RESPONSIBILTY?

CRITERIA FOR ASSIGNING OWNERSHIP?

IDENTIFYING OWNED AND CROSS-DOMAIN RESOURCES?

MSNF: Assigning Ownership

Implication for owner:

a) All logon requests for resources in this domain will be processed by this SSCP. Once the session initiation is completed, ownership plays no role.

b) Owning SSCP must have the appropriate Logon Mode Table, Bind images and USS Tables needed to process logons for all its resources.

How to assign ownership:

a) Geographical Proximity: Generally, a minor and irrelevant issue in assigning ownership.

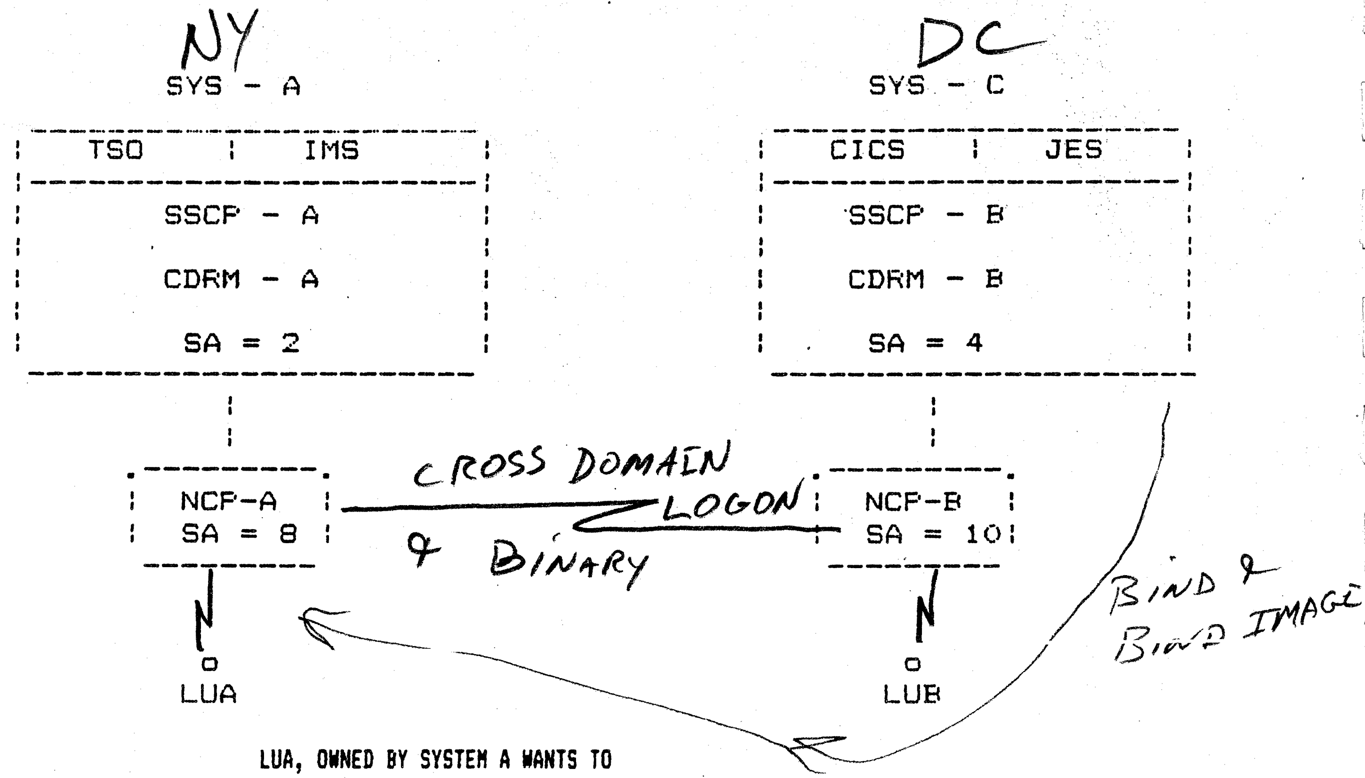
b) Application Considerations: If a terminal is going to be dedicated mostly to one application, its ownership should be assigned to the host containing that application.

c) Operational Considerations: Which location is going to be responsible for tracking trouble reports, requesting maintenance, doing follow-ups, and controlling this part of the network.

d) Authorization Considerations: Not a very common consideration but for sensitive systems, authorization and logon processing could conceivably be assigned to a specific SSCP.

Identifying Resources: Each SSCP contains two tables with descriptions of all the resources. One of the tables contains descriptions of all the owned resources and the other one that of all the cross-domain resources. The latter is known as the Cross Domain Resource Table.

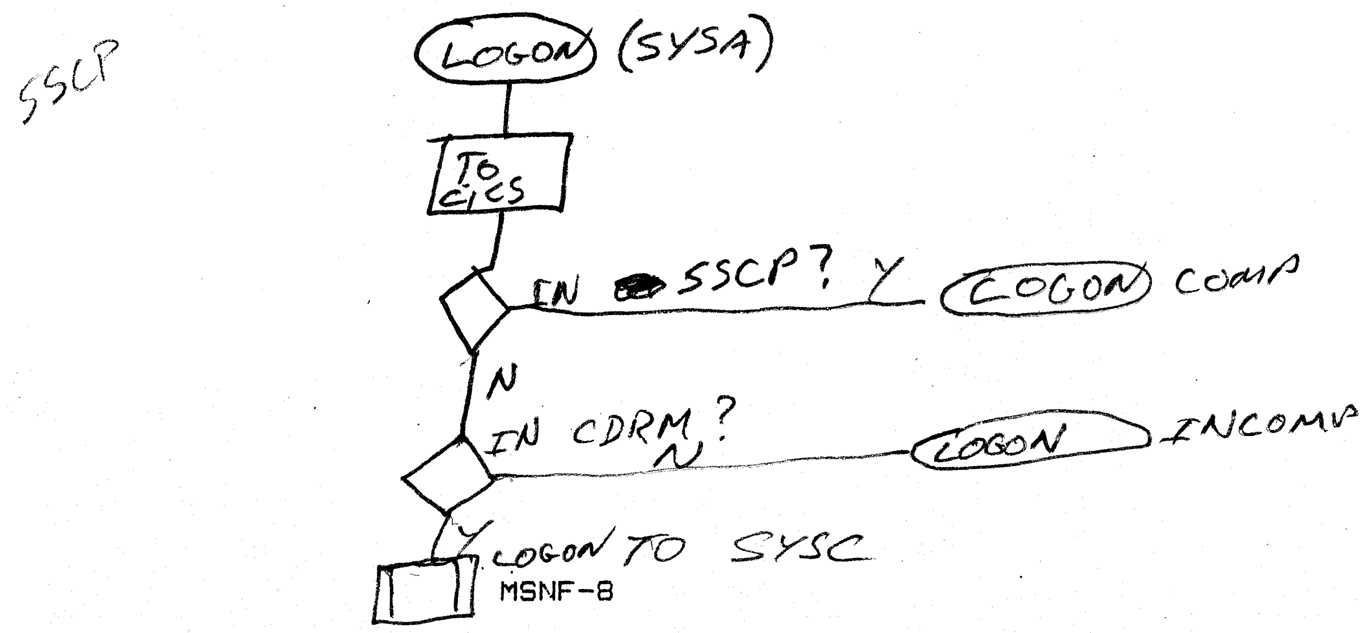
MSNF: CROSS DOMAIN FLOW



LUA, OWNED BY SYSTEM A WANTS TO LOGON TO CICS OWNED BY SYSTEM B

OWNED	CROSS-DOMAIN
TSO	CICS
IMS	JES
LUA	LUB

OWNED	CROSS-DOMAIN
CICS	TSO
JES	IMS
LUB	LUA



Cross-Domain Data Flow

1. NCP, SA=8, receives the logon request for CICS from LU1 and forwards it to the host owning LU1, SYS-A.

2. SSCPA in SYS-A determines that CICS is not a local resource and forwards the logon request to its cross-domain manager, CDRMA.

3. CDRMA goes through the cross-domain resources definitions and determines that CICS is a CD resource.

4. CDRMA sends the SNA command CDCINIT to CDRMC along with BIND image name.

5. CDRMC verifies that LU1 is defined as a CD resource to System C and that CICS is running and accepting logons.

6. When both CDRMs are satisfied of the legitimacy of the request, CICS logon exist is driven. If CICS accepts the logon, it causes the BIND command to flow to LU1.

7. If Lu1 accepts the BIND, the cross-domain session is in place.

8. All communications from now on involve only LU1, NCP (SA8), NCP (SA10), and System C. The cross-domain may continue even if System A goes down. System A is not needed for session termination either.

NETWORK TO BE USED AS AN EXAMPLE FOR MSNF DEFINITIONS

NY	DC	LA
SYS-A	SYS-B	SYS-C
SSCPA CDRMA SA=2 IMS	SSCPB CDRMB SA=4 TSO	SSCPC CDRMC SA=6 CICS
NCPA SA=3	NCPB SA=5	NCPC SA=7
LUA	LUB	LUC

(NCPA ———— NCPB ———— NCPC)

NY

VBUILD TYPE

CDRMA CDRM SUBAREA=2, ELEMENT=1,
CDRMB CDRM " =4, " =1,
CDRMC CDRM " =6, " =1,

Cross Domain names need to be same in all 3 sites

ADDITIONAL DEFINITIONS NEEDED FOR MSNF

1. NAMES OF ALL CROSS-DOMAIN RESOURCE MANAGERS - CDRM MAJOR NODE CDRMA(NY) CDRMB(DC) CDRMC(LA)

2. NAMES OF ALL CROSS-DOMAIN RESOURCES - CROSS-DOMAIN RESOURCES MAJOR NODE

3. DESCRIPTIONS OF CROSS-DOMAIN ROUTES- PATH TABLES.

1.

NY

~~[illegible]~~	TSO
IMS	CICS
LUA	LUB
	LUC

DC

TSO	IMS
LUB	CICS
	LUA
	LUC

LA

CICS	IMS
LUC	TSO
	LUA
	LUB

VBUILD TYPE= [illegible]

TSO CDRM=CDRMB
LUB CDRM=CDRMB
CICS CDRM=CDRMC
LUC CDRM=CDRMC

CDRM MAJOR NODE

(NAME)	VBUILD	TYPE=CDRM
(NAME)	CDRM	SUBAREA=N ELEMENT=I ISTATUS=ACTIVE/INACTIVE

CDRM Major Node

VBUILD:	Begins a major mode
name:	Optional, if defined must be unique, leave blank
TYPE=CDRM:	Identifies it as a CDRM node

CDRM:	Defines a CDRM, need one per CDRM
name:	Required, identifies the CD resource
SUBAREA=	Subarea number of the host SSCP of which this CDRM is a part.
ELEMENT=	Must be 1 for ACF/VTAM or 0 for ACF/TCAM
ISTATUS=	Specifies initial status of this manager as active or inactive.

CDRSC: CROSS DOMAIN RESOURCES MAJOR NODE.

(NAME)	VBUILD	TYPE-CDRSC
(NAME)	CDRSC	CDRM=CDRM NAME
		ISTATUS=ACTIVE/INACTIVE

Cross Domain Resources Major Node:

VBUILD:

name: Not needed, do not code, if coded must be unique.

TYPE=CDRSC: Identifies the begining of the cross-domain resources major node.

CDRSC: Defines a cross-domain resource, need one per CD resource.

name: Required, must be the network name of the LU.

CDRM: Name of the CDRM in the host that owns this cross-domain resource.

ISTATUS Initial status ACTIVE/INACTIVE.

PATH TABLES: DEFINING ROUTING INFORMATION (PRE-REL. 3)

- CODED IN EACH VTAM AND EACH NCP
- TABLES DIFFERENT IN EACH NODE
- FOR EACH DESTINATION, PATH TABLES IDENTIFY THE NEXT NODE IN THE PATH
- MULTIPLE TABLES MAY BE NEEDED TO COVER ALL DESTINATIONS

TWO DEFINITIONS:

ADJACENT NODE: A NODE NO MORE THAN ONE LINK AWAY

DESTINATION NODE: ANY NODE WHICH IS NOT AN ADJACENT

```
PATH01     PATH       ADJSUB=n,DESTSUB=(x,y,...)
```

Path Tables: as mentioned earlier, Path Tables are used to describe the route for PIUs between two end points.

Path Tables are defined separately in ACF/VTAM and ACF/NCP using the PATH macro. Though the contents of entries differ on the PATH macro between VTAM and NCP the format of the macro used is exactly the same as follows:

PATH: Name of the macro to describe a path.

PATH01: System designer provided name for this path. Eight (8) character name using standard System 370 assembler conventions. Name must be coded on the PATH macro.

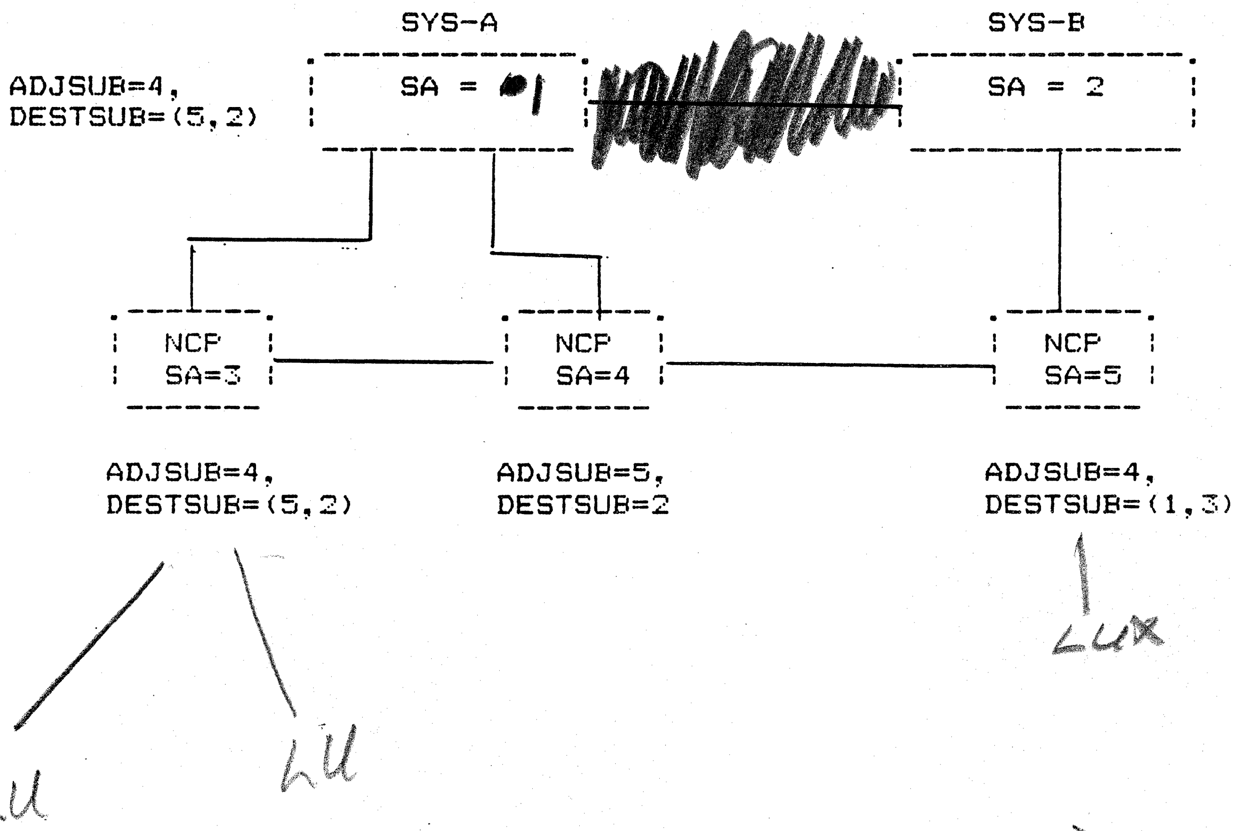
ADJSUB and DESTSUB: In the node in which this statement is coded, deliver all messages for destinations, DESTSUB, with subareas (x,y,---) to the subarea "n", ADJSUB, as the next node in this path.

Or in other words, deliver all PIUs for destination subareas (x,y,---) to subarea 'n'. Subarea 'n', in turn, through its own PATH statements would determine where to put the PIU next.

In the example shown, all PIUs destined for subareas 2, 4, and 8 will be delivered by this node to an adjacent node with subarea number 18. Subarea 18 node will know what to do with this PIU next.

It might be worthwhile to recollect that destination subarea of a PIU is specified in the TH as part of destination network address.

PATH DEFINITION: EXAMPLE (PRE-REL 3)



PQ1 PATH ADJSUB=4, DESTSUB=(5,2)

Path Definition Example:

Shown in this diagram are examples of PATH statements. Before looking at specific examples, here are additional considerations to be aware of in designing PATH STATEMENTS:

1. Each destination subarea must be covered in some PATH statement.

2. Path statements must use the most direct (shortest) path.

3. Adjacent subareas must not be coded as destinations. (Every one knows who their adjacents are)

Path statement for system A:

```
P01        PATH        ADJSUB=4,DESTSUB=(5,2)
```

means that this host should deliver all messages for subarea 5 or subarea 2 to subarea 4 and subarea 4 would know what to do with it.

Other statements can be interpreted in a similar manner.

P01 PATH ADJSUB=4, DESTSUB=(5,2)

P02 PATH ADJSUB=

UNIT 11

ACCESS METHODS REVIEW, NTO, AND NETWORK MANAGEMENT

OBJECTIVES:

TO COMPARE AND CONTRAST VARIOUS ACCESS METHODS DISCUSSED IN THIS COURSE

TO DESCRIBE NON-SNA DEVICE SUPPORT THROUGH THE USE OF NETWORK TERMINAL OPTION (NTO)

TO PROVIDE OVERVIEW OF COMMUNICATION NETWORK MANAGEMENT (CNM) PRODUCTS:

- NETWORK COMMUNICATIONS CONTROL FACILITY (NCCF)
- NTEWORK PROBLEM DETERMINATION APPLICATION (NPDA)

1. EXTRA COST SOFTWARE PACKAGE TO EXTEND NCP CAPABILITIES TO SUPPORT CERTAIN NON-SNA DEVICES.

2. RUNS WITH NCP IN LOCAL 3705.

3. MAKES THE FOLLOWING DEVICES LOOK LIKE SNA DEVICES TO HOST:

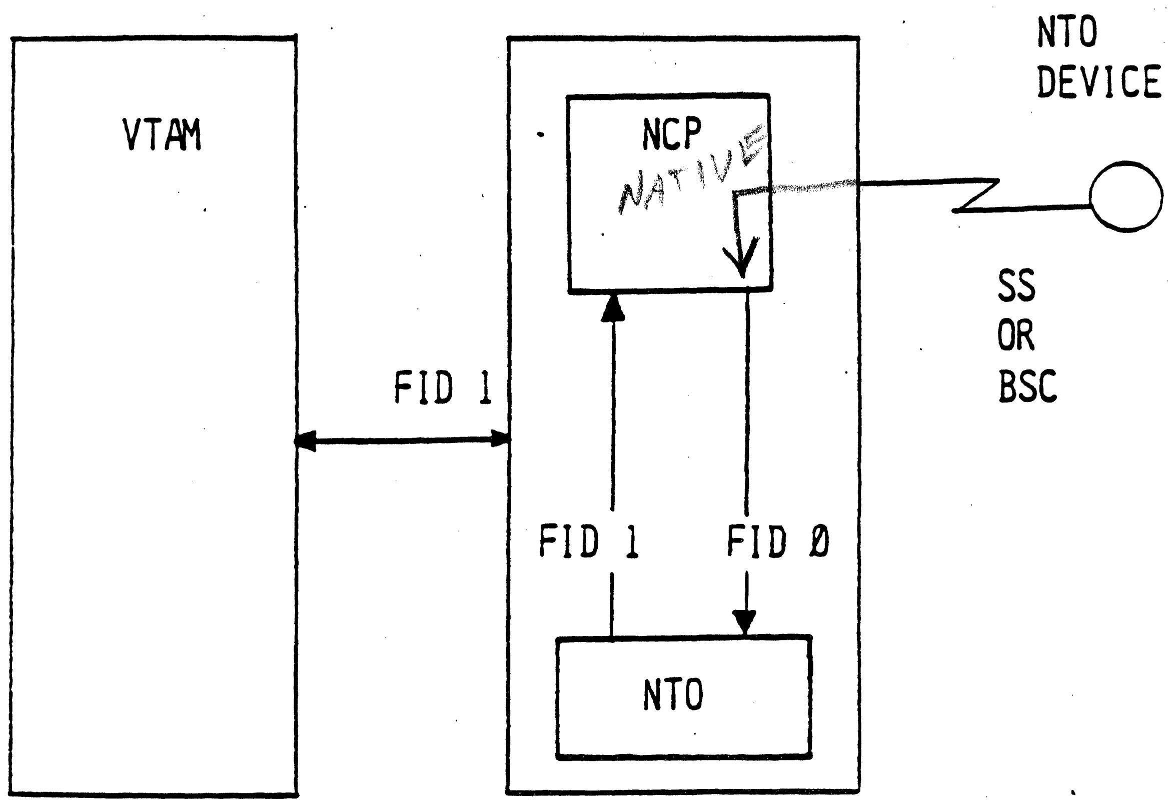
   IBM 2740/2741
   IBM 3780
   IBM 1750 AND 3750 (PBXs)
   TWX 33/35

4. NO AUTO CALL OPERATIONS.

5. DEVICES SUPPORTED THROUGH NTO ARE ALSO CALLED NTO DEVICES.

6. NTO MAKES THESE DEVICES LOOK LIKE A PU.T1, LU SESSION TYPE 1 SUCH AS IBM 3767.

NETWORK TERMINAL OPTION (NTO): INTRODUCTION



1. NTO DEIVCE SENDS NATIVE MODE (BSC/SS) DATA TO NCP.

2. NCP CONVERTS IT TO A FID Ø FORMAT AND SENDS IT TO NTO.

3. NTO CONVERTS FID Ø FORMAT DATA TO FID 1 FORMAT.

4. NCP SENDS FID 1 DATA TO THE HOST.

(HOST TO NETWORK: HOST SENDS FID 1 DATA, NTO CONVERTS IT TO FID Ø, NCP CONVERTS FID Ø TO NATIVE MODE).

NOTES: I) NTO APPEARS AS AN SSCP WITH ITS OWN NETWORK ADDRESS.

II) USS TABLES MUST BE DEFINED TO REMOVE CONTROL CHARACTERS SUCH AS TABS, BACKSPACE, ETC.

NTO: OVERVIEW OF OPERATION

1. EXTRA COST SOFTWARE PACKAGES FOR USE IN SNA ENVIRONMENT

2. EACH RUNS AS AN <u>APPLICATION</u> IN THE HOST COMPUTER (LU)

3. NPDA CAN NOT BE USED WITHOUT NCCF

NCCF/NPDA: INTRODUCTION

COMMUNICATION NETWORK MANAGEMENT (CNM)

1. CNM - A TERM OFTEN USED TO REFER TO NCCF/NPDA AS A GROUP

2. A GENERIC TERM, NOT A PRODUCT

3. IBM USES THE TERM TO REFER TO A "SYSTEMATIC METHODOLOGY TO OPERATE AND MANAGE A COMPLEX NETWORK"

4. PRESENTLY, ONE WAY TO IMPLEMENT CNM CAPABILITIES IS BY USING NCCF/NPDA

5. TIED INTO IBM PRODUCTS SUCH AS THEIR "SMART" MODEMS AND CLUSTER CONTROLLERS

6. PRACTICALLY, MANDATORY IN AN MSNF OR OTHERWISE COMPLEX NETWORK

1960s

SIMPLE SYSTEMS, NO NETWORK MANAGEMENT TOOLS IN BTAM, COMPLETELY USER RESPONSIBILITY

EARLY 70s

1. CICS AND OTHER MONITORS WITH MASTER TERMINAL CAPABILITY, LIMITED TO NETWORK OWNED BY THE MONITOR

2. TCAM TAKES NETWORK MANAGEMENT OUT OF APPLICATIONS, WITH TCS EXTENDED CONTROL OVER MULTIPLE HOSTS, EACH HOST MUST HAVE TCS.

1974

VTAM HAS NETWORK CONTROL AS AN INTERGRAL PART OF SSCP, 1977 TCAM ALSO GAINS SSCP CAPABILITY

1976

NOSP, FIRST PACKAGE FOR NETWORK MANAGEMENT OUTSIDE ACCESS METHOD (VTAM ONLY)

1978

NCCF, ENRICHED NOSP, FOR BOTH TCAM AND VTAM. NPDA REPLACES FERS (CICS) AND DEMF (CICS AND IMS) AS ONE INTEGRATED PACKAGE

IBM CNM: HISTORIC EVOLUTION

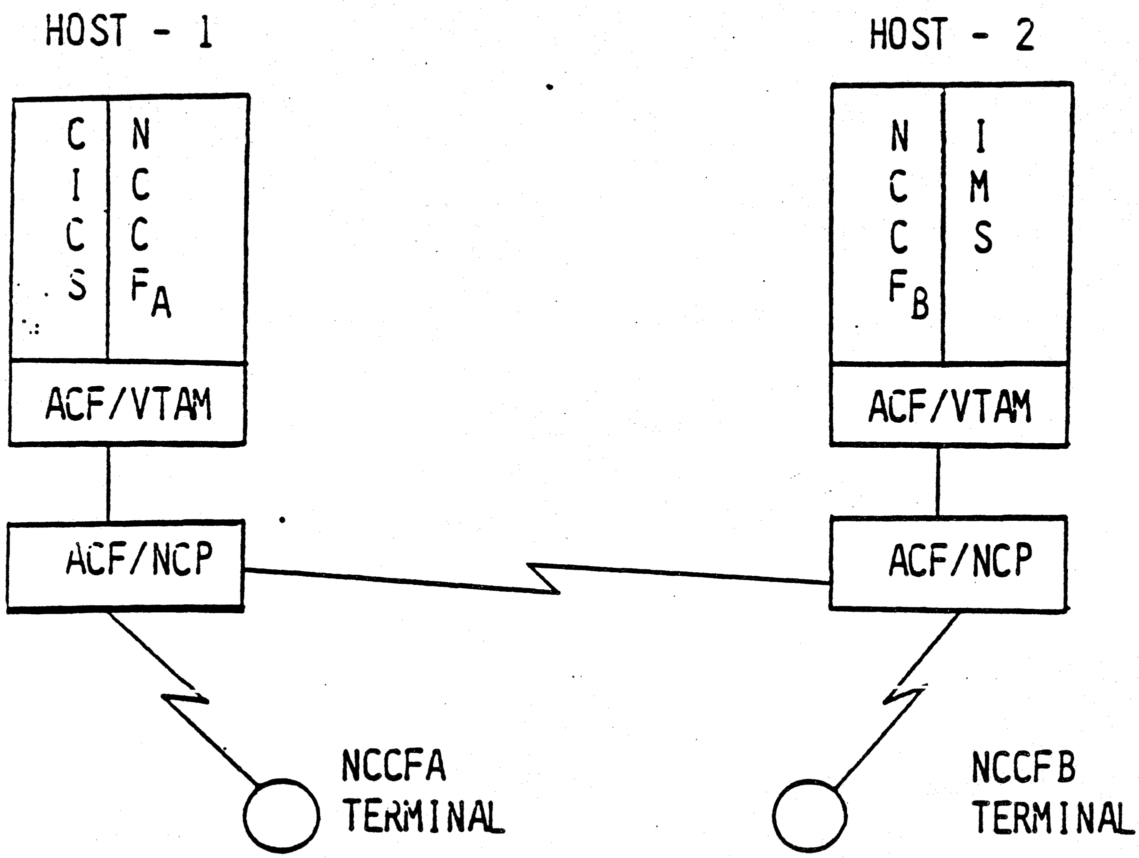
NCCF

1. NETWORK MASTER-TERMINAL FUNCTIONS
2. IBM PROVIDED COMMANDS/USER ENHANCEMENT
3. INTERROGATE/CHANGE STATUS OF NETWORK RESOURCES
4. SUBMIT CROSS DOMAIN COMMANDS TO NCCFS IN OTHER DOMAINS

NPDA

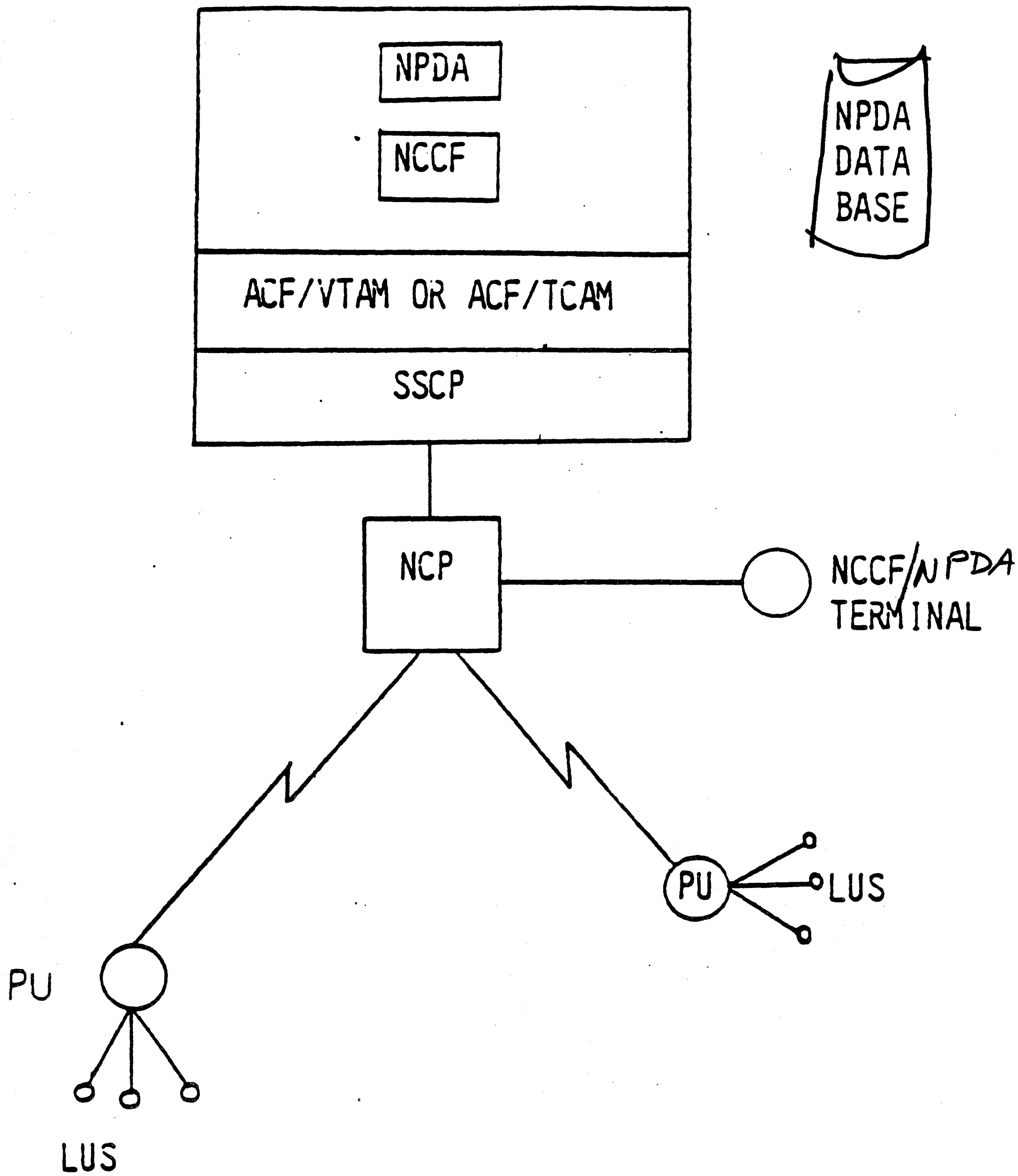
1. RUNS UNDER CONTROL OF NCCF
2. COLLECTS NETWORK ERROR STATISTICS ON A DATA BASE
3. IDENTIFIES NETWORK ERRORS. SUGGESTS CORRECTIVE ACTIONS
4. DISPLAYS ERROR/DIAGNOSTIC INFORMATION.
5. AN OPERATOR CAN INVOKE NPDA FUNCTIONS FROM AN NCCF TERMINAL

NCCF/NPDA: WHAT THEY DO (OVERVIEW)

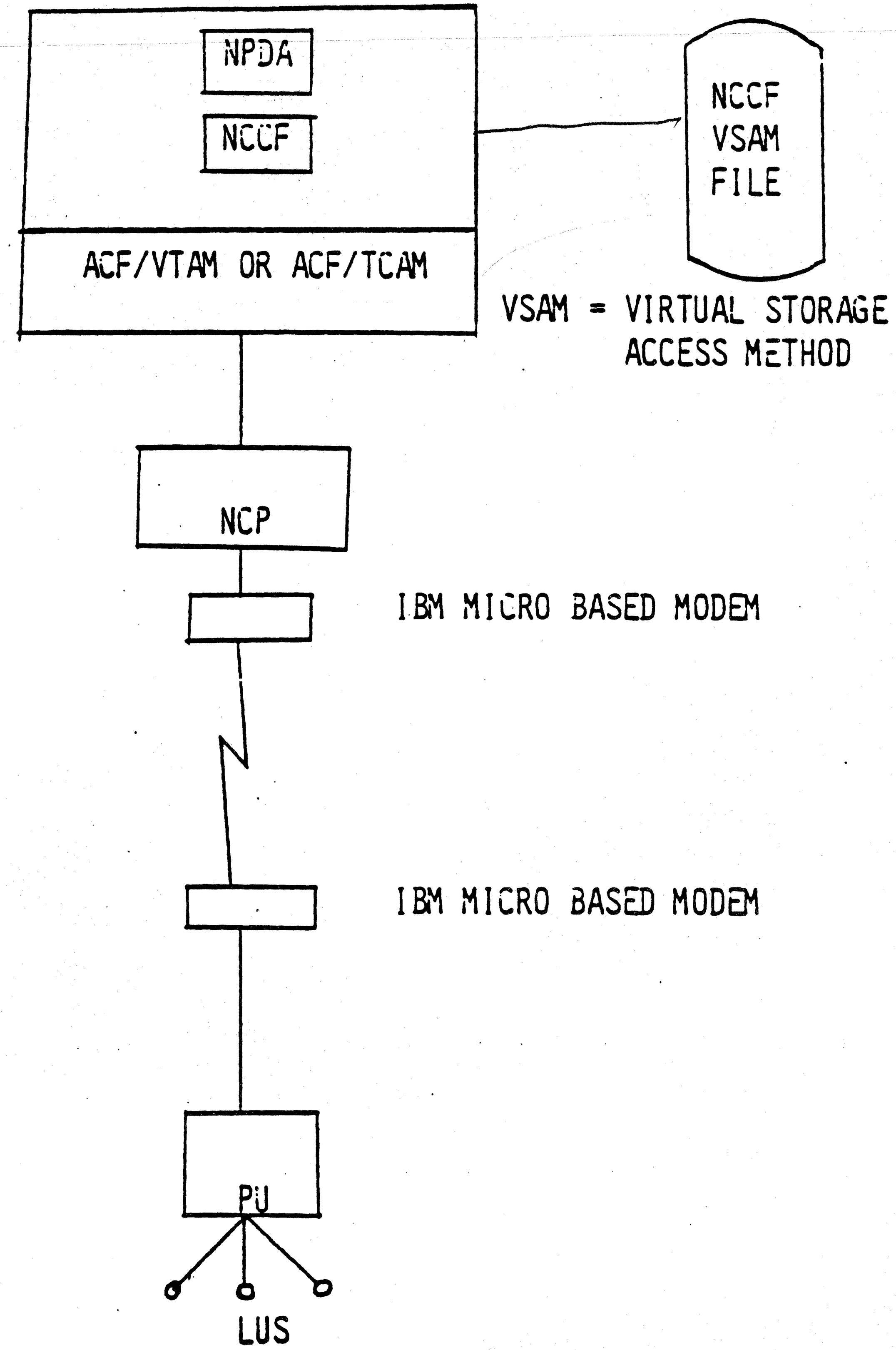


ONLY WAY TO MANAGE OR INTERROGATE CROSS DOMAIN RESOURCES IS THROUGH NCCF

MSNF AND NCCF: CROSS DOMAIN COMMANDS



NCCF/NPDA: OPERATIONAL OVERVIEW



NPDA: ERROR STATISTICS

370X

- CHANNEL ADAPTER ERRORS
- SCANNER ERRORS
- INSTRUCTION EXCEPTION (PROGRAM CHECKS)
- MISCELLANEOUS INTERRUPTS
  - (NEED 370X REFS FOR INTERPRETATION)

LINK LEVEL

- MODEM INTERFACE (E.G. DSR CHECK, DSR NOT UP WITHIN 3 SECS OF DTR)
- HIT COUNT
- LINK QUALITY (PHASE JITTER ETC.)
- NUMBER OF TIMES CARRIER COST

DEVICE (PU) LEVEL

?

DEPENDS UPON DEVICE?

EXAMPLES OF TYPES OF ERROR INFORMATION CAPTURED BY NPDA

1. POWER ON LOCAL/REMOTE MODEM
2. INCORRECT NCPGEN, CORRECT IT (REPLY TO INCORRECT)
3. RUN LINK TEST
4. RUN LINE TRACE

ETC.

EXAMPLES OF ACTIONS THAT NPDA MAY SUGGEST

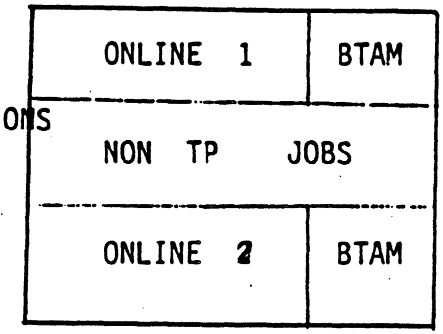
ACCESS METHODS

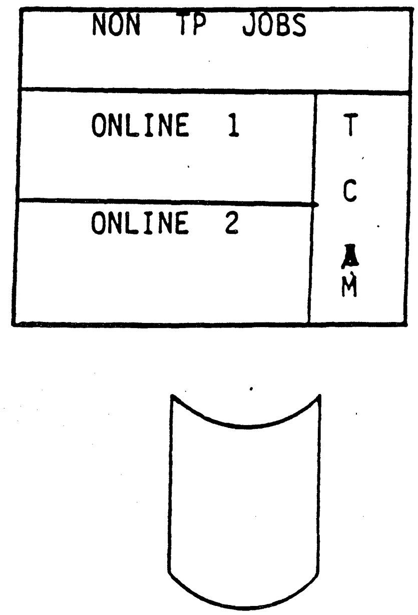
AND

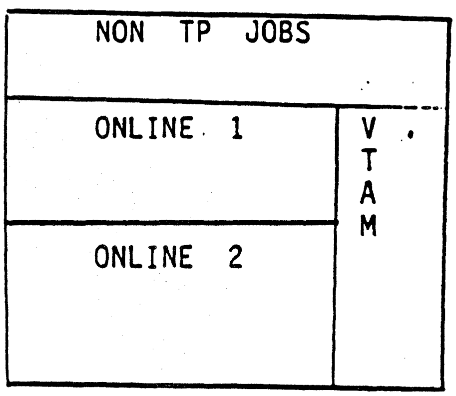
DEVICE SUPPORT SUMMARY

BTAM

1. PART OF APPLICATION
2. AS MANY BTAMs AS APPLICATIONS
3. SEPERATE NETWORK FOR EACH APPLICATION







VTAM

1. VTAM RUNS AS SEPERATE JOB
2. ONLY ONE VTAM IS NECESSARY
3. APPLICATIONS SHARE NETWORK
4. AVAILABLE BOTH WITH OS AND DOS

TCAM

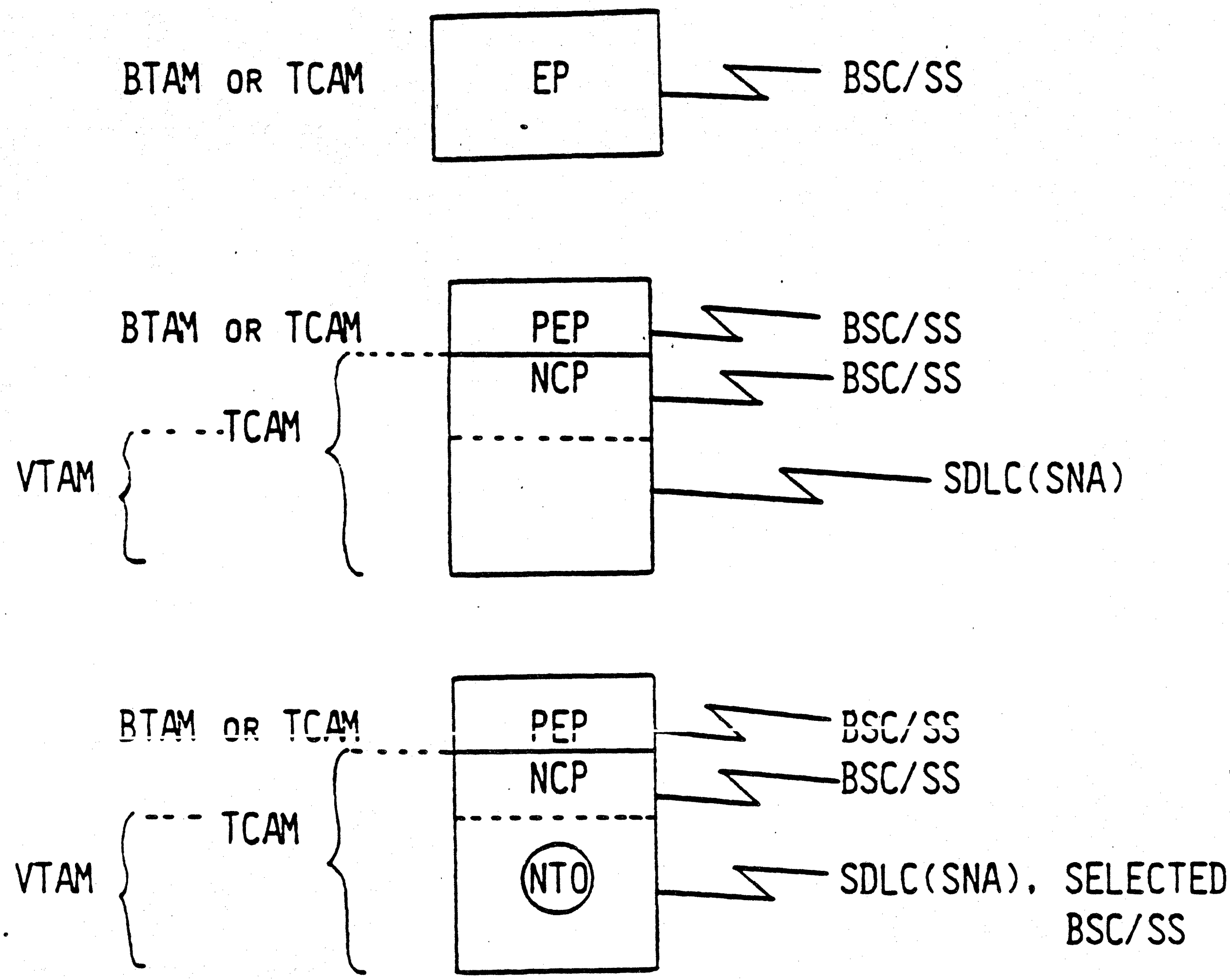
1. TCAM RUNS AS A SEPERATE JOB
2. ONLY ONE TCAM IS NECESSARY
3. APPLICATIONS SHARE NETWORK
4. AVAILABLE WITH OS ONLY
5. APPLICATIONS VIEW NETWORK AS SEQUENTIAL FILE AND USE TCAM Qs

	LINK PROTOCOLS	ERROR RECOV	DIAG. CAP	MULTIPLE HOST	QUEUING	MSG SW.	RECOVERY
BTAM	BSC SS	IN HOST	SIMPLE	NO	NO	NO	NONE
TCAM	BSC SS SDLC	IN HOST (EP) IN 3705 (NCP) - MORE EXTENSIVE	EXTENSIVE	YES	YES	YES	QS AND NETWORK
VTAM	SDLC IBM 3270	IN NCP - MORE EXTENSIVE	EXTENSIVE	YES	NO	NO	NETWORK

FUNCTIONAL COMPARISON - 1

	RESOURCE SHARING	FUNC DISTR.	OPERATOR COMMANDS	TUNING	PERFORMANCE	SYSGEN INSTLL.	STORAGE
BTAM	MINIMAL	NONE	NONE	EASY	VERY GOOD	VERY SIMPLE	>50 K
TCAM	EXTENSIVE	YES	YES	VERY COMPLEX	MOST OVERHEAD	MOST COMPLEX	3/4 MEG
VTAM	EXTENSIVE	YES	YES	COMPLEX	HIGH OVERHEAD	VERY COMPLEX	1/2 MEG

FUNCTIONAL COMPARISON - 2



IBM DEVICE SUPPORT SUMMARY

1. LARGE NUMBER OF PERMUTATIONS/COMBINATIONS

2. ALL MAJOR TERMINAL PRODUCTS SUPPORTED IN ALL ENVIRONMENTS

3. THERE IS LIFE BEYOND IBM, "THINK" ALTERNATIVES:

   - COMTEN
   - CCI
   - OTHERS

DEVICE SUPPORT: SUMMARY AND CONCLUSIONS

SNA AND TELEPROCESSING ACCESS METHODS

TOPICS DICUSSED

PRE-SNA:

3270 Polling

BTAM
EP
TP MONITORS
  CICS
  IMS

SNA:

ACF/VTAM
~~ACF/TCAM~~
ACF/NCP
  NTO
MSNF
NCCF
NPDA

LARGE AMOUNT OF INFORMATION, FAIRLY COMPLEX

A GOOD STARTING POINT FOR MORE IN DEPTH STUDY OF TOPICS INVOLVED

'SAFE JOURNEY HOME'

E N D P A G E: B R 1 4