System/36

Internals

COMMON Session 45B

Dallas, Texas

October 22, 1986

#### Table of Contents

1.0 OPERATING SYSTEM IMPLEMENTATION	•	0 6			0 0	6	0	۰	٠	٠	۰	0	2
2.0 SYSTEM/36 OPERATING SYSTEM .		e e			• •					۰	0	0	~
2.1 SYSTEM SOFTWARE STRUCTURE .	0 0	0 0		0		0	•	0		•	0	0	4
3.0 MAIN STORAGE CONCEPTS		0 0				0		•		۰			Ę
3.1 MAIN STORAGE STRUCTURE 3.1.1 SYSTEM AREA 3.1.1.1 FIXED NUCLEUS: 3.1.1.2 VARIABLE NUCLEUS	e s			. 0		•	۰		9	0	0	•	6
3.1.1 SYSTEM AREA	0 0				0 0	0	0	0	0	0	0		í
3.1.1.1 FIXED NUCLEUS:		• •					0	•	٠	۰	0	0	-
3.1.1.2 VARIABLE NUCLEUS		9 6		• ,	• •	•	. 0	•	۰	٠			8
3.1.1.2.1 SYSTEM QUEUE SPACE ACCE	ESS	6		•	0 0	0	9			0	0		2
3.1.1.2.2 HOW MANY PROGRAMS CAN I													
3.1.1.2.3 TRANSIENT AREA AND TRAN	NSLAT	ED.	TRA	INS.	LEN	TS		0	•		0	•	11
3.1.2 USER AREA		• •			0 0	0	•		•		0		1:
3.1.2.2 WORK SPACE CONSIDERATIONS	2				0							9	1 5
3.2 DATA BUFFERING	5	0 0		0	0 0	0	8	۵	0	0	0		16
3.2.1 USER PROGRAMS		0 0		9		0	•		٥				16
3.2.1.1 "DISK FILE SPACE" - APPR	ENDED		•			0		•					18
3.2.1.2 "DISK FILE SPACE" - NONA	APPEN	DEL	)	•									10
3.3 PROGRAM ATTRIBUTES	٧ ځاست شد شد	صلة المستاد الميلة ا	,										2.0
3.3.1 EXECUTION ATTRIBUTES													21
3.3.1.1 EXECUTION ATTRIBUTES - EX	KAMPL	E	•										22
3.3.1.2 EXAMPLE - REENTRANT CODE	MAJO	RE	ENE	EFI	r								23
3.3.2 STORAGE ATTRIBUTES													24
3.3.3 PROGRAM ATTRIBUTES SUMMARY													25
3.4 PROGRAM OVERLAY STRUCTURE .													26
3.4.1 OVERLAYS			0				9		9	0			28
3.4.2 SEGMENTATION													30
3.4.2.1 TYPES OF SEGMENTS													
3.4.3 MEMORY RESIDENT OVERLAYS	o o				8 6		۰	۰					32
4.0 ADDRESSING			٠			0	۰	0	0	•	ø	0	33
4.1 REAL ADDRESSING OVERVIEW				a .			٥	9	0	•	0		34
4.2 TRANSLATED ADDRESSING OVERVIEW		0 0				6	9		9	0	9		35
4.3 PREFIX ADDRESS CONTAINED TRANSI	LATIO	N		•		6	۰			6	0	•	36
4.4 REGION MAPPING	0 0				o e	0		•	0			•	37
4.5 ADDRESS TRANSLATION REGISTERS (	(ATRS	)		6		Φ	6	۰					38
5.0 PROGRAM EXECUTION CHARACTERISTIC	CS							•		0		9	39
6.0 TASK MANAGEMENT			•	_	-	•	•	0	0	0		•	40
6.1 WAIT STATE												•	41
6.2 READY STATE											•	٠	41
6.3 ACTIVE STATE												0	41
											۰	•	42
	9 0										•	•	44
6.4.2 READY TASK LIST QUEUE	0 9	0 0		0 (		•	•	•		•	0	0	40
=======================================							===		2 000 5				
AEB i												86	

MANUEL STATES AND ADDRESS AND	
CVCTEM/26 TAMEDNATC	

SYSTEM/36 INTERNALS	
	Date obstace deposits
7.0 MAIN STORAGE CONTENTS MANAGEMENT	46
7.1 PROGRAM LOADING	
7.1.1 PROGRAM LAYOUT IN MAIN STORAGE - EXAMPLE	48
7.2 PROCESSING CONSIDERATIONS	
7.3 SYSTEM TIME SLICE	
7.3.1 SYSTEM TIMER	
7.3.2 RESOURCE UTILIZATION SCHEME	52
7.3.2.1 RESOURCE TIMER (R-TIME)	52
	53
7.3.2.2 MSP TIME-OUT TIMER (MSP-TIME)	54 55
7.3.2.2.1 RESOURCE UTILIZATION (MSP-TIME) - EXAMPLE	
7.4 TASK EXECUTION PRIORITY	
7.4.1 EXECUTION PRIORITY VALUES	
7.4.1.1 USER EXECUTION PRIORITIES	
7.4.1.2.1 USER EXECUTION PRIORITY FORMULA	
7.4.1.2.2 USER PRIORITY (FIXED AND VARIABLE) AND DISK I/O - EXAMPLE	61
	62
7.5 SWAPPING FUNCTION	
7.5.1 SWAPPING CRITERIA	64
7.5.1.1 SWAP IN	65
7.5.1.2 SWAP OUT/RELEASE OF MEMORY	
	69
	70
	, 0
3.0 DISTRIBUTION OF SOFTWARE FUNCTIONS AND EXECUTION	7.
8.1 MAIN STORAGE PROCESSOR (MSP) - LAYER 1	72
	73
	74
8.2.1.1 IMMEDIATE SVC - EXAMPLE	75
	76
	77
8.3 I/O DEVICE ATTACHMENTS - LAYER 3	78
	78
8.3.1.1 I/O CHANNEL	79
8.3.2 I/O DEVICE ATTACHMENTS	80
8.3.2.1 DATA STORAGE ATTACHMENT (DSA)	81
8.3.2.2 MAGNETIC TAPE ATTACHMENT	82
8.4 PIPLELINED OPERATING SYSTEM	85
	0 0

		- 19 20 THE THE THE THE THE THE TANK THE SET OF THE SET
AEB	ii	09/13/86

87

89

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8.5 PROCESSORS SUMMARY . . . . . .

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By: Al Brown

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SYSTEM/36	INTERNALS

- 1.0 OPERATING SYSTEM IMPLEMENTATION
- . MULTIPLE USERS (MULTIPROGRAMMING)
- . VIRTUAL
  - STORAGE SWAPPING

#### WHY SWAPPING?

A SIMPLE, EXCELLENT APPROACH TO MANAGE "OVER-COMMINTMENT" OF MAIN STORAGE FOR AN INTERACTIVE ENVIRONMENT (WITH A FINITE NUMBER OF USERS).

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#### 2.0 SYSTEM/36 OPERATING SYSTEM

THE SYSTEM/36 OPERATING SYSTEM IS THE "SYSTEM SUPPORT PROGRAM" (SSP):

- . CONTROLS THE EXECUTION OF ALL JOBS ON THE SYSTEM AND MUST BE IN MAIN STORAGE BEFORE JOBS ARE RUN.
- . RESIDES ON DISK OR DISKETTE AND IS PLACED INTO MAIN STORAGE BY THE IPL (INITIAL PROGRAM LOAD) PROCESS WHICH THE SYSTEM OPERATOR INITIATES.
- . USER INTERFACE:
  - OCL (OPERATION CONTROL LANGUAGE) STATEMENTS
  - SSP PROCEDURES AND COMMANDS
  - SSP UTILITIES
  - USER APPLICATIONS

AEB 3 09/13/86

### 2.1 SYSTEM SOFTWARE STRUCTURE

#### FOR EXAMPLE:

Name of the Control o	(NON-SSP)	PROGRA	M PRODU	CTS USER	APPLICA	ATIONS	The second secon
EXTERNAL	PS/36	BASIC COBOL	LANGUA LANGUA LANGUA I LANGUA	GE GE		00 00 00 00 00 00 00 00 00 00 00 00 00	MAIN
FACILITIES	OPERATION ( LANGUAGE			J	ERVICES	AIDS	STORAGE
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INTERNAL	DATA HANDL	LING SYSTEM SERVICE SUPERVISOR					
FACILITIES	- COLO -					enso esso esso esso esso esso esso esso	CONTROL
			1916 4660 4700 4700 4700 1700 1700 1700 1700 170	1000 (1000) strate distre tanto dazzo gipto 6000 (1000) 100 (1000) spilo strate distre antico 4000 (1000) (1000)		# 1	
CSP SERVICES	INPUT/OUTI	PUT	SYSTEM :	SUPPORT	SUPER	/ISOR	STORAGE
CHAIN GAILDY GAIL	CONTROL CONTRO		රාගත් ක්රහර අතුරුව අමතර ප්රවාද කරනුව ඇත. කතුල පත්තර සේවාව අතුරුව දැන්ව අතුරුව දැන්වුව දැන්වුව දැන්වුව දැන්වුව දැන්වුව දැන්වුව දැන්වුව දැන්වුව දැන්වුව ද	A contra sector dello de			CORRES CO
DEVICE SERVICES	DISK, DISKI AND TAPE		WORK STATION	COMMUNIC	CATIONS	OTHER	INPUT/ OUTPUT
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3.0 MAIN STORAGE CONCEPTS	

. MAIN STORAGE STRUCTURE

MAIN STORAGE CONCEPTS INCLUDES:

- DATA BUFFERING
- PROGRAM ATTRIBUTES
- . MAIN STORAGE ADDRESSING
- . MAIN STORAGE MANAGEMENT

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#### 3.1 MAIN STORAGE STRUCTURE

MAIN STORAGE STRUCTURE INCLUDES:

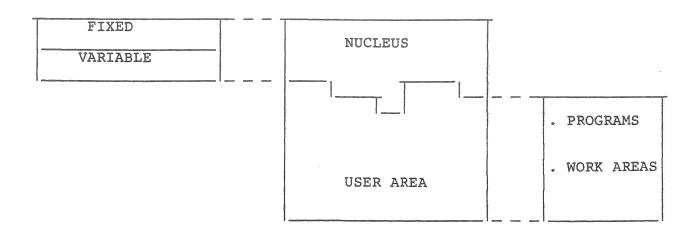
#### SYSTEM AREA

- . NUCLEUS
  - FIXED
  - VARIABLE

#### USER AREA

- . PROGRAMS
  - USER
  - SYSTEM
- . WORK AREAS
  - SYSTEM WORK SPACE (SWS)
  - TASK WORK SPACE (TWS)

#### FOR EXAMPLE:



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#### 3.1.1 SYSTEM AREA

THE SYSTEM AREA INCLUDES:

- . A FIXED NUCLEUS
- . VARIABLE NUCLEUS

#### 3.1.1.1 FIXED NUCLEUS:

THE SYSTEM AREA ALWAYS INCLUDES A MINIMUM FIXED PORTION DEPENDING ON:

- MAIN STORAGE SIZES, AND
- THE SYSTEM/36 MODEL

MAIN STORAGE SIZE	MINIMUM	FIXED N	UCLEUS SIZE
	5360 (1)	5362	5364 (1 AND 2)
128K - 256K	32K	32K	40K
512K	34K	34K	42K
1024K	36K	36K	44K
1792K	38K	N/A	N/A
2048K	40K	40K	N/A
3 MB - 7 MB	64K	N/A	N/A

#### NOTES:

- 1. IF DISPLAYWRITE/36 IS INSTALLED ON THE SYSTEM, ADD AN ADDITIONAL 2.25K.
- 2. INCLUDES AN ADDITIONAL 8K FOR PC TO CSP INTERFACE.

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#### 3.1.1.2 VARIABLE NUCLEUS

. THE VARIABLE NUCLEUS CONTENT DEPENDS ON THE OPTIONS SELECTED DURING CONFIGURATION AND/OR IPL:

	-
VARIABLE NUCLEUS	
(NONSWAPPABLE SYSTEM ROUTINES AND SPACES)	
. CONTROL BLOCKS AND POINTERS	
The start of the s	
. RESIDENT SYSTEM ROUTINES	
TRANSIENT SYSTEM ROUTINES	
. IRANSIENI SISIEM ROUIINES	
. SYSTEM QUEUE SPACE (SQS)	
(AKA: ASSIGN/FREE AREA)	
( on was a saw as as well a saw as a sa	
- MEMORY RESIDENT FORMATS	
- CACHE MANAGEMENT ROUTINES	
	4.76
. CACHE MEMORY	

. THE SYSTEM AREA ALSO INCLUDES A VARIABLE PORTION DEPENDING ON THE ACTIVITY ON THE SYSTEM:

VARIABLE NUCLEUS (NONSWAPPABLE SYSTEM ROUTINES)	SIZES
- BATCH BSC INTERRUPT HANDLER	4 KB
- SDLC INTERRUPT HANDLER	8 KB
- SSP-ICF BSC INTERRUPT HANDLER	12 KB
- BSC 3270 INTERRUPT HANDLER	8 KB
- MSRJE BSC INTERRUPT HANDLER	10 KB
. X.25 INTERRUPT HANDLER	42 KB
. PRINTER DM AND SPOOL INTERCEPT	1 KB
. FOLDER MGR AND I/O ROUTER	2.25 KB

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3.1.1.2.1 SYSTEM QUEUE SPACE ACCESS

(Assign free)

NOW - SLAPPABLE

- . ASSIGN IN MULTIPLES OF 16 BYTES TO 2 KB
- . OUICK FIT ALGORITHM
- . AUTOMATIC RECOVERY WHEN HIGHLY UTILIZED:
  - TAKES 2 KB FROM USER STORAGE
  - DYNAMICALLY MAINTAINED
- . CONTAINS SHARED CONTROL BLOCK DATA
- . ONLY ADDRESSABLE BY PRIVILEGED PROGRAMS

THE FOLLOWING TABLE SHOWS THE APPROXIMATE AMOUNT OF ASSIGN/FREE AREA THAT IS USED FOR SPECIFIC ITEMS:

ITEMS	AMOUNT OF ASSIGN/FREE AREA NEEDED
ACTIVE PROGRAMS	512 BYTES
ACTIVE DISPLAY STATIONS	512 BYTES
ACTIVE PRINTERS	512 BYTES
ACTIVE FILES BEING USED	512 BYTES
DISK CACHE RESIDENT CODE	512 BYTES
DATA COMMUNICATIONS	VARIABLE AMOUNT BASED ON THE TYPE COMMUNICATIONS ACTIVE

NOTE: WHEN A FILE WITH MULTIPLE INDEXES IS USED, EACH INDEX IS AN ACTIVE FILE (EVEN WHEN THAT FILE IS NOT USED BY THE PROGRAM).

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### SYSTEM/36 INTERNALS

#### 3.1.1.2.2 HOW MANY PROGRAMS CAN EXECUTE CONCURRENTLY

FORMULA: NUMBER OF JOBS = A - (B + C + D + E + F + G + H + I + J)WHERE:

- A = INSTALLED MEMORY SIZE
- B = FIXED NUCLEUS SIZE
- C = VARIABLE NUCLEUS SIZE, EXCLUDING CACHE MEMORY SIZE
- $D = (512 \text{ BYTES } \times \text{ THE NUMBER OF ACTIVE PROGRAMS})$
- E = (512 BYTES x THE NUMBER OF ACTIVE DISPLAY STATIONS PER PROGRAM)
- F = (512 BYTES x THE NUMBER OF ACTIVE PRINTERS PER PROGRAM)
- G = (512 BYTES x THE NUMBER OF ACTIVE FILES PER PROGRAM)
- H = DATA COMMUNICATION SUPPORT PER ACTIVE PROGRAM (VARIABLE AMOUNT BASED ON THE TYPE COMMUNICATION ACTIVE)
- I = CACHE MEMORY SIZE, IF ACTIVE
- J = 512 BYTES FOR DISK CACHE RESIDENT CODE

NOTE: THE SYSTEM WILL GIVE YOU A WARNING:

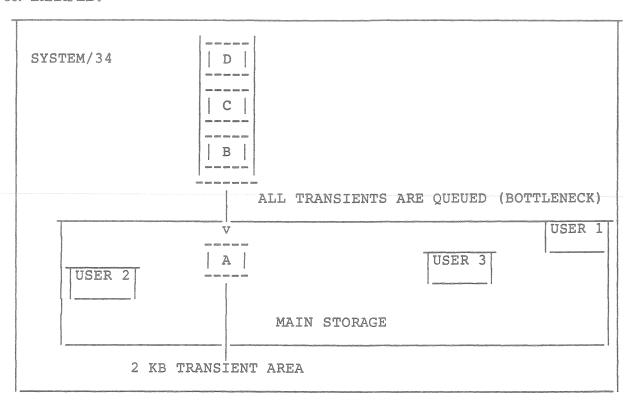
- . DURING IPL, IF LESS THAN 48K OF USER MEMORY IS REMAINING.
- . DURING EXECUTION, WHEN USER MEMORY GOES BELOW 48K.

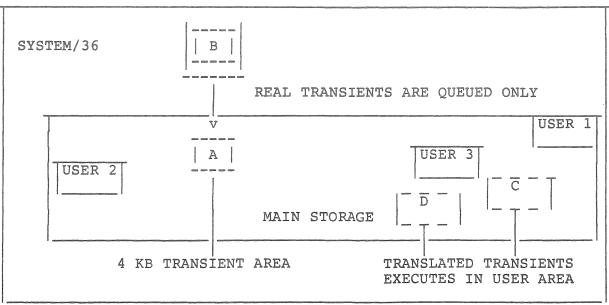
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#### 3.1.1.2.3 TRANSIENT AREA AND TRANSLATED TRANSIENTS

#### FOR EXAMPLE:





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#### 3.1.2 USER AREA

. MAIN STORAGE THAT IS NOT CURRENTLY PART OF THE NUCLEUS

- . DO NOT HAVE TO BE CONTIGUOUS IN MAIN STORAGE
- . DIVIDED INTO 2 KB "PAGES":
  - THE SYSTEM USES PAGES TO KEEP TRACK OF HOW PROGRAMS:
    - -- ARE LOADED INTO MAIN STORAGE
    - -- RUN IN MAIN STORAGE
    - -- ARE SWAPPED IN AND OUT OF MAIN STORAGE
    - -- USE DATA BUFFERS

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#### 3.1.2.1 USER PROGRAMS

THE SYSTEM VIEWS ALL PROGRAMS AS "TRANSLATED TRANSIENT":

- . TRANSIENT ROUTINES:
  - ALLOCATE
  - COMMAND PROCESSOR (NOT MAINLINE)
  - INITIATOR
  - SSP-ICF MANAGEMENT
  - SYSIN
  - SYSLOG
  - TERMINATOR
  - WORK STATION MANAGEMENT (GET OPERATION)
  - WORK STATION MANAGEMENT (PUT AND PUT OVERRIDE OPERATION)
- . LANGUAGE COMPILERS
- . UTILITIES
- . USER APPLICATIONS
  - MEMORY RESIDENT OVERLAYS

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#### WORK SPACE INCLUDES:

SYSTEM WORK SPACE (SWS):

- . TRACE BUFFER
- . INSERT BUFFER (DATA MANAGEMENT)
- . FORMAT INDEX AREA
- . ACTIVE PROCEDURE TABLE
- . WORK STATION BUFFER SPACE

TASK WORK SPACE (TWS):

- . PROCEDURE PARAMETER SAVE AREA
- . INITIATOR WORK AREA
- . SYSIN WORK AREA
- . DISK FILE SPACE:
  - DATA BUFFER
- . COMMAND PROCESSOR WORK AREA

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#### 3.1.2.2 WORK SPACE CONSIDERATIONS

- . VARY IN SIZE FROM 2 KB TO 1.75 MB
- . TASK-RELATED OR SHARED AMONG MULTIPLE TASKS
- . SPACE MAY BE ASSIGNED IN 64-BYTE MULTIPLES
- . IDENTIFIED BY UNIQUE IDS
- . NOT PHYSICALLY ATTACHED TO ANY PROGRAM:
  - MUST USE MAPPING FACILITY

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SYSTEM/36 INTERNALS

#### 3.2 DATA BUFFERING

#### 3.2.1 USER PROGRAMS

- . OBJECT CODE INCLUDES:
  - EXECUTABLE INSTRUCTIONS
  - WORK STATION BUFFER
  - TABLES/ARRAYS
- . OBJECT CODE DOES NOT INCLUDE:
  - PRINT AND DISK BUFFERS
  - FORMAT INDEX AREA
  - STORAGE INDEX

AEB 16 09/13/86

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#### **USER PROGRAMS:**

- . DATA BUFFERS ARE NOT INCLUDED IN THE PROGRAM; THEY ARE IN A "DISK FILE SPACE" WHICH CAN BE EITHER:
  - APPENDED TO THE PROGRAM
  - STORED IN A TASK WORK SPACE
- . MAXIMUM SIZE IS 44 KB PER FILE
- . THE DISK FILE SPACE CONTAINS:
  - RECORD BUFFER
  - INDEX BUFFER
  - INDEX BLOCK
  - CONTROL BLOCK (200 BYTES)

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#### 3.2.1.1 "DISK FILE SPACE" - APPENDED

- . IN ORDER TO GET AN APPENDED BUFFER:
  - PROGRAM AND BUFFER SPACE SIZE MUST BE 64 KB OR LESS
  - SYSTEM MUST HAVE SPACE IN USER AREA
- . WHEN BUFFERS ARE APPENDED TO A PROGRAM, THEY ARE SWAPPED WITH THE PROGRAM

NOTE:

THIS IS THE PREFERRED METHOD. IT IS FASTER THAN NONAPPENDED BUFFERS.

AEB 18 09/13/86

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#### 3.2.1.2 "DISK FILE SPACE" - NONAPPENDED

- . THE TASK WORK SPACE (TWS) IS A SEPARATE ADDRESS SPACE
- . THE TWS REQUIRES MAPPING SERVICES FOR PROGRAMS TO ADDRESS THEM
- . BUFFERS ARE SWAPPED SEPARATELY FROM PROGRAMS

#### NOTE:

THIS METHOD IS MUCH SLOWER THAN APPENDED BUFFERS.

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#### 3.3 PROGRAM ATTRIBUTES

#### THERE ARE TWO TYPES OF PROGRAM ATTRIBUTES:

- . EXECUTION ATTRIBUTES:
  - RELOADABLE
  - REUSABLE
  - REENTRANT
- . STORAGE ATTRIBUTES:
  - NON-SWAPPABLE
  - SWAPPABLE
  - REFRESHABLE

AEB 20 09/13/86

AEB 20 09/13/86

#### 3.3.1 EXECUTION ATTRIBUTES

#### . RELOADABLE:

- ONE COPY SERVICES ONE USER
- A NEW COPY OF THE CODE IS LOADED FOR EVERY USER
- CODE CAN BE CHANGED WHILE IN USE
- USER PROGRAMS, EXCLUDING BASIC PROGRAMS

#### . REUSABLE:

- ONE COPY SERVICES SEVERAL USERS, BUT:
  - -- ONE USER AT A TIME
  - -- OTHER USERS ARE OUEUED
- INTERRUPTIBLE AT A "SOFT STOP"
- CODE CAN BE CHANGED, BUT:
  - -- REINITIALIZED EACH TIME IT IS USED
- SYSTEM PROGRAMS ONLY

#### . REENTRANT:

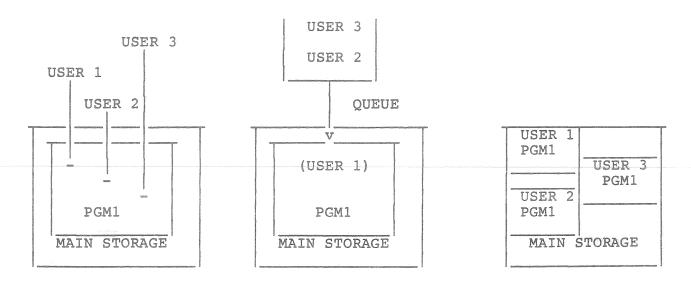
- ONE COPY SERVICES SEVERAL USERS
- INTERRUPTIBLE ANYWHERE
- CODE CANNOT BE CHANGED WHILE IN USE
  - SYSTEM PROGRAMS ONLY

09/13/86 AEB 21 

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#### 3.3.1.1 EXECUTION ATTRIBUTES - EXAMPLE

EXAMPLE: THREE (3) USERS REQUESTING THE SAME PROGRAM (PGM1).



#### REENTRANT

#### . 1 COPY OF PGM1

USERS CONCURRENTLY

#### REUSABLE

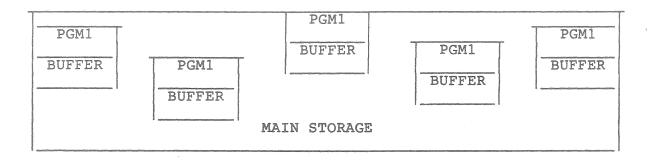
- . 1 COPY OF PGM1
- . CAN BE SHARED BY ALL . CAN BE SHARED BY ALL . EACH COPY OWNED USERS, BUT SERIALLY (PGM1 SERIALLY-REUSABLE)
  - . USERS ARE QUEUED

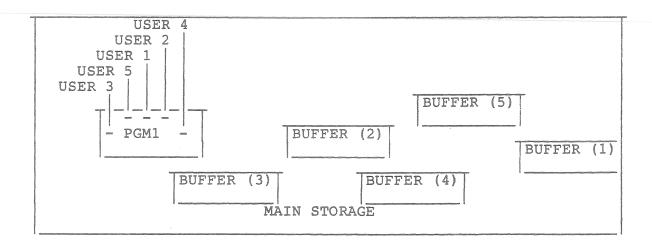
#### RELOADABLE

- . 3 COPIES OF PGM1
  - BY A DIFFERENT USER (PGM1 NONSHAREABLE)

09/13/86 22 

#### 3.3.1.2 EXAMPLE - REENTRANT CODE MAJOR BENEFIT





- . LESS STORAGE REQUIRED TO GET THE SAME NUMBER OF JOBS DONE:
  - PGM1 = 24 KB BUFFER = 6 KB
  - FIVE (5) COPIES OF PGM1 WITHOUT REENTRANCY REQUIRES 150 KB
  - A SINGLE COPY OF PGM1 WITH REENTRANCY REQUIRES 54 KB

AEB 23 09/13/86

IBM 49

#### 3.3.2 STORAGE ATTRIBUTES

- . SWAPPABLE (NONPINNED)
  - PROGRAM SWAPPED TO (TEMPORARILY STORED) DISK
  - SYSTEM DEFAULT FOR ALL USER APPLICATION PROGRAMS
- . NONSWAPPABLE (PINNED)
  - PROGRAM IN MAIN STORAGE ALL THE TIME
  - SYSTEM PROGRAMS ONLY
- . REFRESHABLE (READ ONLY)
  - NEVER SWAPPED TO DISK
  - A NEW COPY OF THE PROGRAM IS LOADED WHEN NEEDED

AEB 24 09/13/86

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#### 3.3.3 PROGRAM ATTRIBUTES SUMMARY

	EXECUTION ATTRIBUTES		
STORAGE ATTRIBUTES	REENTRANT	REUSABLE	RELOADABLE
SWAPPABLE (USER AREA)			. UTILITIES . USER PROGRAMS . PROGRAM . PRODUCTS
			. DATA ENTRY FACILITY (DEF)
NONSWAPPABLE (SYSTEM AREA)	. FIXED NUCLEUS . VARIABLE NUCLEUS		=======================================
REFRESHABLE	. TRANSLATED SYSTEM PROGRAMS	. REAL SYSTEM TRANSIENT PROGRAMS	
	. BASIC PROGRAMS		

AEB 25 09/13/86

#### 3.4 PROGRAM OVERLAY STRUCTURE

#### CONCEPTS

SWAPPING AND OVERLAYING ARE TWO METHODS THE SYSTEM/36 USES TO CONTROL THE USE OF MAIN STORAGE (OR MEMORY). THE OVERLAY STRUCTURE ALLOWS A PROGRAM TO EXECUTE USING LESS STORAGE THAN IT ACTUALLY NEEDS. THAT IS, OVERLAYING:

- . REDUCES THE AMOUNT OF STORAGE COMMITTED BY A PROGRAM.
- LOADS FOR THE LIBRARY ONLY THOSE PORTIONS OF THE PROGRAM
  WHICH ARE NEEDED AT ANY GIVEN TIME.

S/36 Programs.

(Root)

Syptem
Across

Fetch 20K Size of Inagest.
-25K.

Carll Continue A, or BEC.

20K A 10KB 6KC

AEB

26

09/13/86

AFTER A MAINLINE PROGRAM OR SUBROUTINE HAS BEEN COMPILED, THE OVERLAY

LINKAGE EDITOR:

1. STORES THE OBJECT MODULE IN A LIBRARY AND CATALOGS IT IN THE

LIBRARY DIRECTORY AS A SUBROUTINE MEMBER.

2. ATTEMPTS AFTER CREATING A LOAD MODULE, TO FIT A LINK-EDIT

LOAD MODULE INTO THE AMOUNT OF MAIN STORAGE CURRENTLY

AVAILABLE TO A PROGRAM.

3. IF ITEM 2 ABOVE CANNOT BE DONE, DIVIDES THE LOAD MODULE INTO

SEGMENTS AND SUES THE SAME BLOCKS (OR AREA) OF MAIN

STORAGE REPEATEDLY BY OVERLAYING OR REPLACING EACH SEGMENT

AS IT IS NO LONGER NEEDED BY THE PROGRAM.

THE OVERLAY LINKAGE EDITOR:

. CAN BE CALLED DIRECTLY BY THE COMPILER, OR

. IT CAN BE EXECUTED BY YOU

AEB 27 09/13/86

IBM 48:

SISTEM/30 INTERNALS

3.4.1 OVERLAYS

YOU CAN OFTEN SOLVE COMPLEX DATA PROCESSING PROBLEMS BY USING
SEPARATELY COMPILED BUT LOGICALLY INTERDEPENDENT PROGRAMS THAT, AT
EXECUTION TIME, FORM LOGICAL AND PHYSICAL SUBDIVISIONS OF A SINGLE
RUN UNIT. A RUN UNIT IS THE TOTAL MACHINE-LANGUAGE PROGRAM NECESSARY
TO SOLVE A PROCESSING PROBLEM; IT INCLUDE ONE OR MORE OBJECT
PROGRAMS, AND CAN INCLUDE OBJECT FROM SOURCE PROGRAMS WRITTEN IN
ANY OF THE FOLLOWING LANGUAGES:

- . ASSEMBLER
- . COBOL
- . FORTRAN IV

AEB 28 09/13/86

IBM 4 9

5151EM/50 INTERNALS

WHEN YOU SUBDIVIDE THE SOLUTION OF A PROBLEM INTO MORE THAN ONE PROGRAM, THE CONSTITUENT PROGRAMS MUST BE ABLE TO COMMUNICATE WITH EACH OTHER EITHER:

- . THROUGH TRANSFER OF CONTROL
- . THROUGH REFERENCE TO COMMON DATA

#### TRANSFER OF CONTROL

A CALLING PROGRAM CAN TRANSFER CONTROL TO A CALLED PROGRAM, AND THE CALLED PROGRAM CAN ITSELF TRANSFER CONTROL TO YET ANOTHER CALLED PROGRAM; HOWEVER, A CALLED PROGRAM MUST NOT DIRECTLY CALL THE PROGRAM THAT CALLED IT.

WHEN CONTROL PASSES TO THE CALLED PROGRAM, THE PROGRAM RUNS

NORMALLY. WHEN A CALLED PROGRAM COMPLETES PROCESSING, THE PROGRAM

CAN DO ANY OF THE FOLLOWING:

- . TRANSFER CONTROL BACK TO THE CALLING PROGRAM
- . CALL ANOTHER PROGRAM
- END THE RUN UNIT

#### COMMON DATA

PROGRAM INTERACTION MIGHT REQUIRE THAT BOTH PROGRAMS HAVE ACCESS TO THAT SAME DATA.

IN A CALLING PROGRAM, DESCRIBE COMMON DATA ITEMS IN THE SAME MANNER
AS ANY OTHER DATA ITEMS. ALLOCATE STORAGE FOR THESE ITEMS IN THE
CALLING PROGRAM.

AEB 29 09/13/86

### SYSTEM/36 INTERNALS

#### 3.4.2 SEGMENTATION

THE SEGMENTATION FEATURE LETS YOU EXECUTE A LARGE PROGRAM IN A SMALLER AREA OF MAIN STORAGE. YOU USE THE SEGMENTATION FEATURE TO BREAK A PROGRAM INTO A NUMBER OF OVERLAYS (THAT IS, A NUMBER OF SECTIONS THAT ARE SWAPPED INTO AND OUT OF THE SAME AREA OF STORAGE AS REQUIRED FOR PROGRAM EXECUTION).

- FOR COBOL PROGRAMS, BY WRITING SEGMENT-NUMBER ON EACH
  SECTION HEADER, YOU CAN CAUSE EACH SECTION TO BE STORED AS A
  PHYSICALLY INDEPENDENT SEGMENT.
- . FOR RPG II PROGRAMS, THE OVERLAY LINKAGE EDITOR CONTROLS HOW PROGRAMS ARE SEGMENTED, NOT THE PROGRAMMER.

AEB 30 09/13/86

IBM 49.

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#### 3.4.2.1 TYPES OF SEGMENTS

#### THERE ARE TWO TYPES OF PROGRAM SEGMENTS:

- FIXED SEGMENTS
- INDEPENDENT SEGMENTS

#### FIXED SEGMENTS ARE DIVIDED INTO TWO TYPES:

- SEGMENTS THAT ARE NEVER OVERLAID (FIXED PERMANENT SEGMENTS)
- SEGMENTS THAT ARE OVERLAID (FIXED OVERLAYABLE SEGMENTS)

#### INDEPENDENT SEGMENTS:

- CAN OVERLAY AND BE OVERLAID BY OTHER SEGMENTS DURING PROGRAM EXECUTION.
- IS MADE AVAILABLE IN ITS INITIAL STATE THE FIRST TIME YOU PASS CONTROL TO IT.

AEB 09/13/86

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3.4.3 MEMORY RESIDENT OVERLAYS

MEMORY RESIDENT OVERLAYS ALLOWS THE USER:

- . TO IMPROVE THE PERFORMANCE FOR PROGRAMS WHICH MAKE USE OF OVERLAYS BUILT AND LINKED BY THE OVERLAY LINKAGE EDITOR.
- . TO KEEP A LARGE USER PROGRAM OVERLAY SEGMENTS IN MAIN STORAGE
- . TO REDUCE THE THE NUMBER OF <u>DISK READ</u> OPERATIONS ISSUED FOR A PROGRAM ON EACH SUBSEQUENT LOAD OF AN OVERLAY
- . TO REDUCE THE THE NUMBER OF <u>DISK WRITE</u> OPERATIONS THAT MAY OCCUR
  AS A RESULT OF SOMETHING BEING SWAPPED OUT

THE NUMBER OF OVERLAYS THAT ACTUALLY REMAIN IN MAIN STORAGE DEPENDS ON:

- . THE SIZE OF EACH OVERLAY.
- . THE SIZE OF THE AVAILABLE MAIN MEMORY.
- . THE NUMBER AND SIZE OF OTHER PROGRAMS BEING EXECUTED.

AEB 32 09/13/86

TEM 48

SYSTEM/36 INTERNALS
4.0 ADDRESSING
THE SYSTEM HAS TWO MODES OF ADDRESSING:
. REAL ADDRESSING
. TRANSLATED ADDRESSING
SYSTEM PROGRAMS CAN USE EITHER OR BOTH MODES WHILE USER PROGRAMS
CAN ONLY USE THE TRANSLATED ADDRESSING MODE.

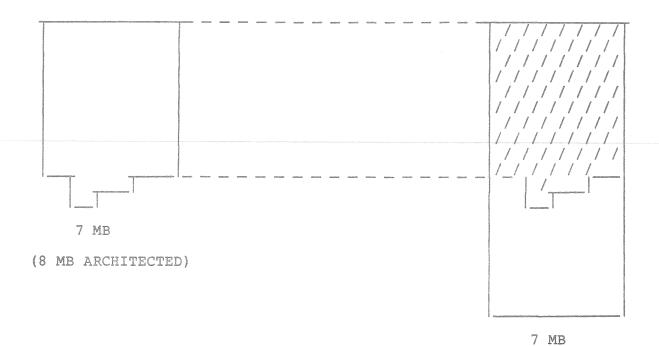
AEB 33 09/13/86

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SYSTEM/36 INTERNALS

# 4.1 REAL ADDRESSING OVERVIEW

SYSTEM PROGRAM ADDRESS SPACE

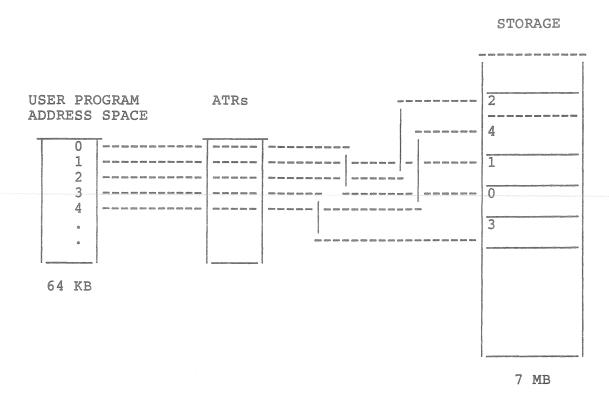
STORAGE



(128 MB ARCHITECTED)

AEB 34 09/13/86

# 4.2 TRANSLATED ADDRESSING OVERVIEW



AEB 35 09/13/86

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### 4.3 PREFIX ADDRESS CONTAINED TRANSLATION

MAIN STORAGE ADDRESSING (REAL) BEYOND 64 KB CAN BE ACCOMPLISHED WITH 2-BYTE ADDRESSES BY THE USE OF PREFIX ADDRESS CONTAINED TRANSLATION (PACT) REGISTER. THIS ALLOWS A "SIMULATION OF 3-BYTE ADDRESSING".

- . A BIT IN THE ADDRESS DESCRIBES WHETHER THE ADDRESS IS TRANSLATED:
  - PROVIDES FOR EXPANSION OF USER REGION BEYOND 64 KB
  - REMOVES NUCLEUS LIMITATIONS (NUMBER OF SIMULTANEOUS EVENTS)
  - KNOWLEDGE OF PROCESSOR OPERATION IS NOT REQUIRED OF THE SYSTEM PROGRAMMER

AEB 36 09/13/86

SYSTEM/36 INTERNALS

#### 4.4 REGION MAPPING

- . ALTER TASK ADDRESSABILITY AT 2 KB BOUNDARIES
- . MAP TO:
  - REQUESTOR'S REGION
  - ANY REGION CURRENTLY ACTIVE
  - WORK SPACE (SWS OR TWS)
- . DATA IS NOT MOVED
- . LOGICAL ADDRESS IS COMPUTED

\_\_\_\_\_\_ AEB 37 09/13/86 

- 4.5 ADDRESS TRANSLATION REGISTERS (ATRS)
- . CAN ADDRESS MAIN STORAGE UP TO A MAXIMUM STORAGE SIZE OF 2 KB
- . THERE ARE 128 ATRS:
  - 64 FOR PROGRAM ADDRESSING:
    - -- TWO SET OF 32
  - 8 FOR PACT REGISTER ADDRESSING:
    - -- SINGLE BYTE REGISTERS
  - 56 FOR INPUT/OUTPUT USE

AEB 38 09/13/86

- 5.0 PROGRAM EXECUTION CHARACTERISTICS
- 1. PROGRAM A IS LOADED (SWAPPED-IN) FROM SECONDARY STORAGE
- 2. PROGRAM A MUST EXECUTE IN THE MAIN STORAGE PROCESSOR (MSP)
- 3. PROGRAM A IS DISPATCHED TO THE MSP BY PRIORITY; PRIORITY DEPENDS ON:
  - A. USER DESIGNATION OR DEFAULT
  - B. FREQUENCY OF A WORK STATION READ OPERATION
  - C. THE NUMBER OF USERS OF THE PROGRAM
- 4. PROGRAM A EXECUTES IN THE MSP UNTIL ONE OF FIVE EVENTS OCCURS:
  - A. THE PROGRAM COMES TO A "LONG WAIT" CONDITION
  - B. THE PROGRAM ISSUES I/O REQUEST
  - C. THE PROGRAM'S UTILIZATION TIME INTERVAL EXPIRES
  - D. THE PROGRAM IS PREEMPTED BY A SIGNIFICANTLY HIGHER PRIORITY
    PROGRAM
  - E. THE PROGRAM TERMINATES
  - 5. PROGRAM B IS LOADED INTO MAIN STORAGE (SWAPPED-IN) FOR EXECUTION.

    IF MAIN STORAGE IS UNAVAILABLE, THE MAIN STORAGE OF THE MOST

    ELIGIBLE ACTIVE TASK IS SELECTED AND TRANSFERRED TO SECONDARY

    STORAGE (SWAPPED-OUT) TO MAKE ROOM FOR THE INCOMING PROGRAM
  - 6. STEP 4 IS REPEATED FOR PROGRAM B
  - 7. PROGRAM C IS SWAPPED-IN. THE PROCESS CONTINUES AS FOR PROGRAM B.

AEB 39 09/13/86

SYSTEM/36 INTERNALS

6.0 TASK MANAGEMENT

#### FUNCTION

- . CONTROLS THE TASK ACTIVITY FOR THE MAIN STORAGE PROCESSOR.
- . ASSIGNING EACH TASK A STATE (OR CONDITION):
  - A WAIT STATE,
  - A READY STATE, OR
  - AN ACTIVE STATE.

(BOTH THE (TASK DISPATCHER AND MSP CONTROL HANDLE ACTIVE TASKS.)

AEB 40 09/13/86

#### 6.1 WAIT STATE

WAIT STATE OF A TASK MEANS THE TASK IS WAITING ON THE ACTIVE PROGRAM LIST QUEUE FOR SOMETHING TO HAPPEN OR TO FINISH BEFORE THE TASK IF CONSIDERED READY. THE TASK COULD BE WAITING FOR SOME I/O TO BE COMPLETED. FOR EXAMPLE:

A "LONG WAIT" STATUS IS GIVEN TO A USER TASK IMMEDIATELY AFTER
AN ACCEPT OR GET OPERATION TO A WORK STATION HAS BEEN
ISSUED. THS USER TASK REMAINS IN "LONG WAIT" STATUS UNTIL THE
WORK STATION OPERATOR PRESSES THE ENTER KEY, ANY COMMAND KEY, OR
ANY FUNCTION KEY.

#### 6.2 READY STATE

THE READY STATE OF A TASK MEANS THE TASK IS NOT CURRENTLY EXECUTING IT IS ON THE READY TASK LIST QUEUE), BUT HAS ALL THE REQUIREMENTS IT NEEDS TO EXECUTE.

### 6.3 ACTIVE STATE

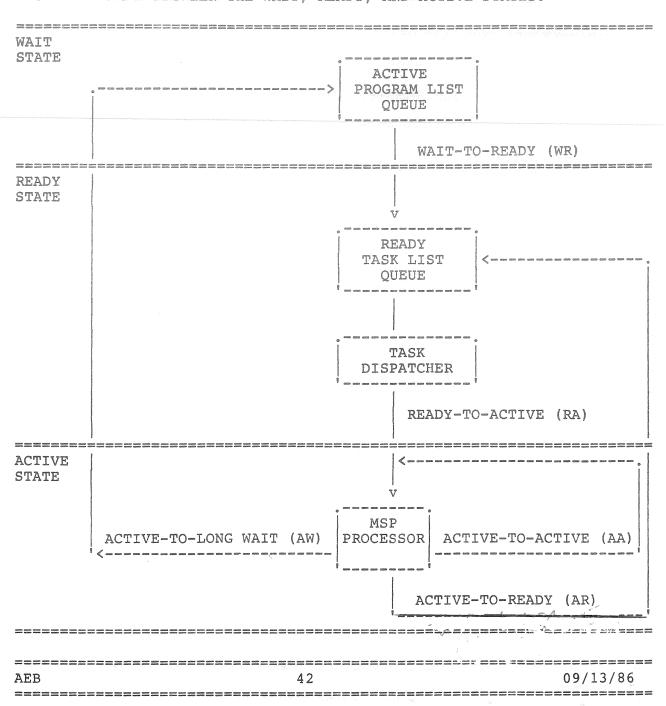
THE ACTIVE STATE OF A TASK MEANS THE TASK IS NOW RUNNING IN THE MSP.

AEB 41 09/13/86

IM 49

### 6.4 TASK EXECUTION TRANSITIONS

IT IS IMPORTANT TO UNDERSTAND HOW TASKS ARE QUEUED AND COMPETE FOR SYSTEM RESOURCES. THE DIAGRAM BELOW SHOWS THE VARIOUS TRANSITIONS TASKS CAN MAKE BETWEEN THE WAIT, READY, AND ACTIVE STATES.



A BRIEF DESCRIPTION OF EACH OF THE TRANSITIONS FOLLOWS:

- (AA) ACTIVE-TO-ACTIVE. THE TASK WILL NOT GIVE UP THE MSP WHEN

  R-TIME OR MSP-TIME IS EXCEEDED, BECAUSE THERE ARE NO OTHER

  TASKS OF EQUAL OR HIGHER PRIORITY WAITING IN THE READY TASK

  LIST QUEUE.
- (AR) ACTIVE-TO-READY. THE TASK GIVES UP THE MSP BECAUSE IT EXCEEDS

  ITS MSP-TIME AND THERE ARE OTHER TASKS OF EQUAL OR HIGHER

  PRIORITY WAITING IN THE READY TASK LIST QUEUE. THE TASK IS

  PUT INTO THE READY TASK LIST QUEUE IN FIFO ORDER WITHIN ITS

  PRIORITY GROUP.
- (AW) ACTIVE-TO-LONG WAIT. THE TASK GIVES UP THE MSP AS A RESULT

  OF A LONG WAIT. (A PROGRAM DOES A READ OPERATION TO A WORK

  STATION). THE TASK IS PUT INTO THE ACTIVE PROGRAM LIST QUEUE

  IN FIFO ORDER WITHIN ITS PRIORITY GROUP.
- (RA) READY-TO-ACTIVE. THE TASK IS SELECTED TO EXECUTE FROM

  THE READY TASK LIST IN FIFO ORDER WITHIN ITS PRIORITY GROUP.
- (WR) WAIT-TO-READY. THE OPERATION THAT PUT THE TASK IN A LONG
  WAIT STATUS COMPLETES. THE TASK IS PUT INTO THE READY
  TASK LIST QUEUE IN FIFO ORDER WITHIN ITS PRIORITY GROUP.

AEB 43 09/13/86

DM 48

## 6.4.1 ACTIVE PROGRAM LIST QUEUE

THE SYSTEM MAINTAINS A LIST (OR QUEUE) TO KEEP TRACK OF THE STATUS OF ALL ACTIVE PROGRAMS

AN ACTIVE PROGRAM CAN BE EITHER:

- . IN MAIN STORAGE
- . IN THE SWAP AREA ON DISK (THAT IS, THE TASK WORK AREA -- TWA)

  THE SYSTEM USES THE POSITION OF THE PROGRAM ALONG WITH THE EXECUTION

  PRIORITY TO DECIDE WHICH PROGRAMS TO SWAP IN AND OUT OF MAIN

  STORAGE.

ACTIVE PROGRAMS	PROCESSING PRIORITY	POSITION ON THE ACTIVE PROGRAM LIST QUEUE
PROGRAM A PROGRAM B PROGRAM C PROGRAM D PROGRAM E PROGRAM F	HIGH = 196 MEDIUM = 132 LOW = 68 HIGH = 196 MEDIUM = 132 LOW = 68	1 3 5 2 4 6

AEB 44 09/13/86

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# SYSTEM/36 INTERNALS

# 6.4.2 READY TASK LIST QUEUE

WHEN A TASK IS ON THIS LIST (OR QUEUE), IT:

- . IS NOT CURRENTLY EXECUTING IN THE MSP, BUT IS READY
- . HAS ALL THE REQUIREMENTS IT NEEDS IN ORDER TO EXECUTE
- . HAS NOT BEEN SELECTED TO EXECUTE BY THE TASK DISPATCHER

ACTIVE	PROCESSING	PROCESSING   DISPATCHING   POSITION ON THE		POSITION ON
PROGRAMS	PRIORITY	STATUS	ACTIVE PROGRAM	THE READY
QUEUE	gless of the state	g and a second	LIST QUEUE	TASK QUEUE
STOPPING COLUMN TO THE		TERRAL MANAGEMENT AND		distantivament
		PROGRAM PROGRAM AND AN ENGLISH AND	distinct shall be in the status and the control of	escription and the original and an appropriate the original and a second
PROGRAM 1	HIGH = 19	6 WAITING		dazas
PROGRAM 2	LOW = 6	8 READY	6	2
PROGRAM 3	NORMAL = 12	1 WAITING	5	0000
PROGRAM 4	HIGH = 19	6 WAITING	2	000
PROGRAM 5	Normal = 12	9 READY	4	1
PROGRAM 6	Normal = 13	3 WAITING	3	1209
			TOTAL DESIGNATION AND ADDRESS OF THE PROPERTY	

AEB 45 09/13/86

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SYSTEM/36 INTERNALS

- 7.0 MAIN STORAGE CONTENTS MANAGEMENT
- 7.1 PROGRAM LOADING

BEFORE LOADING A PROGRAM, THE SYSTEM:

- A. RESERVES A 64 KB AREA IN THE TASK WORK AREA (TWA) ON DISK (I.E., THE TASK SWAP AREA)
- B. REQUIRES A SPECIFIC AMOUNT OF MAIN STORAGE SPACE (I.E., A REGION)

  FOR PROGRAM EXECUTION. A REGION SIZE FOR A PROGRAM IS DETERMINED

  BY EITHER:
  - . DEFAULT LOGIC

IS PROGRAM EXECUTION SIZE LESS THAN 24 KB?

YES

NO |
REGION SIZE IS SET TO 24 KB (DEFAULT REGION SIZE)

IS PROGRAM EXECUTION SIZE GREATER THAN THE LARGEST

NONAPPENDED BUFFER PLUS 16 KB?

YES

NO |
REGION SIZE IS SET TO PROGRAM EXECUTION SIZE

REGION SIZE IS SET TO THE LARGEST NONAPPENDED BUFFER PLUS

16 KB

NOTE: AN ADDITIONAL 16 KB IS ADDED TO THE TASK WORK SPACE BY DISK DATA MANAGEMENT WHEN A BUFFER IS NONAPPENDED.

- . USER SPECIFIED EITHER:
  - // REGION OCL STATEMENT
  - SET PROCEDURE

AEB 46 09/13/86

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ERROR CONDITIONS:

THE PROGRAM TERMINATES DUE TO LACK OF SUFFICIENT USER MAIN STORAGE WHEN PROGRAM EXECUTION SIZE IS:

- . GREATER THAN AVAILABLE USER MAIN STORAGE
- LESS THAN AVAILABLE USER MAIN STORAGE, BUT A NONAPPENDED BUFFER PLUS 16 KB IS LARGER THAN AVAILABLE USER MAIN STORAGE

AEB 47 09/13/86

IBM 48.

# SYSTEM/36 INTERNALS

### 7.1.1 PROGRAM LAYOUT IN MAIN STORAGE - EXAMPLE

	MAIN STORAGE	LOGICAL PROGRAM ON DISK
0 KB		0 KB 1 2
16 KB	MINIMUM NUCLEUS	4 KB 3 4
32 KB	9	8 KB 5 6
48 KB	10	12 KB 7 8
64 KB	7 1 1	16 KB 9 10
80 KB	15 4	20 KB 11 12
96 KB	3 5	24 KB 13 14
112 KB	, 16	28 KB   15   16
		estração contra recurso recursos recurs
7120 KB	6	52 KB
7136 KB	8 13 14	56 KB
7152 KB	2   11   12	60 KB
	= 2 KB	

- . PROGRAMS ARE SCATTERED IN MAIN STORAGE IN 2 KB PAGES
- . HARDWARE ADDRESS TRANSLATION PROVIDES LOGICAL/REAL MAPPING:
  - ELIMINATES STORAGE FRAGMENTATION

AEB 48 09/13/86

SYSTEM/30 INTERNALS

7.2 PROCESSING CONSIDERATIONS

SYSTEM/36 LETS YOU ASSUME AN IMPORTANT ROLE IN THE MANAGEMENT AND SCHEDULING OF YOUR JOBS. YOU CAN AFFECT:

- . THE ORDER IN WHICH YOUR JOBS ARE PRESENTED TO BE EXECUTED BY THE USE OF DIFFERENT JOB QUEUE PRIORITIES IN THE INPUT JOB QUEUE.
- . THE SWAPPING AND MAIN STORAGE PROCESSOR UTILIZATION OF YOUR PROGRAMS BY THE USE OF DIFFERENT EXECUTION PRIORITIES.

THREE OTHER FACTORS TO CONSIDER IN OBSERVING THE BEHAVIOR OF YOUR JOBS ARE:

- . TIME SLICE
- . EXECUTION PRIORITIES
- . SWAPPING

AEB 49 09/13/86

ALD 49 07/13/00

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SYSTEM/36 INTERNALS

#### 7.3 SYSTEM TIME SLICE

SYSTEM/36 TIME SLICE INCLUDES TWO ELEMENTS:

- . A RESOURCE UTILIZATION SCHEME:
  - R-TIME (400 MS OF TIME FOR OVERALL SYSTEM RESOURCE USAGE)
  - MSP-TIME (100 MS OF TIME FOR MAIN STORAGE PROCESSOR USAGE)
- . A SYSTEM TIMER
  - MANAGES RESOURCE UTILIZATION
  - 200 MS

THE ACTUAL EXECUTION TIME FOR A TASK DEPENDS ON WHEN THE TASK:

- . GOES TO A "LONG WAIT" STATUS
- . EXCEEDS ITS R-TIME

AEB 50 09/13/86

7.3.1 SYSTEM TIMER

THE SYSTEM HAS A 200 MS INTERNAL TIMER INTERVAL CALLED THE "SYSTEM TIME-OUT COUNT". WHEN IT EXPIRES, IT:

- . RELEASES MAIN STORAGE OF A SHARED SYSTEM PROGRAM THAT'S IN A "LONG WAIT" STATUS (I.E., WHEN THE CURRENT DEMAND COUNT REACHES ZERO AND THERE ARE NO ACTIVE USERS OF THE PROGRAM)
- . DOWNGRADES THE PROGRAM'S PRIORITY WHEN R-TIME IS EXCEEDED,
  EXCLUDING THE FIRST TIME R-TIME IS EXCEEDED
  - . DOWNGRADES THE DEMAND OF SYSTEM PROGRAMS AND SYSTEM WORK SPACE (SWS)
  - . AUTOMATICALLY RESETS TO 200 MS AND, UPON EXPIRING, REPEATS THE ABOVE STEPS
  - . MAKES MAIN STORAGE AVAILABLE

377

AEB 51 09/13/86

IBM 49:

#### SYSTEM/36 INTERNALS

7.3.2 RESOURCE UTILIZATION SCHEME

#### 7.3.2.1 RESOURCE TIMER (R-TIME)

THIS IS A SCHEME EMPLOYED BY THE SYSTEM TO CHARGE A USER TASK FOR USING A SYSTEM RESOURCE. THE NUMBER OF MILLISECONDS (MS) DEDUCTED FROM THE 400 MS ALLOTTED, DEPENDS ON THE RESOURCE USED.

- . AN APPROXIMATE TIME FOR MSP AND CSP UTILIZATION.
- . A THEORETICAL TIME FOR PHYSICAL I/O OPERATIONS.

FORMULA:  $R-TIME = S - (U \times F) - (MSP-TIME) - (CSP-TIME)$ 

S = 400 MS (BASE VALUE)U = 8.192 MS (TIMER UNIT)F = I/O TIMER UNIT FACTOR

#### DEVICES

# 1255 (MICR) DISK PRINTER (SYSTEM NON-SPOOL) DISKETTE TAPE DISKETTE DATA COMPRESSION

# I/O TIME UNIT FACTOR VALUE

2 PER PHYSICAL OPERATION 3 PER PHYSICAL OPERATION 11 PER PHYSICAL OPERATION COMPANY OF THE PARTY OF T 49 PER PHYSICAL OPERATION 50 PER PHYSICAL OPERATION 60000 60000 = 51 PER MULTIPLE PHYSICAL **OPERATIONS** 

MSP-TIME = MAIN STORAGE PROCESSOR TIME USED SINCE THE LAST TIME OUT CSP-TIME = CONTROL STORAGE PROCESSOR TIME (FOR BASIC AND FORTRAN EMULATION)

WHEN R-TIME IS EXCEEDED AND THERE IS A TASK OF EQUAL OR HIGHER PRIORITY READY TO EXECUTE, THE TASK COULD BE FORCED OUT (SWAPPED-OUT) OF MAIN STORAGE.

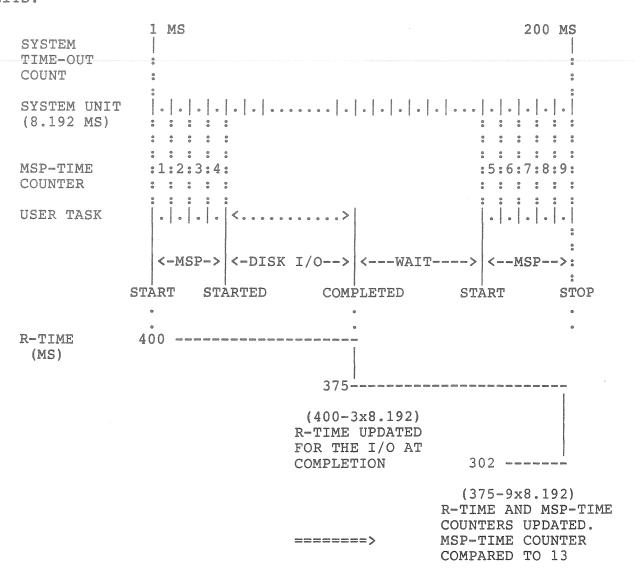
09/13/86 AER 52 

#### 7.3.2.1.1 RESOURCE UTILIZATION (DISK I/O AND MSP) - EXAMPLE

A PROGRAM IS EXECUTED BY THE MSP FOR A PERIOD OF 4 SYSTEM UNITS

BEFORE STARTING AN I/O DISK OPERATION. WHEN THIS OPERATION IS

COMPLETED, IT HAS TO WAIT A LITTLE (BECAUSE THE MSP IS CURRENTLY USED BY ANOTHER TASK) BEFORE BEING EXECUTED AGAIN BY THE MSP FOR 5 SYSTEM UNITS.



AEB 53 09/13/86

# SYSTEM/36 INTERNALS

7.3.2.2 MSP TIME-OUT TIMER (MSP-TIME)

THIS IS A SCHEME EMPLOYED BY THE SYSTEM TO LIMIT THE INFLUENCE OF A MSP PROCESSOR-BOUND PROGRAM, IF ONE PROGRAM HAS BEEN EXECUTING FOR MORE THAN 100 MS.

. APPROXIMATE TIME FOR MSP UTILIZATION:

FORMULA:  $MSP-TIME = C \times U$ 

C = MSP-TIME COUNTER

U = 8.192 MS (TIMER UNIT)

- . CHECKED EVERY 200 MS (I.E., WHEN THE SYSTEM TIMER EXPIRES)
- . MSP-TIME EXPIRES WHEN THE "MSP-TIME COUNTER" REACHES A VALUE OF 13 (I.E., 13  $\times$  8.192 = 106 MS) OR HIGHER.
- . WHEN MSP-TIME IS EXCEEDED AND THERE IS A TASK OF EQUAL OR HIGHER PRIORITY READY TO EXECUTE, THE TASK IS KICKED OUT OF THE MSP.

AEB 54 09/13/86

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# 7.3.2.2.1 RESOURCE UTILIZATION (MSP-TIME) - EXAMPLE

SYSTEM TIME-OUT COUNT	1 MS		200 MS
SYSTEM UNIT (8.192 MS)			
MSP-TIME COUNTER	:1:2:3:4:5:6:7:	8:9:0:1:2:3:4:	:5:6:7:8:
USER TASK	<msp< td=""><td></td><td>TWO DISK OPs &lt;&gt; &lt;-MSP-&gt;</td></msp<>		TWO DISK OPs <> <-MSP->
R-TIME (MS)	400	5770 674 (680 (620 680 680 680 680 680 680 680 680 680 68	
		350 (400-6x8.192) R-TIME UPDATED FOR THE I/O AT COMPLETION	
		=====>	(350-18x8.192) R-TIME AND MSP-TIME COUNTERS UPDATED. MSP-TIME COUNTER COMPARED TO 13

AEB 55 09/13/86

-	THE COURS SHOW WHICH COURS ON	NA CANA SECUE ACUSE ANTER COSTO COST	COURT CONTROL SECURI SALESSE ANNOTA SOURCE STATUM GASSA SECURI SE	
	and these stress areas areas of	Mer MANN access selves selves leases cours deres acces delete de		
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7.4	TASK	EXECUTION	PRIORITY	

TWO PRIORITY TYPES:

- . FIXED
  - SYSTEM (NOT AVAILABLE TO USERS)
  - USER SPECIFIED:
    - -- HIGH
    - -- MEDIUM
    - -- LOW
- . VARIABLE
  - NORMAL (DEFAULT PRIORITY)

AUTOMATIC PRIORITY ADJUSTMENT IS PROVIDED.

AEB 56 09/13/86

# SYSTEM/36 INTERNALS

#### 7.4.1 EXECUTION PRIORITY VALUES

THE FOLLOWING TABLES SHOW CATEGORIES AND VALUES (OR LEVELS) ASSIGNED TO:

- . SYSTEM PROGRAMS:
  - SEVEN FIXED CATEGORIES
  - RANGING FROM A LOW OF 240 TO A HIGH OF 255.

USAGE	FIXED		
ELIGATIVA PARA PARA PARA PARA PARA PARA PARA PA	DEFINE	VALUE	
SYSTEM	SYSTEM	1 2 3 4 5 6 7	255

- . USER PROGRAMS:
  - THREE FIXED CATEGORIES
  - ONE VARIABLE CATEGORY

USAGE	FIXED		VARIABLE			
0023033	DEFINED	VALUE	SWITCH	DEFAULT	VALUE	SWITCH
	HIGH	239 192	YES or ON		239	
USER	MEDIUM	191 128	uphin edit uphi colo (Tito Tito colo diberrifetti fina	NORMAL		NO or
	LOW	127 64			69	OFF

AEB 57 09/13/86

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# SYSTEM/36 INTERNALS

#### 7.4.1.1 USER EXECUTION PRIORITIES

PRIORITY IS THE RELATIVE RANKING OF ITEMS. FOR EXAMPLE, A JOB WITH HIGH PROCESSING PRIORITY SHOULD RUN FASTER THAN A JOB WITH MEDIUM OR LOW PRIODITY.

- . YOU CAN SPECIFY FOUR DIFFERENT EXECUTION PRIORITIES FOR YOUR JOB OR JOB STEPS.
- . THESE EXECUTION PRIORITIES AFFECT THE SWAPPING AND THE WAY YOUR

  PROGRAM GAINS CONTROL OF THE MAIN STORAGE PROCESSOR FROM THE

  DISPATCHER.

IF YOU DO NOT SPECIFY AN EXECUTION PRIORITY FOR YOUR JOB, THE SYSTEM ASSIGNS YOUR JOB A NORMAL PRIORITY.

TO SPECIFY THE EXECUTION PRIORITY OF YOUR JOB(S), YOU CAN USE THE FOLLOWING:

- . PRTY COMMAND:
  - HIGH OR ON
  - MEDIUM
  - NORMAL OR OFF
  - LOW
- . // ATTR OCL STATEMENT:
  - HIGH OR YES
  - MEDIUM
  - NO (EQUIVALENT TO NORMAL)
  - LOW

AEB 58 09/13/86

AEB 58 09/13/86

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# 7.4.1.2 USER EXECUTION PRIORITY FORMULA

FORMULA: PRIORITY =  $(4 \times N) + V$ 

4 = INCREMENT/DECREMENT FACTOR

N = NUMBER OF ATTACHED WORK STATIONS OR SSP-ICF SESSIONS

V = BASE PRIORITY VALUE

#### FIXED

- HIGH OR SWITCH ON = 192

- MEDIUM = 128

- LOW = 64

# VARIABLE

- NORMAL OR SWITCH OFF = 129

### AUTOMATIC PRIORITY ADJUSTMENT:

- . THE PRIORITY DECREASES BY 4 (DECREMENT FACTOR):
  - WHEN R-TIME IS EXCEEDED
  - BY A "LONG WAIT" STATUS (TO INCREASE SWAP ELIGIBILITY)
  - WHEN A WORK STATION OR SSP-ICF SESSION IS RELEASED
- . THE PRIORITY INCREASES BY 4 (INCREMENT FACTOR) WHEN A WORK STATION OR SSP-ICF SESSION IS ATTACHED
- . THE PRIORITY IS RESET TO ORIGINAL PRIORITY WHEN THE LAST
  SUBTRACTION BRINGS THE PRIORITY EQUAL TO OR BELOW THE BASE
  VALUE OF ITS GROUP ON A "LONG WAIT" STATUS

. Fixed Petz Only never goes below base value.

AEB 59 09/13/86

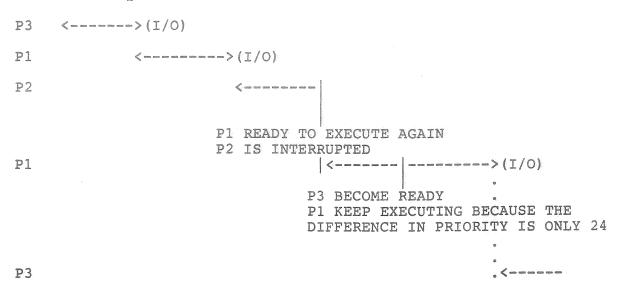
# SYSTEM/36 INTERNALS

#### 7.4.1.2.1 USER PRIORITY (VARIABLE) AND DISK I/O - EXAMPLE

### THREE TASKS READY TO EXECUTE:

ACTIVE PROGRAMS QUEUE	PROCESSING PRIORITY	DISPATCHING STATUS	POSITION ON THE ACTIVE PROGRAM LIST QUEUE	POSITION ON THE READY TASK QUEUE
districtive automorphische districtive des comments au en contra constitut on contra constitut cons	europiniam edidiki P-Villah III Citis -n-holari emilalihidi rinh ilini lisaha derresada eslapsita sistemini ri		described and the second of th	Elektrik gegyst senten proprie de verfrauser zenten en opgigen del kiele en de Tallen den de bevelonde de skild blik del del
PROGRAM 1	NORMAL = 109	READY	variance contractive contracti	2
PROGRAM 2	NORMAL = 69	READY	3	3
PROGRAM 3	NORMAL = 133	READY		1
4004-Validition (Intelligence of the American Communication Communicatio		CONTENTED CONCONTRACTOR (CO. A. MANAGEMENT CO.		

### **EXECUTION SEQUENCE:**



AEB 60 09/13/86

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# SYSTEM/36 INTERNALS

7.4.1.2.2 USER PRIORITY (FIXED AND VARIABLE) AND DISK I/O - EXAMPLE

FIVE TASKS READY TO EXECUTE:

	ACTIVE PROGRAMS QUEUE	PROCESSING PRIORITY	DISPATCHING STATUS	POSITION ON THE ACTIVE PROGRAM LIST QUEUE	POSITION ON THE READY TASK QUEUE
	«Менний Пасимуют» инобарот «Морго и нараси» «Поросы и научурова учений учений предправательной предправательной предправательной и поросы и нарагия и поросы и нарагия и поросы				epigeweitigsvarmagingstalverblantitiongerifigeweitige Herverblantin Herverblantin (1975) 1994
	PROGRAM 1	HIGH = 196	READY		1
	PROGRAM 2	NORMAL = 133	WAITING	3	5
	PROGRAM 3	NORMAL = 69	READY	5	3
	PROGRAM 4	HIGH = 196	READY	2	2
-	PROGRAM 5	NORMAL = 109	WAITING		4

### **EXECUTION SEQUENCE:**

## NOTES:

TASKS P1 AND P4 BEING 32 PRIORITY VALUES HIGHER CAUSES:

- . TASKS P2, P5, AND P3 TO SELDOM EXECUTE
- . TASKS P2, P5, AND P3 TO BE INTERRUPTIBLE DURING EXECUTION:
  - TASKS P1, P4, P2, AND P5 WILL INTERRUPT TASK P3 DURING EXECUTION
  - TASKS P1, P4, AND P2 WILL INTERRUPT TASK P5 DURING EXECUTION
  - TASKS P1 AND P4 WILL INTERRUPT TASK P2 DURING EXECUTION

AEB 61 09/13/86

IEM 48:

SISTEM/30 INTERNALS

# 7.4.2 TASK PRIORITY FREQUENCIES - EXAMPLE

# EXAMPLE - PRIORITY FREQUENCIES DURING EXECUTION

PRIORITY	FREQUENCY	PERCENT	
64	27	0.034	CAN CANNON CHANGE CHANGE SEASON SEASO
69	7557	9.515	BATCH JOBS
73 77 81 85 89 93 97 101 105 109 113 117 121 125 128	32 37 114 245 483 789 1062 1073 1155 1372 1583 1932 2524 4498 128	0.040 0.047 0.144 0.308 0.608 0.993 1.337 1.351 1.454 1.727 1.993 2.433 3.178 5.663 0.161	
129 133	18670 16877	23.597 21.249	THE LARGEST PERCENTAGES
137 141 145 149 192 196 240 250 252	3453 1388 922 177 6 38 1 199	4.348 1.748 1.161 0.223 0.008 0.048 0.001 0.251 0.249	
254	12875	16.210	DISK LOCKS

AEB 62 09/13/86

### 7.5 SWAPPING FUNCTION

- . PROVIDES OPERATOR/PROGRAMMER INDEPENDENCE FROM:
  - STORAGE
  - DISK TYPE/SIZE
  - OTHER CONCURRENT OPERATIONS
- . UTILIZES ALL STORAGE AVAILABLE IN ALL CONFIGURATIONS
- . SWAPS
  - A MINIMUM OF 24 KB OR THE ENTIRE PROGRAM OR WORK SPACE
  - PROGRAMS (SYSTEM OR USER)
  - SYSTEM WORK SPACE
  - TASK WORK SPACE
- . ALLOWS FINE TUNING THROUGH THE PRIORITY PARAMETER ON COMMANDS AND OCL STATEMENTS

AEB 63 09/13/86

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SYSTEM/36	INTERNALS
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#### 7.5.1 SWAPPING CRITERIA

#### SWAP-IN:

. PRIORITY SELECTION

#### SWAP-OUT:

- . PREEMPTIVE DISPATCHING BY PRIORITY GROUP
  - FIXED AND VARIABLE
    - A) LONG WAIT
    - B) TASK PRIORITY
    - C) PROGRAM DEMAND COUNT
  - VARIABLE
    - -- RESOURCE UTILIZATION TIME INTERVALS

# THRASHING PREVENTION TECHNIQUES

- . ATTEMPT TO GIVE ALL TASKS A GUARANTEED FIXED TIME INTERVAL AFTER SWAP-IN, EXCEPT WHEN:
  - THE TASK GOES TO "LONG WAIT" STATUS
  - THE TASK REQUIRES MORE MAIN STORAGE TO EXECUTE
- . REDUCE SWAPPING OF EQUAL PRIORITY TASKS

AEB 64 09/13/86

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7.5.1.1 SWAP IN

THE SWAP-IN PROCESS STARTS:

- . WHENEVER STORAGE BECOMES AVAILABLE (END-OF-JOB, FOR EXAMPLE)
- . AT EACH CYCLE OF THE SYSTEM TIMEOUT COUNT
- . WHEN STORAGE IS NEEDED

AFTER THE PRIORITY OF EACH TASK HAS BEEN UPDATED, THE CONTROL STORAGE SUPERVISOR LOOKS FOR A CANDIDATE TO SWAP IN. THE CONTROL STORAGE SUPERVISOR SEARCHES:

- STEP 1. THE ACTIVE TASKS LIST QUEUE, FROM TOP TO BOTTOM (THAT IS, FROM HIGH TO LOW PRIORITY)
- STEP 2. FOR A TASK READY TO EXECUTE, BUT CURRENTLY NOT COMPLETELY IN STORAGE.

IF A TASK IS SELECTED TO HAVE SOME OF ITS COMPONENTS SWAPPED IN, IT
IS GUARANTEED TO RECEIVE AT LEAST ONE FULL R-TIME (400 TO 599 MS, 500
MS BEING THE AVERAGE OF TIME), UNLESS:

- . IT GOES INTO A LONG WAIT, OR
- . MORE STORAGE IS REQUESTED BY THAT TASK.

AEB 65 09/13/86

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#### 7.5.1.2 SWAP OUT/RELEASE OF MEMORY

IN ORDER TO SELECT THE CANDIDATE TO BE EJECTED, THE SYSTEM USES THE STORAGE OWNER LIST, ALREADY MENTIONED. THIS LIST IS IN TWO PARTS:

PART I - LONG WAIT:

CONTAINS, FROM THE OLDEST TO THE MOST RECENT WAIT,

AREAS IN A LONG WAIT (SYSTEM PROGRAMS AND AREAS WITH

DEMAND COUNT = 0, OR USER PROGRAMS WITH GET OR ACCEPT

FROM DISPLAY PENDING)

#### PART II - TASK PRIORITY:

IS FOLLOWED BY THE LIST OF ALL PROGRAMS OR WORK AREAS NOT INCLUDED IN THE FIRST PART OF THE LIST, WITH THE LEAST RECENTLY SWAPPED IN AT THE TOP AND THE MOST RECENTLY SWAPPED IN AT THE BOTTOM

THE SEARCH IS BASED ON THE PRIORITY OF THE TASK BEING SWAPPED IN AND CAN BE UP TO FOUR STEPS.

A TASK TEMPORARILY UNSWAPPABLE (BECAUSE OF AN OUTSTANDING I/O OPERATION OR BECAUSE IT IS CURRENTLY RUN BY THE MSP, FOR EXAMPLE) CANNOT BE SELECTED.

IF THE TASK IS JUST SWAPPED IN, IT IS NOT SWAP ELIGIBLE.

AEB 66 09/13/86

THE FOUR STEPS ARE:

### STEP 1 - LEVEL 1 (LONG WAITS)

SEARCHES FOR PROGRAMS AT A LONG WAIT; FROM THE OLDEST TO THE MOST RECENT WAIT. THE FIRST APPROPRIATE AREA IS TAKEN. IF NONE IE FOUND, STEP 2 IS PERFORMED.

#### STEP 2 - LEVEL 2 (TASK PRIORITY)

SEARCHES FOR A PROGRAM TO SWAP-OUT THAT IS MORE THAN 32 PRIORITY POINTS LOWER THAN THE PROGRAM BEING SWAPPED-IN. BECAUSE OF THE WAY THE STORAGE OWNER LIST IS ORGANIZED, THE AREA SELECTED WILL ALSO BE THE ONE WHICH HAS BEEN SWAPPED IN FOR THE LONGEST. IF NONE IS FOUND, STEP 3 IS PERFORMED.

## STEP 3 - LEVEL 3 (TASK PRIORITY)

SEARCHES FOR A PROGRAM TO SWAP-OUT THAT IS 32 PRIORITY POINTS

LOWER THAN THE PROGRAM BEING SWAPPED-IN. IF NONE IS FOUND, STEP 4

IS PERFORMED.

## STEP 4 - LEVEL 4 (TASK PRIORITY)

THE PROGRAM BEING SWAPPED-IN IS LOWER IN PRIORITY THAN THE PROGRAM BEING SWAPPED-OUT, THE SWAP WILL OCCUR. (IF THE SWAP DOES NOT OCCUR, A "DEADLOCK CONDITION" IS POSSIBLE.)

AEB 67 09/13/86

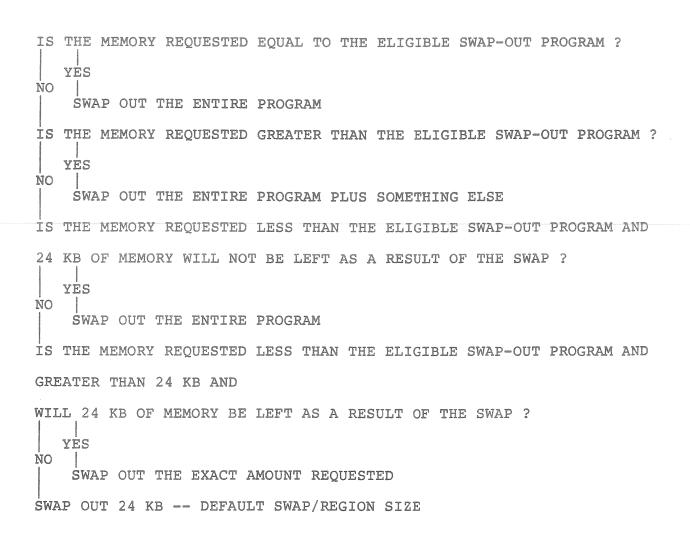
AFTER A STORAGE AREA HAS BEEN SELECTED FOR SWAP OUT, IT IS PUT INTO THE DISK TASK WORK AREA (TWA), EITHER:

- ENTIRELY, IF IT IS SMALLER OR EQUAL TO THE SPACE NEEDED OR IF THE SIZE LEFT IN MAIN STORE AFTER SWAPPING THE SPACE NEEDED IS LESS THAN 24 KB.
- PARTIALLY FOR ALL OTHER CASES. THE PORTION OF THE PROGRAM WRITTEN
  ON DISK IS EQUAL TO THE SPACE NEEDED WITH A MINIMUM OF 24 KB.

AEB 68 09/13/86

# SYSTEM/36 INTERNALS

### 7.5.1.2.1 SWAP ALGORITHM



#### **EXAMPLE:**

MEMORY NEEDED	SIZE OF THE PROGRAM TO BE SWAPPED-OUT	PORTION SWAPPED OUT
12 KB 12 KB 18 KB 26 KB 24 KB	10 KB 30 KB 50 KB 60 KB 24 KB	10 KB (PLUS SOMETHING ELSE) 30 KB (ENTIRE PROGRAM) 24 KB (DEFAULT SWAP SIZE) 26 KB (EXACT AMOUNT) 24 KB (ENTIRE PROGRAM)

AEB 69 09/13/86

#### 7.5.2 SWAPPING OCCURRENCES

SWAPPING OR RELEASING STORAGE CAN OCCUR AT TWO TIMES:

- . IMMEDIATELY (UNCONDITIONALLY)
  - WHEN THE TASK IS PREEMPTED BY A TASK OF SIGNIFICANTLY HIGHER PRIORITY
  - WHEN THE PROGRAM ISSUES A WAIT SVC OR A READ OPERATION TO THE WORK STATION
  - WHEN THE PROGRAM ENDS
- . DELAYED (CONDITIONALLY)

AFTER THE SYSTEM TIME-OUT COUNT EXPIRES:

- WHEN THE TASK EXCEEDS ITS R-TIME
- WHEN THE TASK PRIORITY IS DOWNGRADED TO EQUAL TO OR BELOW THE INCOMING TASK
- WHEN THE TASK PROGRAM DEMAND COUNT REACHES ZERO (i.e., CURRENTLY IN A LONG WAIT)

OTHER FACTORS THAT CAN INCREASE SWAPPING ARE:

- A HEAVILY LOADED SYSTEM
- NOT ENOUGH MAIN STORAGE SPACE
- POOR PROGRAM DESIGN

AEB 70 09/13/86

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#### 8.0 DISTRIBUTION OF SOFTWARE FUNCTIONS AND EXECUTION

THE SYSTEM/36 SOFTWARE FUNCTIONS AND EXECUTION IS DISTRIBUTED INTO THREE LAYERS WITHIN THE CPU. THESE THREE LAYERS ARE:

LAYER 1	MAIN STORAGE PROCESSOR (MSP)		
		SVC CALL	
LAYER 2	CONTROL STORAG	GE PROCESSO	DR (CSP)
LAYER 3	I/O DEVICE ATT	TACHMENTS	

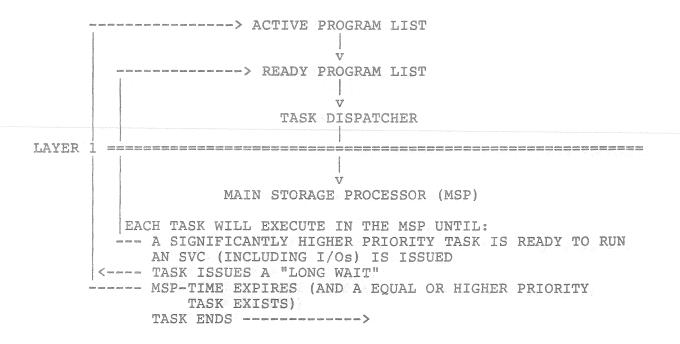
FUNCTION ARE DISTRIBUTED IN THIS MANNER TO PROVIDE MORE OVERLAPPED EXECUTION AND THEREFORE MORE SYSTEM PERFORMANCE THAN WOULD AVAILABLE WITH A MULTIPROCESSOR SYSTEM. THESE MULTIPLE PROCESSORS OPERATE ALMOST INDEPENDENTLY WITH THE FUNCTION SYNCHRONIZATION OCCURRING WITHIN THE CSP.

AEB 71 09/13/86

# SYSTEM/36 INTERNALS

8.1 MAIN STORAGE PROCESSOR (MSP) - LAYER 1

THE FOLLOWING SHOWS THE MAIN STORAGE PROCESSOR (LAYER 1) EXECUTION LOGIC FLOW:



AEB 72 09/13/86

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8.2 CONTROL STORAGE PROCESSOR (CSP) - LAYER 2

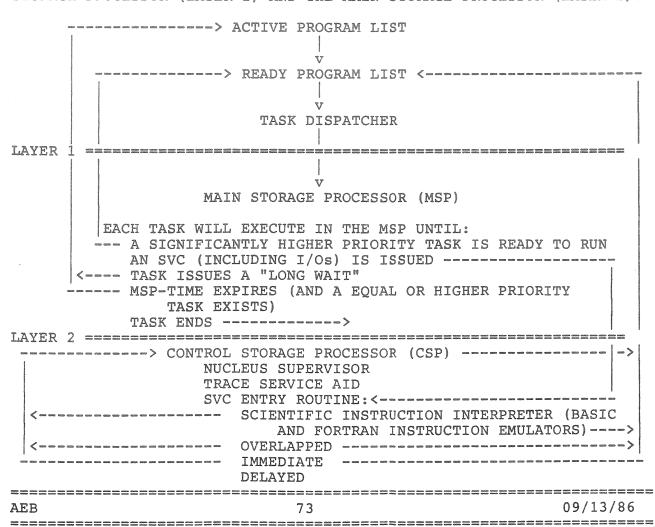
#### MSP/CSP INTERACTION:

- ONE OF THE MAJOR IMPROVEMENTS TO S/36, WHICH IMPACTS SYSTEM PERFORMANCE, IS THE WAY THE MSP AND THE CSP INTERACT.
- . THE CONTROL STORAGE PROCESSOR AND THE MAIN STORAGE PROCESSOR

  INTERFACE THROUGH SUPERVISOR CALL (SVC) INSTRUCTIONS AND COMMON

  DATA AREAS.

THE FOLLOWING SHOWS THE EXECUTION INTERFACE BETWEEN THE CONTROL
STORAGE PROCESSOR (LAYER 2) AND THE MAIN STORAGE PROCESSOR (LAYER 1):



SISIEM/ 30 INTERNALS

8.2.1 SUPERVISORY CALLS (SVCS)

BASED ON THE SVC REQUESTED, THE CONTROL STORAGE PROCESSOR DETERMINES

IF THE OPERATION IS VALID AND IMMEDIATE, OVERLAPPED, OR DELAYED:

#### . IMMEDIATE

- A THE MAIN STORAGE PROCESSOR IS STOPPED TEMPORARILY.
- B AFTER THE FUNCTION IS PERFORMED, CONTROL RETURNS TO THE

  MAIN STORAGE PROCESSOR AND EXECUTION RESTARTS AT THE

  FIRST INSTRUCTION AFTER THE SVC, IF THERE IS NO OTHER TASK

  OF A SIGNIFICANTLY HIGHER PRIORITY READY TO EXECUTE.

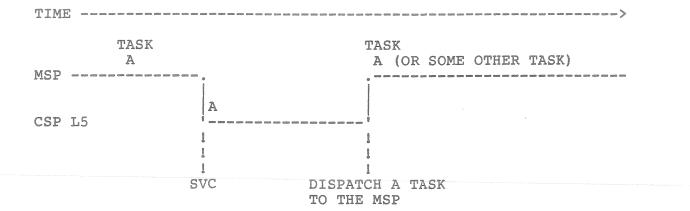
#### . OVERLAPPED OR DELAYED

IF THE SVC INSTRUCTION IS OVERLAPPED OR DELAYED, AN ENTRY ROUTINE IN THE CONTROL STORAGE PROCESSOR DETERMINES IF ANOTHER TASK CAN BE EXECUTED AND, IF SO, REQUESTS THE MSP HARDWARE TO LOAD THE REGISTERS OF THE MSP FOR A DIFFERENT TASK AND RESUME EXECUTION.

AEB 74 09/13/86

# SYSTEM/36 INTERNALS

8.2.1.1 IMMEDIATE SVC - EXAMPLE

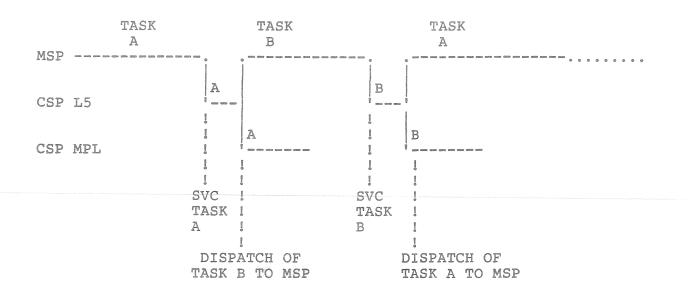


AEB 75 09/13/86

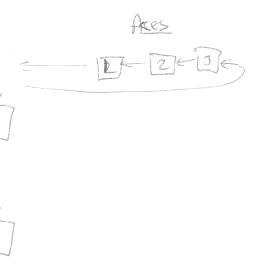
IBM 49:

# SYSTEM/36 INTERNALS

#### 8.2.1.2 OVERLAPPED SVC - EXAMPLE



- . MSP AND CSP RUNNING SIMULTANEOUSLY
- . "DEAD" TIMES FOR BOTH PROCESSORS GREATLY REDUCED

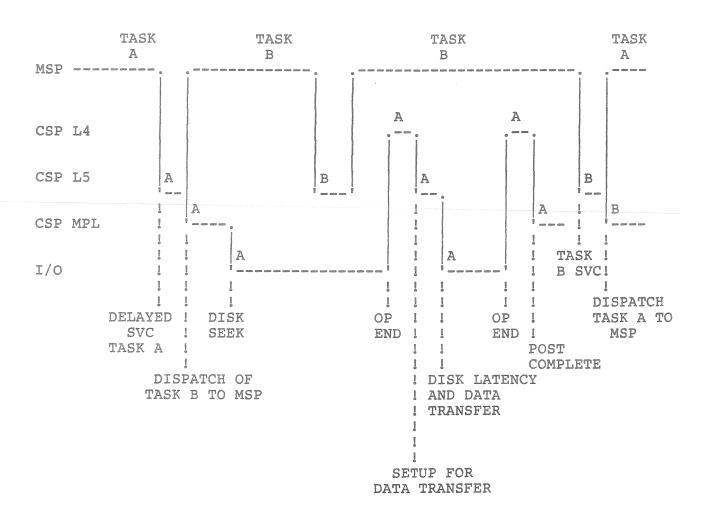


AEB 76 09/13/86

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#### 8.2.1.3 DELAYED SVC (FOR DISK) - EXAMPLE



- . PARALLEL PROCESSORS (MULTIPLE MICROPROCESSORS):
  - MSP
  - CSP
  - CSP/I (I/O)

AEB 77 09/13/86

8.3 I/O DEVICE ATTACHMENTS - LAYER 3

8.3.1 I/O SUPPORT FUNCTION

THE I/O SUPPORT FUNCTION SUPPORTS THE SYSTEM I/O DEVICES. EACH I/O DEVICE HAS ITS OWNS FUNCTIONAL MICROCODE THAT, IN CONJUNCTION WITH THE I/O DEVICE AND I/O ADAPTER, PRESENT AN I/O INTERFACE TO THE CONTROL PROCESSOR.

THE I/O SUPPORT FUNCTION PROVIDES SOME COMMON SUBROUTINES FOR ALL I/O DEVICES, BUT THE MAJORITY OF THE SUBFUNCTIONS WITHIN THE I/O SUPPORT FUNCTION ARE DEVICE-DEPENDENT.

AEB 78 09/13/86

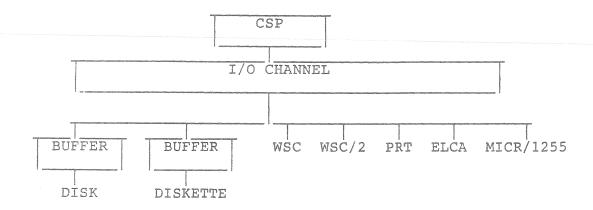
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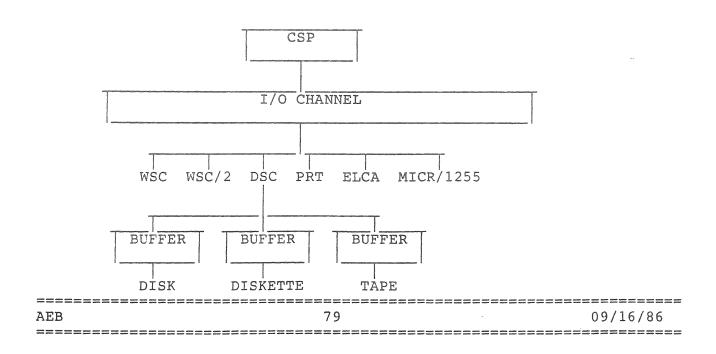
#### 8.3.1.1 I/O CHANNEL

THE I/O PROCESSORS ARE LINKED TO THE CSP BY A "CHANNEL", WHICH IS REALLY A 2-BYTE BIDIRECTIONAL BUS, RUNNING AT 2.5 MEGABYTES BURST DATA RATE.

THE FOLLOWING ILLUSTRATES THE I/O CHANNEL WITHOUT THE DSC INSTALLED:



THE FOLLOWING ILLUSTRATES THE I/O CHANNEL WITH THE DSC INSTALLED:



property (COS) (SOS) (SO	AND COLOR COLOR COLOR STREET STREET COLOR	Co chance desired species telegraph designs schools schools schools schools schools schools schools selected schools selected schools selected solution company.	esiscos acidido aplicido similado mirente 62009 del COI antenio esperio Acidido 60000 ES estudos estudas aplicidos apresios questes 00000 40000 abrilho apresio 40000 60000 60
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#### 8.3.2 I/O DEVICE ATTACHMENTS

I/O DEVICES ARE ATTACHED TO THE SYSTEM I/O CHANNEL BY VARIOUS I/O DEVICE ATTACHMENTS, THESE ARE:

- . DATA STORAGE ATTACHMENT (DSA)
- . WORKSTATION ATTACHMENT
- . MAGNETIC TAPE ATTACHMENT
- . SYSTEM PRINTER ATTACHMENT
- . COMMUNICATIONS ATTACHMENT
- . 1225 MICR ATTACHMENT

AEB 80 . 09/16/86

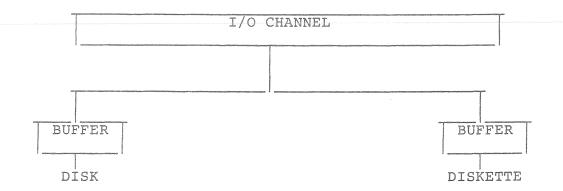
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### SYSTEM/36 INTERNALS

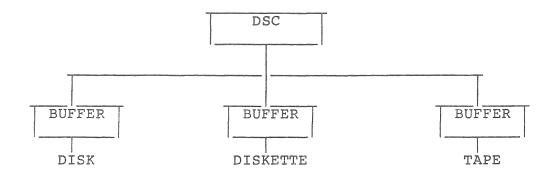
#### 8.3.2.1 DATA STORAGE ATTACHMENT (DSA)

THE DATA STORAGE ATTACHMENT IS A PIECE OF HARDWARE TO WHICH SEVERAL DEVICES CAN BE ATTACHED.

THE <u>DISK/DISKETTE DSA</u> HAS EIGHT 256-BYTE BUFFERS, ORGANIZED IN TWO SETS OF FOUR. EACH SET CAN BE ALLOCATED TO DISK SPINDLES 1, 2, 3, 4, OR DISKETTE.



THE TAPE DSA HAS ONE SET OF FOUR 256-BYTE BUFFERS, AND CAN BE ALLOCATED TO EITHER ONE OF THE TAPE DRIVES.



AEB 81 09/16/86

/IBM 104

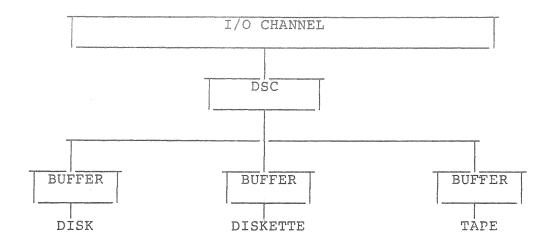
# SYSTEM/36 INTERNALS

#### 8.3.2.2 MAGNETIC TAPE ATTACHMENT

THE DATA STORAGE CONTROLLER (DSC) PROCESSES DISK, DISKETTE, AND TAPE I/O ON SYSTEMS THAT HAVE THE TAPE ATTACHMENT. IN ADDITION, DATA FILE TRANSFERS FROM DEVICE TO DEVICE ARE DONE IN THE DSC.

THE DEVICE-TO-DEVICE OPERATION APPLIES TO TRANSFER OF DATA:

- . FROM TAPE TO DISK
- . FROM DISK TO TAPE
- . FROM DISK TO DISKETTE
- . FROM DISKETTE TO DISK
- . FROM DISK TO DISK



AEB 82 09/16/86

SYSTEM/36 INTERNALS

THE FOLLOWING SHOWS THE RELATIONSHIP OF THE I/O PROCESSORS (LAYER 3 WITHOUT THE DATA STORAGE CONTROLLER - DSC) AND THE CSP (LAYER 2):

AEB 83 09/16/86

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SISTEM/36 INTERNALS

THE FOLLOWING SHOWS THE RELATIONSHIP OF THE I/O PROCESSORS (LAYER 3 WITH THE DATA STORAGE CONTROLLER - DSC) AND THE CSP (LAYER 2):

NUCLEUS SUPERVISOR TRACE SERVICE AID SVC ENTRY ROUTINE: <----SCIENTIFIC INSTRUCTION INTERPRETER (BASIC AND FORTRAN INSTRUCTION EMULATORS) OVERLAPPED IMMEDIATE DELAYED I/O CHANNEL V WSC WSC/2 PRT DSC ELCA MICR/1255

BUF

DISK DISKETTE TAPE

BUF

V

BUF

V

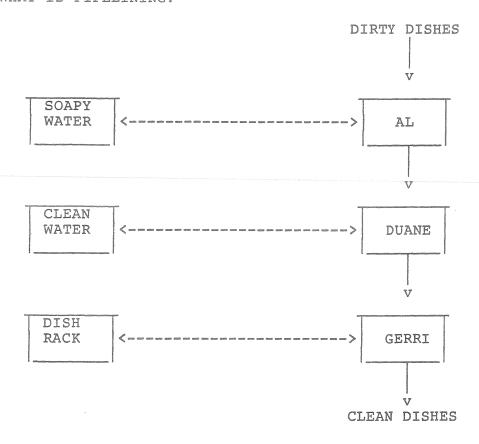
AEB 84 09/16/86

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# SYSTEM/36 INTERNALS

#### 8.4 PIPLELINED OPERATING SYSTEM

#### WHAT IS PIPELINING?

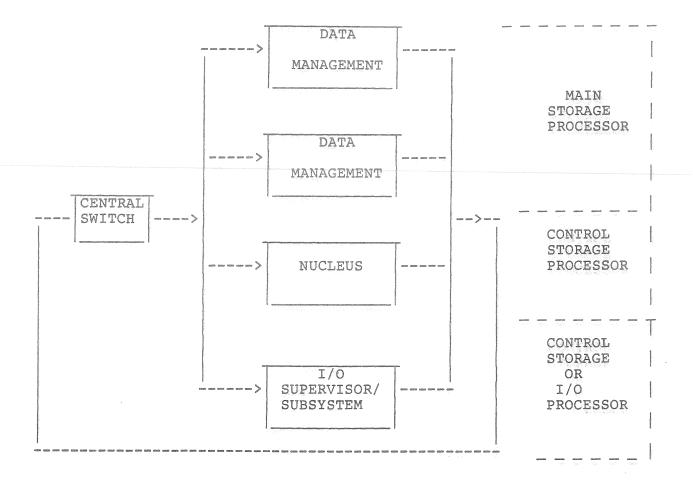


AEB 85 09/16/86

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# 

- . PIPELINING APPLIED TO A HIGHER LEVEL OF ABSTRACTION
- . EXECUTION STATIONS ARE PROCESSORS



AEB 86 09/16/86 

#### 8.5 PROCESSORS SUMMARY

#### REQUIRED PROCESSORS ON SYSTEM/36:

- . MAIN STORAGE PROCESSOR (MSP)
- . CONTROL STORAGE PROCESSOR (CSP)
- . SECOND WORK STATION CONTROLLER (WSC/2) -- PROVIDES CAPABILITY
  FOR THE 1ST THROUGH 36TH LOCAL WORKSTATIONS

#### ADDITIONAL PROCESSORS AVAILABLE ON SYSTEM/36:

- . DATA STORAGE CONTROLLER (DSC), INSTALLED WHEN TAPE IS ORDERED
- . EIGHT LINE COMMUNICATIONS ADAPTER (ELCA), INSTALLED WHEN MORE THAN ONE COMMUNICATION LINE IS USED ON A 5360
- . PRINTER CONTROLLER (PRT) FOR THE 3262
- . MAGNETIC INK CHARACTER RECOGNITION UNIT CONTROLLER (MICR) FOR THE 1255
- . SECOND WORK STATION CONTROLLER (WSC/2) -- PROVIDES CAPABILITY
  FOR THE 37TH THROUGH 72ND LOCAL WORKSTATIONS

AEB 87 09/16/86

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SYSTEM/36 INTERNALS

#### PROCESSOR SPECIFICATIONS

FOR 5360, 5362, AND 5364:

PROCES	SSOR	ADDRESS	DATA	MIPS	STORAGE	MEMORY	INST
		WIDTH	WIDTH	(NATIVE)	SIZE	CYCLE	SET
NAME	TYPE	(BITS)	(BITS)		(KB)	(NS)	
						- I	
MSP	MSP	16 - 24	8 - 2048	.360	128 -2048	200	SS
CSP	CSP	16	16	1.3	64 - 128	200	RR
WSC	CSP/I	16	16	1.3	32 - 96	200	RR

FOR 5360:

					The second streets streets desired streets special special streets attended to the contract of		
PROCES	SSOR	ADDRESS	DATA	MIPS	STORAGE	MEMORY	INST
**************************************		WIDTH	WIDTH	(NATIVE)	SIZE	CYCLE	SET
NAME	TYPE	(BITS)	(BITS)	dispersion of the second of th	(KB)	(NS)	
				· ·			
PRT	ATOM	16	4 - 8	1.1	8	325	RR
DSC	CSP/I	16	16	1.3	128	200	RR
ELCA	CSP/I	16	16	1.3	32 - 64	200	RR
MICR	ATOM	16	4 - 8	1.1	6 - 34	325	RR
WSC/2	CSP/I	16	16	1.3	32 - 96	200	RR

FOR 5360 MODEL D (ONLY)

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PROCES	SSOR	ADDRESS	DATA	MIPS	STORAGE	MEMORY	INST
		WIDTH	WIDTH	(NATIVE)	SIZE	CYCLE	SET
NAME	TYPE	(BITS)	(BITS)		(KB)	(NS)	
MSP CSP	MSP CSP	16 - 24 16	8 - 2048 16	.610	128 -7168 64 - 128	100	SS RR

#### DEFINITIONS:

ATOM	A TINY OPTIMIZED MICROPROCESSOR
CSP/I	CONTROL STORAGE PROCESSOR FOR I/O
MIPS	MILLIONS OF INSTRUCTIONS PER SECOND
NS	NANOSECONDS (I.E., BILLIONTH OF A SECOND) PER BYTE
RR	REGISTER-TO-REGISTER INSTRUCTION SET
SS	STORAGE-TO-STORAGE INSTRUCTION SET

AEB 88 09/16/86

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SYSTEM/36	INTERNALS
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#### 9.0 SUMMARY

THE SYSTEM/36 INCORPORATES INNOVATIVE TECHNOLOGY TO MAINTAIN A HIGH LEVEL OF SYSTEM:

- . USABILITY
- . AVAILABILITY
- . DATA INTEGRITY

THE DISTRIBUTION OF FUNCTION WITHIN THE SYSTEM/36 PROVIDES:

- . PARALLELISM WITHIN THE OPERATING SYSTEM IN ALL MAJOR AREAS
- . SEVERAL PROCESSORS, EACH TUNED TO A SEPARATE TASK; THUS THE PERFORMANCE AND RELIABILITY OF THE ENTIRE SYSTEM IS SIGNIFICANTLY

**ENHANCED** 

- . A COMBINATION OF:
  - DATA PROCESSING
  - OFFICE AND PROFESSIONAL SERVICES
  - DISTRIBUTED PROCESSING

INTO ONE MULTIPURPOSE SYSTEM.

AEB 89 09/16/86