

" MEMORY MANAGEMENT "

A VIDEOTAPE BY WENDELL HENRY

Extra Commentary by

Chris Moeller

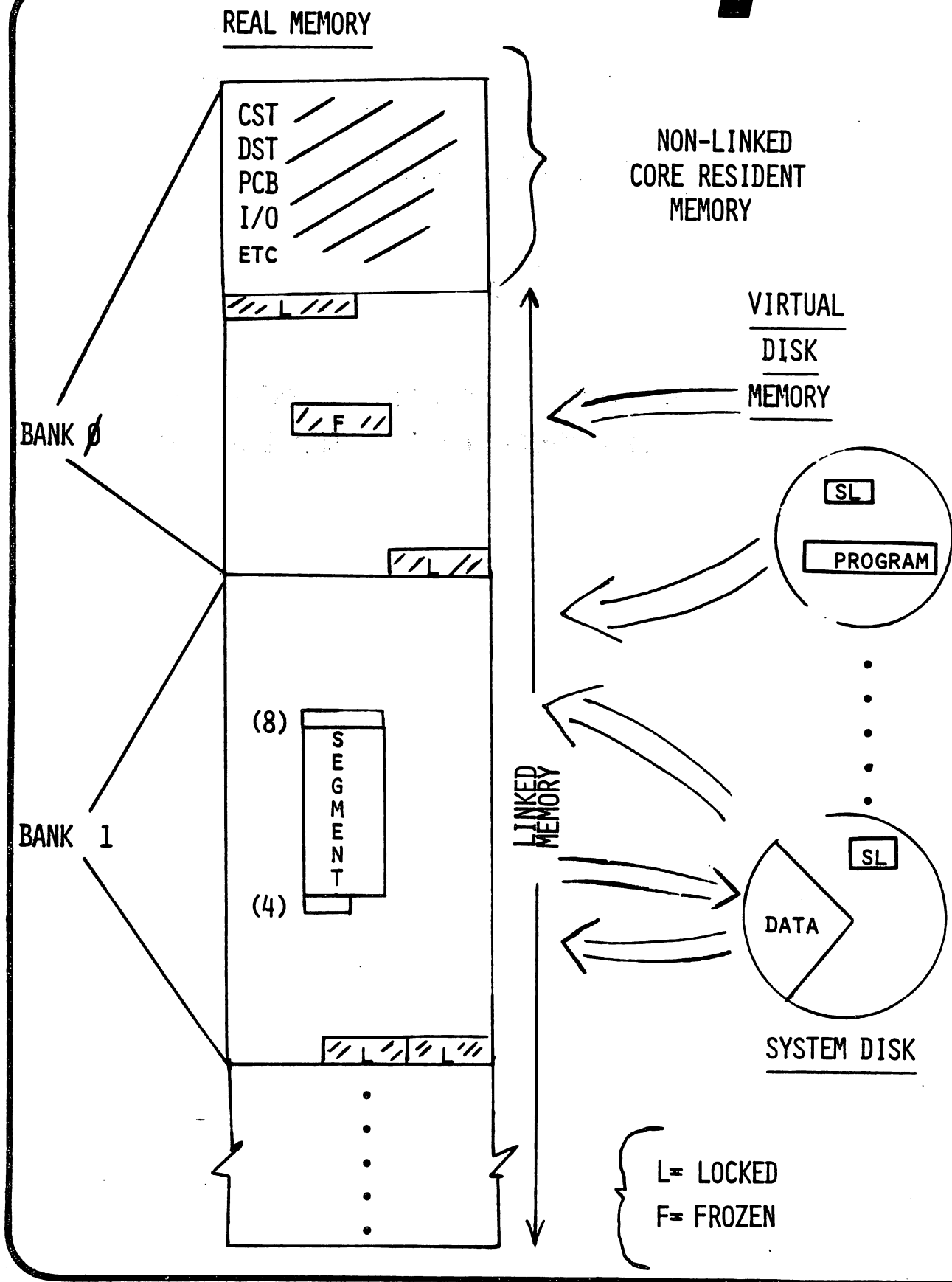
HP Cupertino

MPE III
MEMORY RESOURCE
MANAGEMENT

MEMORY RESOURCE MANAGEMENT

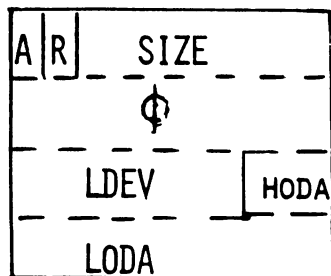
OBJECTIVE

ATTEMPT TO MAXIMIZE THE PROBABILITY THAT A SEGMENT
WILL BE IN REAL MEMORY WHEN IT IS NEEDED BY A PROCESS.



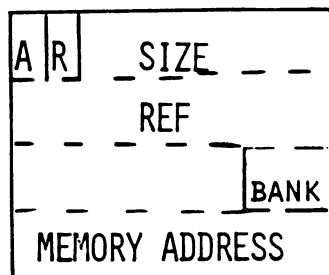
CST/DST ENTRY

- CST/DST ENTRY DEFINES MEMORY STATE OF SEGMENT



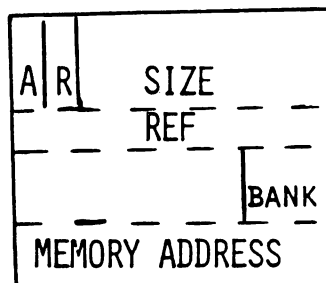
ABSENT SEGMENT

- A=1
- LOGICAL DEVICE # OF DISK
- HODA/LODA - DISK ADDRESS



PRESENT SEGMENT

- A=0
- REF - REFERENCE COUNT
- BANK/ADDR - BANK AND MAIN MEMORY ADDRESS



PSEUDO ABSENT SEGMENT

- A=1
- REF <> 0
- BANK/ADDR - BANK AND MAIN MEMORY ADDRESS

- R - BIT DEFINES WHETHER SEGMENT HAS BEEN REFERENCED
(PRESENT SEGMENT ONLY)
- SET BY MICROCODE DURING PCAL PROCESSING
 - SET BY MIRCOCODE DURING MTDS/MFDS PROCESSING
 - SET BY SOFTWARE DURING EXCHANGE DB

MEMORY STATES

- MEMORY IS MANAGED AS CODE AND DATA SEGMENTS
- AN ALLOCATED SEGMENT IS IN ONE OF THESE STATES
 - ABSENT — THE SEGMENT IS NOT IN MAIN MEMORY. IT IS IN VIRTUAL MEMORY (ON DISK)
 - PRESENT — THE SEGMENT IS IN MAIN MEMORY
 - AN UP-TO-DATE COPY OF A CODE SEGMENT ALSO EXISTS IN VIRTUAL MEMORY
 - AN OUT-OF-DATE COPY OF A DATA SEGMENT EXISTS IN VIRTUAL MEMORY
 - PSEUDO ABSENT — THE SEGMENT IS AVAILABLE FOR OVERLAY

MEMORY LINKS

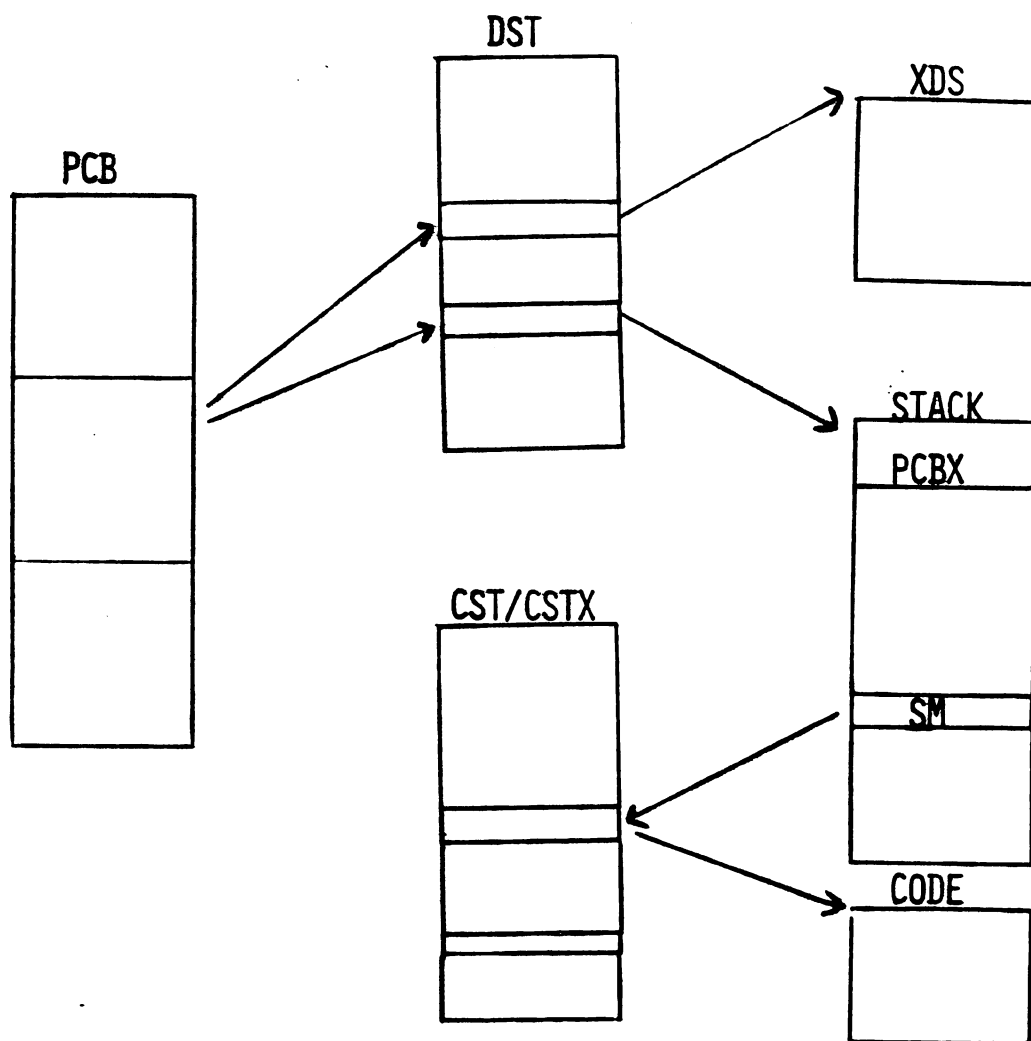
- ALL REGIONS OF LINKED MAIN MEMORY ARE PRECEDED AND FOLLOWED BY CONTROL INFORMATION (MEMORY LINKS)
 - MEMORY IS ALLOCATED AS MULTIPLES OF 4 WORDS
 - THE LINK IN FRONT OF AN AREA IS 8 WORDS LONG
 - THE LINE FOLLOWING AN AREA IS 4 WORDS LONG
- ALL FREE (UNALLOCATED) AREAS OF MAIN MEMORY ARE DOUBLY LINKED TOGETHER. THE MOST RECENTLY FREED REGION IS AT THE FRONT OF THE LIST
- ALL ALLOCATED AREAS OF MAIN MEMORY ARE POINTED TO BY THE CST/DST ENTRIES

PROCESS

- EXECUTABLE ENTITY
- CONTROL INFORMATION IN PCB
- PROPERTIES
 - HAS WORKING SET
 - HAS MEMEORY STATE
 - CORE RESIDENT
 - IN CORE
 - ABSENT
 - OUT OF MEMORY
 - ON SCHEDULING QUEUE
 - READY LIST - NEEDS THE CPU
 - DISCARD LIST - WAIT FOR EVENT COMPLETION BEFORE NEEDING THE CPU
 - NO QUEUE

PROCESS

- BASIC EXECUTABLE ENTITY
- SEVERAL PROCESSES MAY BE RUNNING ON BEHALF OF ONE USER (JOB)



MEMORY ALLOCATION MANAGER (MAM)

- EXECUTES AS A PROCESS
- SCHEDULED BY DISPATCHER
 - DISPATCHER HAS DETECTED THAT THE HIGHEST PRIORITY PROCESS IS ABSENT
 - MAM WAS AWAKENED DIRECTLY BY ANOTHER PROCESS FOR HELP
- CONTROLS THE PLACEMENT/REPLACEMENT OF ALL SEGMENTS IN LINKED MEMORY

TABLES REQUIRED BY MAM

- MTAB - CORE RESIDENT - CONTROL INFORMATION:
- FOR ALL CURRENT MAM I/O REQUESTS
 - FOR ALL CURRENT ABSENCE REQUESTS
- AVAIL'- CORE RESIDENT - THE CURRENT MEMORY AVAILABLE IN EACH BANK. AVAILABLE MEMORY IS THE SUM OF FREE AREAS AND AREAS ALLOCATED TO SEGMENTS WHICH ARE OVERLAY CANDIDATES
- WSET - CORE RESIDENT - CONTAINS THE WORKING SETS OF ALL EXECUTING PROCESSES
- CHANGE'- CORE RESIDENT - USED TO DETERMINE WHETHER AVAILABLE SPACE IN A BANK HAS INCREASED
- ORDER'- BANK NUMBERS SORTED IN ORDER OF MOST AVAILABLE SPACE

WORKING SET

- A WORKING SET PER EXECUTING PROGRAM
- ALL PROCESSES EXECUTING THE SAME PROGRAM SHARE THE SAME WORKING SET - POINTED TO BY PCB
- ALL "PRESENT" SEGMENTS MUST BE MEMBERS OF AT LEAST ONE WORKING SET
- A "SYSTEM" WORKING SET IS MAINTAINED FOR ALL MPE CODE AND DATA SEGMENTS SINCE THESE SEGMENTS ARE SHARED BY ALL EXECUTING PROGRAMS
- EACH WORKING SET IS DYNAMIC IN SIZE
- WHEN A SEGMENT IS REMOVED FROM A WORKING SET IT IS DEALLOCATED OR MADE AN OVERLAY CANDIDATE

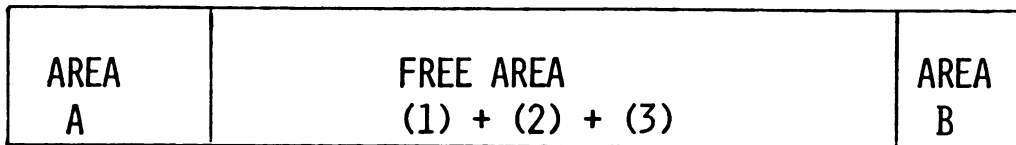
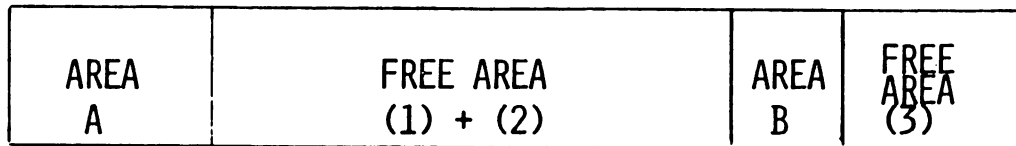
WORKING SET

- INDICATES WHICH CODE AND DATA SEGMENTS ARE USED BY THE EXECUTING PROGRAM MOST FREQUENTLY
- IF AN EXECUTING PROCESS IS FAULTING FREQUENTLY THE WORKING SET IS ALLOWED TO GROW
- IF AN EXECUTING PROCESS IS FAULTING INFREQUENTLY THE WORKING SET IS REDUCED
 - IF THE LAST FAULT WAS $\leq$ 100ms AGO THE NEW SEGMENT IS ADDED TO THE WORKING SET
 - IF THE LAST FAULT WAS $>$ 100ms AGO ALL SEGMENTS WHICH WERE NOT REFERENCED DURING THE LAST 100ms ARE REMOVED FROM THE WORKING SET. THE NEW SEGMENT IS ADDED.

WORKING SET PARAMETERS

- ALFA - TIME SINCE LAST REFERENCE COUNTER UPDATE.
STORED IN EACH WORKING SET. EACH TIME A PROCESS
EXECUTES ITS CPU USAGE WILL BE ADDED TO ALFA FOR
HIS WORKING SET.
- TAU - A VALUE OF 100 ms. PRESENTLY CONSIDERED TO BE AN
OPTIMUM INTER-FAULT TIME
- LAT - TIME SINCE LAST ABSENCE TRAP FOR A PROCESS.
STORED IN EACH PROCESS' PCB.

FREE SPACE COMPACTION



MEMORY MANAGEMENT ALGORITHM

