I N T R O D U C T I O N

T O

V M / 3 7 0

JULY 7 - 8, 1975

INTRODUCTION TO VM/370

JULY 7 AND 8

I. INTRODUCTION OF COURSE AND STAFF

II. GENERAL DESCRIPTION OF VM/370

III. VIRTUAL MACHINE DESCRIPTION

IV. CP FACILITIES

V. CMS FACILITIES

VI. CP IMPLEMENTATION

VII. VM/370 RESTRICTIONS

VIII. PERFORMANCE TOOLS

IX. SYSTEM INTEGRITY

X. DEMONSTRATION

TEXTS:

- CMS Primer (SR20-4438)
- VM/370 Introduction (GC20-1800)
- Command Language Guide for General Users (GC20-1804)
- VM/370 Edit Guide (GC20-1805)

PREREQUISITES:

- General knowledge of virtual systems
- Read CMS Primer, Chapters I, II, III, VII, IX
- Read VM/370 Introduction
- Familiarity with:

  IBM System/370 Principles of Operation (GA22-7000)

GENERAL

DESCRIPTION

Virtual Machine Facility/370 (VM/370) Library

(Release 2 PLC 11)

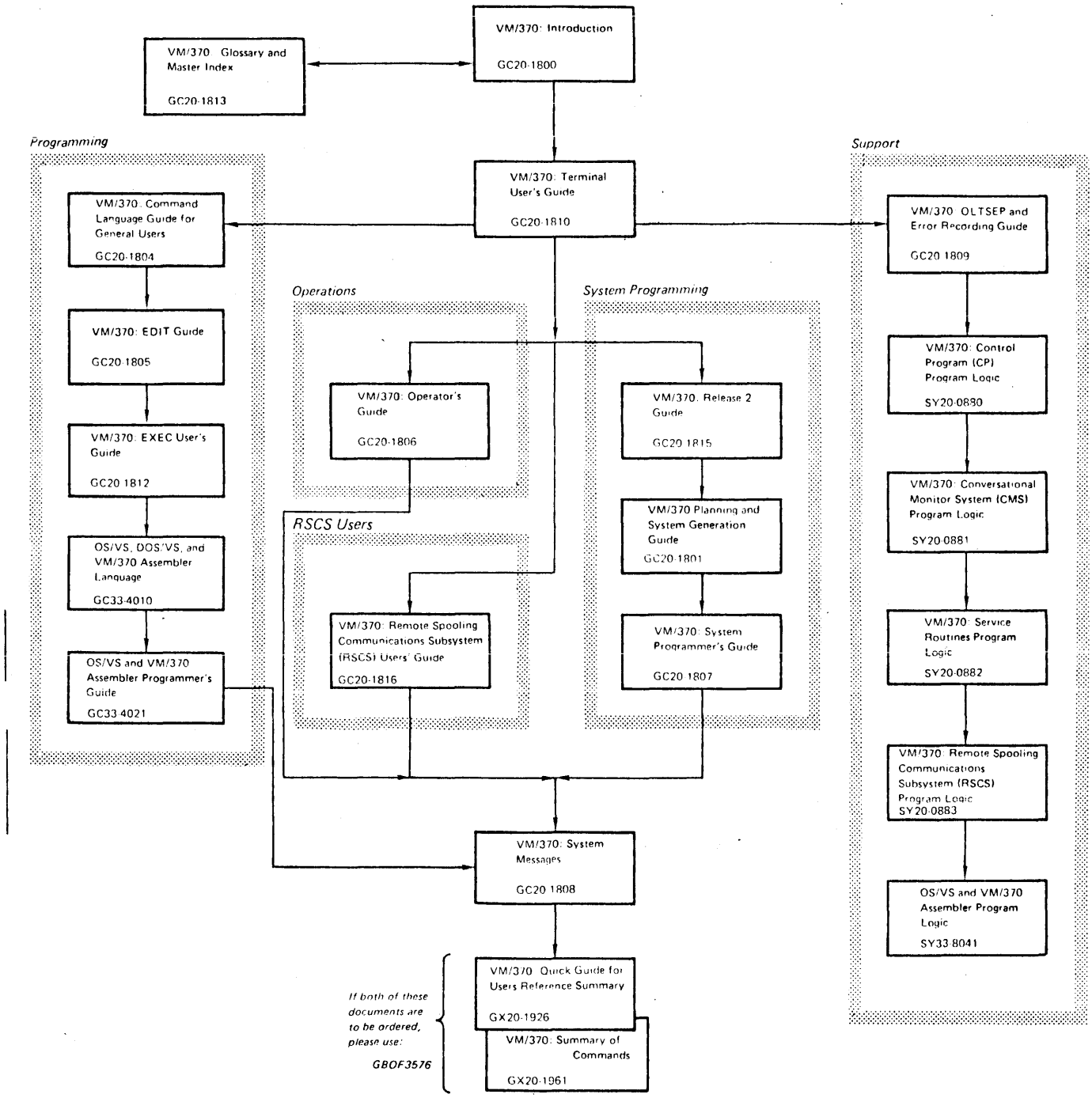


Figure 1. Virtual Machine Facility/370 Library

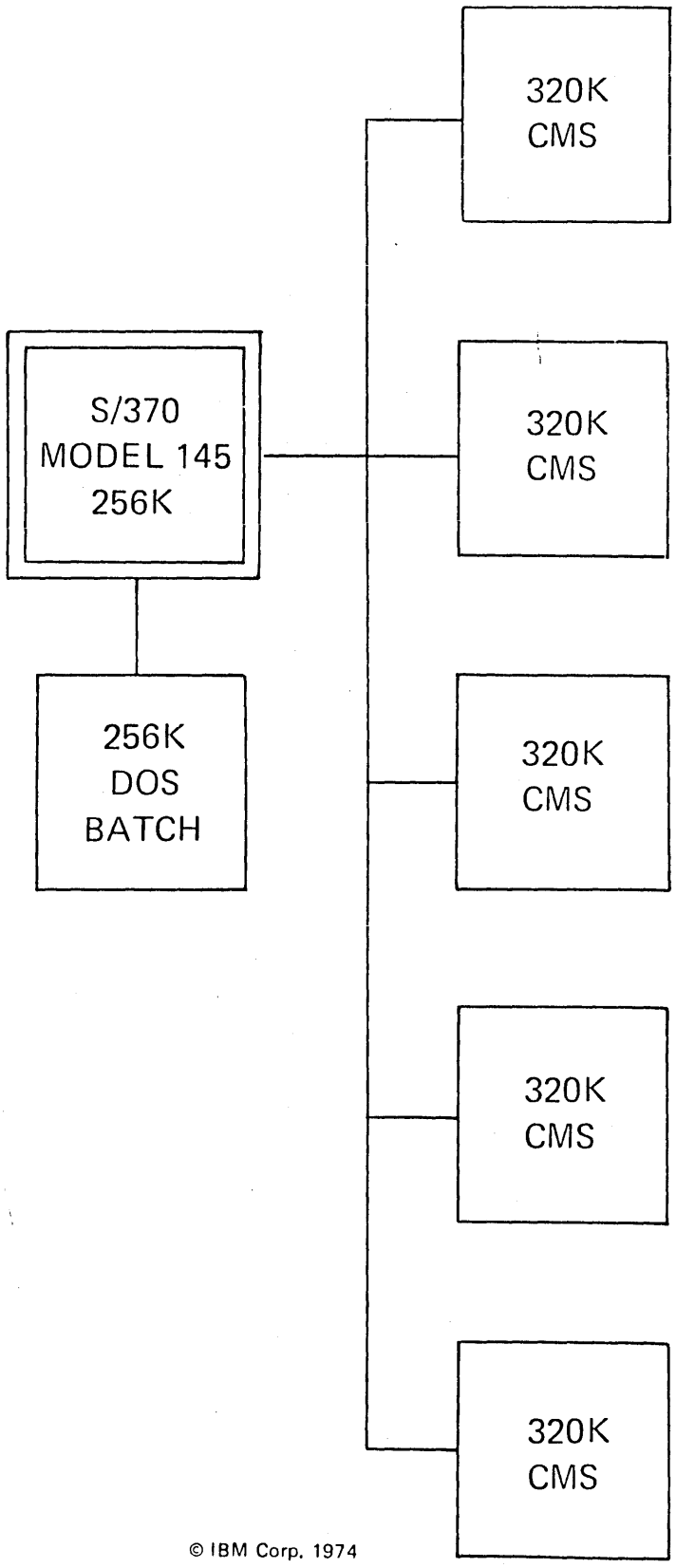
VM/370 SYSTEM CONTROL PROGRAM

- CP CONTROL PROGRAM
- CMS TIME SHARING SUBSYSTEM
- RSCS REMOTE SPOOLING SUBSYSTEM

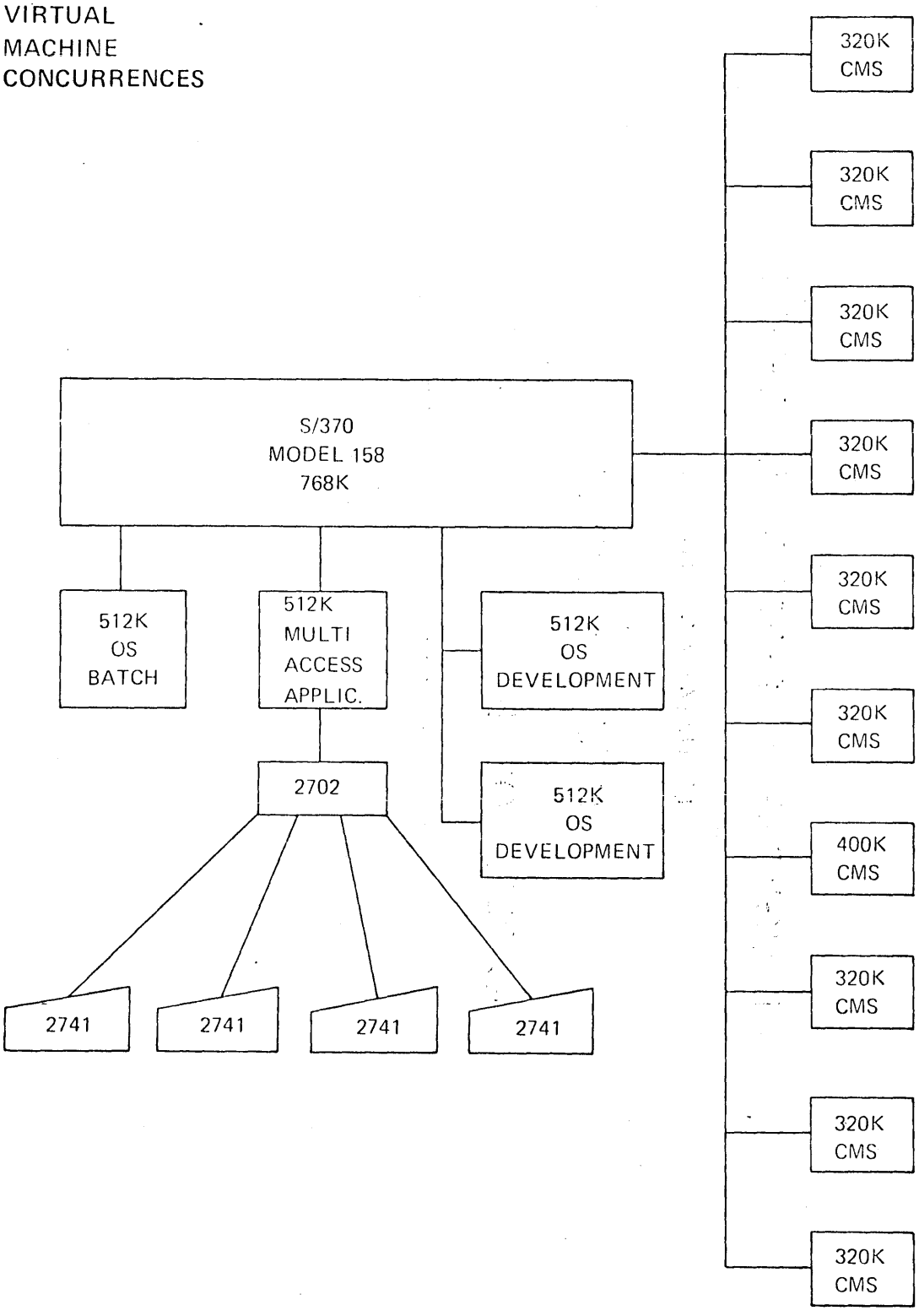
VIRTUAL MACHINE –
THE FUNCTIONAL EQUIVALENT OF A REAL COMPUTING SYSTEM

- VM/370 MANAGES CONCURRENT EXECUTION OF MULTIPLE VIRTUAL MACHINES
- VIRTUAL MACHINE OPERATING SYSTEMS SCHEDULE AND CONTROL USER WORK FLOW

VIRTUAL MACHINE CONCURRENCES



VIRTUAL
MACHINE
CONCURRENCES



4048

VIRTUAL MACHINE OPERATING SYSTEMS

CMS	VM/370
DOS	DOS/VS
OS	OS/VS1
OS-ASP	OS/VS2
PS44	RSCS

MODES OF OPERATION

BATCH

INTERACTIVE

MULTI-ACCESS

V.1.6/H.1.6

VIRTUAL MACHINE RESTRICTIONS

- NO TIME DEPENDENT CODE
- NO DYNAMICALLY MODIFIED CCWs

  EXCEPT OS–ISAM

  OS/VS – TCAM

  RUNNING IN V=R

- DIAGNOSE A SPECIAL INTERFACE

SYSTEM REQUIREMENTS

REQUIRES: 240K OF REAL STORAGE

DYNAMIC ADDRESS TRANSLATION FACILITY

SYSTEM TIMING FACILITIES

SUPPORTS: SYSTEMS/370, 135 THROUGH 168

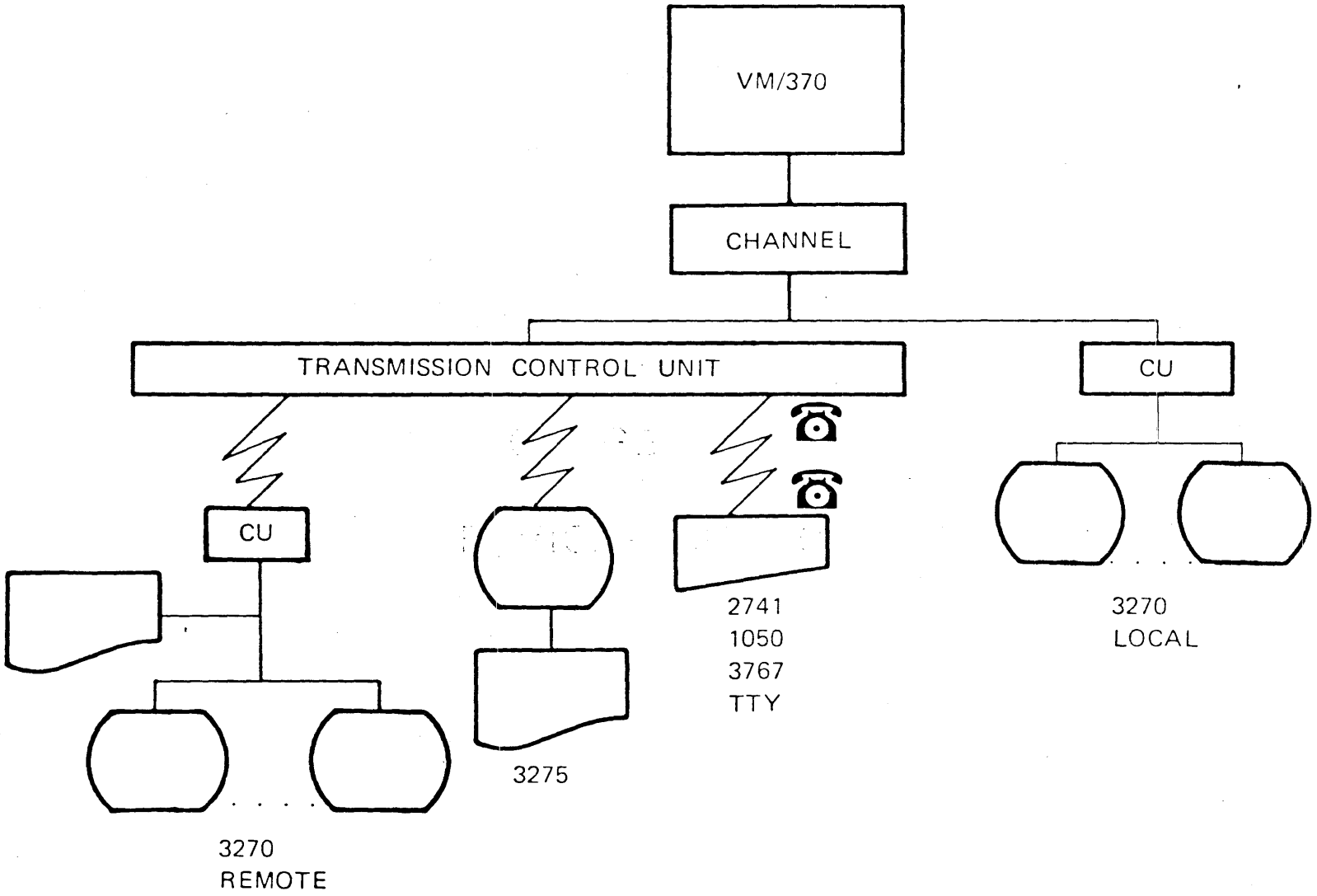
SUPPORTED DEVICES

CONSOLES:	3210
	2150
	3066
	3215, 7412
TRANSMISSION CU:	2701, 2702, 2703
	ICA
	3704/3705
DIRECT ACCESS DEVICES:	2314/2319
	3330/3333
	3340
	2305
MAGNETIC TAPES:	2400, 2415, 2420
	3410/3411, 3420
PRINTERS:	1403, 1443, 3211
READERS/PUNCHES:	2510, 2520, 2540
	3505, 3525

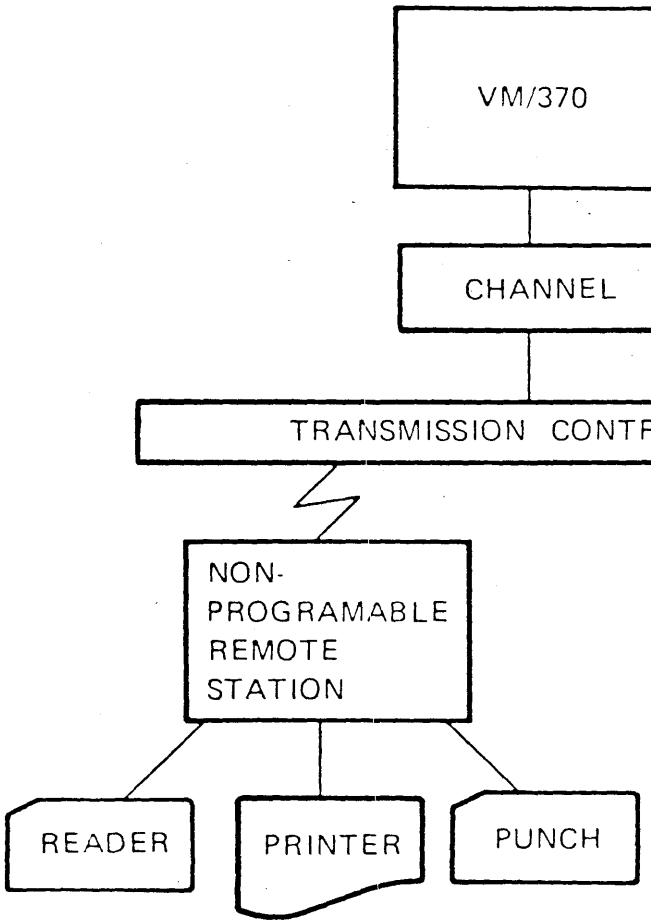
3704/3705 COMMUNICATIONS CONTROLLERS

- 270X EMULATION PROGRAM
- NETWORK CONTROL PROGRAM
- PARTITIONED EMULATION PROGRAMMING
- FACILITIES TO:
  - GENERATE
  - LOAD
  - DUMP

VM/370 TERMINALS



VM/370 REMOTE WORKSTATION SUPPORT



2770
2780
3770
3780

SYSTEM 3 MODEL 10
SYSTEM/360
SYSTEM/370
1130 SYSTEM
2922 TERMINAL

VIRTUAL MACHINE DESCRIPTION

MACHINE COMPONENTS

- CONSOLE
- CPU
- STORAGE
- DEVICES AND CHANNELS

TERMINAL/CONSOLE

VIRTUAL	OPERATOR'S CONSOLE
REAL	SYSTEM CONSOLES AND TERMINALS SUPPORTED BY VM/370

STORAGE

VIRTUAL	8K TO 16M BYTES MAIN STORAGE
REAL	MINIMUM 240K DYNAMIC RELOCATION ALLOCATION BY PAGE OPTIMIZED USAGE

CPU

VIRTUAL	S/370 PRINCIPLES OF OPERATION MULTIPLE SYSTEMS ENVIRONMENT
REAL	TIME SLICING ENVIRONMENT PROBLEM STATE EXECUTION

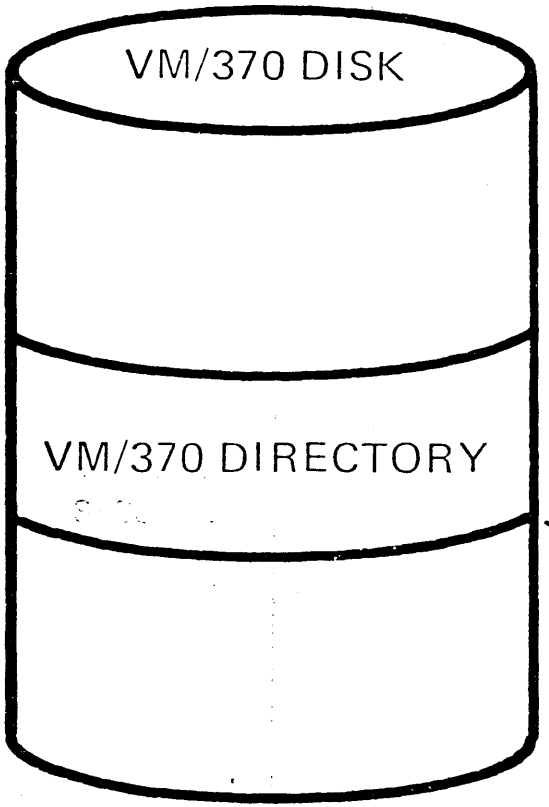
I/O DEVICES

VIRTUAL	COMPLETE DEVICE CONTROL EXECUTION RESTRICTION
REAL	DEVICE TRANSLATION STORAGE TRANSLATION SCHEDULING ERROR RECORDING

VIRTUAL MACHINE DEVICE ASSIGNMENTS

- DEDICATED DEVICES
  - TERMINALS
  - DISKS
  - TAPES
  - U/R
  - OTHERS
- SHARED DISKS
- SPOOLED U/R
- MINIDISKS
- SHARED TCU's
- CHANNEL–TO–CHANNEL ADAPTER

CREATING A VIRTUAL MACHINE




```
USER DOSSYS DOSPASS 256K 1M G
CONSOLE 01F  1052
SPOOL   00C  2540 READER
SPOOL   00D  2540 PUNCH
SPOOL   00E  1403
MDISK   130  2314 0 100 DOSRES
MDISK   131  2314 0 202 DOSDATA
```

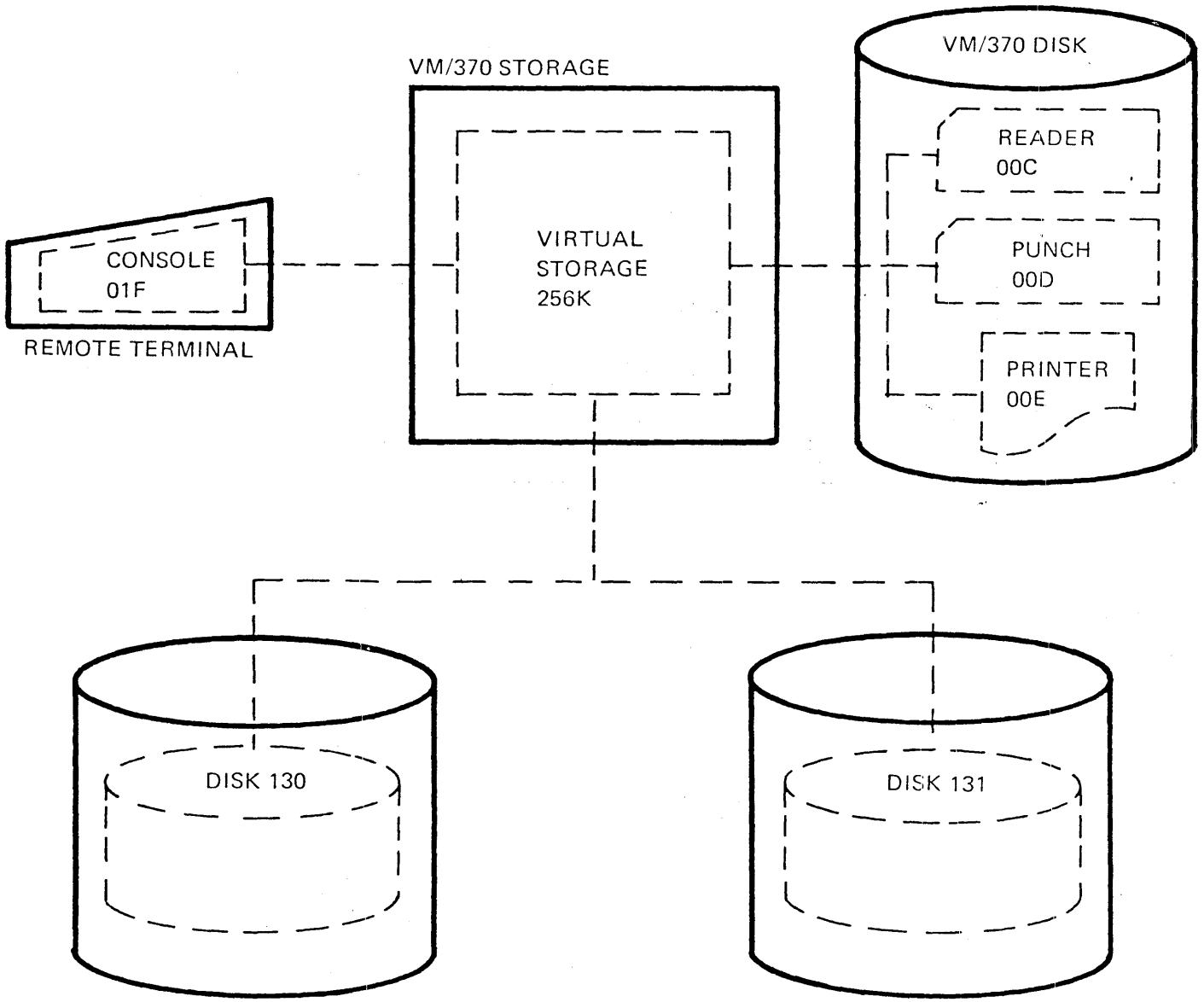
login dossys

ENTER PASSWORD:

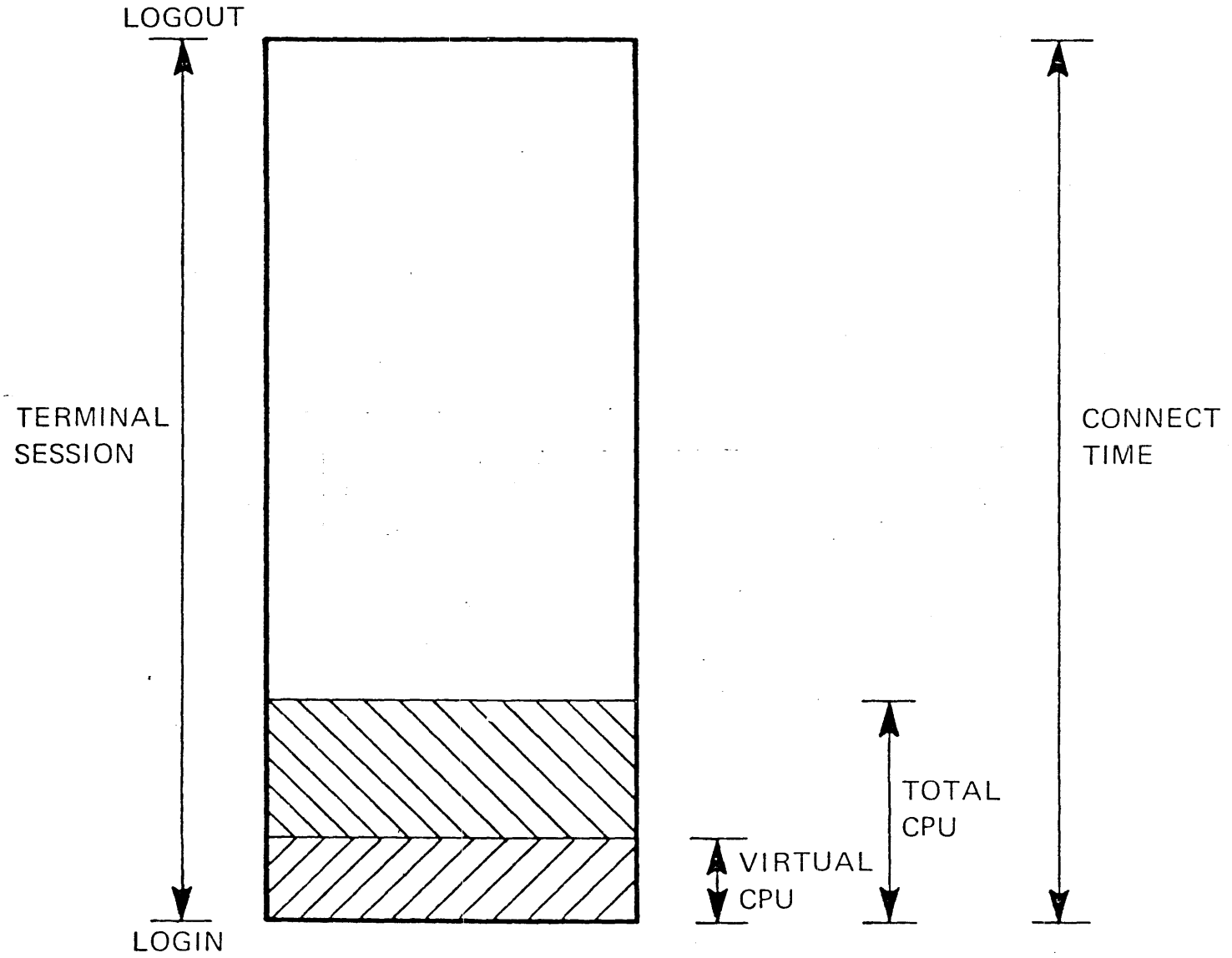
dospass

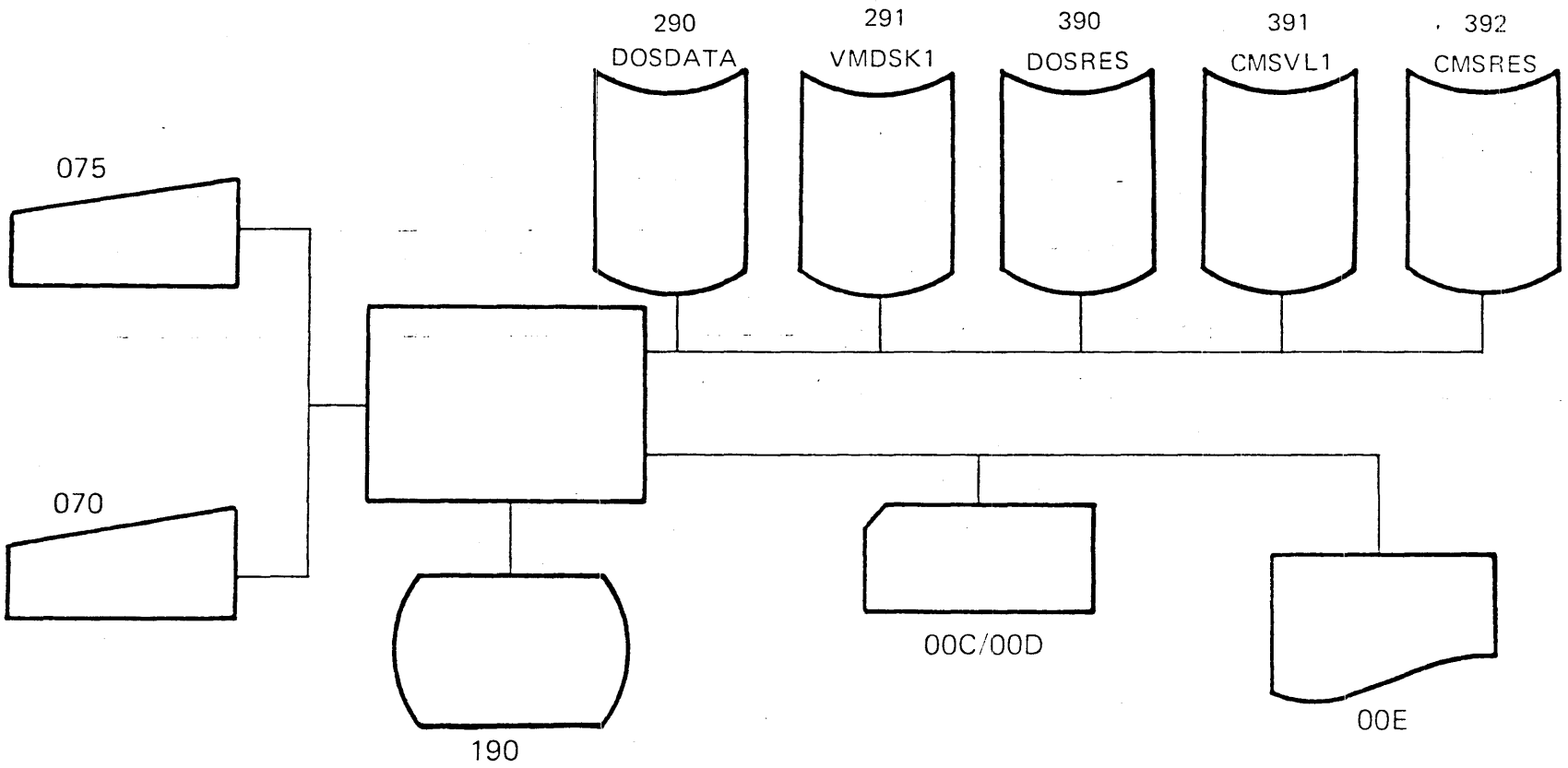
ipl 130

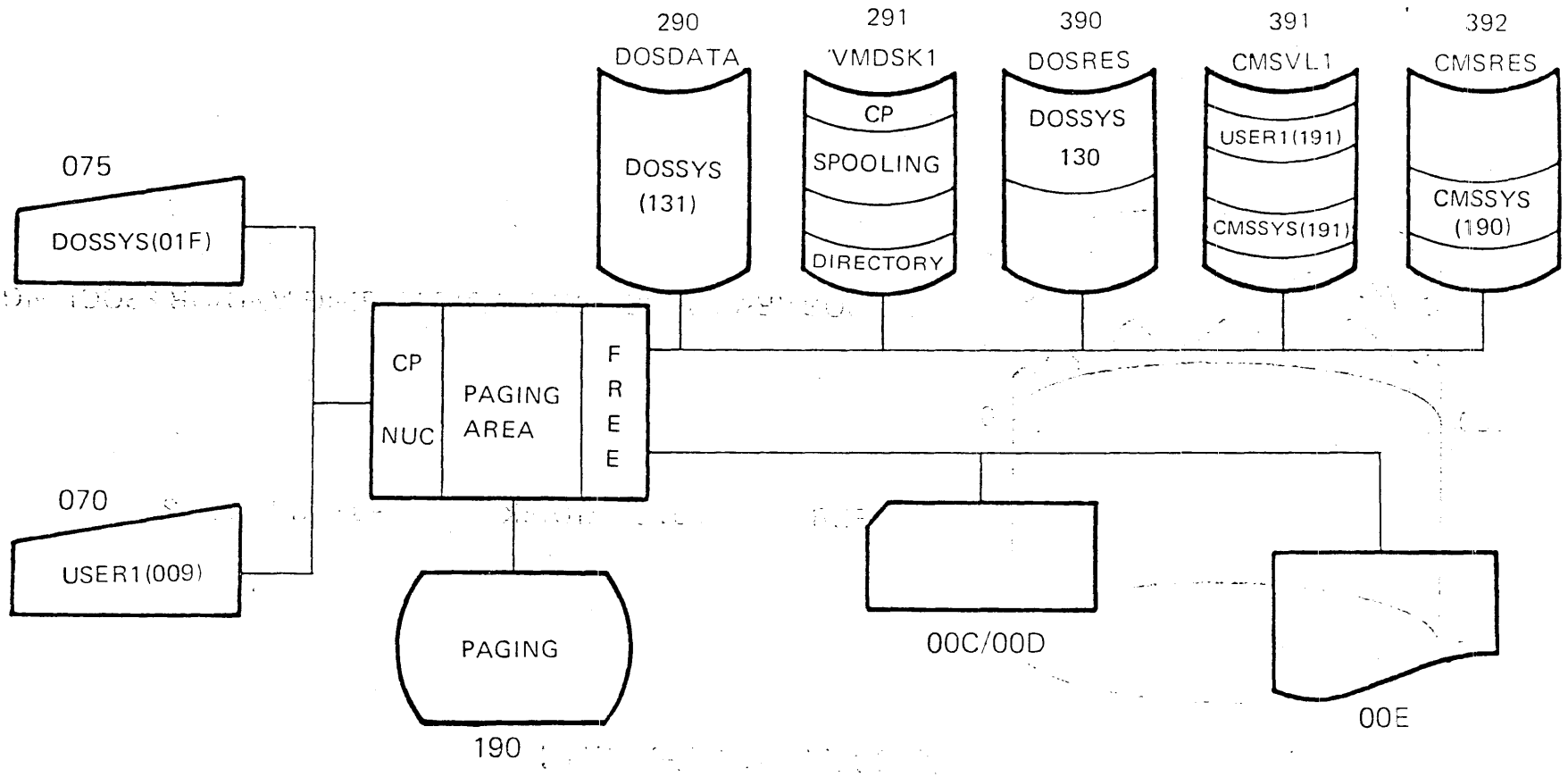
VIRTUAL MACHINE CONFIGURATION



VM/370 LOGOUT







DIRECTORY DESCRIPTION

```
USER   USER1    DPEDV    320K    1M
CONSOLE    009        1052
SPOOL      00C        2540    READER
SPOOL      00D        2540    PUNCH
SPOOL      00E        1403
LINK       CMSSYS     190     190     R
MDISK      191        2314    020     007   CMSVL1

USER   CMSSYS   SPASS  320K    1M   EG
CONSOLE    009        1052
SPOOL      00C        2540    READER
SPOOL      00D        2540    PUNCH
SPOOL      00E        1403
MDISK      190        2314     50   110   CMSRES
MDISK      191        2314    080   010   CMSVL1
```

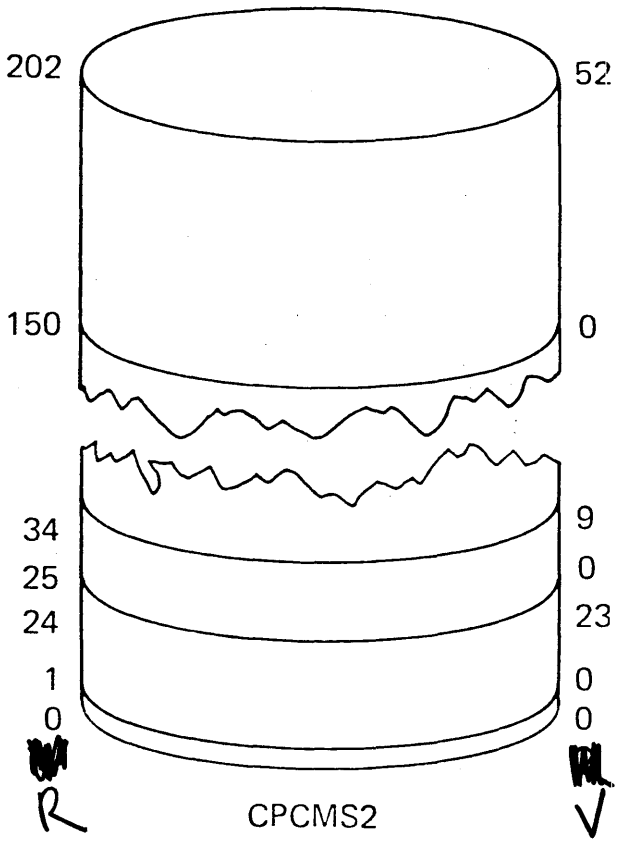
C P

F A C I L I T I E S

DISK SHARING

- PHYSICAL PACK SHARING
- PHYSICAL DATA SHARING

PHYSICAL PACK SHARING



USERB 291 MINIDISK 53 CYLINDERS

TEMPORARY SPACE FOR VM/370 PAGING AND/OR SPOOLING

USERA 191 MINIDISK 10 CYLINDERS

USERC 291 MINIDISK 24 CYLINDERS

V.3.2/H.3.2

IN THE DIRECTORY FOR USERC:

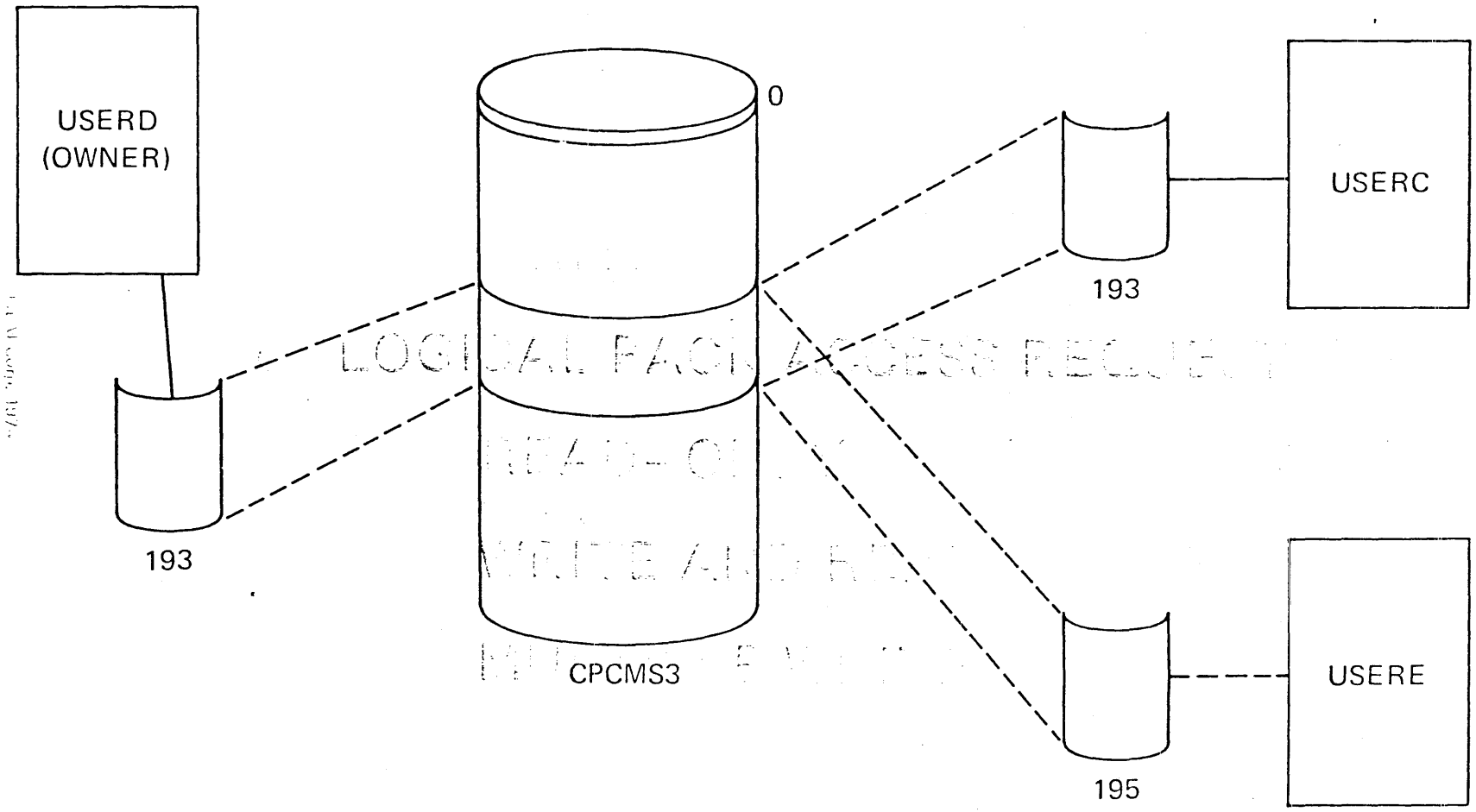
MDISK 291 2314 001 024 CPCMS2 W

TEMPORARY DISKS

CP DEFINE T2319 AS 196 CYL 5

- OBTAINS 5 CYLINDERS
- FROM VM/370 T-DISK AREA
- FOR THE DURATION OF THE TERMINAL SESSION

LOGICAL PACK SHARING



LOGICAL PACK SHARING

- DEVICE OWNED BY USERD

  MDISK 193 2314 091 010 CPCMS3 R READPASS

- DEVICE AUTOMATICALLY LINKED TO USERC

  LINK USERD 193 193 R

- DEVICE DYNAMICALLY LINKED BY USERE

  LINK USERD 193 195 R

  ENTER READ PASSWORD

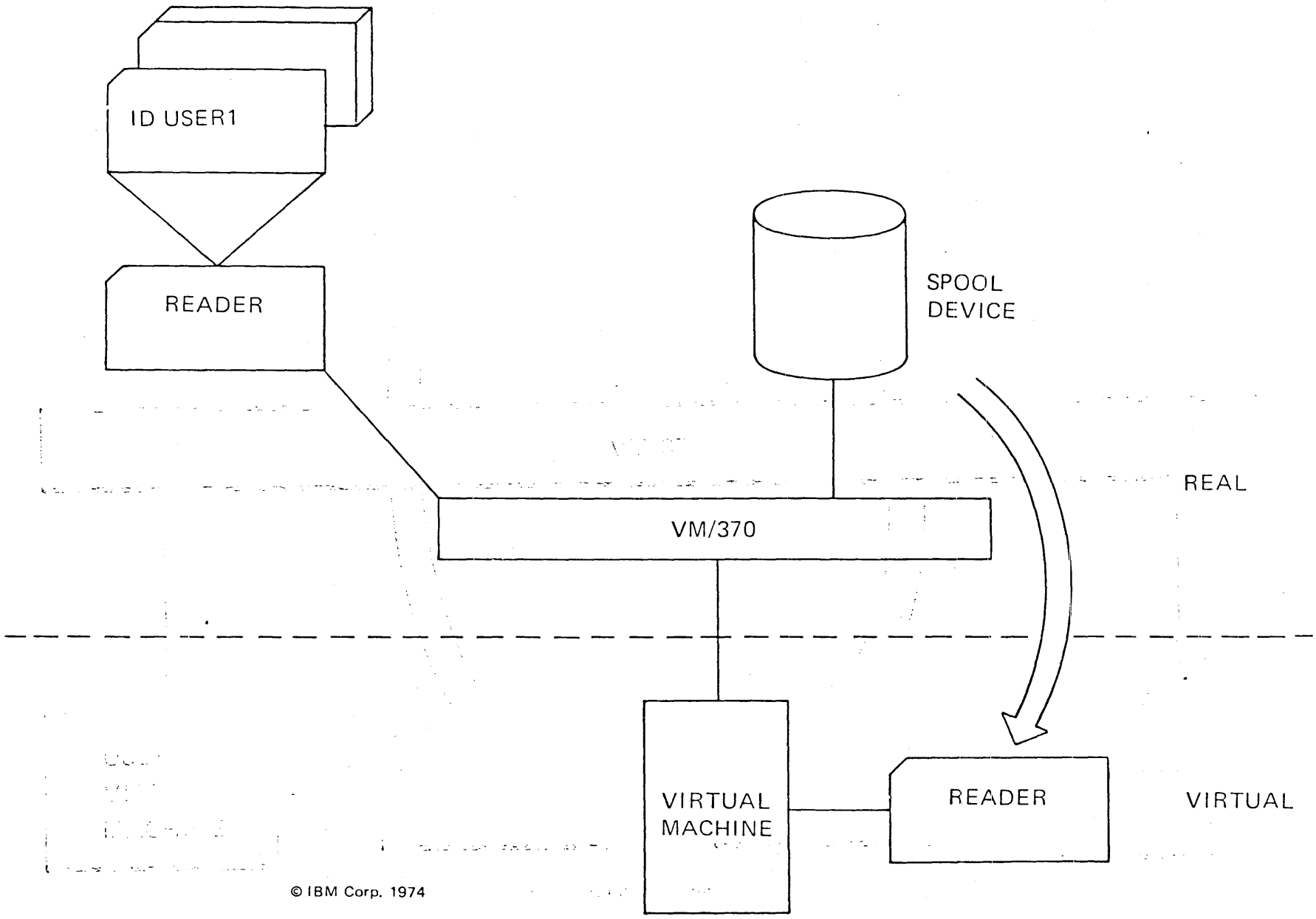
  READPASS

- LOGICAL PACK ACCESS
  - READ
  - WRITE
- LOGICAL PACK ACCESS REQUEST
  - READ–ONLY
  - WRITE AND READ
  - MULTIPLE WRITE

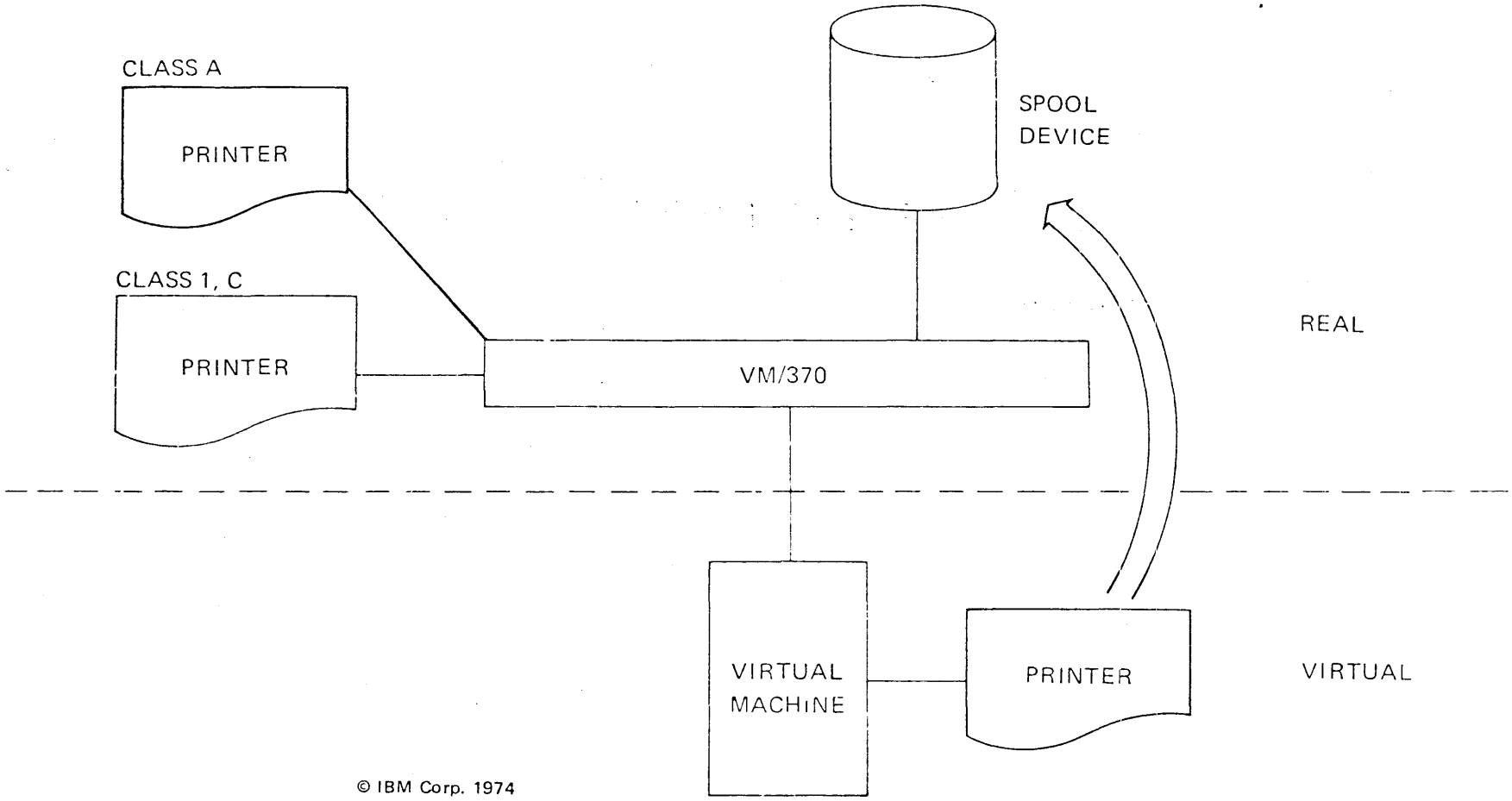
CP SPOOLING FUNCTIONS

- SIMULATE OPERATION OF VIRTUAL U/R DEVICES
- OPERATE REAL U/R DEVICES
- PROVIDE INTERFACE BETWEEN VIRTUAL MACHINES
  - FILE SHARING
  - REMOTE WORKSTATION
- PROVIDE VIRTUAL CONSOLE SPOOLING

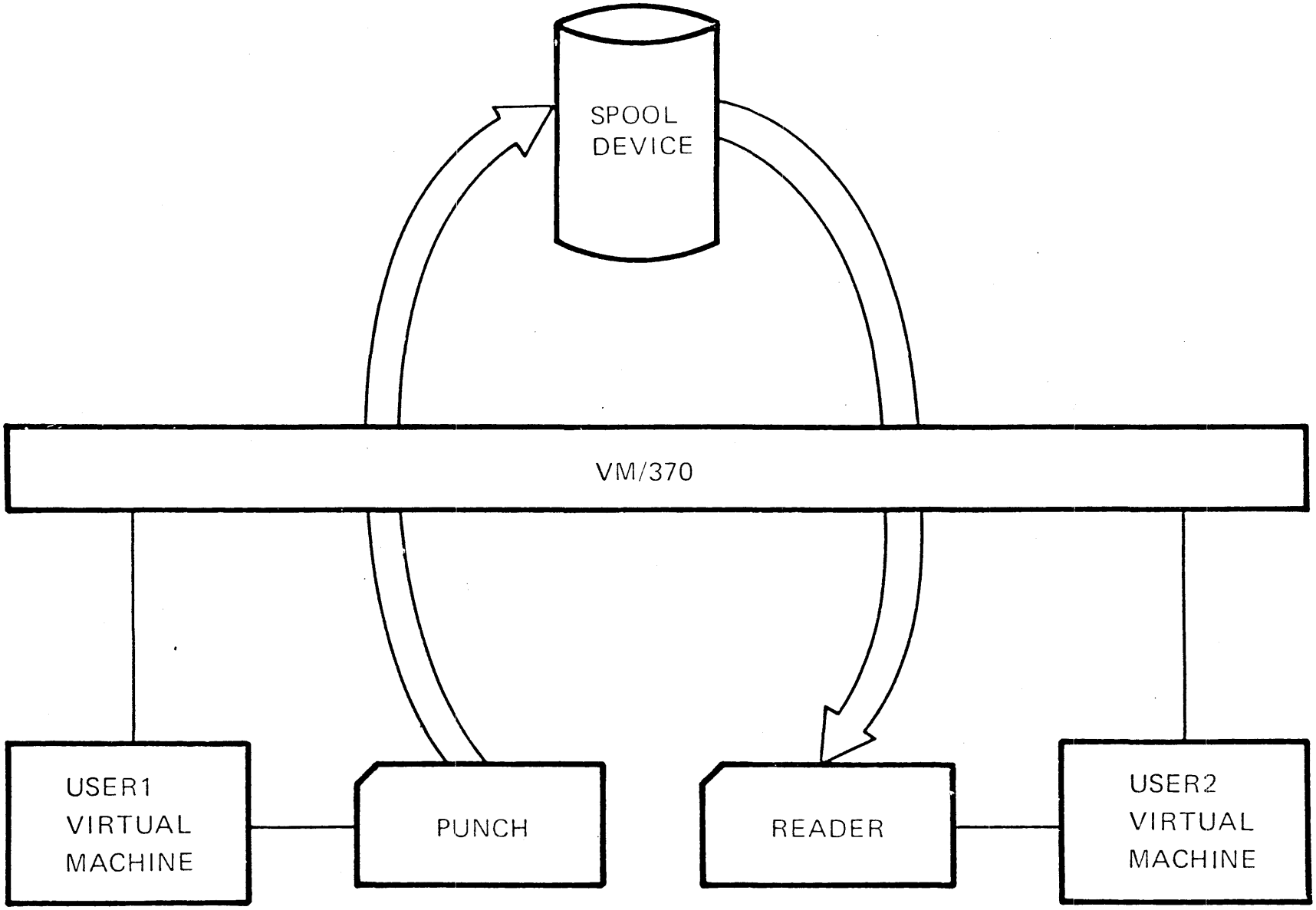
LOCAL SPOOLING



LOCAL SPOOLING



SHARING FILES



REMOTE SPOOLING COMMUNICATIONS SUBSYSTEM

RSCS IS

A MULTITASKING OPERATING SYSTEM

DESIGNED TO RUN IN A VIRTUAL MACHINE

CONTROLLING THE TRANSFER OF FILES

OVER A REMOTE NETWORK

OF UP TO SIXTEEN REMOTE STATIONS

REMOTE SPOOLING COMMUNICATIONS SUBSYSTEM

RSCS PROVIDES

- HOST SUPPORT

  RSCS ACTS AS THE HOST SYSTEM TO A NETWORK OF REMOTE WORKSTATIONS

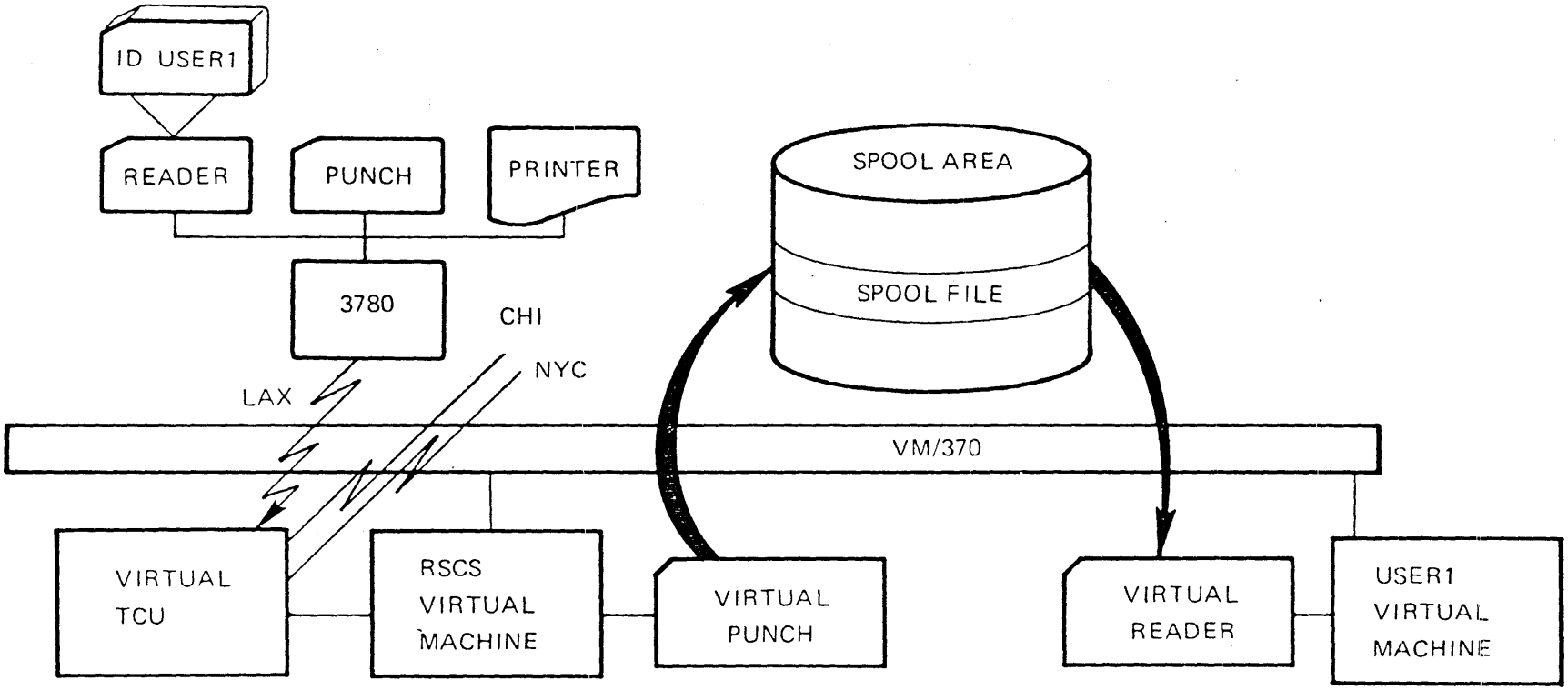
- RJE SUPPORT

  RSCS ACTS AS A REMOTE WORKSTATION TO A HASP/ASP HOST SYSTEM

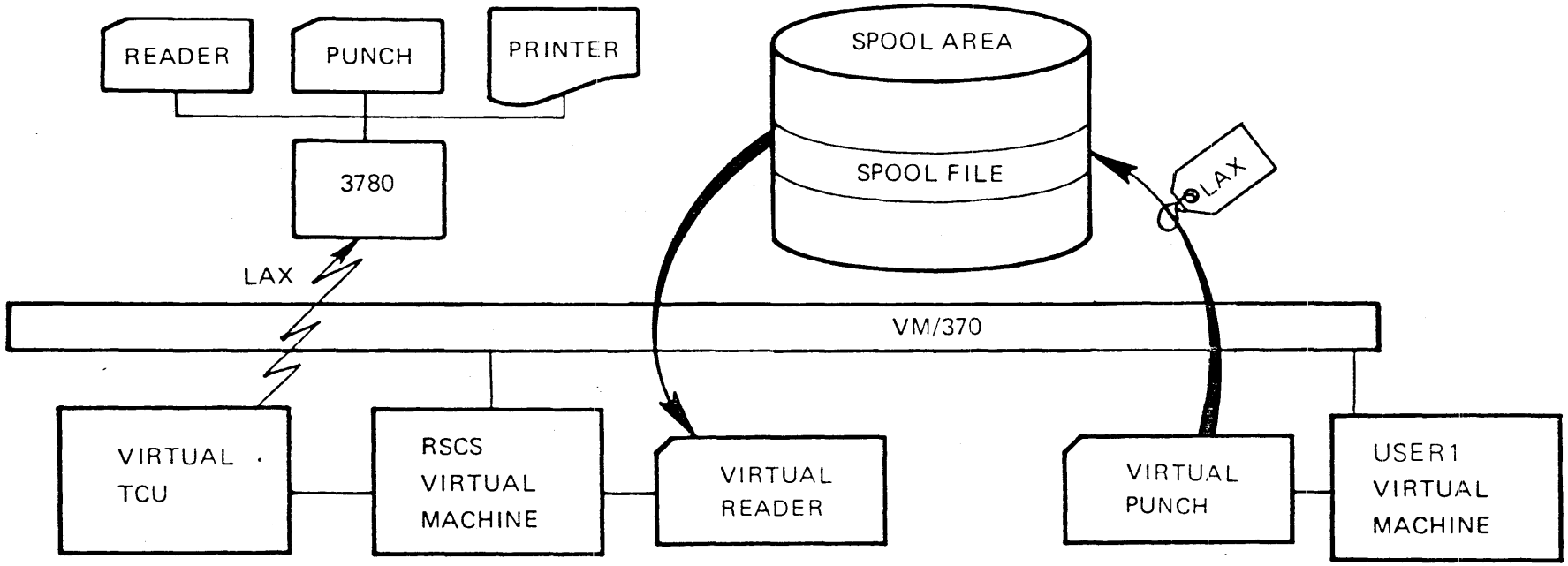
- STATION TO STATION COMMUNICATION

  RSCS TRANSMITS A FILE FROM ONE REMOTE STATION TO ANOTHER

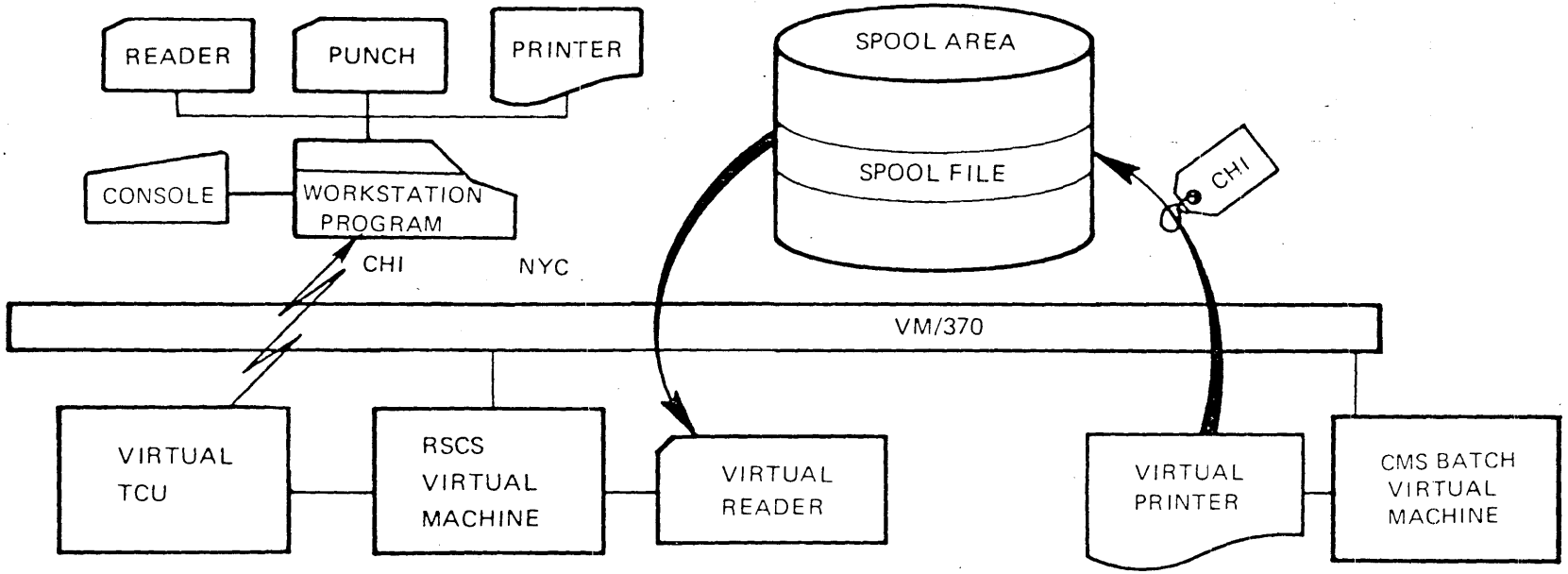
REMOTE SPOOLING INPUT
TO CMS VIRTUAL MACHINE



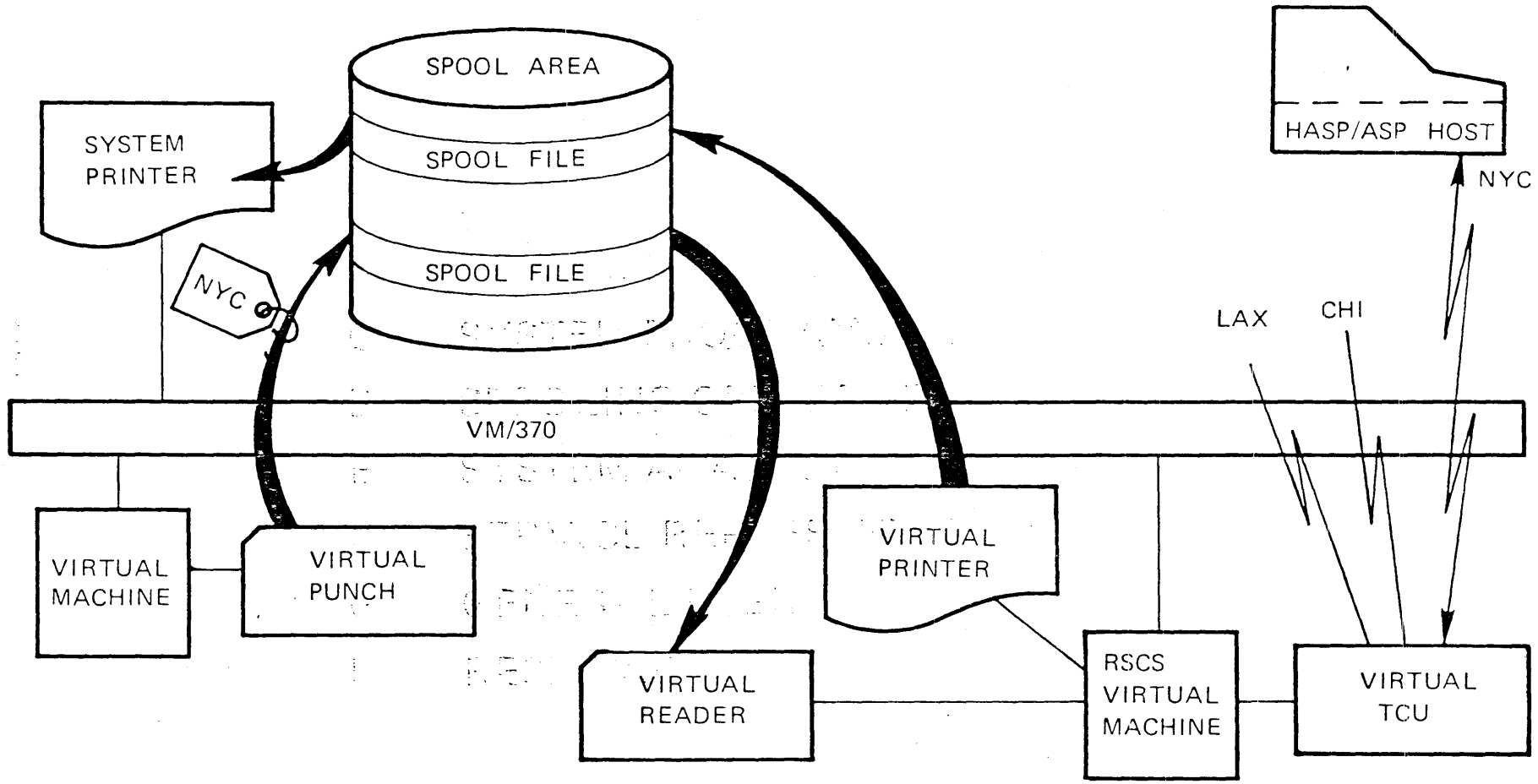
REMOTE SPOOLING OUTPUT
FROM CMS VIRTUAL MACHINE



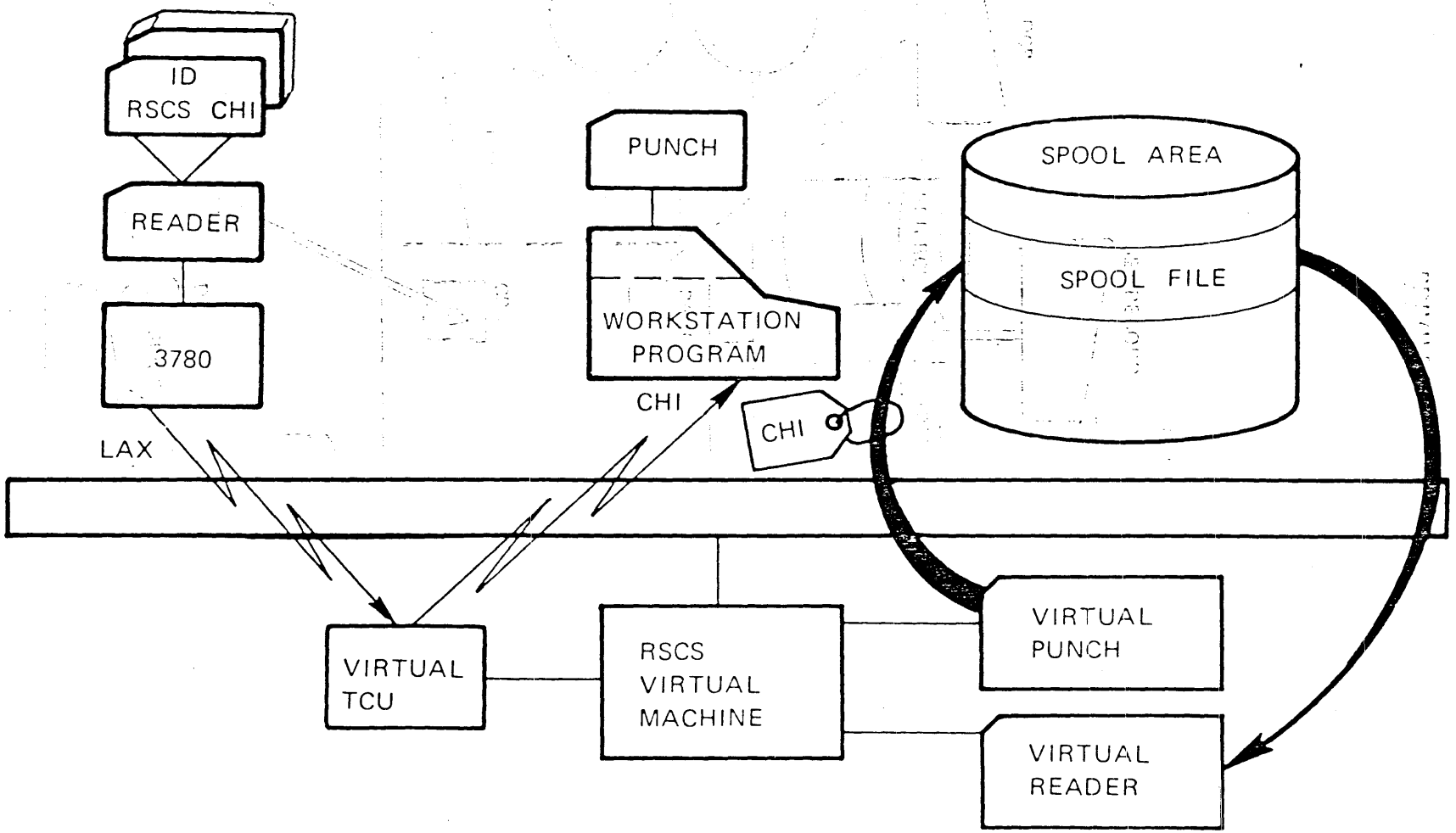
REMOTE PROGRAMMABLE WORKSTATIONS



RSCS AS AN RJE STATION



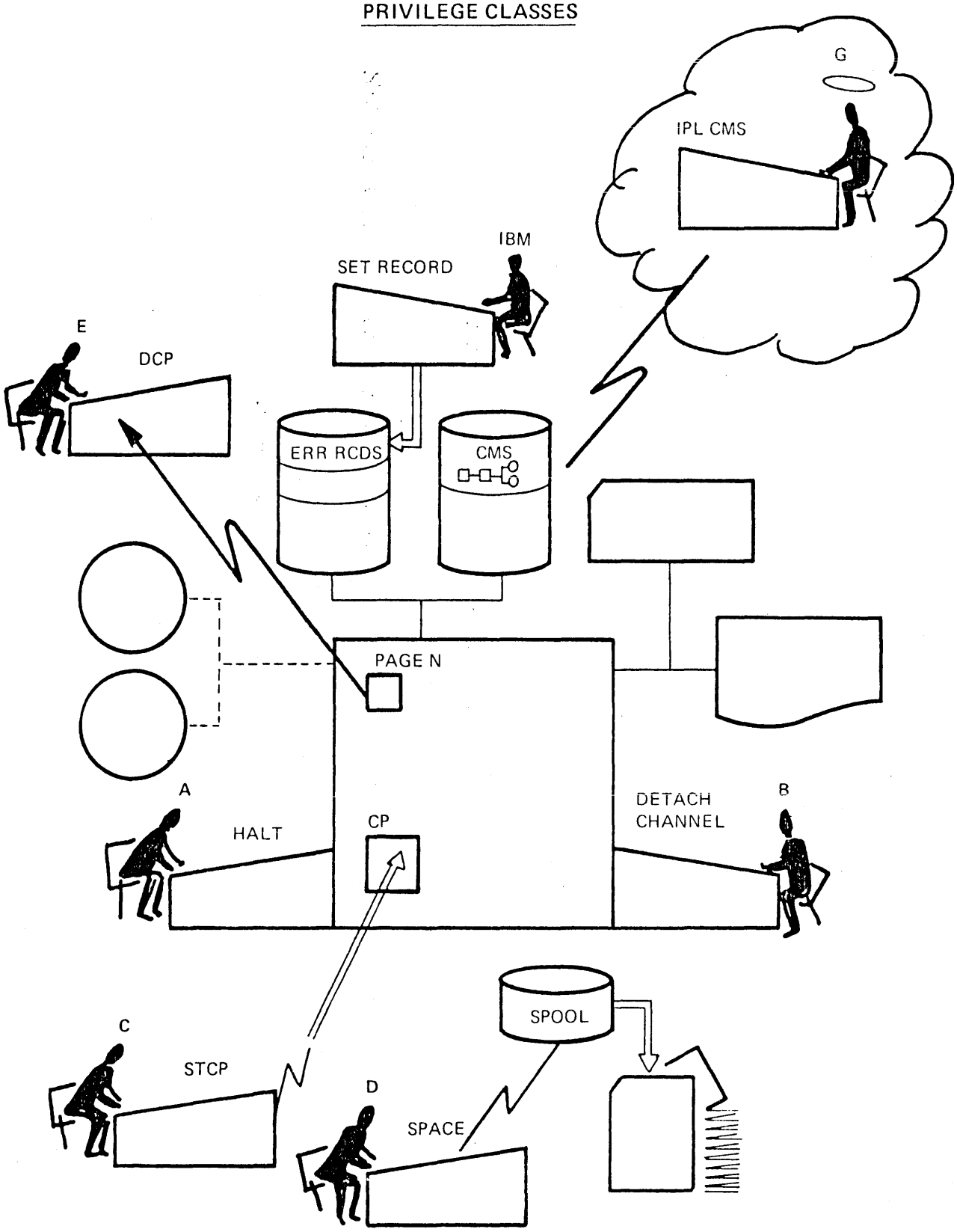
STATION TO STATION COMMUNICATION

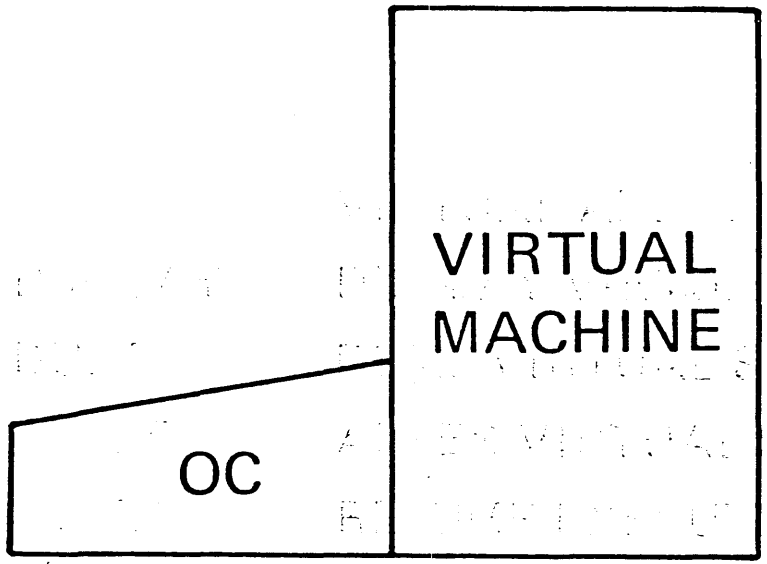


COMMAND PRIVILEGE CLASSES

A	PRIMARY SYSTEM OPERATOR
B	SYSTEM RESOURCE OPERATOR
C	SYSTEM PROGRAMMER
D	SPOOLING OPERATOR
E	SYSTEM ANALYST
F	SERVICE REPRESENTATIVE
G	GENERAL USER
H	RESERVED

PRIVILEGE CLASSES





IPL
BEGIN
EXTERNAL
SYSTEM CLEAR
SYSTEM RESET
SYSTEM RESTART

DEVICE CONTROL COMMANDS

READY	*SET A DEVICE END INTERRUPT*
RESET	*CLEAR ALL INTERRUPTS AND ERROR CONDITIONS*
REWIND	*REWIND AND READY A TAPE DRIVE*
NOTREADY	*MAKE A DEVICE NOT READY*

CP CONSOLE FUNCTIONS

ADSTOP	STOP EXECUTION AT A SPECIFIED VIRTUAL ADDRESS
DISPLAY	DISPLAY VIRTUAL STORAGE
DUMP	DUMP VIRTUAL STORAGE ON PRINTER
STORE	ALTER VIRTUAL STORAGE OR REGISTERS
BEGIN	RESUME EXECUTION

CP TRACE

- TRACE VIRTUAL MACHINE ACTIVITY
- OUTPUT ON CONSOLE AND/OR PRINTER
- OPTION TO ENTER CP CONSOLE FUNCTION MODE AFTER EACH TRACE
- CHOOSE TRACE ACTIVITY

  SVC INTERRUPTS

  I/O INTERRUPTS

  PROGRAM INTERRUPTS

  EXTERNAL INTERRUPTS

  PRIVILEGED INSTRUCTIONS

  I/O INSTRUCTIONS

  SUCCESSFUL BRANCHES

  ALL INSTRUCTIONS

  CHANNEL PROGRAMS

VIRTUAL MACHINE COMMUNICATION

MSG	OPERATOR	
MSG	userid	
QUERY	LOGMSG	
QUERY	NAMES	
QUERY	USERS	
QUERY	userid	
QUERY	TIME	
QUERY	VIRTUAL	DASD
QUERY	VIRTUAL	TAPES
QUERY	VIRTUAL	LINES
QUERY	VIRTUAL	UR
QUERY	VIRTUAL	STORAGE

USING TAPES IN A VIRTUAL MACHINE

VIRTUAL MACHINE OPERATOR	VM/370 OPERATOR
	attach 283 to dossys as 180
TAPE 180 ATTACHED	TAPE 283 ATTACH TO DOSSYS 180
rewind 180	
.	
.	
.	
detach 180	
TAPE 180 DETACHED	TAPE 283 DETACHED DOSSYS

REDEFINING THE VIRTUAL MACHINE

- CHANGE SIZE OF VIRTUAL STORAGE

  DEFINE STORAGE AS 1024K

- CHANGE VIRTUAL DEVICE ADDRESSES

  DEFINE 130 AS 135

- ADD DEDICATED DEVICES

  ATTACH 283 TO DOSSYS AS 180

- ADD SPOOLED UNIT RECORD

  DEFINE PRINTER AS 00B

- ADD VIRTUAL LINES

  DEFINE LINE AS 030

- ADD TEMPORARY DISKS

  DEFINE T2314 AS 132 CYL 20

- DELETE IO DEVICES

  DETACH 132

ACCOUNTING PROCEDURES

THREE TYPES OF ACCOUNTING RECORDS

- VIRTUAL MACHINE USAGE
- DEDICATED DEVICE USAGE
- TEMPORARY DISK SPACE USAGE

ENTRY POINT FOR USER WRITTEN ROUTINES

USER ACCOUNTING STATISTICS

TERMINAL CONNECT TIME

VIRTUAL CPU TIME

VM/370 EXECUTION TIME

CARDS READ AND PUNCHED

LINES PRINTED

PAGE READS AND WRITES

NUMBER OF VIRTUAL SIO's

DEVICE ACCOUNTING STATISTICS

- DEVICE CONNECT TIME
- DEVICE CODE
- NUMBER OF CYLINDERS OF T–SPACE

SYSTEM PERFORMANCE FACILITIES

- PREFERRED VIRTUAL MACHINE OPTIONS
- VIRTUAL MACHINE ASSIST
- BIASED SCHEDULER
- VM/VS HANDSHAKING FEATURE
- VM/370 MEASUREMENT FACILITY

C M S

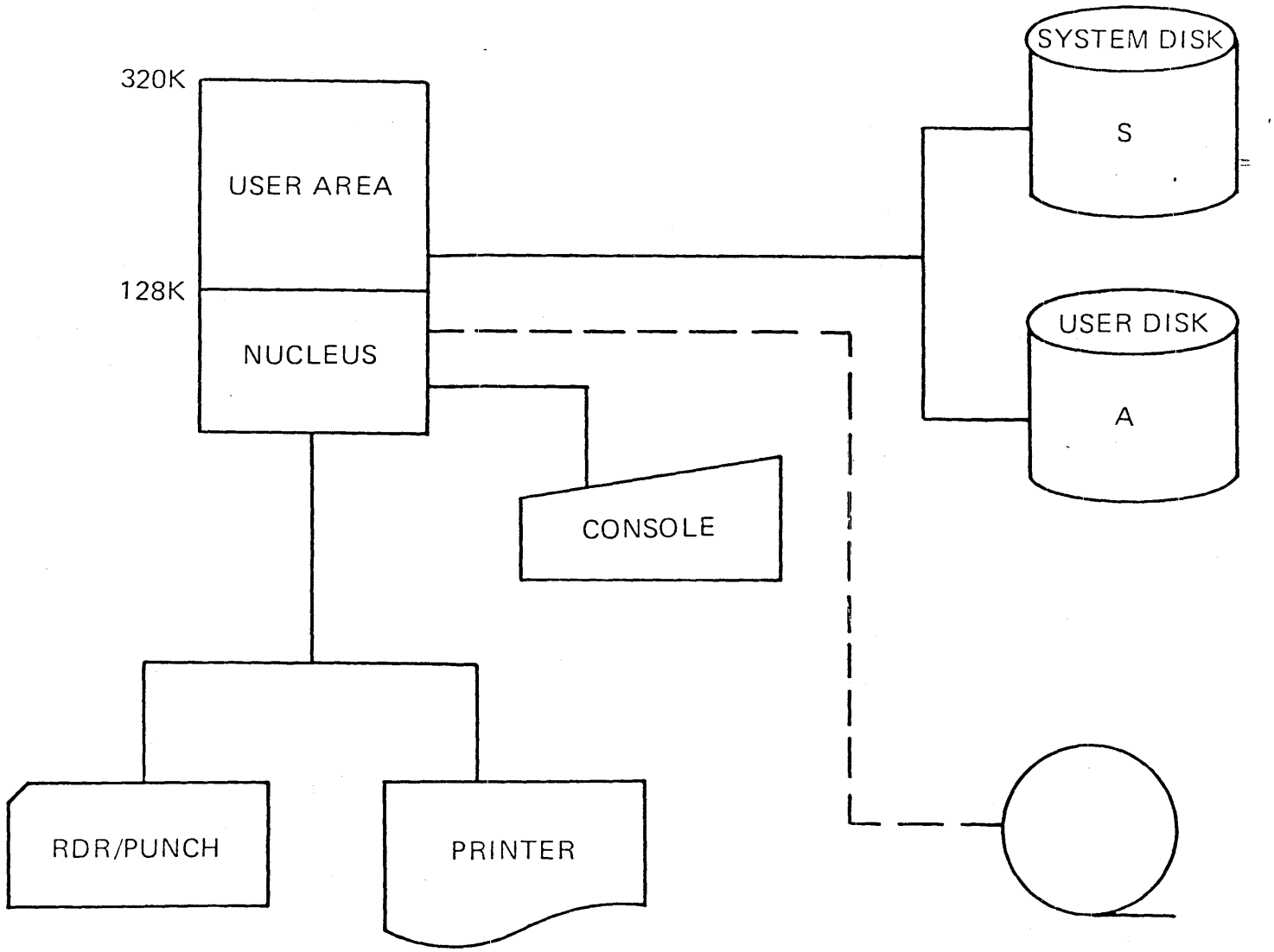
F A C I L I T I E S

CONVERSATIONAL MONITOR SYSTEM

- SINGLE USER
- CONVERSATIONAL
  - FILE CREATION AND MANAGEMENT
  - PROGRAM COMPILATION AND EXECUTION
  - APPLICATION PROGRAM EXECUTION

V.4.1/H.4.1

TYPICAL CONFIGURATION



USER FACILITIES

FILE MANAGEMENT SYSTEM

LANGUAGE FACILITIES

INTERACTIVE EXECUTION

FILE MANAGEMENT SYSTEM

- CREATE AND UPDATE FILES

  FROM THE TERMINAL

  FROM A PROGRAM

  FROM A VIRTUAL CARD READER

- SHARE FILES AMONG USERS

- NOT COMPATIBLE WITH OS FILES

PROGRAM LANGUAGE FACILITY

- S/370 ASSEMBLER
- BASIC
- APL
- FORTRAN IV
- ANS COBOL
- PL/I

INTERACTIVE EXECUTION

- PROGRAMS WRITE TO TERMINAL
- PROGRAMS READ FROM TERMINAL
- DEBUGGING FACILITIES

EXECUTION TIME RESTRICTIONS

- SYSTEM SERVICES
  - SELECTED OS SVC SIMULATION
  - NO DOS SVC SIMULATION

- DATA MANAGEMENT
  - SIMULATES SELECTED OS ACCESS METHODS AS CMS FILES
    - BDAM
    - BPAM
    - QSAM
    - BSAM
  - READS OS FILES
    - SEQUENTIAL
    - PARTITIONED
  - READS DOS FILES
    - SEQUENTIAL

ALTERNATING OPERATING SYSTEMS

- AUGMENT CMS WITH

  ADDITIONAL LANGUAGES
  ISAM EXECUTION
  DOS EXECUTION

- PROVIDE ACTUAL ENVIRONMENT TEST

  PROGRAM DEVELOPMENT
  SYSTEM MAINTENANCE

- USE CMS TO

  CREATE JOBSTREAMS
  CREATE PROGRAMS
  COMPILE PROGRAMS
  MODIFY PROGRAMS

```
#
vm/370 online
login user1 mask
ENTER PASSWORD:
********
LOGMSG - 12:37:20 02/14/74
* VM/370 WILL BE UP UNTIL 9:00PM
LOGON AT 14:26:31 EST THURSDAY 02/14/74
ipl 190
CMS VERSION 2.0
```

```
edit testprog fortran
NEW FILE:
EDIT:
input
INPUT:
      write (6,10)
10    format ('a=')
      ree@ad (5,20) a
20    format (8.3)
      x=a**2
      write (6,25) a,x
      return
      end

EDIT:
file
R;
```

```
fortgi testprog
004 20 FORMAT (8.3)
                    $
   01) IEY013I SYNTAX
25                          IEY022I UNDEFINED LABEL
R(008);
```

```
edit testprog fortran
EDIT:
locate /(8/
20     FORMAT (8.3)
change /8/f8/
20     FORMAT (F8.3)
locate /25/
       WRITE (6,25) A,X
input  25     format (2f8.3)
top
type  *
       WRITE (6,10)
10     FORMAT ('A=')
       READ (5,20) A
20     FORMAT (F8.3)
       X=A**2
       WRITE (6,25) A,X
25     FORMAT (2F8.3)
       RETURN
       END
EOF:
file
R;
```

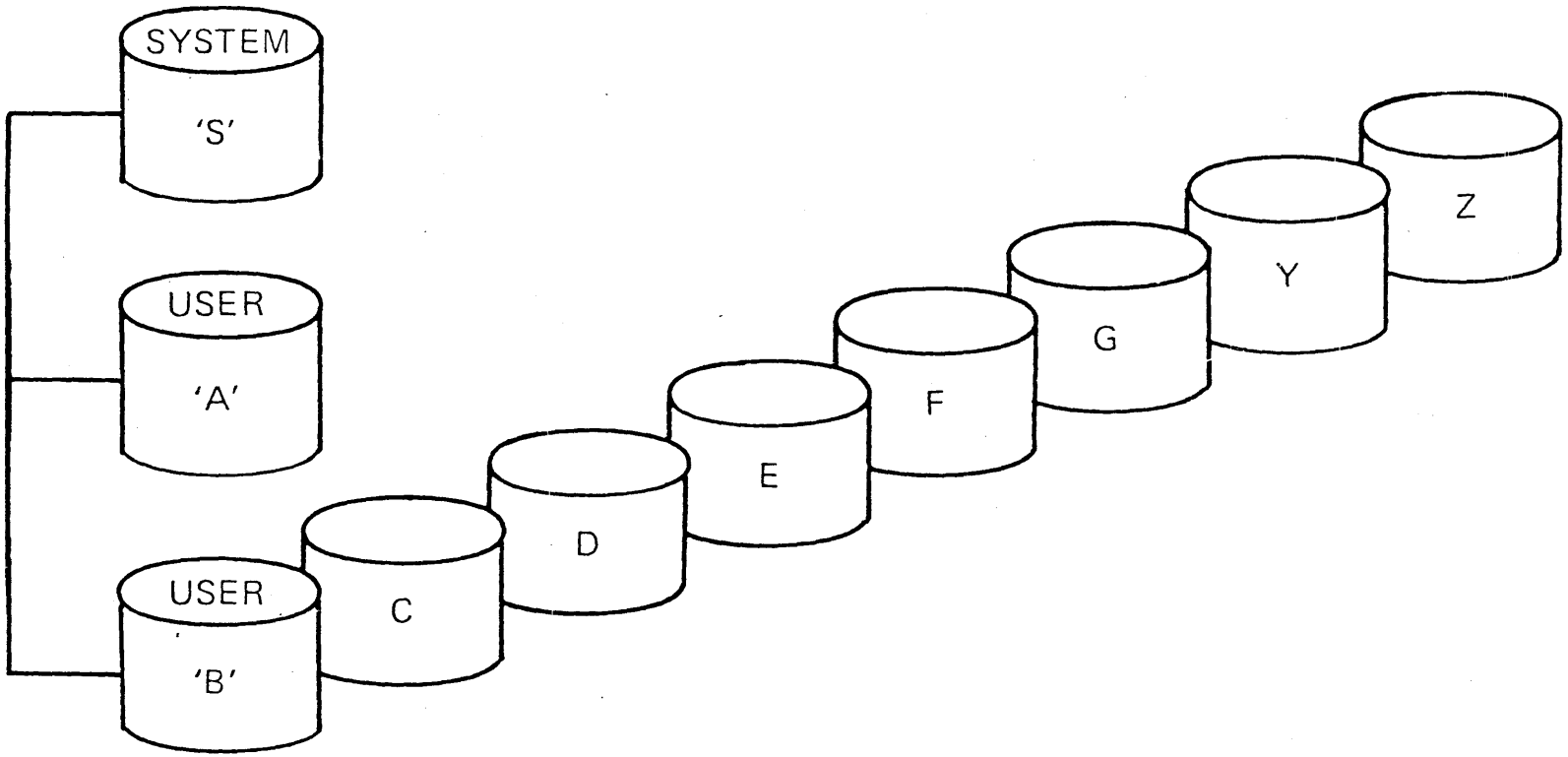
```
fortgi testprog
R;
listfile
FILENAME    FILETYPE    MODE
TESTPROG    FORTRAN     A1
TESTPROG    LISTING     A1
TESTPROG    TEXT        A1
R;
run testprog
A=
2.5
     2.500    6.250
R;

print testprog listing
R;
punch testprog text
R;
```

DISK FILE MANAGEMENT

- S DISK REQUIRED
- UP TO NINE SIMULTANEOUS USER DISKS
- PREFORMATTED PHYSICAL BLOCKS
- FIXED OR VARIABLE LOGICAL RECORDS
- SEQUENTIAL OR DIRECT ACCESS

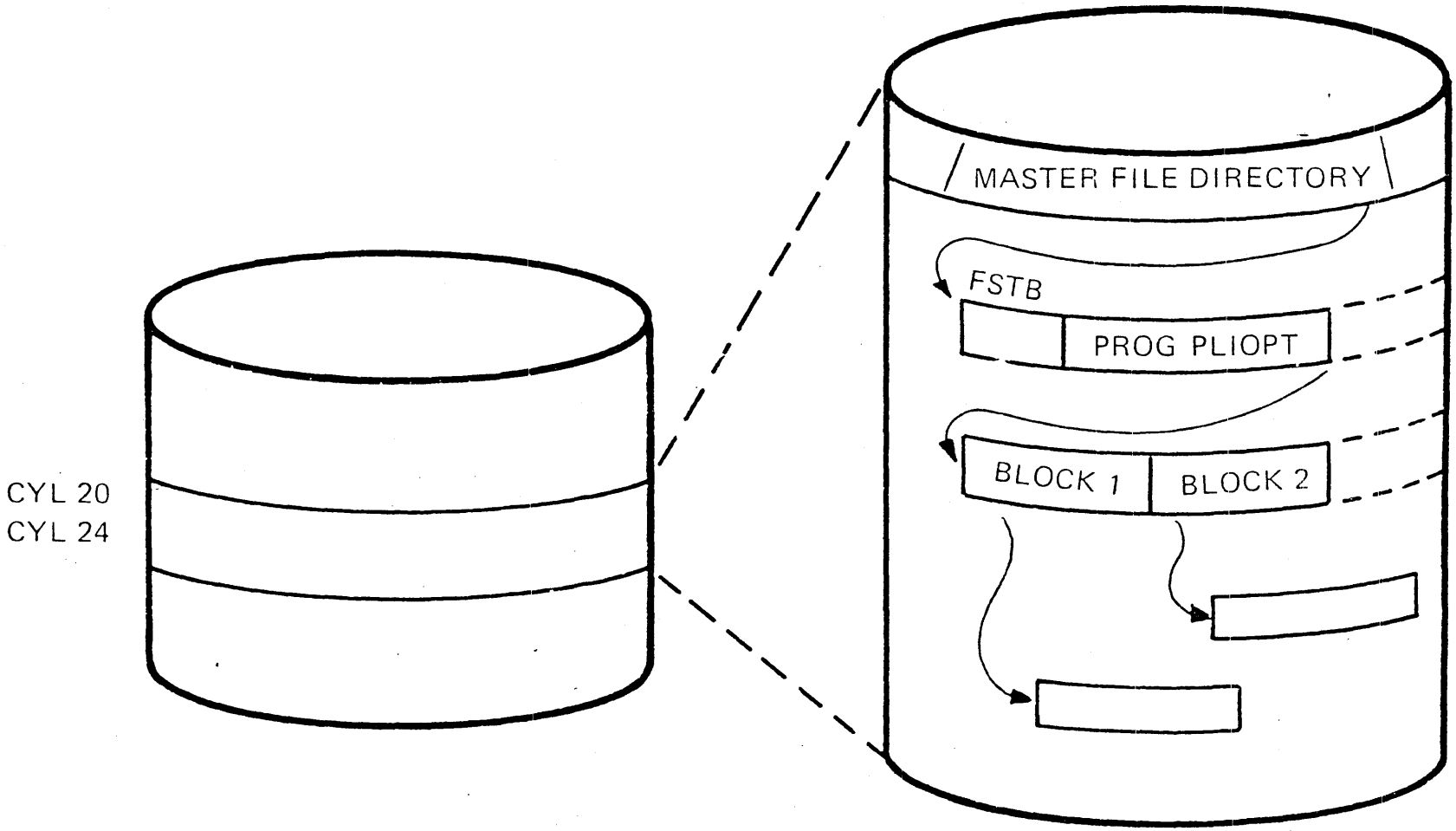
DISK NAMING



FILE ALLOCATION

- EACH MINI-DISK IS FORMATTED
  - CMS UTILITY
  - CONTROL INFORMATION ON CYL 0
- CMS MAINTAINS STATUS OF EVERY BLOCK
- ALLOCATES NEW FILES TO UNUSED BLOCKS
- DEALLOCATES BLOCKS WHEN FILE IS ERASED
- BUILDS A CHAIN LINK REFERENCE

DIRECTORY ON DISK



FILE NAMING

- EACH FILE HAS A THREE-COMPONENT NAME
  - FILENAME — IDENTIFIES FILE
  - FILETYPE — IMPLIES
    - SAME RECORD CHARACTERISTICS
    - SAME USAGE
  - FILEMODE — SPECIFIES
    - FILE DIRECTORY
    - MODE OF ACCESS

TWO LEVELS OF SHARING

- CP LINK BY DISK
  - READ/ONLY
  - READ/WRITE

- CMS ACCESS BY FILE
  - PRIVATE
  - READ/WRITE
  - READ/ERASE

CMS EDITOR

- CREATE FILES FROM TERMINAL
  - FIXED OR VARIABLE LENGTH RECORDS
  - MAXIMUM RECORD SIZE OF 160
  - OPTIONAL LINE NUMBER PROMPTING
- SELECT FILE CHARACTERISTICS
  - AUTOMATIC BASED ON FILETYPE
  - MAY BE SPECIFIED BY USER
- UPDATE FILES FROM TERMINAL
  - UPDATE BY CONTEXT OR LINE NUMBER
  - ADD, DELETE OR INSERT LINES
  - DISPLAY ALL OR PART OF A FILE
  - EXTRACT AND COMBINE FILES
- SUPPORT FOR 3270
  - FULL SCREEN DISPLAY OPTION
  - SCROLL CAPABILITY

CREATE AND MODIFY DISK FILES

EDIT

COPYFILE

UPDATE

MOVEFILE

SORT

CONTROL DISK FILES

LISTFILE

TYPE

ERASE

RENAME

COMPARE

DISK

TAPE SUPPORT

- UP TO FOUR TAPES USED BY COMMANDS
- USER SPECIFIED MODE AND RECORDING
- NO MULTIVOLUME SUPPORT
- NO LABEL SUPPORT

PROGRAM WRITING

- MULTIPLE PROGRAMMING LANGUAGES
- MACRO LIBRARIES

PROGRAM LOADING

- TEXT LIBRARIES
- LOADER SATISFIES UNRESOLVED REFERENCES

INTERACTIVE EXECUTION

- READ AND WRITE TERMINAL
  - VIA CONSOLE I/O
- USE LANGUAGE FACILITIES
  - COBOL INTERACTIVE DEBUG
  - FORTRAN INTERACTIVE DEBUG
  - PL/I CHECKOUT COMPILER
- SUSPEND PROGRAM EXECUTION
  - VIA ATTENTION KEY
  - ENTER CP CONSOLE FUNCTIONS
  - RESUME EXECUTION
- STOP PROGRAM EXECUTION OR OUTPUT
  - VIA ATTENTION KEY
  - CMS IMMEDIATE COMMANDS
- TRACE PROGRAM EXECUTION
  - CP TRACE
  - CMS SVCTRACE
- CMS DEBUG ENVIRONMENT
  - MACHINE ADDRESS LEVEL

COMMAND LANGUAGE EXTENSIONS

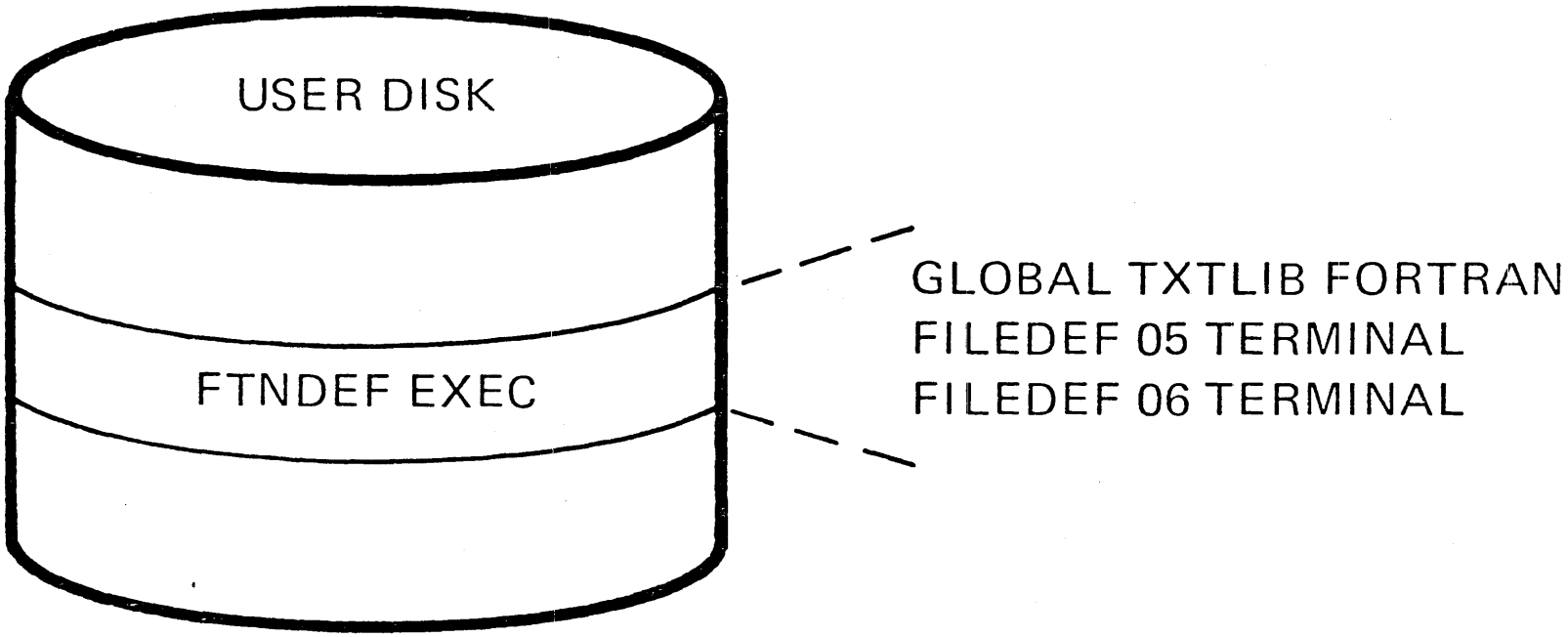
- MODIFY CMS COMMAND NAMES
  - STANDARD ABBREVIATIONS
  - USER SYNONYMS

- EXEC PROCESSOR
  - CATALOGED COMMAND PROCEDURES
  - INVOKED LIKE A CMS COMMAND
  - PROFILE EXEC

- ADD NEW COMMANDS
  - ANY FILE WITH FILETYPE MODULE

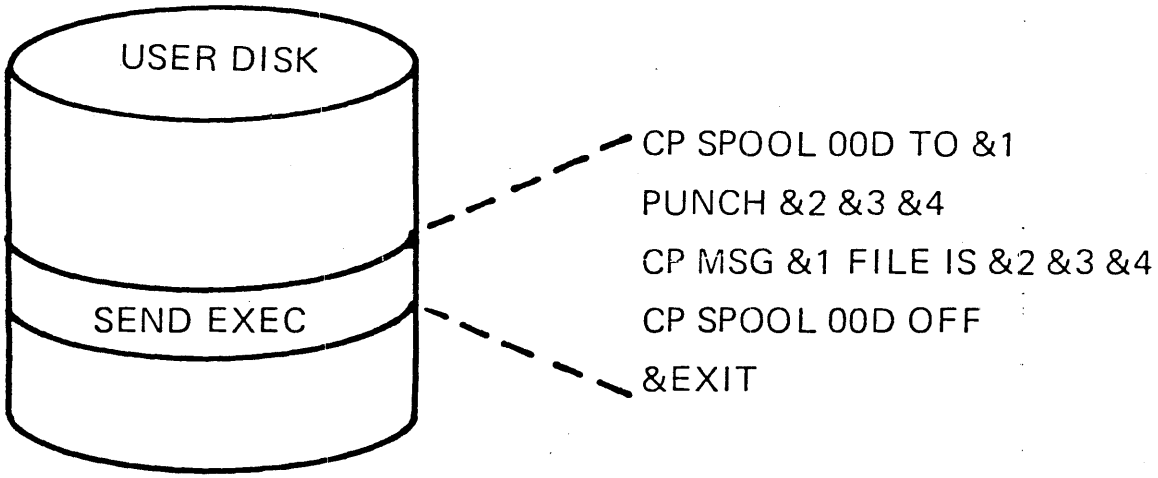
- REPLACE EXISTING COMMANDS
  - WITH EXEC FILE
  - WITH MODULE FILE

EXEC EXAMPLE



INVOKED FROM TERMINAL:
FTNDEF

EXEC EXAMPLE



INVOKED FROM TERMINAL:

```
SEND USER2 PROGA COBOL A1
```

COMMAND EXECUTION:

```
CP SPOOL 00D TO USER2
PUNCH PROGA COBOL A1
CP MSG USER2 FILE IS PROGA COBOL A1
CP SPOOL 00D OFF
```

CMS BATCH FACILITY

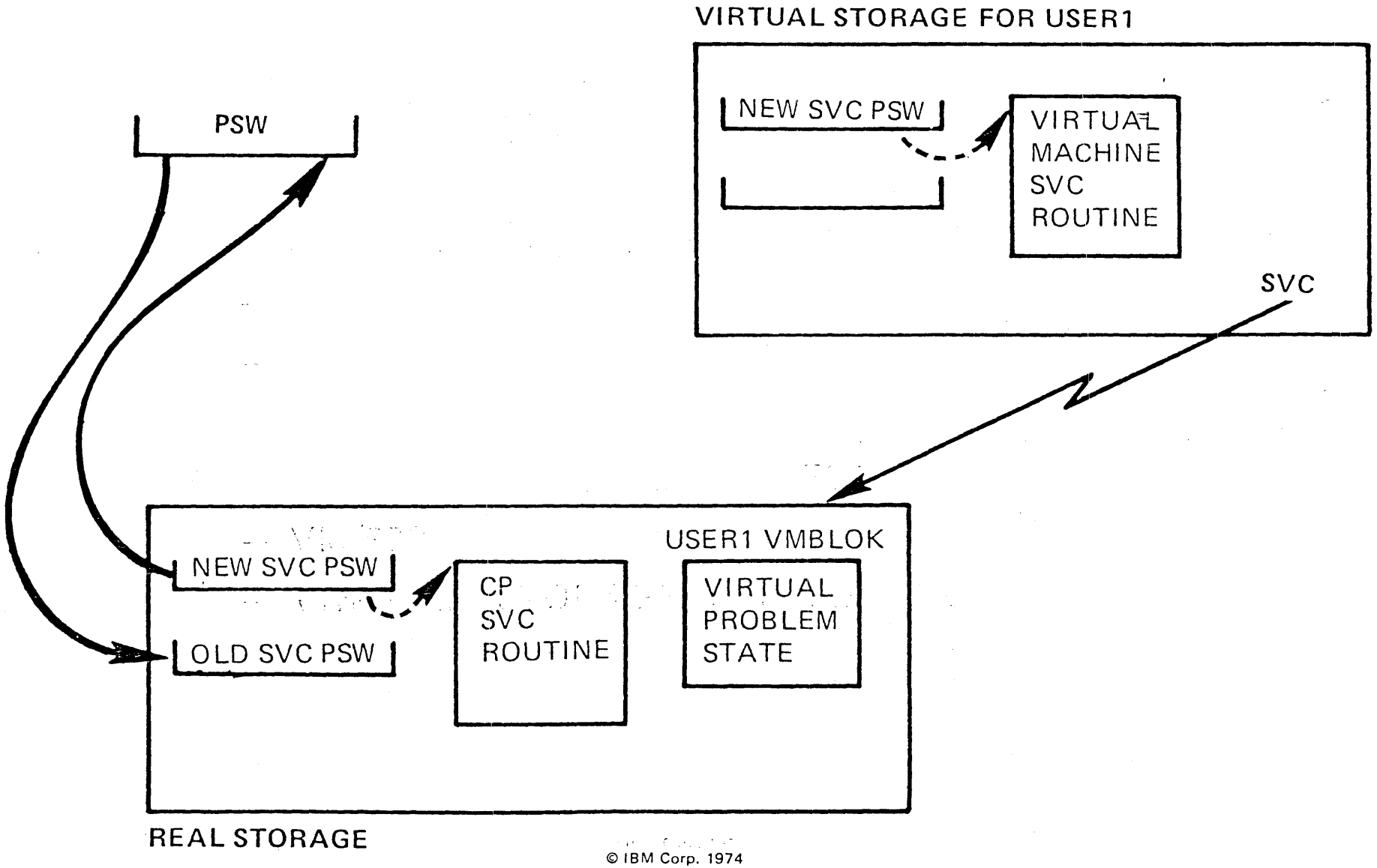
- VIRTUAL MACHINE DEDICATED TO BATCH MODE
- CONTINUOUSLY RUNNING BATCH MACHINE
- INPUT FROM:
  - ANOTHER VIRTUAL MACHINE
  - REAL CARD READER
- ACCEPTS IN AN INPUT JOB:
  - ANY USER PROGRAM WRITTEN IN A LANGUAGE SUPPORTED BY CMS
  - MOST CP AND CMS COMMANDS
- USEFUL FOR:
  - NON-CMS USER WITH BATCH REQUIREMENT
  - CMS USER WITH COMPUTE-BOUND JOBS

C P

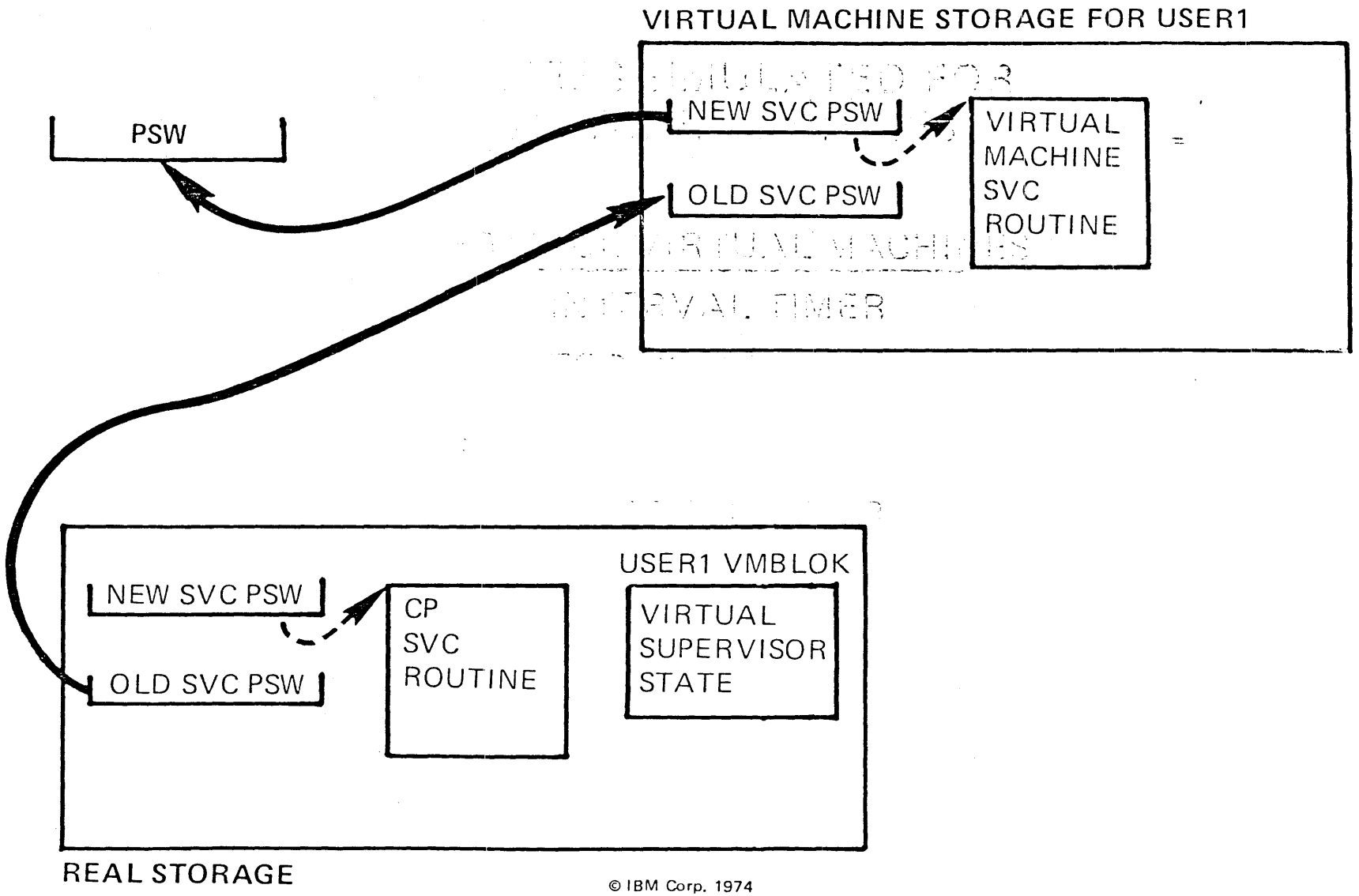
I M P L E M E N T A T I O N

- CPU MANAGEMENT
- STORAGE MANAGEMENT
- I/O MANAGEMENT

HARDWARE INTERRUPT



CP SIMULATION



VIRTUAL MACHINE ASSIST FEATURE

- RELIEVES CP OF PROCESSING OVERHEAD FOR
  - SELECTED PRIVILEGED INSTRUCTIONS
  - SVC INTERRUPTS
  - VIRTUAL MACHINE PAGE FAULTS

- IMPROVED PERFORMANCE FOR
  - VM/370
  - VIRTUAL STORAGE SYSTEMS RUNNING UNDER VM/370

TIMERS SIMULATED FOR VIRTUAL MACHINES

BC MODE VIRTUAL MACHINES

INTERVAL TIMER

TOD CLOCK

EC MODE VIRTUAL MACHINES

INTERVAL TIMER

CPU TIMER

TOD CLOCK

CLOCK COMPARATOR

CPU MANAGEMENT

- SCHEDULER
  - SELECTS COMPETING SUBSET
  - COMPETING FOR

    CPU TIME
    REAL STORAGE
    IO
- DISPATCHER
  - SELECT FROM COMPETING SUBSET

    TIME SLICE

TYPES OF USERS

- INTERACTIVE
  - UTILIZES TERMINAL I/O
  - AT FREQUENT AND REGULAR INTERVALS
  - LOW RESOURCE USER
- NON-INTERACTIVE
  - HIGH COMPUTE USER AND/OR
  - INFREQUENT TERMINAL USER
  - HIGH RESOURCE USER

INTERACTIVE MACHINES RECEIVE

PREFERENTIAL TREATMENT

SCHEDULER

- MAINTAINS ELIGIBLE LIST
- IN SCHEDULING PRIORITY SEQUENCE
- PROMOTES A USER TO DISPATCHABLE WHEN HIS STORAGE REQUIREMENTS WILL NOT OVERLOAD THE SYSTEM
- SERVICES ALL INTERACTIVE USERS FIRST

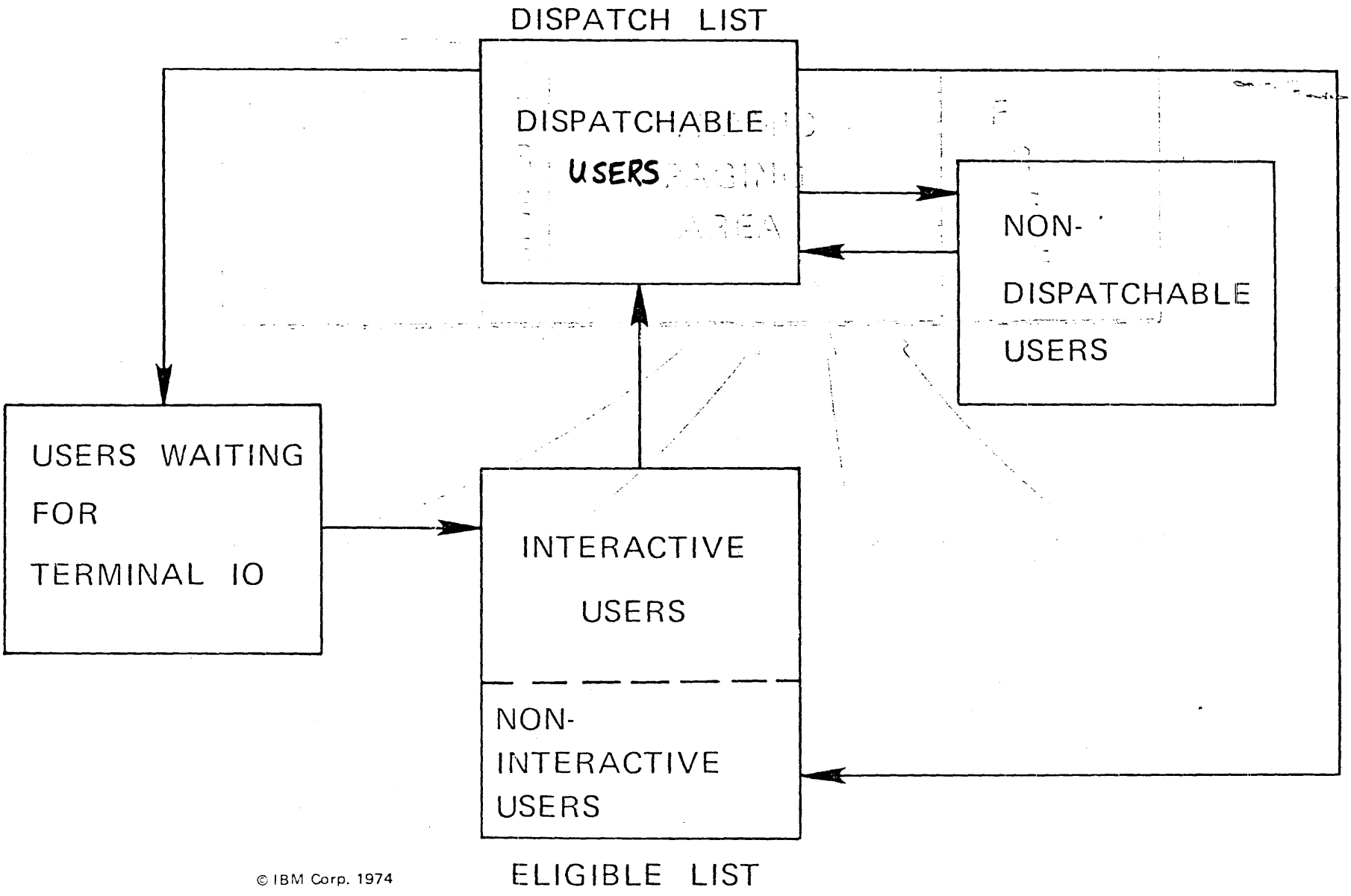
SCHEDULING PRIORITY

- USER FACTORS
  - USER PRIORITY
  - PROJECTED WORKING SET
- SYSTEM FACTORS
  - PAGING BIAS
  - USER BIAS
  - INTERACTIVE BIAS
- TIME FACTORS
  - TIME STAMP BASE
  - PRIORITY DELAY FACTOR

DISPATCHER

- MAINTAINS DISPATCH LIST
- IN DISPATCHING PRIORITY SEQUENCE
  - RATIO OF CPU TIME TO WAIT TIME
- ALLOCATES A MAXIMUM TIME SLICE
  - BASED ON TYPE OF USER
- ALLOCATES A MAXIMUM QUANTUM OF CPU TIME
  - BASED ON PAST ACTIVITY

OVERVIEW OF SCHEDULER/DISPATCHER



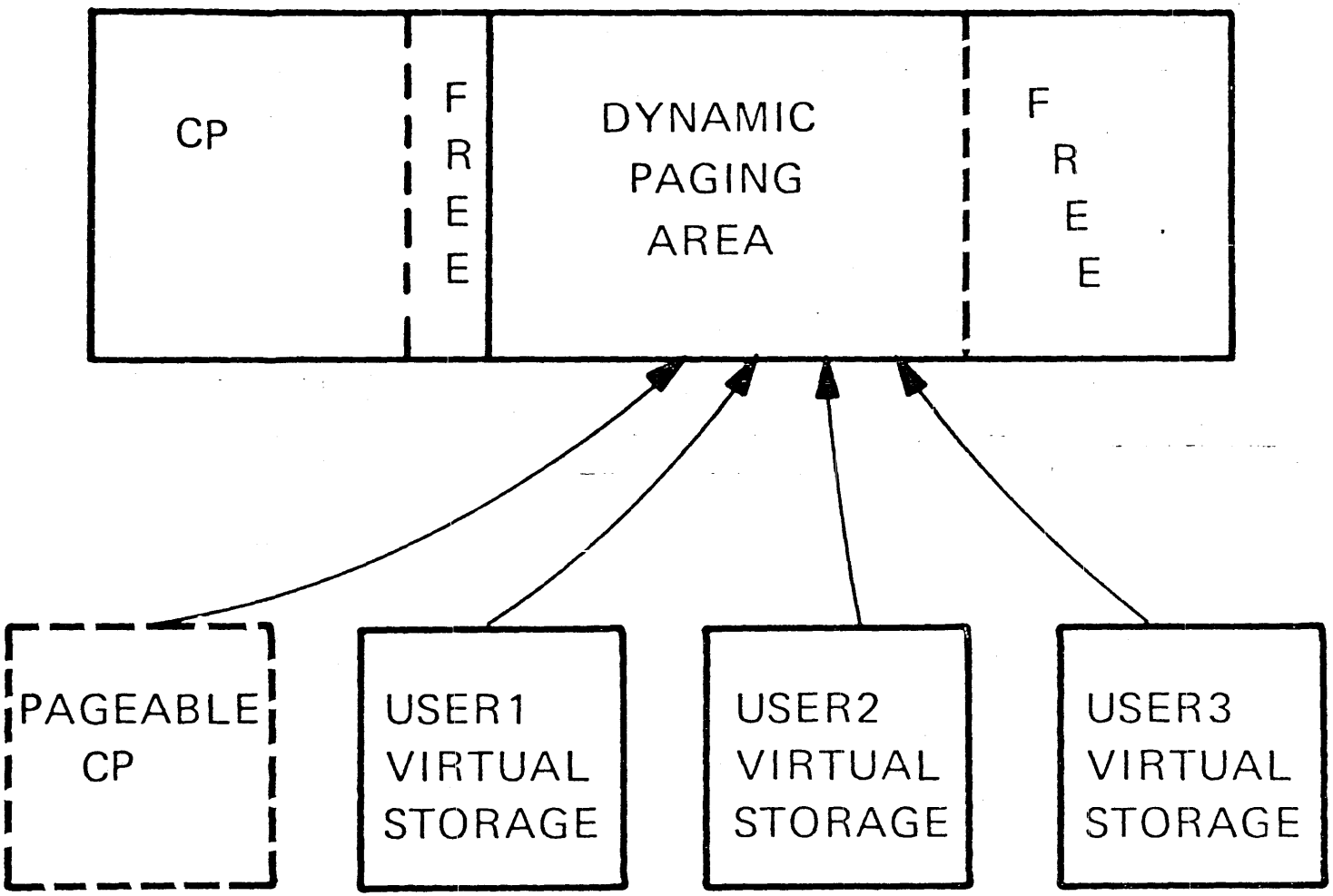
FAVORED EXECUTION

- BASIC

  VIRTUAL MACHINE DOES NOT WAIT IN ELIGIBLE LIST

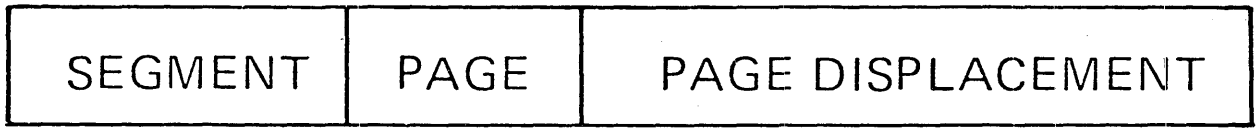
- PERCENTAGE

  DISPATCHER ATTEMPTS TO GIVE ONE VIRTUAL MACHINE A SPECIFIED PERCENTAGE OF CPU TIME

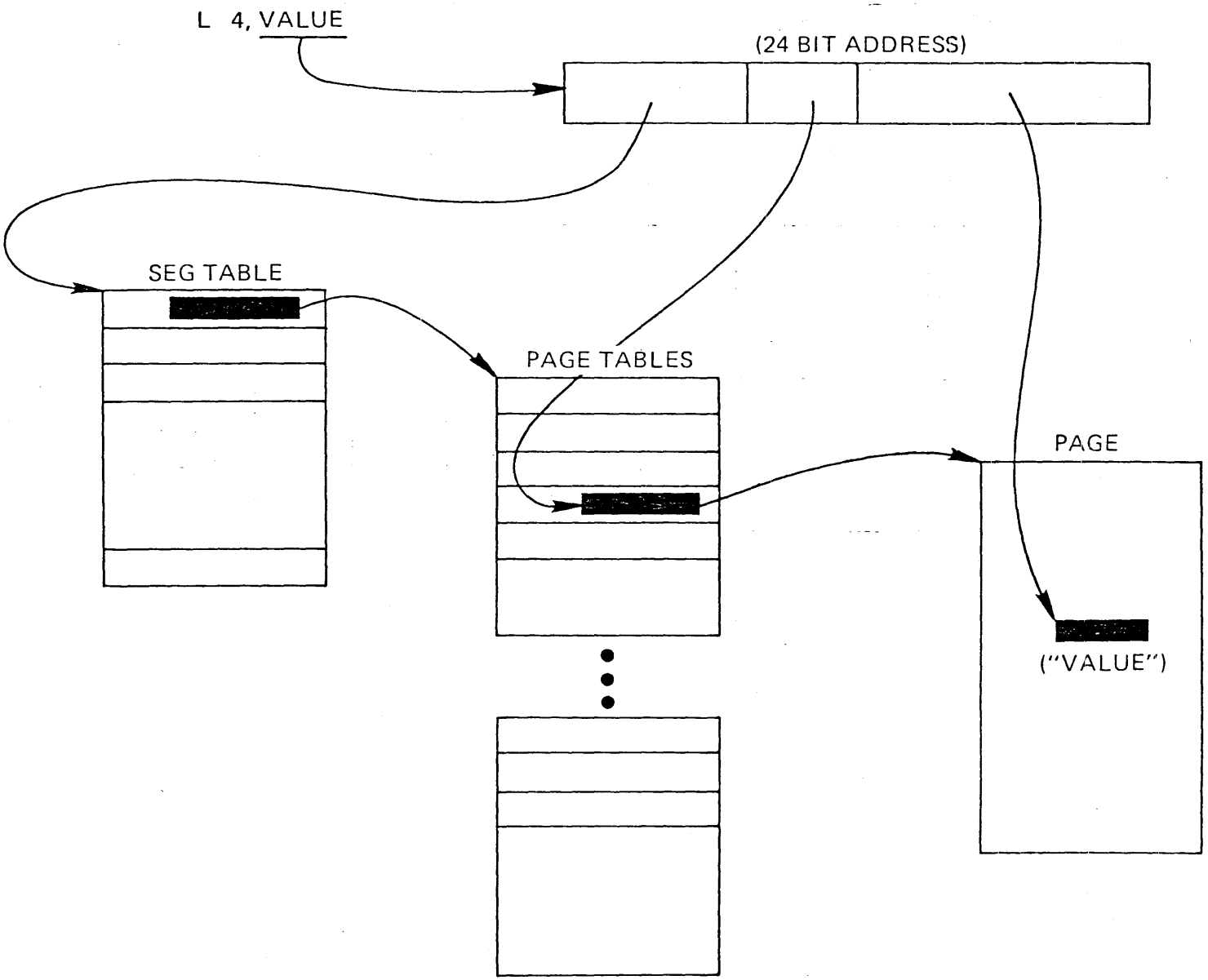


VIRTUAL MACHINE STORAGE ADDRESSES

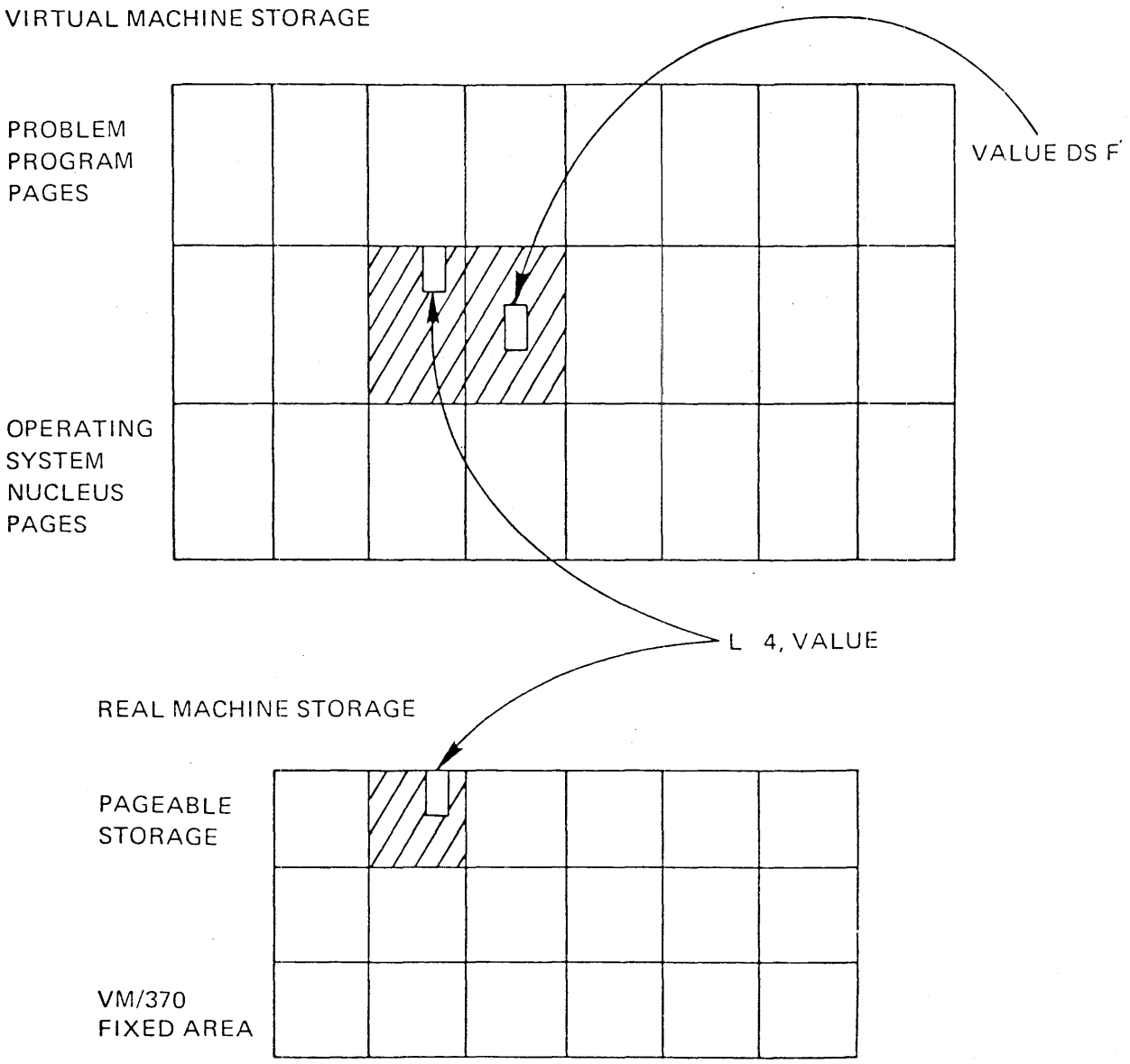
DYNAMIC ADDRESS TRANSLATION INTERPRETS THE EFFECTIVE ADDRESS AS:



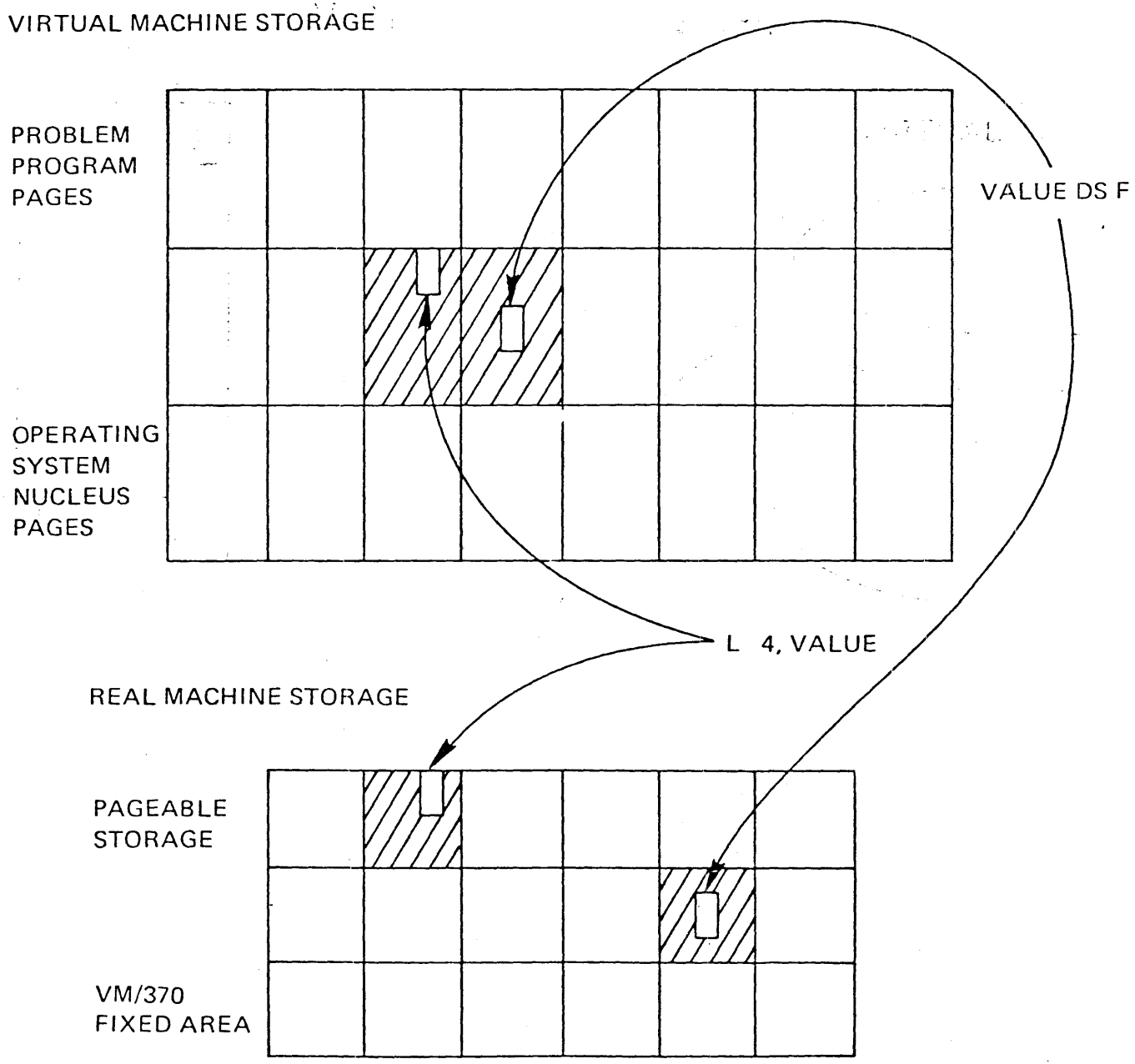
DYNAMIC ADDRESS TRANSLATION



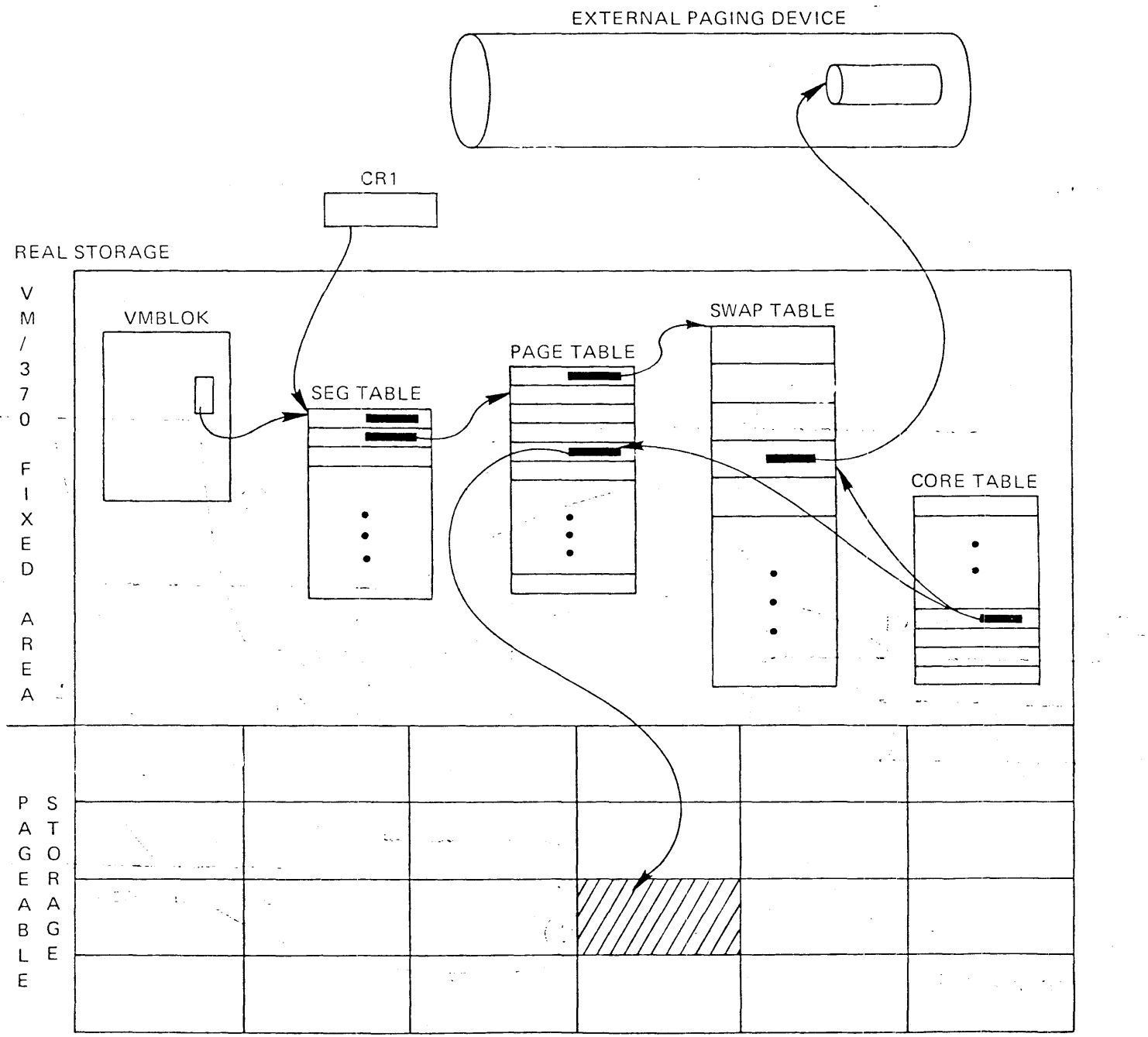
DEMAND PAGING



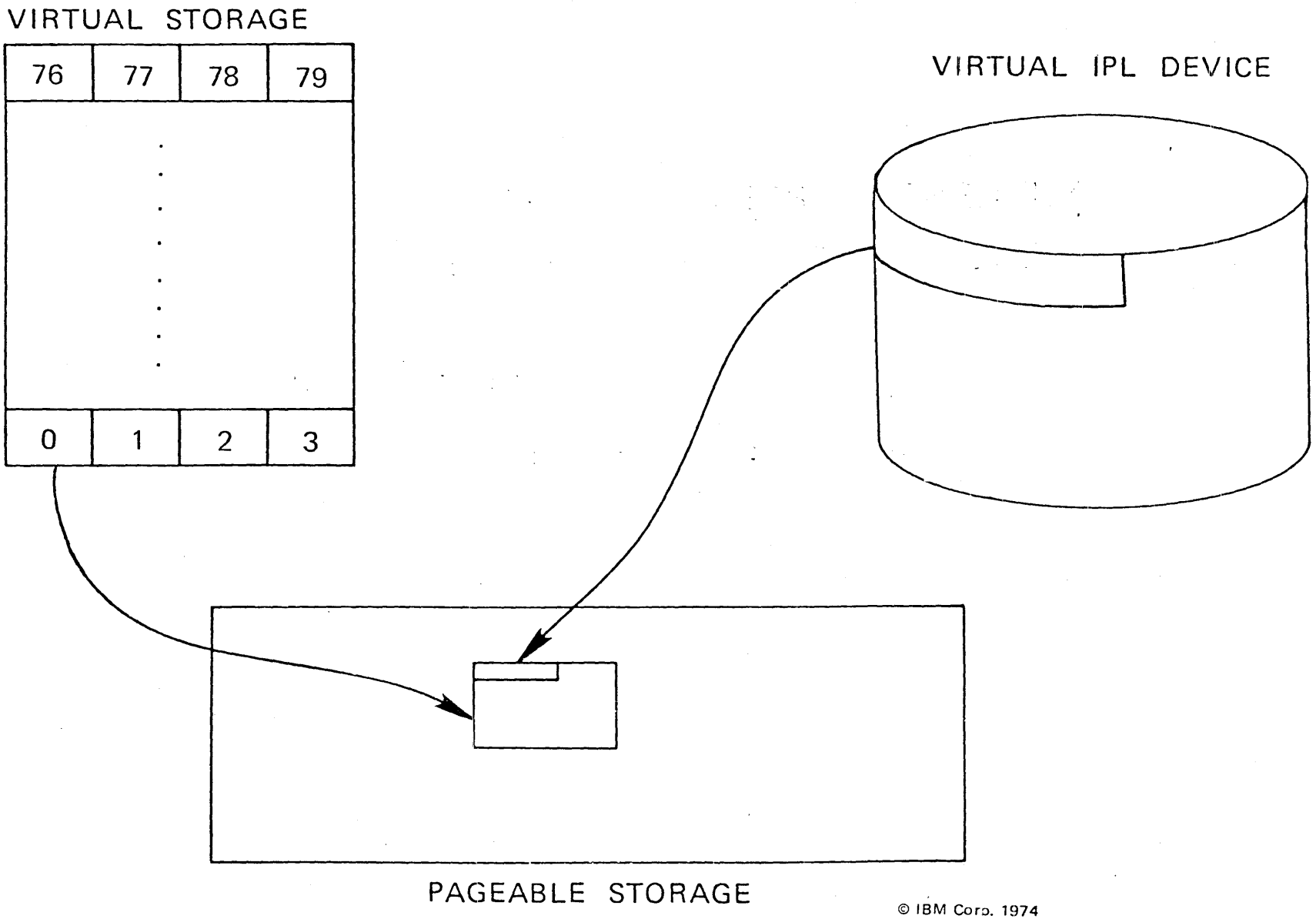
DEMAND PAGING

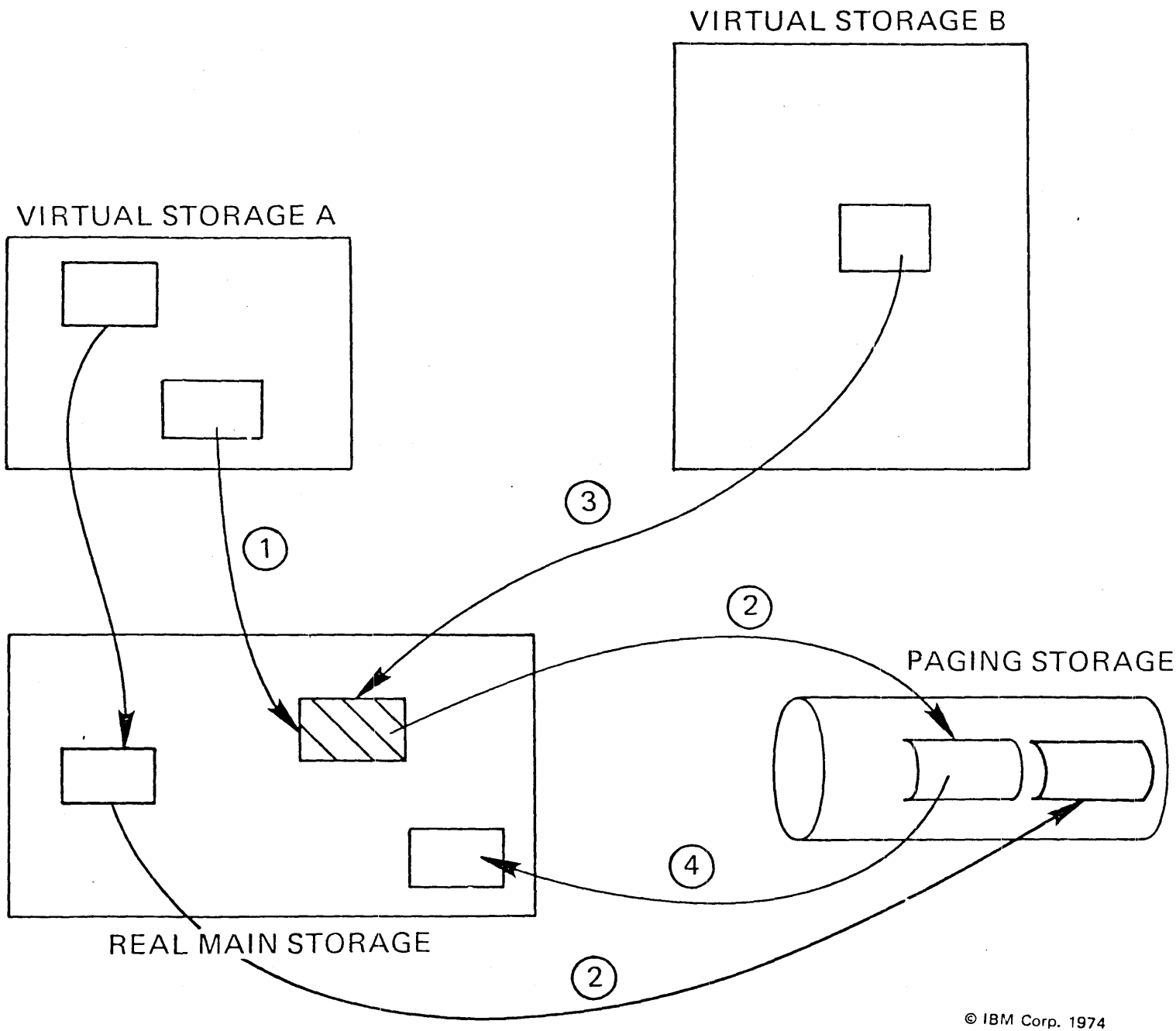


STORAGE MANAGEMENT



VIRTUAL MACHINE IPL





PAGE FRAME LISTS

- **USER LIST**
  - ALLOCATED TO USERS CURRENTLY COMPETING FOR SYSTEM RESOURCES
- **FLUSH LIST**
  - ALLOCATED TO USERS DROPPED FROM DISPATCH LIST
- **FREE LIST**
  - AVAILABLE FOR ALLOCATION

PAGE FRAME MOVEMENT

- USERLIST TO FLUSHLIST

  AT TIME SLICE END

- FLUSHLIST TO FREELIST

  TO REPLENISH FREELIST MINIMUM

- USERLIST TO FREELIST

  AT RE-IPL

  AT LOGOFF

  VIA DIAGNOSE

  TO REPLENISH FREELIST MINIMUM

EXTERNAL SPACE ALLOCATION

- COMMON POOL OF SPACE FOR PAGING AND SPOOLING
- VARIABLE SPACE REQUIREMENTS
- DEMAND ALLOCATION BY CYLINDER
- PREFERRED PAGING DEVICES

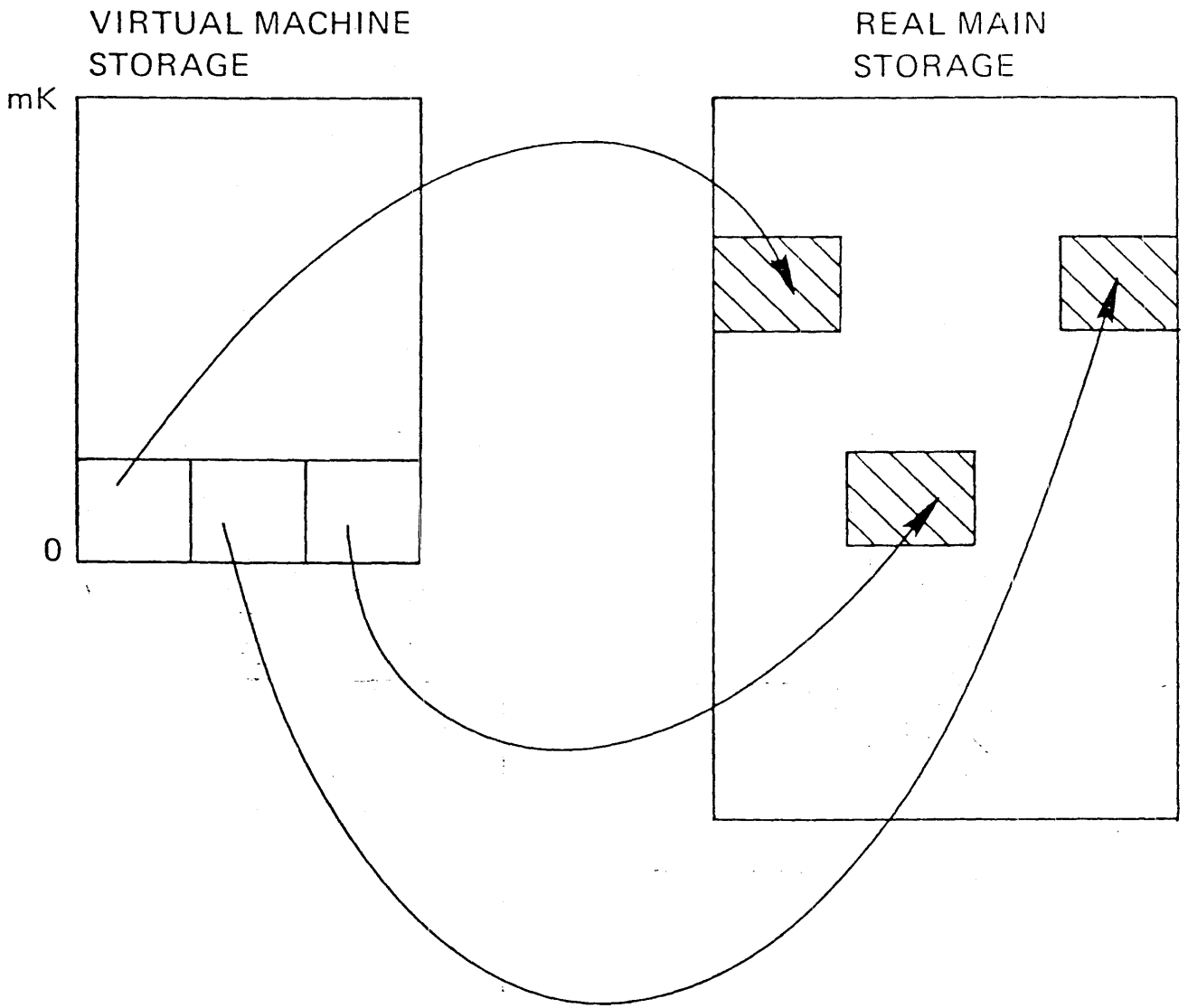
EXTERNAL SLOT SELECTION

- UPWARD MIGRATION
- OPTIMIZE SEEK TIME
- DYNAMIC RELEASE

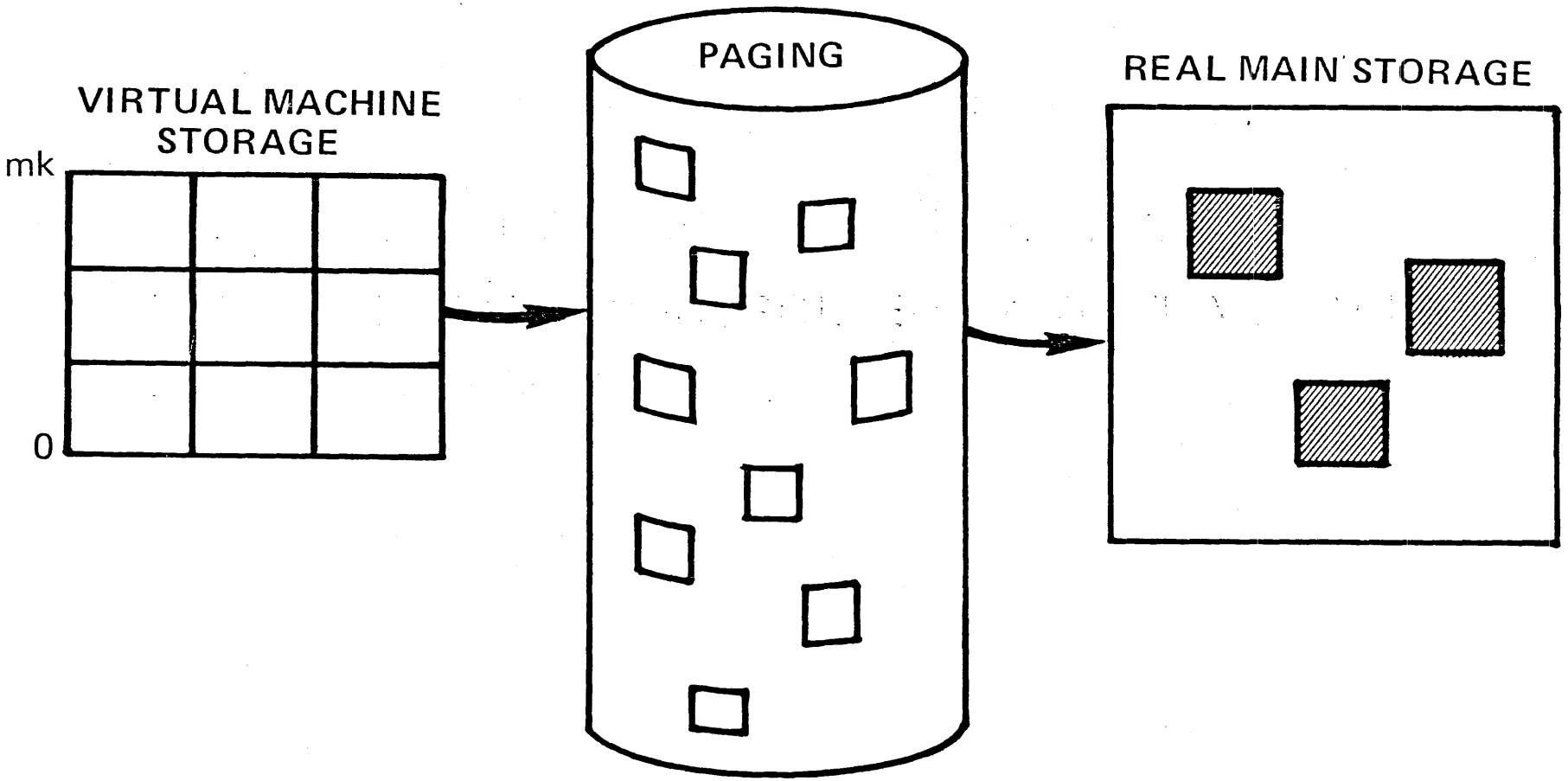
PERFORMANCE OPTIONS FOR STORAGE MANAGEMENT

- LOCKED PAGES
- RESERVED PAGE FRAMES
- VIRTUAL = REAL

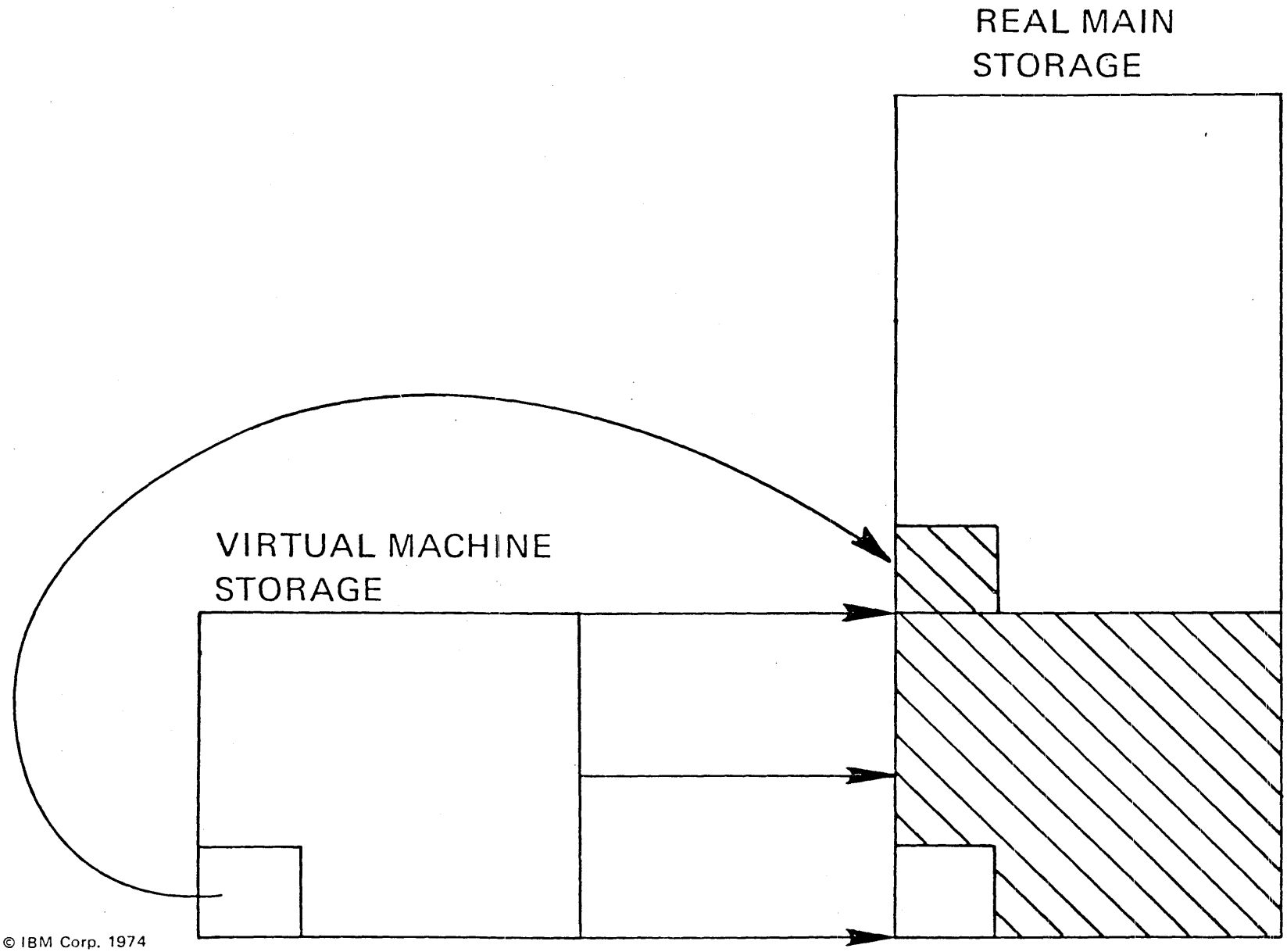
LOCKED PAGES



RESERVED PAGE FRAMES



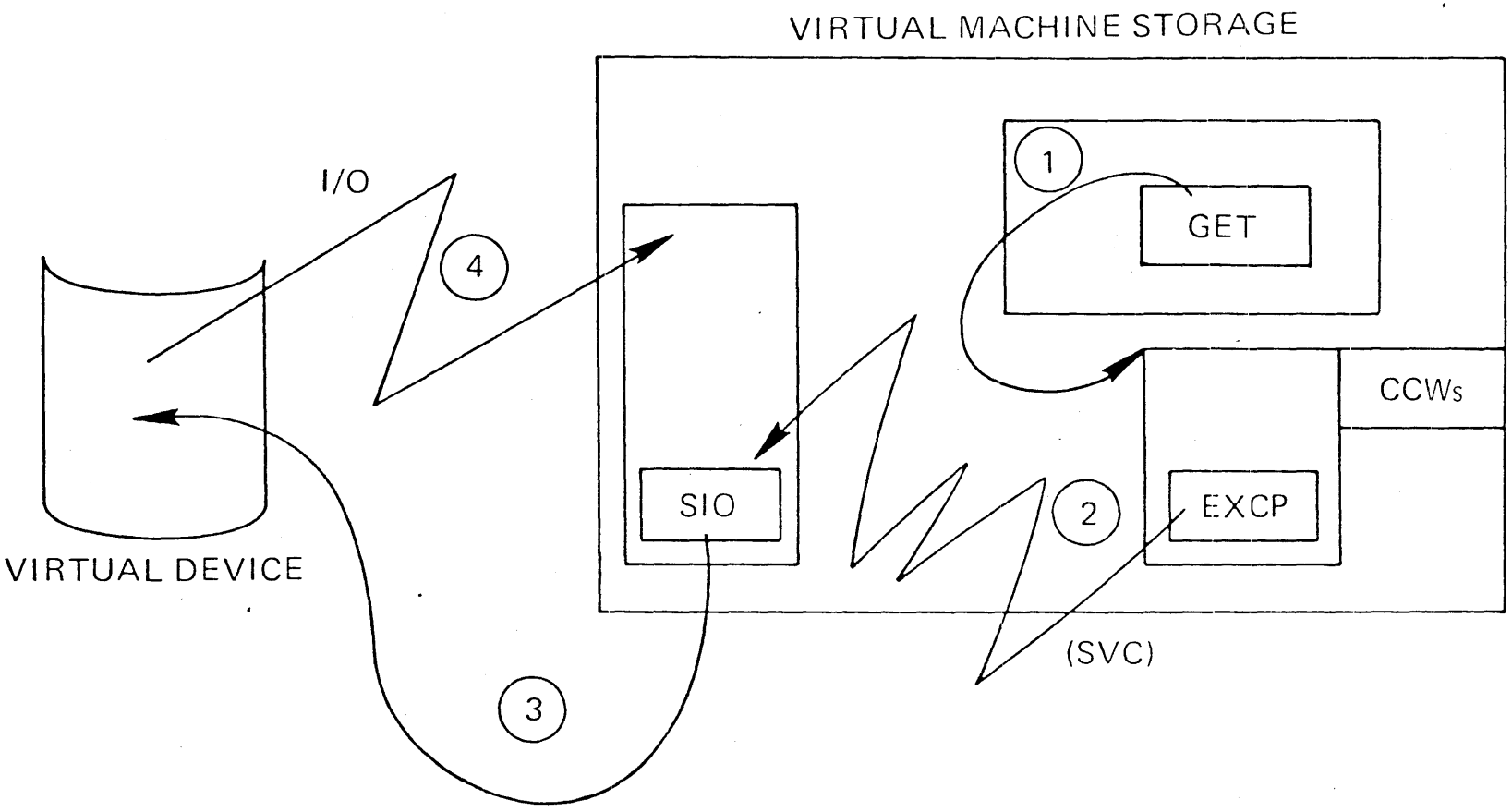
VIRTUAL = REAL



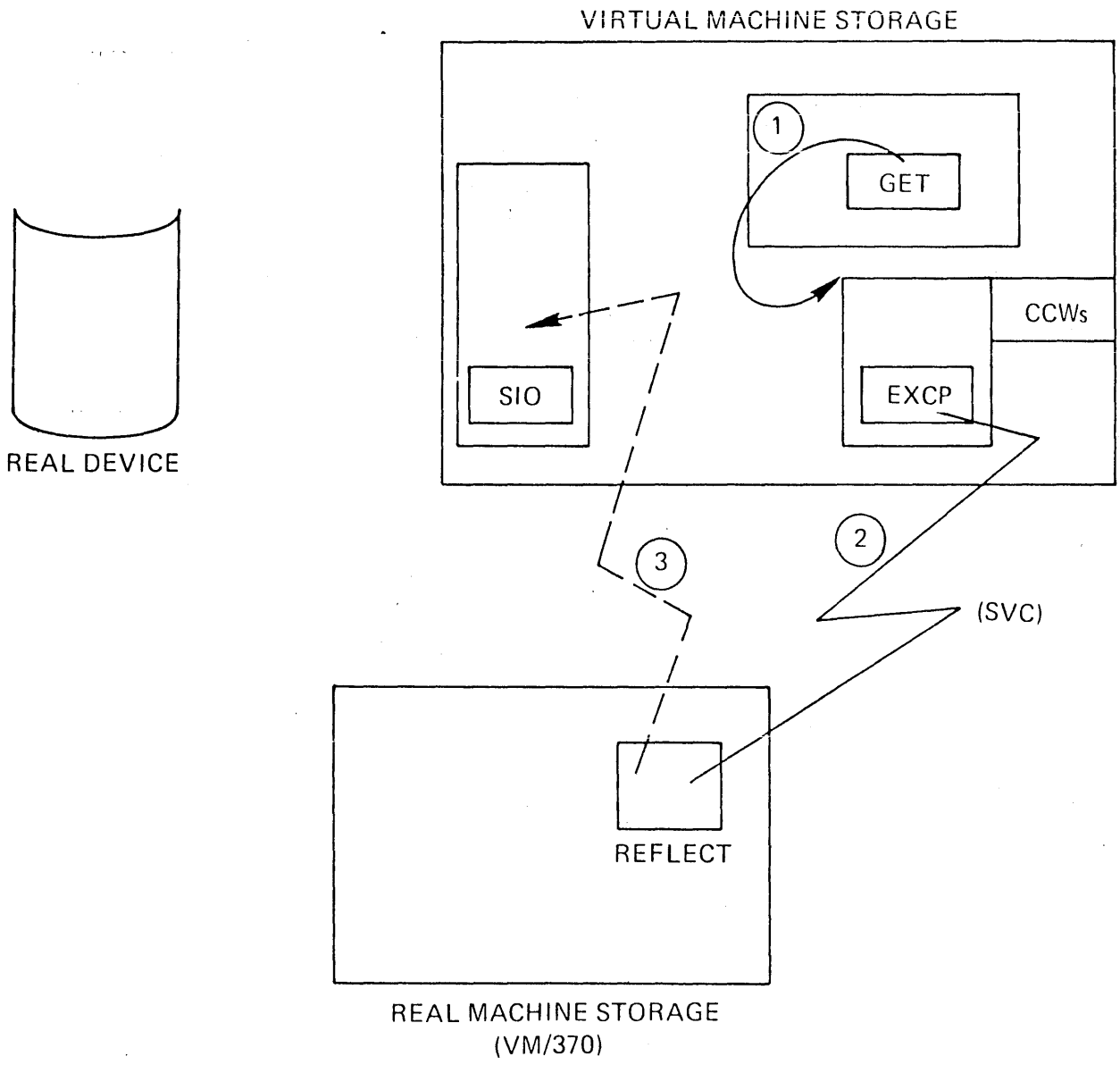
VIRTUAL MACHINE I/O OPERATIONS

- I/O OPERATIONS INITIATED BY VIRTUAL MACHINE
- I/O ERROR RECOVERY CONTROLLED BY VIRTUAL MACHINE
- I/O ERRORS RECORDED BY VM/370

EXPECTED I/O SEQUENCE

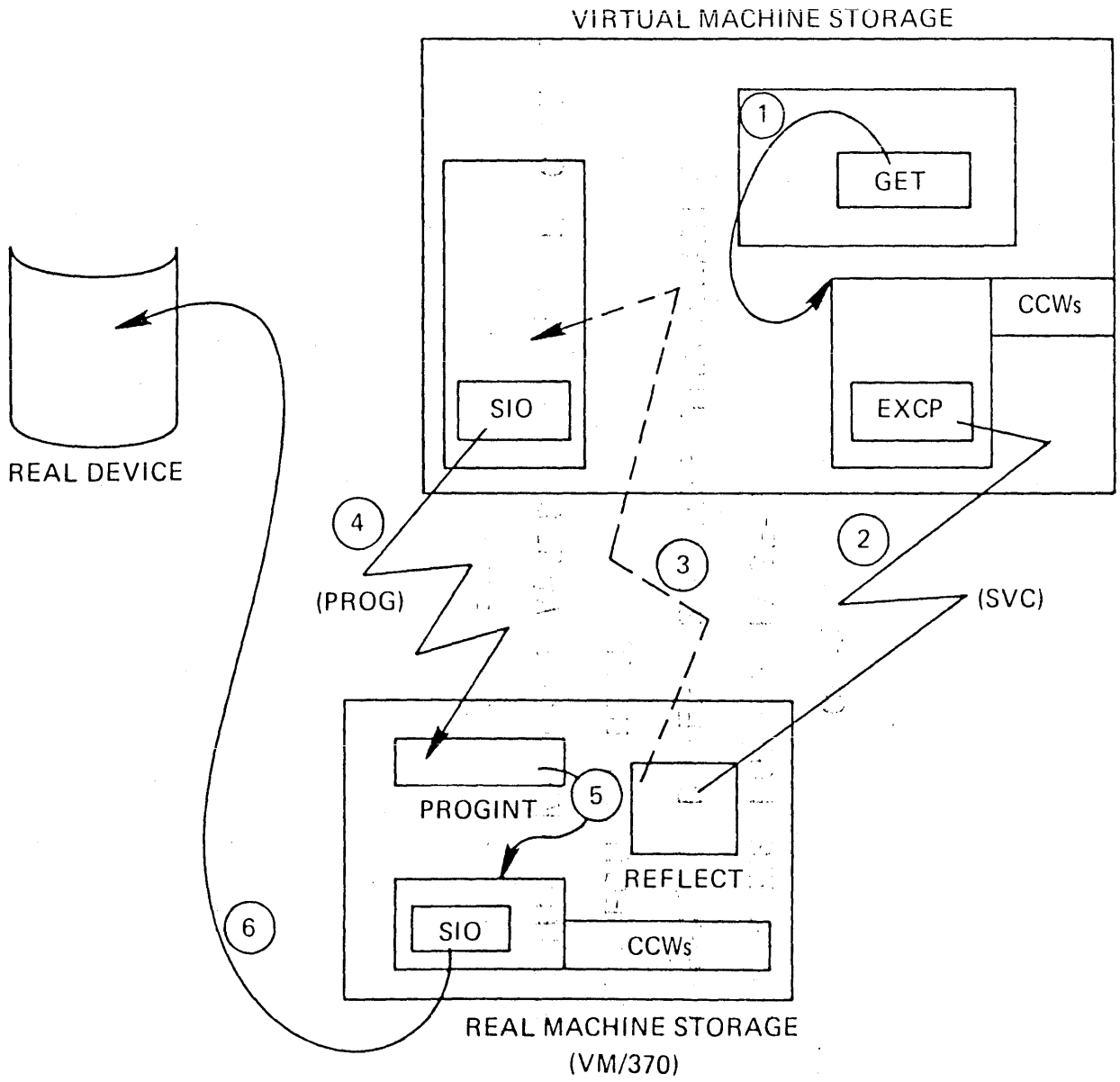


INTERRUPT REFLECTION



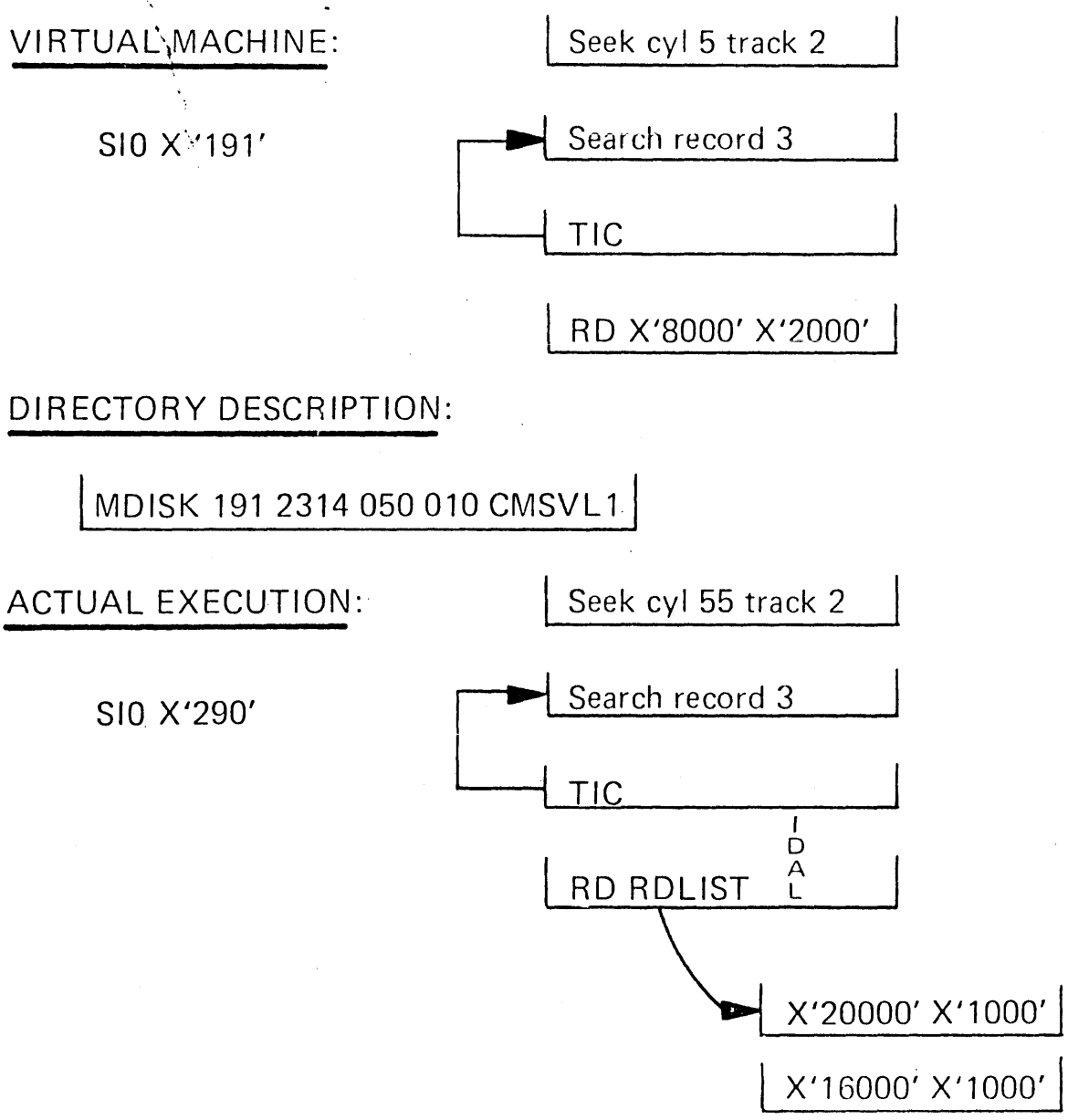
I/O SEQUENCE

INTERRUPT REFLECTION
PROBLEM STATE EXECUTION



I/O SEQUENCE

CCW TRANSLATION



PERFORMANCE CONSIDERATIONS FOR I/O MANAGEMENT

- DIAGNOSE INTERFACE
  - USED BY CMS
  - CP PERFORMS THE ERROR RECOVERY
  - VIRTUAL MACHINE WAITS UNTIL I/O IS COMPLETE
- VIRTUAL EQUALS REAL
  - BYPASSES BUFFER STORAGE TRANSLATION
  - BYPASSES BUFFER PAGE-INS
- VIRTUAL MACHINE CHANNEL MODE
  - BYTE MULTIPLEXOR
  - BLOCK MULTIPLEXOR
  - SELECTOR

VM/370

RESTRICTIONS

VM/370 RESTRICTIONS

- DYNAMICALLY MODIFIED CHANNEL PROGRAMS
- MINI-DISK RESTRICTIONS
  - MVT ISAM
  - IBCDASDI
- TIMING DEPENDENCIES
- CPU MODEL DEPENDENCIES
  - LOGOUT AREA
  - CPU ID
  - CHANNEL ID
  - NO OTHER CPU SIMULATION

VM/370 RESTRICTIONS (CONTINUED)

- VM CHARACTERISTICS
  - V=R I/O
  - OS BTAM, OS QTAM, DOS QTAM, OS TCAM, OS/VS TCAM
  - NUMBER OF PAGES FOR I/O < MAX USER PAGES
  - NO READ DIRECT, WRITE DIRECT
  - PSEUDO-TIMER DOESN'T RETURN INTERRUPT FROM SIO
  - VM IPL WITH NO CLEAR
  - DATA TRANSFER, MAXIMUM 2032 BYTES To/from Virt. Console
  - NO MORE THAN 73 VIRTUAL DEVICES (SPOOL)

ANY PHYSICAL DEVICE IS A REAL DEVICE, VIRTUAL DEVICES ARE SIMULATED BY VM.

VM/370 RESTRICTIONS (CONTINUED)

- CMS RESTRICTIONS
  - MAXIMUM 246 CYLINDERS ON A 3330 for MINIDISK
  - NO DEDICATED UNIT RECORD EQUIPMENT
  - EXECUTING OS PROGRAM BY SIMULATION
  - NO EXECUTION OF DOS OBJECT PROGRAMS
  - DOES NOT CREATE, READ, WRITE DOS DATA SETS
  - DOES NOT CREATE, WRITE OS DATA SETS
  - CMS UNDER VM/370

PERFORMANCE

TOOLS

VM/370 PERFORMANCE TOOLS

- VM/370 MEASUREMENT FACILITY

  LOAD INDICATORS

  VM/MONITOR

- VM/STATISTICS GENERATING PACKAGE

LOAD INDICATORS

FOR OPERATORS AND SYSTEMS STAFF

INDICATE	LOAD	
	USER	*
	QUEUES	USERID
	I/O	
	PAGING	WAIT
		ALL

FOR USERS

INDICATE	LOAD	
	USER	*

ACNT COMMAND RESETS ALL LOAD ACCUMULATORS.

LOAD INDICATORS

LOAD -- CPU TIME PERCENTAGE
USERS IN QUEUE 1
USERS IN QUEUE 2
USE PERCENTAGE OF REAL STORAGE
SCHEDULER CONTENTION RATIO

USER -- NUMBER USER'S PAGES RESIDENT
USER'S WORKING SET SIZE
PAGE READS
PAGE WRITES
VIRTUAL PAGES ON DISK PAGING SPACE
VIRTUAL PAGES ON DRUM PAGING SPACE
TOTAL VIRTUAL TIME
TOTAL VIRTUAL AND SIMULATION TIME
NON-SPOOLED I/O REQUESTS
VIRTUAL CARDS READ
VIRTUAL CARDS PRINTED
VIRTUAL CARDS PUNCHED

LOAD INDICATORS

FOR OPERATORS ONLY

QUEUES --	ELIGIBLE OR QUEUE LISTS OCCUPIED (E1, E2, Q1, Q2)
	STATUS INDICATORS (RU, PG, IO, EX, PS)
	NUMBER OF PAGES RESIDENT IN REAL STORAGE (HEXADECIMAL)
	WORKING SET IN PAGES (HEXADECIMAL)
I/O --	USERS IN I/O WAIT
	ADDRESS OF REAL DEVICE
PAGING WAIT --	USER IDS IN PAGE WAIT
	NUMBER OF PAGE FRAMES ON DRUM AND DISK
PAGING ALL --	PAGE RESIDENCY DATA FOR ALL USERS

MONITOR

DISPLAY			
ENABLE	PERFORM		
	RESPONSE		
	SCHEDULE		
	USER		
	INSTSIM		
	DAS TAP		
	SEEKS		
	SYSPROF		
INTERVAL	NNNNN	SEC	
		MIN	
START	CPTRACE		
	TAPE	RADDR	MODE

VM/MONITOR

RECORD FOLLOWING EVENTS

- EXTERNAL INTERRUPTS
- SVC INTERRUPTS
- PROGRAM INTERRUPTS
- MACHINE CHECK INTERRUPTS
- I/O INTERRUPTS
- FREE STORAGE REQUESTS
- RELEASE OF FREE STORAGE
- ENTRY INTO SCHEDULER
- QUEUE DROP
- RUN USER REQUESTS
- START I/O
- UNSTACK I/O INTERRUPTS
- STORING A VIRTUAL CSW
- TEXT I/O
- HALT DEVICE
- UNSTACK IOBLOK OR TRQBLOK
- NCP BTU

MONITOR COMMAND

MONITOR

DISPLAY			
ENABLE	PERFORM		
	RESPONSE		
	SCHEDULE		
	USER		
	INSTSIM		
	DASTAP		
	SEEKS		
	SYSPROF		
INTERVAL	NNNNN	SEC	
		MIN	
START	CPTRACE		
	TAPE	RADDR	MODE 800
			MODE 1600
			MODE 6250
STOP	CPTRACE		
	TAPE		

VM/STATISTICS GENERATING PACKAGE

REDUCTION OF DATA FROM VM/370 MEASUREMENT FACILITY.

SUMMARIZATION TECHNIQUES.

FORMAT AND PRINT TRACE DATA.

VM/SGP

PROGRAM GENERATOR

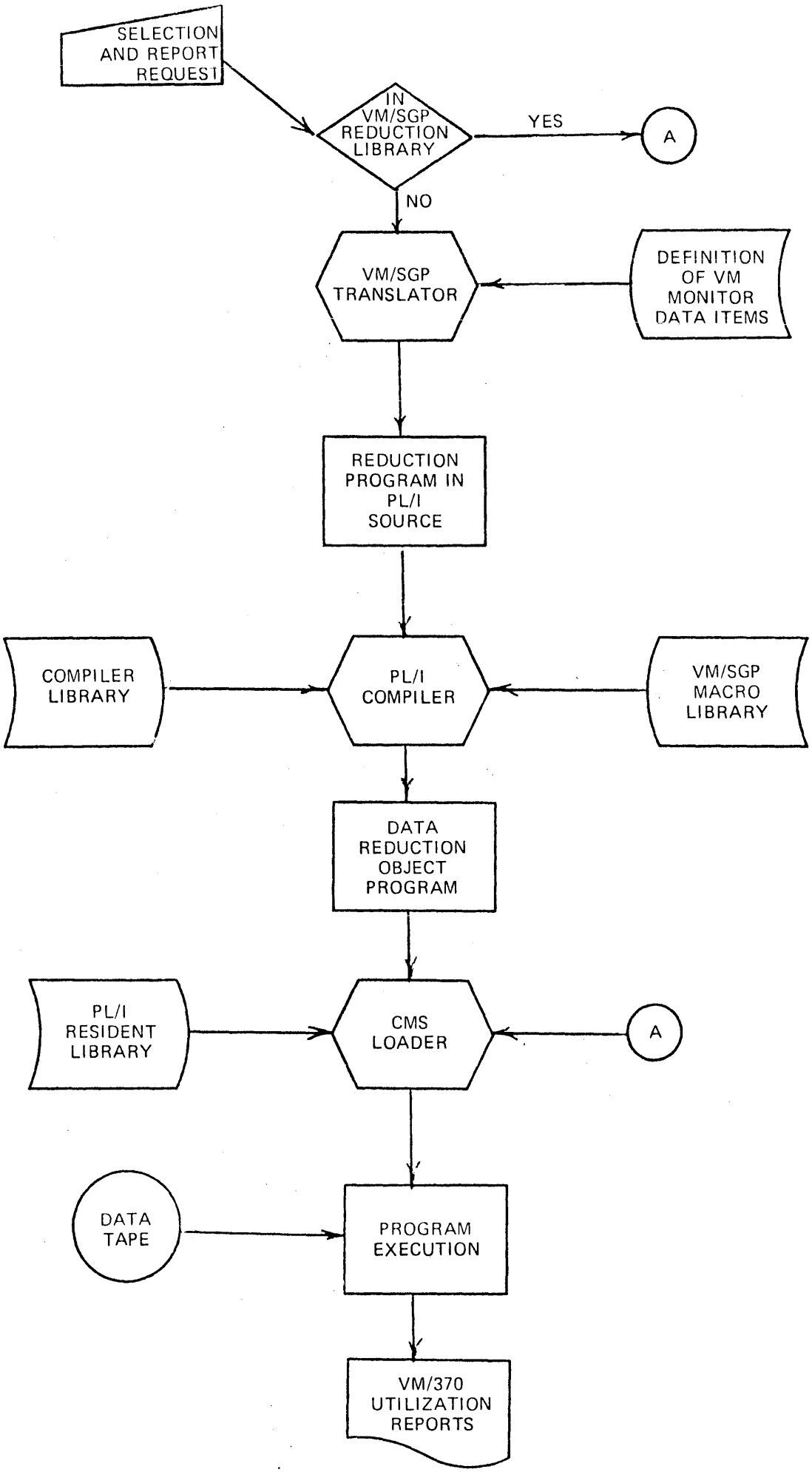
USES PL/1 LANGUAGE

STATISTICAL ANALYSIS

- MEANS
- VARIANCES
- STANDARD DEVIATIONS
- DISTRIBUTIONS

ACCUMULATIVE HISTORY

- HARDWARE UTILIZATION
- SOFTWARE PERFORMANCE
- USER LOAD



The flow to produce data reduction programs for the VM/370 Measurement Facility using VM/SGP.

SIMPLE KEYWORD USAGE

PERCENT__CPU

PAGING__RATE

USERS__LOGGED

MEAN

MIN

MAX

TOTAL

```
REQUIRE   (CLASS__NUMBER = 4, &CODE__NUMBER = 0) &
           (USERID = 'ABC')  &
          ('10.00.00' <= TIME<= '12.00.00');
```

SYSTEM

INTEGRITY

VM/370 INTEGRITY

- EIGHT-CHARACTER USER ID
- EIGHT-CHARACTER PASSWORD
- MINI-DISK PASSWORD
- STORE AND FETCH PROTECTION
- CP COMMAND PRIVILEGE CLASS

OS/360 AND VM/370
SECURITY/INTEGRITY COMPARISON

- OS/360
  - SINGLE ADDRESS SPACE
  - ADDRESS SPACE PARTITIONED
  - PROTECTED BY STORAGE KEYS
  - USERS ACCESS THEIR OWN REGION
  - CONTROL BLOCKS MANAGE USES AND RESOURCES
  - MANY SVR CONTROL BLOCKS IN USER REGIONS
  - MANY PORTIONS OF OS EXECUTED IN USER REGIONS

OS/360 AND VM/370
SECURITY/INTEGRITY COMPARISON (CONTINUED)

- VM/370
  - CP CONTROLS THE REAL RESOURCES
  - CMS IS ONE-USER OPERATING SYSTEM
  - CP CREATES VIRTUAL MEMORY FOR EACH USER
  - VIRTUAL MEMORY CODE NOT INTERFERED BY CP
  - NO COMMON CP AND USER ACCESS METHOD
  - I/O OF VM MAPPED INTO REAL I/O SUBSYSTEM
  - MINI-DISK MAPPED INTO REAL DISK PACK