TO: MTB Distribution

FROM: Tom VanVleck

DATE: 11 November 1977

SUBJECT: HLSUA Meeting Report

The Honeywell Large Systems Users Association held its fall meeting, HLSUA XXV, in Phoenix on October 17-21, 1977. This memo contains my notes on: Highlights
Site Status
System Change Proposals

Also included are copies of the following presentation slides:
Bob Montee - Product Calendar
Harry Quackenboss - Transaction Processing
Harry Quackenboss - Priority Scheduling
Pat Lyon - WORDPRO
David Levin - FORTRAN
Allen Berglund - Tape Facilities
Ron Riedesel - RCP

HIGHLIGHTS

1. Multics got extensive mention by Steve Jerritts (Vice-President/General Manager USISG) and Ken Thatcher (Director DPO Marketing) in opening addresses. Dick Hill (Director Development Programs PMO) also spoke to users at the beginning of the first Multics session. All three asserted that "Multics is a product whose time has come", and that the company is going to push it.

2. Most users were satisfied with Multics and wanted:

   Reliability improvements
   RCP
   Performance improvements
   Better FORTRAN

3. Jim Cook told a long tale of woe about DCC's performance.

4. Jim Foote, Manager of Time Sharing Services at GM, said that in the last year Multics has shown itself to be "head and shoulders above anything else in power and flexibility--and head and shoulders above anything else in grief." GM has had several major catastrophes and the long recovery times have hurt. They have a DTSS in the same machine room, and it doesn't seem to have these problems.

Site Review: Short term problems

AFDSC	Reliability - 451's, zero pages RCP - volume access control Multi - CPU performance
USGS	FORTRAN RCP - drive management
USL	Reliability - 451's, zero pages
IN	*Trouble* reporting & bug fixes Tape - utilities DBM restart/recovery
RADC	Performance Reliability
DCC	Performance Reliability
GM	Reliability - automatic operation *Faster* catastrophe recovery

SYSTEM CHANGE PROPOSALS

FORUM XXIV, Miami

SCP 1573: Consistency of Multi-segment Files after Volume Reload. (AFDSC)
Value score 180.

Hope to do this for MR7.

SCP 1575: Enhanced Absentee Control. (USL, AFDSC, MIT)
Value score 180.

Planned for MR7.

SCP 1582: Retrieval of MRDS Data to COBOL Structure. (IN)
Value score 70.

Supplied in MR6, with GENERATE DESCRIPTORS clause in COBOL.

SCP 1579: Support Page Printing System. (DCC, AFDSC)
Value score 110.

No plan.

SCP 1584: User Purge of Page (GM)
Value score 86.

Under study.

SCP 1577: RJE for Programmable 2780. (USGS-R)
Value score 140.

Supplied in MR6.

SCP 1574: Dynamic Modification of Tuning Parameters Based on Configuration. (RADC)
Value score 180.

Still under study.

SCP 1568: Report Zeroing of Pages in Salvager. (AFDSC)
Value score 200.

MR6 provides several facilities to accomplish this. The volume salvager and the hardcore supervisor log messages reporting the volume position of damaged segments. Answering service programs and administrative tools can convert these messages into pathnames. The record_to_vtocx and vtoc_pathname tools also assist in identifying damaged segments.

SCP 1569: Variable Size Process Directories. (USL, AFDSC)
Value score 200. Also charging for process directory usage.

Under study.

SCP 1580: Support Shared Blocked vfiles. (DCC)
Value score 110.

Supplied in MR6.

SCP 1576: Tape Archive. (USL, IN, AFDSC)
Value score 150.

Planned for MR7.

SCP 1583: Secure Terminal Audit. (GM)
Value score 86.

Part (cross-ring attachment) supplied in MR6. Other parts being considered for MR7. RPQ also being considered.

SCP 1572: Software Maintenance Service. (USGS-D)
Value score 140. Distribution of trouble reports and fixes by hardcopy.

Being considered.

SCP 1578: Accounting Breakdown for Device Charges by Shift. (RADC)
Value score 120.

Being considered.

SCP 1570: Consider Total User Impact in Scheduler. (AFDSC)
Value score 200.

Supplied in MR6, scheduler option to schedule by total CPU.

SCP 1571: Extend I/O Daemon Accounting for Special Forms. (USL)
Value score 200.

Under study.

SCP 1581: Limit Number of Concurrent Processes per User. (DCC)
Value score 110.

Under study.

FORUM XXV, Phoenix, October 1977

Phx 1: Support old_fortran. (AFDSC)
Support through MR8 is requested. Better conversion tools and support of 255K COMMON blocks are also desired.

Phx 2: Detect and Recover from Hardware Errors. (GM)
Automatic deletion of failing blocks of memory is one issue; The general thrust is to keep the system up if at all possible.

Phx 3: Support Character Data in Real Variables in new_fortran. (USGS)

Phx 4: Support log_terminal_session, save_terminal_session Commands. (USL)

Phx 5: Add Data Aggregates to MRDS. (AFDSC)

Phx 6: Eliminate SST Card. (GM)

Phx 7: Do not Require Tape Output Blocks to be Mod 4 Chars. (USL)

Phx 8: Add Demand Meters to Traffic Control. (AFDSC)
This is to support an attempt to determine "think time" for user community. User wants total time each process is demanding resources, and system total.

Phx 9: Fix Date/Time Message in BOS to Spell out Year. (GM)

Phx 10: Add cobol_abs Command. (USL)

Phx 11: Support MRDS Databases Protected by Rings. (AFDSC)

Phx 12: Improve I/O Daemon Segment Deletion. (GM)
Do not delete segment if any printer errors occurred. If segment is to be deleted, do it correctly (DTM updating bug).

Phx 13: Large Files. (AFDSC)

Phx 14: Extend cancel_daemon_request, list_daemon_requests. (AFDSC)
Allow other generic request types. Use number of queues from lod_tables, not constant 3. Show position in queue (but respect AIM).

Phx 15: Support usave, uload Interfaces to Hierarchy Backup. (GM)

Phx 16: Support Full PL/I Macro Processor, IBM-Compatible. (USL, PRHA, AFDSC)
AFDSC suggests use of Consistent System's "max".

Phx 17: New Realtime Scheduling Option. (AFDSC)
User suggests mode, in MGT, where RT processes go to tail of eligible queue. This is proposed as an attempt to make better use of memory, since memory seems to be under-utilized.

Phx 18: Allow new_proj to Specify Project Directories on Alternate Logical Volume. (GM)

Phx 19: Permit Data Model Change in MRDS without Unload and Reload. (AFDSC)

Phx 20: Add Operator command "abs run". (AFDSC)

Phx 21: Support Functions from "ted". (AFDSC)
Would like subroutine interface too.

Phx 22: Support Condition Handling within exec_com. (AFDSC)

Phx 23: Change Length of onsource Pseudovariable. (AFDSC)

Phx 24: Improve Mail Reading. (AFDSC)
User wants functions like "read_mail".

Phx 25: Enhance or Extend archive Command. (AFDSC)
User suggests functions such as those in Consistent System "lds".

Phx 26: Improve Accounting System. (AFDSC)
Main desire is to create auditable record of all use.

Phx 27: Extend AIM Audit Mechanism. (AFDSC)
User wants seg_init, dir_init, mc_seg_init flags, as described in initial AIM design docs.

Phx 28: Support Block Mode for Terminals. (AFDSC)

Phx 29: Add -no_link Option to copy and move. (AFDSC)

Phx 30: Extend list_accessible, list_not_accessible. (AFDSC)
User wants to specify Person.Proj.

Phx 31: Support project_start_up.ec. (AFDSC)
Aids in setting up user environment.

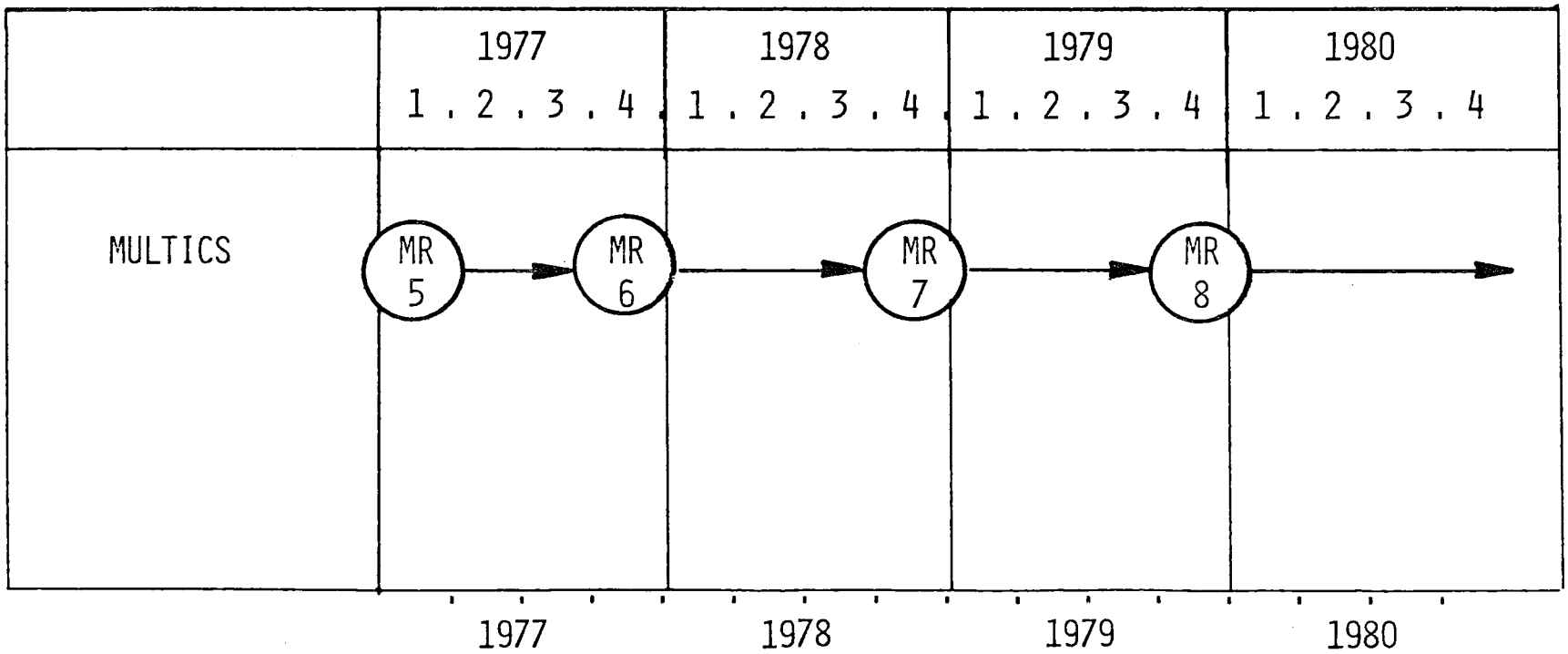
Phx 32: Support Search Rules for info files and exec_com. (AFDSC)

Planned for MR7.

Phx 33: Add -eligible Option to list_abs_requests. (AFDSC)

Phx 34: Complete RCP. (AFDSC)
Reserver functions desired. Operator request to bump attachable resources. Time-limit for attachments.

LARGE SYSTEMS SOFTWARE ROADMAP - MULTICS



Bob Montee
Forum XXV
10/18/77

MULTICS SOFTWARE OVERVIEW

SUMMARY

1. IMPROVE PRICE/PERFORMANCE COMPETITIVENESS
2. ACHIEVE UTILITY GRADE RELIABILITY/MAINTAINABILITY
3. UPGRADE NETWORKING/COMMUNICATION CAPABILITIES
4. COMPLETE/INTEGRATE TP FACILITY
5. COMPLETE/INTEGRATE WORD PROCESSING FACILITIES
6. REPLACE/COEXIST WITH COMPETITIVE SYSTEMS/NETWORKS
7. PROVIDE MORE USER-ORIENTED DOCUMENTATION

MULTICS SOFTWARE OVERVIEW

1. IMPROVE PRICE/PERFORMANCE COMPETITIVENESS

	MR6.0 1977	STRATEGY	MR7.0 1978	MR8.0 1979
CURRENT SITUATION			HARDWARE: FNP, DISK	TAPE, DISK, FNP
			SOFTWARE: FORTRAN, PL/I SYSTEM	COBOL, SYSTEM
a.	Poor FORTRAN performance	IMPLEMENTATION	. DN6678 . MSS500 Ø1 . FORTRAN optimization	. 6250 BPI tape . MSS500 Ø2 . Extended Memory 50Kb FNP
b.	Small interactions too expensive		. PL/I loop optimizer . System performance enhancements	. COBOL performance . System performance enhancements

MULTICS SOFTWARE OVERVIEW

2. Achieve Utility Grade Reliability/Maintainability

	MR6.0 1977		MR7.0 1978	MR8.0 1979
CURRENT SITUATION		STRATEGY	. Failsoft . Online T&D . More Recovery/Restart	. Auto deconfiguration . Checkpoint/restart . Online T&D
a. Incomplete T&D's				
b. Incomplete hardware availability aids		IMPLEMENTATION	. Reduced software vulnerability to hardware failure . Resume task after system failure . Shadow copying option . Mainframe online T&D's (recovery/restart - covered individually)	. Automatic deconfiguration . Absentee checkpoint/restart . Online T&D
c. Minimal task restart capabilities				

MULTICS SOFTWARE OVERVIEW

3. Upgrade Networking/Communication Capabilities

	MR6.0 1977	MR7.0 1978	MR8.0 1979
CURRENT SITUATION		. Clustered terminals . Secure RJE . ARPANet	. L6 . HDLC . X.25 . SDLC
STRATEGY	a. Emphasis on Low Speed terminals & ARPANet		
IMPLEMENTATION	b. No poll & select, no cluster terminals, no concentration, incomplete RJE c. Minimal Honeywell network conformance	. Remote concentration polling . VIP support . 3270 support . Secure RJE facilities . ARPANet enhancements	. Intelligent terminal support . HDLC . X.25 . SDLC link

MULTICS SOFTWARE OVERVIEW

4. Complete/Integrate TP Facility

	MR6.0 1977	MR7.0 1978	MR8.0 1979
CURRENT SITUATION			
STRATEGY		. Large files . MDBM/EUF/TP extensions	. Large Files . COBOL in TP . MIDS/DBTG . Natural language EUF
IMPLEMENTATION		. Large files Ø1 . MDBM extensions . TP extensions . Improved EUF integrity and security . Simplified EUF interface	. Large files Ø2 . Operational extensions . Integrate COBOL MCS . MIDS extensions/DBTG compliance . Natural language EUF interface

MULTICS SOFTWARE OVERVIEW

5. Complete/Integrate Word Processing Facilities

MR6.0 1977		MR7.0 1978	MR8.0 1979
CURRENT SITUATION a. Almost complete publications facility b. Further interface simplification required	STRATEGY	. Complete facilities for manual production	. Photocomposition . Office oriented word processing . Interactive tutorials
	IMPLEMENTATION	. Complete production-oriented capabilities . Prototype office-oriented capabilities	. Photocomposition . Office-oriented W.P. product . Interactive tutorials

MULTICS SOFTWARE OVERVIEW

6. Replace/Coexist with Competitive Systems/Networks

		MR6.0 1977	MR7.0 1978	MR8.0 1979
CURRENT SITUATION	STRATEGY		. PL/I packed decimal . Conversion tools . Upgrade GCOS 4/J . Upgrade tapes . Upgrade accounting . Better absentee . COBOL compliance	. File generations . GCOS tapes/performance . Conversion tools . Accounting extensions . COBOL Report Writer . Interactive IBM Ø1 . FORTRAN 77
Difficult to convert new name site to Multics; tools, facilities and some necessary "conventional" features lacking.	IMPLEMENTATION		. PL/I packed decimal . Macro preprocessor . Upgrade GCOS environment to 4/J (minus front end software) . Improve tape processing . Improve forms control . Accounting extensions . Improve absentee processing flexibility . COBOL enhancements FIPS compliance . Extend RCP	. Multiple file generation . GCOS tape compatibility . GCOS environment performance . IBM, Burroughs, UNIVAC tools . Accounting extensions . COBOL Report Writer . Interactive OS interface Ø1 . FORTRAN 77

MULTICS SOFTWARE OVERVIEW

7. Provide More User-Oriented Documentation

MR6.0 1977		MR7.0 1978	MR8.0 1979
CURRENT SITUATION	STRATEGY	. More	. Tutorial
- Too little - Too late - Not tutorial	IMPLEMENTATION	. User documentation . PLMs . (Covered individually)	. User documentation . PLMs . Ease-of-use Manuals . (Covered individually)

TRANSACTION PROCESSING

HLSUA

FORUM XXV

OCTOBER 18

1977

PHOENIX, ARIZONA

HARRY QUACKENBOSS, MULTICS MARKETING (PHOENIX)

TRANSACTION PROCESSING

FUNCTIONAL REQUIREMENTS

- COMMUNICATIONS
  - TP ENVIRONMENT TERMINALS
  - FORMS TERMINAL SUPPORT
  - MULTIPLEX/MULTI-DROP
- DATA BASE SUPPORT
  - DATA BASE MANAGER
  - RESTART & RECOVERY
  - CONCURRENT ACCESS
  - SECURITY
- SCHEDULING
  - DISPATCHING
  - "MULTI-THREAD"
  - INTER PROGRAM COMMUNICATION
- ADMINISTRATION/USER INTERFACES
- PERFORMANCE

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COMMUNICATIONS REQUIREMENTS

TERMINAL CHARACTERISTICS

- o CRT
- o BLOCK TRANSFER MODE
- o PROTECTED FIELDS
- o MULTI-PLEXING & MULTI-DROP

AIDS

- o SCREEN FORMAT GENERATION

MESSAGE HANDLING & ACKNOWLEDGMENT

- o QUEUEING I/O
- o MESSAGES RECEIVED
- o TRANSACTION PROCESSED

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DATA BASE REQUIREMENTS

- o CODASYL DATA BASES
- o RELATIONAL DATA BASES
- o CONCURRENT ACCESS STRATEGIES
  - QUEUEING ACCESSES
- o RECORD LEVEL LOCKOUT
- o JOURNALIZATION
  - BEFORE IMAGES FOR TRANSACTION ABORT & ROLLBACK
  - AFTER IMAGES FOR RECOVERY & ROLL FORWARD
- o RECOVERY FUNCTION
- o CHECKPOINT FUNCTION
- o DATA BASE SECURITY & INTEGRITY
- o VERY LARGE FILE SUPPORT

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SCHEDULING REQUIREMENTS

- o DIFFERING CHARACTERISTICS FOR DIFFERENT FUNCTIONS
- o TERMINAL CONTROL
  - FUNCTION REQUEST
  - DIALOGUE OF FILL-IN-BLANK
  - GENERAL SHORT COMPUTATIONAL REQUIREMENTS
  - OPTIMIZE TERMINAL OPERATOR PRODUCTIVITY
- o TRANSACTION PROCESSING
  1) ALL TRANSACTIONS SIMILAR IN I/O VOLUME & PROCESSING
  2) WIDE VARIANCE IN PROCESSING REQUIRED
- o MAY WANT TO PROCESS SERIAL TRANSACTIONS BY MEANS OTHER THAN FIFO (PRIORITIZATION)

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TRANSACTIONS NEED TO BE MULTI-THREAD,

PARALLEL PROCESS

MULTI-PROGRAMMING ENVIRONMENT WITH

INTER-PROCESS DISPATCHING,

OTHER IMPLICATIONS:

QUEUEING OF I/O, & TASKS

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GOOD NEWS!

MULTICS SUPPORTS:

- PURE, RE-ENTRANT APPLICATIONS PROGRAMS
  IN ANY LANGUAGE
- QUEUED I/O FOR TERMINALS & FILES
- I/O IS DEVICE INDEPENDENT
- INTER TASK COMMUNICATION (IPC-)
- STATE-OF-THE-ART
  VIRTUAL FILE MANAGER (VFILE-)
- STATE-OF-THE-ART DATA BASE MANAGER
  - RELATIONAL (MRDS)
  - CODASYL (MIDS)

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- FILE SHARING, SECURITY CONTROLS THROUGH ACL'S

- CONCURRENT ACCESS WITH RECORD LEVEL LOCKOUT BY VFILE-

- AUTOMATIC RESTART OF INTERRUPTED OPERATIONS BY VFILE-

- TERMINAL SUPPORT AVAILABLE FOR VIP7705 (SINGLE STATIONS) & 3270 (LIMITED) EXISTS

- PRIORITY SCHEDULER ADAPTABLE TO DIVERSE CONCURRENT REQUIREMENTS

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INTERFACES

T.P. ADMINISTRATOR

- o TABLE DEFINITION OF:
  - TERMINALS & LINES ATTRIBUTES
  - DATA BASES
  - APPLICATIONS PROGRAMS
  - OPERATORS
- o DATA BASE ADMINISTRATOR TOOLS
- o TOOLS TO START & STOP TRANSACTION PROCESSING ENVIRONMENT

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APPLICATIONS PROGRAMMING INTERFACE

- o WELL DEFINED RULES
- o ANY LANGUAGE SUPPORTED

  FORTRAN, COBOL, BASIC, PL1, APL, LINUS
- o INPUT-OUTPUT IN STANDARD WAY
- o ERROR HANDLING IN STANDARD WAY
- o DATA BASE MANAGER WILL BE IMPORTANT PART OF APPLICATIONS ENVIRONMENT

OPERATOR INTERFACE

- o EASILY TAILORED
- o DEFINED BY ADMINISTRATOR

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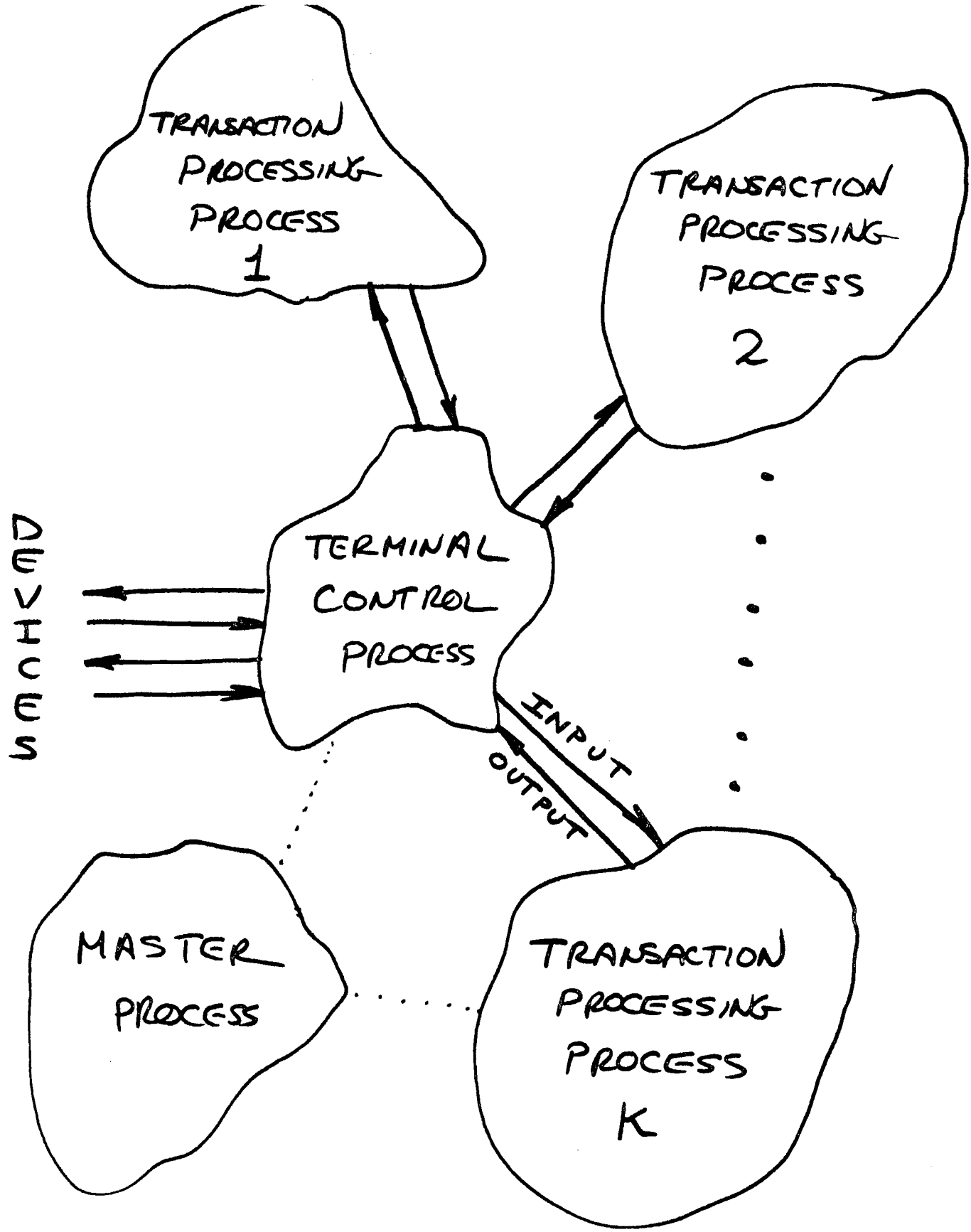
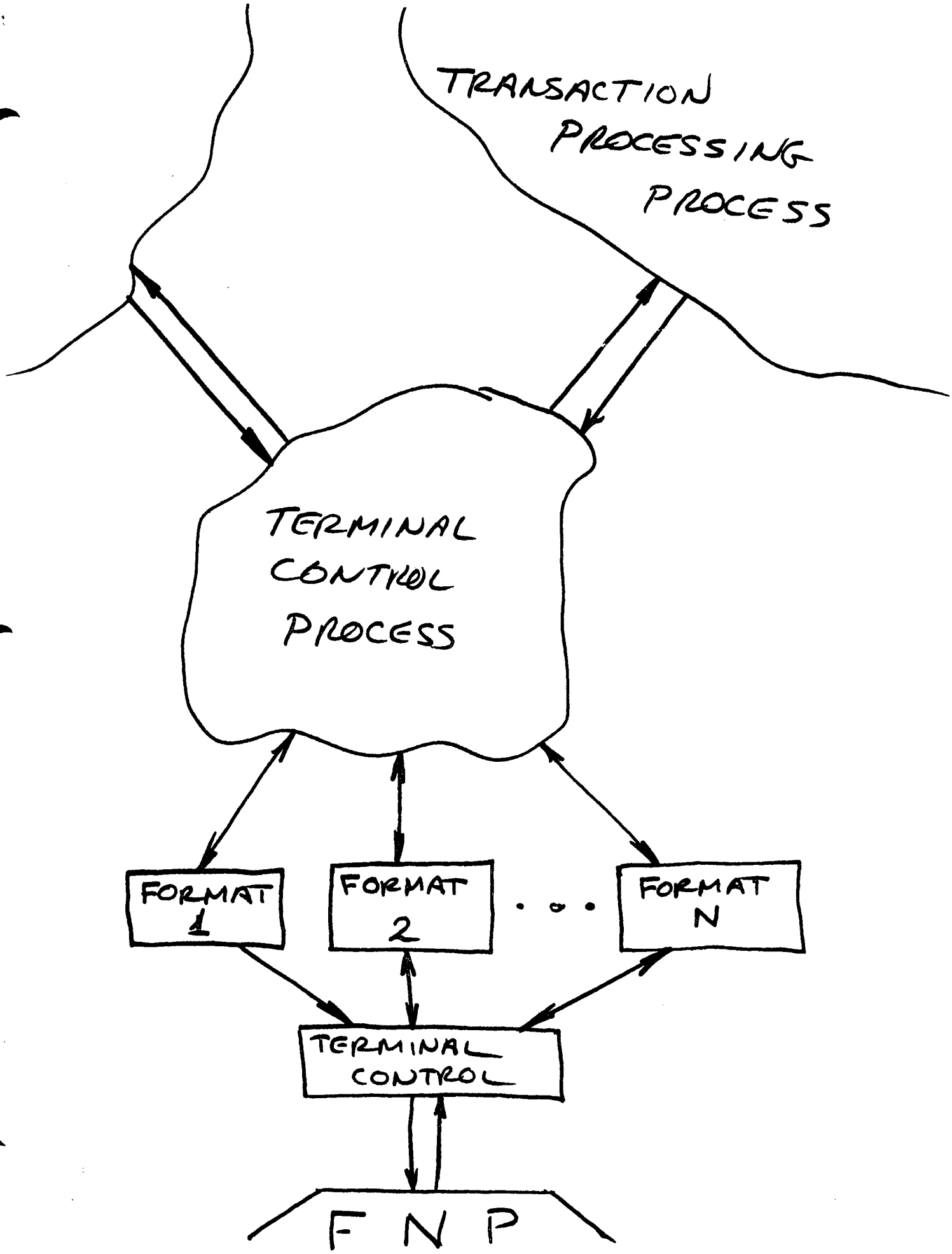
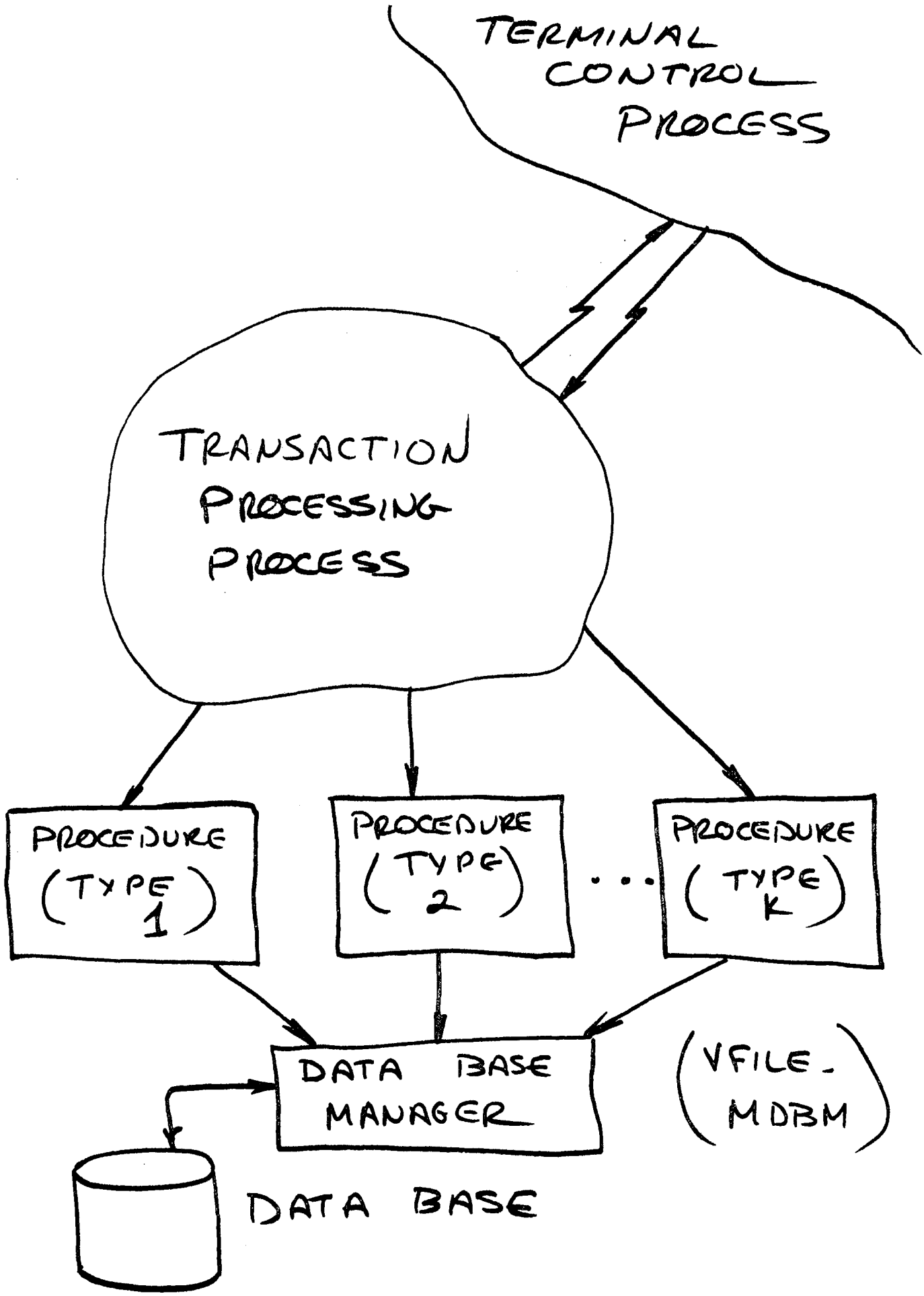

TRANSACTION PROCESSING PROCESS 1
TRANSACTION PROCESSING PROCESS 2
TERMINAL CONTROL PROCESS
DEVICES
INPUT
OUTPUT
MASTER PROCESS
TRANSACTION PROCESSING PROCESS K


TRANSACTION
PROCESSING
PROCESS
TERMINAL
CONTROL
PROCESS
FORMAT
1
FORMAT
2
. . .
FORMAT
N
TERMINAL
CONTROL
F N P


TERMINAL CONTROL PROCESS
TRANSACTION PROCESSING PROCESS
PROCEDURE (TYPE 1)
PROCEDURE (TYPE 2)
PROCEDURE (TYPE K)
DATA BASE MANAGER
(VFILE_ MDBM)
DATA BASE

NEW ITEMS

- VIP SUPPORT
- 3270 COMPATIBLE DEVICES
- REMOTE POOLING & CONCENTRATION
- LARGE FILE SUPPORT
- DATA BASE MGR ENHANCEMENTS
    - o CONCURRENT ACCESS
    - o RESTART/RECOVERY VIA JOURNALIZATION AT VFILE-

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PRIORITY SCHEDULING

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RESOURCE ALLOCATION FACILITIES

- LOAD CONTROL GROUPS
  - * CONTROL MAX (WEIGHTED) LOGGED IN USERS BY GROUP
  - * DEFINE BUMPING (PREMEPTING) RULES
- WORK CLASSES
  - * DYNAMIC CONTROL OF CPU ALLOCATION

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WORK CLASSES: PERCENT MODE

- EACH CLASS ASSIGNED A GUARENTEED MINIMUM OF CPU AVAILABLE
- WORK CLASS "SIZE" IS CONSTANT AS # OF USERS CHANGES

  (BUT PER-USER RESPONSE VARIES)
- IDLE CPU IS AVAILABLE FOR RE-DISTRIBUTION
- SUM OF PERCENTS MUST = 100%

WORK CLASSES: DEADLINE MODE

- EACH CLASS ASSIGNED

  R1 - RESPONSE TIME AFTER INTERACTION

  Q1 - QUANTA FOR FIRST INTERVAL

  R2 - INTERVAL BETWEEN SUBSEQUENT QUANTA

  Q2 - QUANTA FOR SUBSEQUENT INTERVALS

PER-USER NON-INTERACTIVE USAGE RATE =

$$\frac{Q2}{Q2 + R2}$$

EXAMPLE: $\dfrac{.25 \text{ SEC}}{.25 + 4.75 \text{ SEC}} = 5\%$ OF 1 CPU

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REALTIME WORK CLASSES

- CAN BE ADDED WHEN SCHEDULER IS IN % MODE OR DEADLINE MODE
- ASSIGNED QUANTA & RESPONSE TIME LIKE DEADLINE MODE
- READY PROCESSES PLACED IN REAL-TIME QUEUE
- USED FOR:

  INITIALIZER

  IO DAEMON

  DEMO FOR PROSPECTS

  BENCHMARKS

  HIGH PRIORITY USERS

CHANGEABLE SCHEDULING PARAMETERS

TEFIRST	-	TIME QUANTA AWARDED AFTER INTERACTION
TELAST	-	SUBSEQUENT TIME QUANTA
TIMAX	-	DETERMINES HOW "NON-INTERACTIVE" JOBS ARE SORTED INTO READY QUEUE. A PROCESS WILL NOT BE SORTED LOWER THAN IIMAX SECONDS SINCE INTERACTION
MAXE	-	MAX ELIGIBLE PROCESS
WSF	-	WORKING SET FACTOR
WSA	-	WORKING SET ADDEND

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READY- HAS WORK TO DO. READY TO RUN

RUNNING- EXECUTING ON A PROCESSOR

BLOCKED- NOT READY. AWAITING AN EVENT:

- o INPUT FROM TERMINAL
- o TAPE MOUNT
- o SIGNAL FROM ANOTHER PROCESS

EVENT OCCURANCE IS AN INTERACTION AND CAUSES A WAKEUP

WAITING- WAITING FOR A PREDICTABLY SHORT EVENT.

- o DISK PAGE ARRIVAL

STOPPED- PENDING DESTRUCTION BY INITIALIZER

ELIGIBILITY:

- o NOT ALL READY PROCESSES ARE CANDIDATES TO RUN
- o ELGIBILITY IS AWARDED SUBJECT TO:

(A) ELIGIBLE PROCESSES MAXE

(B) WORKING SET ESTIMATES SYSTEM W.S.

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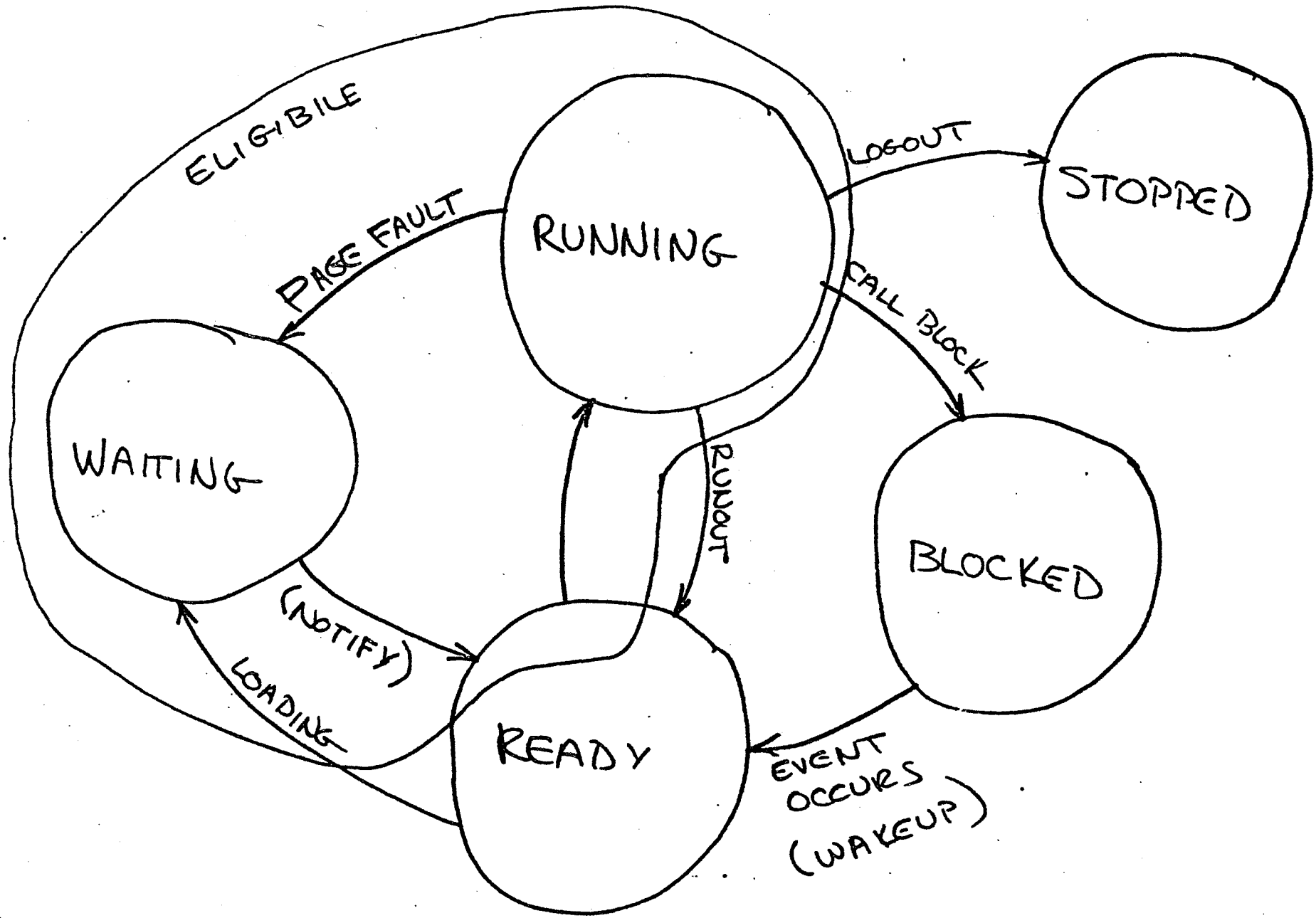
ELIGIBILE
RUNNING
LOGOUT
STOPPED
PAGE FAULT
CALL BLOCK
WAITING
RUNOUT
BLOCKED
(NOTIFY)
LOADING
READY
EVENT
OCCURS
(WAKEUP)

GUIDELINES

(1) CAUTION: USE REALTIME SPARINGLY

- WHEN DEADLINE ARRIVES, ELGIBILITY IS AWARDED WITHOUT LOOKING AT MAXE, WSF
- INITIALIZER SHOULD BE HIGHEST PRIORITY REALTIME PROCESS. (AVOID DEADLY EMBRACES DURING FATAL PROCESS ERRORS)
- LOAD CONTROL CAN HELP KEEP FROM OVER-BOOKING

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(2) IF SOME WORK CLASSES ARE SMALL (10%), RESPONSE AT USER LEVEL WILL BE MORE CONSISTENT WITH SHORT QUANTA:

EXAMPLE: TEFIRST = .75 SEC — 1 SEC
TELAST = .25 SEC — .5 SEC

PERMITS GOOD RESPONSE TO SMALL COMMANDS, BUT PROHIBITS HOGGING THE MACHINE.

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TRANSACTION PROCESSING ENVIRONMENT EXAMPLE

(1) PLACE "WORKER" PROCESSES IN % MODE WORK CLASS, CHOOSE TEFIRST & TELAST IN ACCORDANCE WITH TRANSACTION CHARACTERISTICS. (HEAVY TRANSACTIONS ⇒ LONGER QUANTA TO MAXIMISE THROUGHPUT)

(2) PLACE I/O PROCESSES (HANDLING TERMINALS) IN REALTIME CLASS, CHOOSE R1, Q1, R2, Q2 COMPATIBLE WITH LINE SPEEDS AND TERMINAL I/O VOLUMES.

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GOVERNORS

(1) FORCE K% OF SYSTEM TO BE HELD IN RESERVE.

- HAVE 3 PROCESSORS ON LINE, BUT ONLY WANT USERS TO SEE 2 PROCESSORS.

SOLUTION:

(A) SET UP WORK-CLASS WITH 33% CPU

(B) REGISTER IDLE.DAEMON, LOGGED IN VIA COORDINATOR

(C) LOGIN DILE.DAEMON & RUN IDLE (A SMALL COMPUTE BOUND PROGRAM)

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(2) MAKE % FOR EACH WORK CLASS BE A MAXIMUM CPU LIMIT

(A) USE IDLE.DAEMON

(REGISTER WITH MULTIPLE ATTRIBUTE)

(B) LOG IN 1 PROCESS FOR EACH WORK CLASS.

(C) SET TIMAX HIGH, SO ALWAYS RUNS LOWER

PRIORITY THAN INTERACTIVE/ABSENTEE JOBS

IN SAME WORK CLASS

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A SIMPLE "COMPUTER BOUND" PROGRAM:

```
      SUBROUTINE IDLE
100   CONTINUE
      K = 10
      M = K/100
      GO TO 100
      END
```

AN "IDLE" EXEC-COM:

```
& LABEL IDLE
& COMMAND-LINE OFF
SET-WORK-CLASS & 1
SET-TIMAX 20
```

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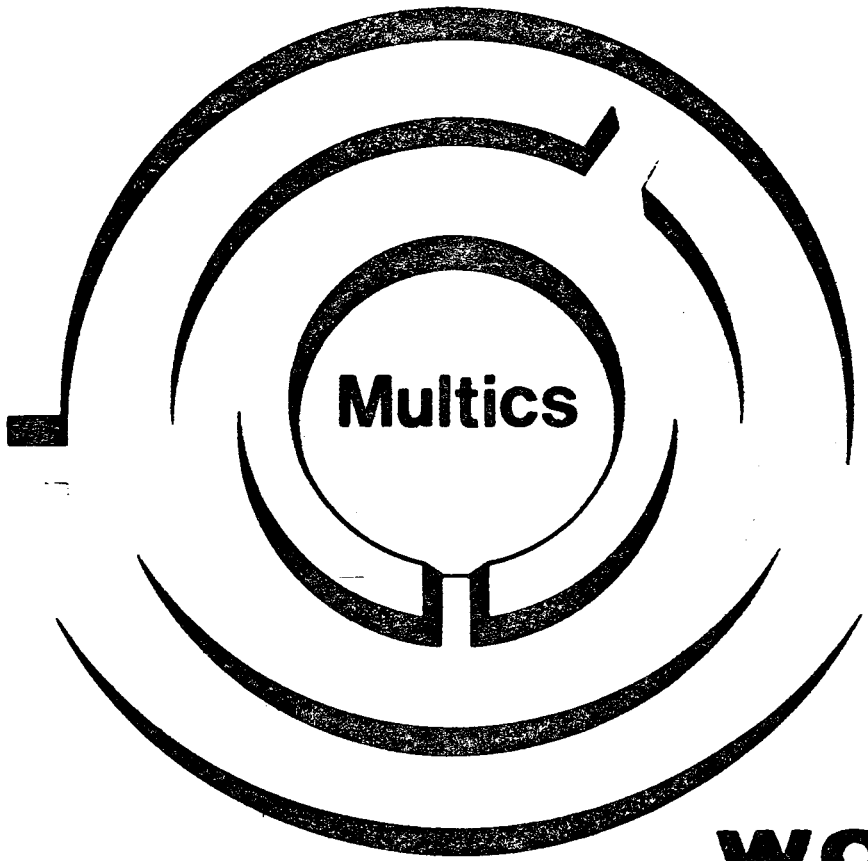
MULTICS - WORDPRO

LEVEL 68/MULTICS



WORDPRO

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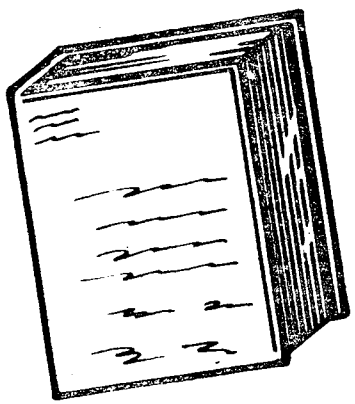
MULTICS - WORDPRO

☐WORDPRO

- A COMPREHENSIVE SET OF TOOLS FOR THE AUTOMATED CREATION, EDITING, PUBLICATION, DISTRIBUTION, AND MAINTENANCE OF DOCUMENTS



- LETTERS
- REPORTS
- SPECIFICATIONS
- PROPOSALS
- PURCHASE ORDERS
- INVOICES
- CONTRACTS
- BILLS OF MATERIALS
- MANUALS
- ETC.

MULTICS - WORDPRO

☐ WHY WORD PROCESSING?

■ IMPROVED PEOPLE PRODUCTIVITY  COST REDUCTION

- INCREASED SPEED OF DOCUMENT DEVELOPMENT
- SHORTENED REVIEW/UPDATE CYCLES
- QUALITY CONTROL IMPROVEMENT SIMPLIFICATION
- ENHANCED MAINTENANCE CAPABILITIES
- MORE FLEXIBLE DOCUMENT FORMATTING CONTROL
- IMPROVED DOCUMENT DISTRIBUTION MECHANISMS
- REDUCED PAPERWORK, COPIES REQUIREMENTS

MULTICS - WORDPRO

☐WORDPRO

- A CENTRALIZED APPROACH TO DOCUMENT PROCESSING
- AN INTEGRATED PART OF THE MULTICS DATA PROCESSING SPECTRUM
- A VEHICLE FOR AUTOMATING THE OFFICE OR THE PUBLICATIONS CENTER

MULTICS - WORDPRO

☐ LEVEL 68/MULTICS

■ WORD PROCESSING IMPLEMENTED AS ANOTHER DIMENSION TO LEVEL 68/MULTICS SERVICES:

- WORD PROCESSING
- TRANSACTION PROCESSING
- PROGRAM DEVELOPMENT
- TIME SHARING
- REMOTE/LOCAL BATCH
- DATA BASE MANAGEMENT
- INTERACTIVE GRAPHICS

MULTICS - WORDPRO

☐ LEVEL 68/MULTICS IMPLEMENTATION

■ UNIQUE CAPABILITIES

- DOCUMENT MANAGEMENT
- CUSTOMIZED USER ENVIRONMENT
- SECURITY
- QUALITY CONTROL
- ELECTRONIC MAIL

MULTICS - WORDPRO

☐ DIFFERENT EVOLUTIONARY PATHS IN WORD PROCESSING

- OFFICE-ORIENTED SYSTEMS
  - HIGHLY SIMPLIFIED INTERFACES
  - AUTOMATIC TYPEWRITER ORIENTATION
  - FIXED, STANDARD FORMATS
  - LETTERS, MEMOS, REPORTS

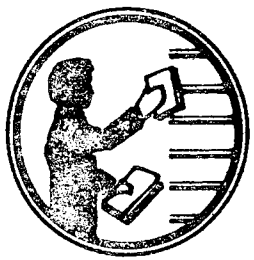
- PUBLICATION-ORIENTED SYSTEMS
  - SIMPLE TYPEWRITER INTERFACES FOR TEXT ENTRY, EDIT
  - MIXTURE OF UNIQUE, STANDARD FORMATS
  - MORE ADVANCED CAPABILITIES FOR UNIQUE FORMATS
  - COMPREHENSIVE DOCUMENT MAINTENANCE TOOLS
  - OUTPUT FLEXIBILITY (HARDCOPY, ONLINE FILES, TAPE, CARDS, ETC.)
  - COMPLETE DISTRIBUTION SYSTEM (ONLINE ACCESS)

} BOTH HAVE EVOLVED INDEPENDENTLY AND SEPARATELY FROM DATA PROCESSING OPERATIONS

MULTICS - WORDPRO

☐ WORDPRO OFFERS BOTH IN ONE SYSTEM

- THE "LETTER" SUBSYSTEM (OFFICE-ORIENTED)
  - PRE-DEFINED, SELECTABLE FORMATS
  - TYPEWRITER INTERFACE
  - TUTORIALS FOR LEARNING



- THE "DOCUMENT" SUBSYSTEM (PUBLICATION-ORIENTED)
  - PRE-DEFINED, SELECTABLE FORMATS
  - FLEXIBILITY IN FORMAT CONTROL (UNIQUE FORMATS)
  - DOCUMENT MAINTENANCE TOOLS
  - OUTPUT FLEXIBILITY, CONTROL
  - ELECTRONIC MAIL FOR DOCUMENT DISTRIBUTION, ACCESS

} BOTH INTEGRATED WITHIN THE MULTICS DATA PROCESSING ENVIRONMENT

A-18-235M

MULTICS - WORDPRO

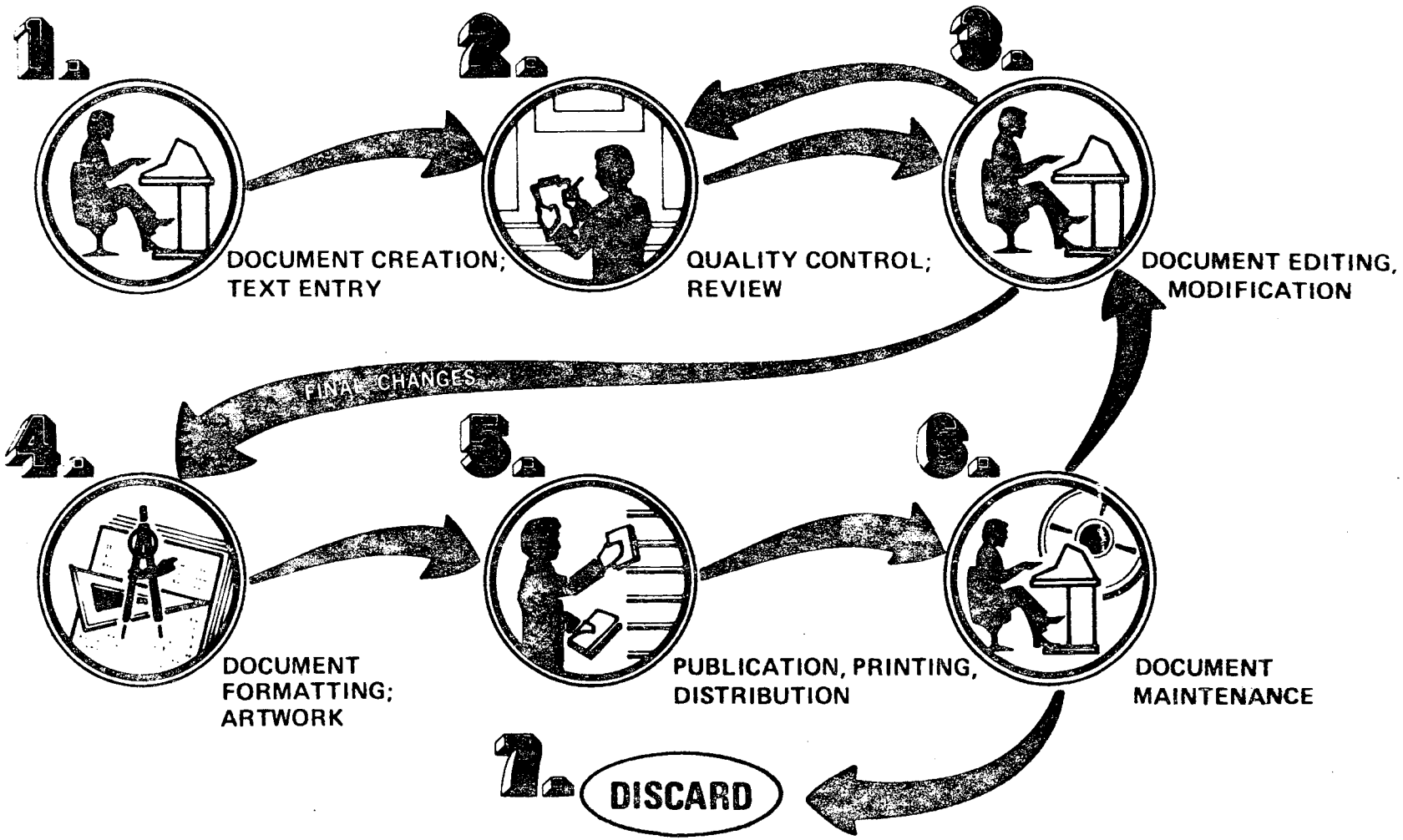
☐ LEVEL 68/MULTICS

■ WORD PROCESSING FULLY INTEGRATED WITH DATA PROCESSING

- ALL TEXT, DATA, CREATED VIA WORDPRO AVAILABLE TO DATA PROCESSING
- WORDPRO CAN BE USED TO FACILITATE DATA CAPTURE FOR DATA PROCESSING APPLICATIONS
- DATA CREATED/USED BY DATA PROCESSING APPLICATIONS CAN BE USED IN WORDPRO DOCUMENTS

MULTICS - WORDPRO

☐THE DOCUMENT LIFE CYCLE



A-18-241M

MULTICS - WORDPRO

☐DOCUMENT CREATION

- MULTICS COMMUNICATION SYSTEM INTERFACE
  - FREE-FORMAT ENTRY: NO SPECIAL CHARACTER, LINE ORIENTATION
  - ANY TERMINAL CAN BE USED
  - NO EXPENSIVE, DEDICATED DEVICES REQUIRED
  - ONLINE HELP FILES FOR REFERENCE, LEARNING
- POWER-TYPING
  - PRE-DEFINED FORMATS
  - ON-COMMAND FORMAT SELECTION
  - AUTOMATIC PARAGRAPH NUMBERING (OPTIONAL)
- SPEEDTYPE
  - TYPE LESS→TYPE MORE FASTER
  - ABBREVIATION OF COMMONS WORDS
  - ABBREVIATION OF LENGTHY STRINGS
  - ABBREVIATION OF DIFFICULT WORDS
  - AUTO-CORRECTION OF TYPOS
  - AUTOMATIC SUFFIXING, PREFIXING
  - STORES ABBREVIATED TEXT, SAVES STORAGE

MULTICS - WORDPRO

☐ DOCUMENT CREATION (CONTINUED)

■ SPEEDTYPE EXAMPLES

TYPE:	RESULTS:
TWMC	To Whom It May Concern:
ECI	Example Company, Inc.
SY	Sincerely Yours
HISI	Honeywell Information Systems, Inc.
hte	the
_HISI	Honeywell Information Systems, Inc.
dic+	dictionaries

MULTICS - WORDPRO

☐QUALITY CONTROL; REVIEW

- ONLINE DICTIONARIES
  - 50,000 ENGLISH WORDS
  - ADD TO , DELETE FROM AS NEEDED
  - MULTIPLE DICTIONARIES POSSIBLE
  - AUTOMATED TYPO DETECTION
- REVIEW DRAFTS
  - CHANGE BARS
  - TEXT COMPARISON PROGRAMS
  - OUTPUT TO LINE PRINTER OR REMOTE PRINTERS

MULTICS - WORDPRO

☐DOCUMENT EDITING; MODIFICATION

- CURSOR-CONTROLLED EDITING
  - TERMINAL-ORIENTED, SIMPLE INTERFACE
  - OVERTYPING
  - INSERTION, DELETION
- STRING-ORIENTED EDITING
  - CONTEXT OR LINE-ORIENTED
  - POWERFUL BOOLEAN SELECTION CAPABILITIES
  - GLOBAL EDITING
  - MACRO PROGRAMMING
  - SPECIAL CHARACTER SELECTION

MULTICS - WORDPRO

☐DOCUMENT FORMAT CONTROL

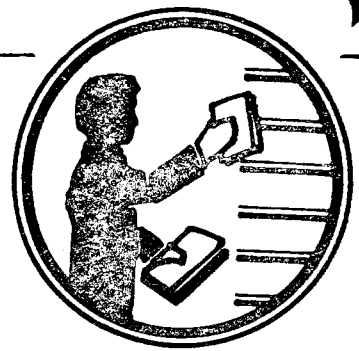
- PAGE WIDTH, LENGTH
- MARGINS
- OPTIONAL MULTIPLE TOTAL DICTIONARY HYPHENATION
- HEADERS, FOOTERS
- MULTI-COLUMN CONTROL
- AUTOMATIC PAGINATION
- FRONT AND BACK PRINTING
- AUTOMATIC FOOTNOTES
- CENTERING OF COLUMNS, LINES
- AUTOMATIC INDEX GENERATION
- AUTOMATIC TABLE OF CONTENTS CREATION
- SPACE CONTROL FOR PHOTOS, DIAGRAMS
- INSERTION OF FILES, PARAGRAPHS
- PARAGRAPHS RENUMBERED AUTOMATICALLY

MULTICS - WORDPRO

☐ LIST PROCESSING

- ONLINE LISTS OF INFORMATION
  - MAILING LISTS
  - CUSTOMER LISTS, ETC.
- FORM LETTERS
- SIMPLE LIST FORMAT
- EASY UPDATE, ONLINE VIA WORDPRO EDITOR
- SHARING OF LISTS
- SECURITY OF LISTS
- OUTPUT FORMATTING VIA WORDPRO FORMATTER

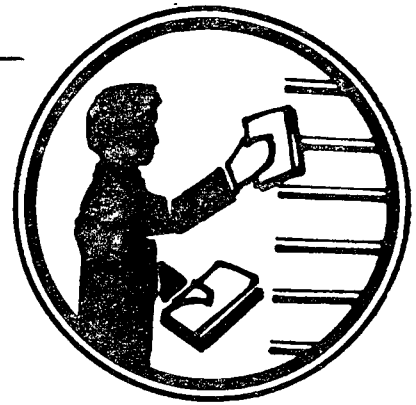
MULTICS - WORDPRO



☐PUBLICATION

- OUTPUT CONTROL
  - OUTPUT TO ANY TERMINAL
    - LINE PRINTER
    - PLOTTING TERMINAL
    - TTY, ETC.
    - SPECIAL FORMS
  - OUTPUT TO A FILE
    - ONLINE MAINTENANCE
    - ONLINE LIBRARY
    - ELECTRONIC DISTRIBUTION, ACCESSIBILITY
    - ARCHIVING TO TAPE
  - OUTPUT TO MICROFORM
    - GOULD
    - SINGER
  - OUTPUT TO PAGE PRINTING SYSTEM
    - 18,000 LPM
    - MULTICOLOR
    - LOGOS
    - SPECIAL FORMS

MULTICS - WORDPRO



☐PUBLICATION (CONTINUED)

- PHOTO-COMPOSITION
  - AUTOMATIC TYPE-SETTING
  - TABLE DRIVEN APPROACH
    - VARIOUS DEVICES SUPPORTABLE
  - USES OUTPUT FROM FORMATTER
- INSERTION OF GRAPHICS ONLINE
  - GRAPHICS SYSTEM OUTPUT TO HARDCOPY

MULTICS - WORDPRO

☐ DOCUMENT DISTRIBUTION

■ SEVERAL APPROACHES:

- SINGLE COPY; ONLINE, REMOTE PERUSAL
  (AVOIDS DISTRIBUTION ENTIRELY)
- MICROFORM
  (MINIMIZES PACKAGE SIZE)
- ELECTRONIC MAIL
  (AUTOMATES IN-HOUSE MAILS, TELEX)
- NORMAL MULTI-COPY, PHYSICAL SHIPMENT
  (CAN UTILIZE PAGE PRINTER, LINE PRINTERS)

MULTICS - WORDPRO

☐ ELECTRONIC MAIL

- EACH USER HAS A SECURE MAILBOX
- SEND IMMEDIATE MESSAGES
- SEND BULK MAIL
  - MEMOS
  - FORMATTED LETTERS
  - ENTIRE DOCUMENTS
  - ADDRESS OF A DOCUMENT
- MULTICS MAILING LISTS
  - SEND MAIL TO ONE USER
  - SEND MAIL TO A LIST OF USERS
- SEND MAIL TO OTHER SITES

MULTICS - WORDPRO

☐ ELECTRONIC MAIL

- INSTANTANEOUS DISTRIBUTION AND DELIVERY OF MAIL, MESSAGES
- MANAGEMENT OF MEMOS
  - SECUIRTY
  - EASE OF STORAGE
  - EDITING
  - DATA BASE MANAGEMENT
  - AUTOMATIC ARCHIVING
- AUTOMATIC MESSAGES, REMINDERS
- TOTAL AUTOMATION OF IN-HOUSE MAIL

MULTICS - WORDPRO

☐DOCUMENT MAINTENANCE

- ONLINE TOOLS
  - VERSION MAINTENANCE
  - ADDENDA
  - SECTION CONTROL
- ARCHIVAL STORAGE
  - MAGNETIC TAPE
  - OFFLINE DISK PACKS
  - CARDS, ETC.
- SECURITY, SHARING OF MULTICS
  - MOST SECURE SYSTEM AVAILABLE

MULTICS - WORDPRO

☐ ADVANTAGES OF THE WORDPRO APPROACH

- SIMPLICITY OF TERMINAL OPERATOR INTERFACE
- SIMPLE, INEXPENSIVE DEVICES
- FLEXIBILITY FOR UNIQUE DOCUMENTS
- ECONOMICS OF SCALE OF "MAXI" VS. "MINI" SYSTEM APPROACH
- TOTAL INTEGRATION WITH DATA PROCESSING ENVIRONMENT
- UNIQUE FUNCTIONAL CHARACTERISTICS

MULTICS - WORDPRO

☐ LEVEL 68/MULTICS

■ IMPLEMENTATION AS ANOTHER DIMENSION OF MULTICS PROVIDES:

- CAPABILITY FOR ALMOST LIMITLESS GROWTH IN EASY, INEXPENSIVE STEPS
- UTILIZATION OF SIMPLE, INEXPENSIVE I/O DEVICES
- UNEQUALLED FLEXIBILITY
  - –TYPE, LOCATION OF DEVICES
  - –LIMITLESS FORMATS
  - –INTERFACES FOR NOVICE, EXPERT, IN BETWEEN

The Multics FORTRAN Compiler

and

Runtime I/O Routines

- o new_fortran Design Goals
- o Old FORTRAN Compiler
- o FORTRAN Runtime I/O Routines
- o Documentation
- o MR6.0 Changes
- o Planned MR7.0 Changes
- o Looking Ahead

FORTRAN Design Goals

- Minimal Resource Usage
- Easy Conversion from Others Systems to Multics
- Easy to Use
- Generated Object Code is Efficient
- Efficient Runtime Support Routines
- Informative Error Diagnostics from Compiler and Runtime
- Good User Documentation

COMPILER RESOURCE USAGE

Relative to old_fortran

Five (5) times faster than old_fortran

Internal Representation -- Two (2) Segments Instead of Nine (9) or More

EASY CONVERSION FROM OTHER SITES

- Two Source Formats
  - Card-image (As Defined by 1966 ANSI Standard)
  - Free-form (In common use on most time-sharing systems)
- Language is Superset of 1966 ANSI Standard
- Compilation of Multiple Subprograms
- Relaxed Statement Order Requirements
- Most Programs Run Without Conversion
- old_fortran Format is the Worst Case

EASY TO USE

- Compiler Generates Standard Multics Object Segment
- All Multics Features Available to FORTRAN Programmer
- All Entry Points Available From Outside the Segment
- Compiler Generates Complete Listing Segment
- Powerful Symbolic Debugger (probe)
- Using main_ as Entry Point For Main Program Allows Renaming of Segment
- Open and Close Statements Provide I/O Control
- New FORTRAN Runtime I/O Routines are More Flexible
- The set_fortran_common Command Initializes Common Blocks
- The run Command Provides a Run-unit Facility

ERROR DIAGNOSTICS

Improved per User Request

DOCUMENTATION

AT58, Rev.1 -- Multics FORTRAN Manual

Addendum A to AT58, Rev.1

Online Info Segments Submitted With MR5.0

Online Info Segments Submitted With MR6.0

OLD FORTRAN

OLD_FORTRAN USERS ARE ENCOURAGED TO BECOME NEW_FORTRAN USERS

SEPARATED FROM PL/I

INSURES INTEGRITY OF OLD_FORTRAN COMPILER

OLD_FORTRAN DOES NOT AUTOMATICALLY BENEFIT FROM FUTURE CODE GENERATOR CHANGES

INDEFINITE AVAILABILITY

10 BUGS REPORTED (2 CANNOT BE FIXED)

FORTRAN RUNTIME I/O ROUTINES

Common to Both Compilers

Compatibility is Very Important

MR5.0 Problems Led to New Procedures:

- Prereleasing
- Exposure at More Sites
- Better Testing of Software
- Emphasis on Compatibility

MR6.0 Changes

Planned MR7.0 Changes

- Semantic of Endfile Statement to Be Changed
  - old_fortran Object not Affected
  - new_fortran Object Truncates File

MR6.0 CHANGES -- FORTRAN I/O

PROGRAM COMPLETELY RESTRUCTURED

- EASIER TO MAINTAIN
- MORE EFFICIENT
- PREVENT RECURRENCE OF MR5.0 PROBLEM

NEW FEATURES

13 BUGS REPORTED

ALL BUGS FIXED

FORTRAN I/O BUG FIXES

- Corrected All MR5.0 Errors
- Improved Error Messages

PERFORMANCE IMPROVEMENTS

- Improvements in Array Vector I/O
- Tuning Speedup
- Complete Tuning Study Underway

NEW FEATURES - FORTRAN I/O

OPEN AND CLOSE STATEMENTS

DYNAMIC REOPENING OF FILES

REWIND AND BACKSPACE IMPLEMENTED FOR TAPE I/O MODULES

WARNING ABOUT REWIND AND BACKSPACE SUPPRESSED

THE DEFAULT DIRECT ACCESS FILE IS INDEXED

BETTER ERROR RECOVERY IF AN ERROR OCCURS WHILE OPENING A FILE

"COMMAND ABORTED" MESSAGE SUPPRESSED

THE MEANING OF THE NEWLINE CHARACTER IN LIST-DIRECTED I/O HAS CHANGED

THE SEMI-COLON (;) AND SLASH (/) CHARACTERS TERMINATE LIST-DIRECTED INPUT

NEW FEATURES - FORTRAN I/O

THE DEFER ATTRIBUTE IS AVAILABLE FOR ALL FILES;
DEFAULT VALUE IS OFF

THE PROMPT ATTRIBUTE IS AVAILABLE FOR ALL FILES ATTACHED TO THE TERMINAL

FORMATTED AND UNFORMATTED I/O CANNOT BE PERFORMED ON THE SAME FILE

SEQUENTIAL ACCESS AND DIRECT ACCESS CANNOT BE PERFORMED ON THE SAME FILE

MR6.0 CHANGES -- NEW_FORTRAN

VERSION 1 OPTIMIZER

NEW STATEMENTS

NEW BUILTIN FUNCTIONS

PERFORMANCE ENHANCEMENTS

NEW FEATURES

38 BUGS REPORTED
35 BUGS FIXED
3 BUGS REMAIN UNFIXED
(OF THESE, 1 WAS NOT A USER REPORTED BUG)

9 SUGGESTED IMPROVEMENTS
4 IMPROVEMENTS IMPLEMENTED

8 PLANNED LANGUAGE FEATURES
2 FEATURES IMPLEMENTED

VERSION 1 OPTIMIZER

IMPROVES SUBSCRIPTING CODE

COMBINES REDUNDANT SUBEXPRESSIONS

REDUCES COMPUTATION

EXPRESSIONS MAY ONLY BE LOADED ONCE

OPTIMIZES ARRAY VECTORS IN I/O LISTS

EXAMPLE-

```
write (6,51) (a(i),i=1,n
```

PERFORMS MACHINE DEPENDENT OPTIMIZATIONS

EXAMPLES-

STORE ZERO (STZ)

ADD TO STORAGE (ASQ)

USE SHIFT TO MULTIPLY BY POWER OF 2

EXAMPLES-

```
x = 4* (y*z) -3 / (y*z)

y = sqrt(x) / a
z = sqrt(x) / a
```

NEW STATEMENTS

CLOSE STATEMENT

SIMILAR TO PROPOSED FORTRAN STANDARD

ENTRY STATEMENT

OPEN STATEMENT

SIMILAR TO PROPOSED FORTRAN STANDARD

SOME EXTRA FIELDS SPECIFIC TO MULTICS

NEW BUILTIN FUNCTIONS

ACOS (DACOS)

ASIN (DASIN)

TAN (DTAN)

LOG

LOG10

PERFORMANCE ENHANCEMENTS

COMPILER TUNED

ADDITION OF OPTIMIZER HAS NEGLIGIBLE EFFECT ON PERFORMANCE

NEW FEATURES - NEW_FORTRAN

ALLOW MORE THAN 16K OF ADDRESS SPACE (UP TO 128K)

IMPROVED LISTING SEGMENT

- INCLUDES SIZE OF STACK FRAME
- LISTS UNUSED COMMON BLOCK MEMBERS AND PARAMETERS

ALLOW UP TO 63 (OR 62) ARGUMENTS IN CALL

IMPROVED ERROR MESSAGES

CONVERT LONG SINGLE PRECISION CONSTANT TO DOUBLE PRECISION

EXAMPLES -

```
12345678.
12345678.9
12345678.9E0
12345678.9D0
```

ALLOW STRING DELIMITING CHARACTER TO BE CONTAINED IN THE CONSTANT

EXAMPLE -

```
"TYPE ""HELP"" FOR MORE INFO."
```

LOOP OPTIMIZER

CONVERSION AIDS

RUN UNITS

BUG FIXES

USER REQUESTS

LOOP OPTIMIZER - INCLUDES SOME OF THE FOLLOWING

COMBINES COMMON SUBEXPRESSIONS

PROVIDES MACHINE DEPENDENT OPTIMIZATIONS

OPTIMIZES SUBSCRIPTED REFERENCES

OPTIMIZES ARRAY VECTORS IN I/O LISTS

- - - - - -

REMOVES INVARIANT SUBEXPRESSIONS FROM LOOPS

STATEMENT FUNCTIONS ARE IMPLEMENTED INLINE

- - - - - -

PROVIDES STRENGTH REDUCTION OPTIMIZATIONS

PROVIDES TEST REPLACEMENT OPTIMIZATIONS

ELIMINATES DEAD ASSIGNMENTS

```
      DO 100 I = 1, N                          ORIGINAL
      ...
      M = (J * K) * I
      ...
  100 CONTINUE

      ITEMP1 = J * K                           REMOVE INVARIANT
      DO 100 I = 1, N
      ...
      M = ITEMP1 * I

      ITEMP1 = J * K                           STRENGTH REDUCTION
      ITEMP2 = ITEMP1
      DO 100 I = 1, N
      M = ITEMP1
      ...
      ITEMP1 = ITEMP1 + ITEMP2
  100 CONTINUE

      ITEMP1 = J * K                           FINAL
      I = 1
      DO 100 ITEMP = ITEMP1, ITEMP1*N, ITEMP1
      M = ITEMP
      ...
  100 CONTINUE
```

CONTEMPLATED CONVERSION AIDS

[PROPOSED] - SEPARATELY CONTROLLED COMPATIBILITY CHECKING INCLUDING:

NO WARNINGS ABOUT DESCRIPTORS AND ALL EXTERNAL CALLS HAVE DESCRIPTORS

ALLOWING HOLLERITH CONSTANTS FOR ALL DATA TYPES

NO ARGUMENT LIST CHECKING

ALLOWING OCTAL CONSTANTS FOR CHARACTER VARIABLES

CHOOSING DEFAULT STORAGE CLASS FOR ENTIRE COMPILATION

[RPQ] REMOVE STATEMENT ORDER REQUIREMENTS

[RPQ] ALLOW MORE THAN ONE BLOCK DATA SUBPROGRAM

[PROPOSED] ALLOW INCLUDE FILES

RUN UNITS -- PROVIDE A CORE-LOAD ENVIRONMENT

RUN

SET_FORTRAN_COMMON

RESET_EXTERNAL_VARIABLE

Looking Ahead

Simplify Conversion from Other Systems

More Sophisticated Optimizing Code Generator

Reduce Runtime Costs -- Tune FORTRAN I/O

Prereleasing the Compiler and the Runtime Routines
- For New Features

Postreleasing the Compiler and The Runtime Routines
- For Bug Fixing

User Feedback
- Double Precision Complex Data
- Character Expressions and Operators
- The fld Builtin Function
- ?? Eliminate "Close Files?" ??
- Allow Array and Common Blocks up to 255K Words

Looking Ahead

Possible Topics For FORTRAN User's Guide

- Using vfile_ and What to Avoid
- The Multics Process
  - The Process
  - The Run-unit (Core-load Environment)
- Storage Classes - Automatic vs. Static
- Machine Dependent Coding Practices
- Using System Error Codes in FORTRAN
- Making Permanent Common Blocks
- Mixing FORTRAN & PL/I Programs
  - Logical vs. bit(1) aligned
- Binding vs. Compiling Subprograms Together
  - Quick Call vs. Full Call (50-60 microsecs)
- Multics Descriptors
- Understanding the Listing Segment
- Using a Symbolic Debugger - probe

SUMMARY

MR6.0

IMPROVED I/O

VERSION 1 OPTIMIZER

OPEN AND CLOSE

MR7.0

VERSION 2 OPTIMIZER

FASTER I/O

PRERELEASING – New features

POSTRELEASING – Bug fixes

USER FEEDBACK – old-Fortran
enhancements
bug fixes
(pre post) rel
docu.

BUGS IN OLD_FORTRAN

- O CODE GENERATOR TAKES A LINKAGE FAULT ATTEMPTING TO CREATE A DESCRIPTOR FOR THE ELEMENT OF A PARAMETER ARRAY WITH PARAMETER EXTENTS
- O NO ERROR MESSAGE TEXT IS PRINTED FOR ERROR NUMBER 175; FURTHTERMORE, THIS MESSAGE IS ONLY PRINTED IN THE LISTING SEGMENT, IF PRESENT
- O VERSION INFO STORED BY RECENTLY INSTALLED COMPILER CONTAINS NON-ASCII CHARACTERS
- O OPTIMIZER HAS REFERENCE COUNT PROBLEMS WITH PARAMTER COMPLEX ARRAYS
- O STATEMENT LABEL SYMBOL TABLE CANNOT BE USED BY THE SYSTEM DEBUGGERS
- O THE ERROR 292 IS SOMETIMES GIVEN FOR DATA INITIALIZATIONS. THE ERROR CAN BE REMOVED BY INITIALIZING THE ENTIRE ARRAY.
- O THE ERROR 443 IS ERRONEOUSLY GIVEN FOR SOME OCCURRANCES OF LOGICAL CONSTANTS.
- O THE COMPILER ALLOWS ARRAY NAMES IN CERTAIN CONTEXTS THAT ARE PROHIBITED BY THE LANGUAGE.

o AN INCORRECT DESCRIPTOR PACKED BIT IS GENERATED FOR A COMPLEX FUNCTION RETURN VALUE IF THE FUNCTION NAME IS A PARAMETER OF THE SUBPROGRAM BEING COMPILED AND THE NAME DOES NOT APPEAR IN AN EXTERNAL STATEMENT.

o MODE STATEMENTS OF THE FORM:

MODE*K H_NAME ...

WHERE "H_NAME" IS ANY NAME STARTING WITH A LOWER CASE "H", WILL NOT COMPILE CORRECTLY. THIS IS DUE TO THE COMPILER INTERPRETING DECIMAL INTEGER FOLLOWED BY "H" AS A HOLLERITH CONSTANT.

BUGS FIXED IN FORTRAN I/O

- LIST-DIRECTED OUTPUT FOR A COMPLEX VARIABLE ONLY PRINTS THE REAL PART OF THE VALUE (THE IMAGINARY PART IS NOT PRINTED)
- FORTRAN I/O CANNOT HANDLE A BACKSPACE STATEMENT IF THE FILE POSITION IS THE BEGINNING OF THE FILE (VFILE_ I/O MODULE ONLY)
- FORTRAN I/O ROUTINES FAIL TO OPEN A BLOCKED FILE IF OPENING CREATES THE FILE
- BLOCKED FILES CANNOT BE USED BY FORTRAN_IO_.
- IMPLICIT OPEN DOES NOT WORK FOR ANY ATTACHMENT OR OPENING THAT DOES NOT USE THE VFILE_ I/O MODULE.
- ERROR MESSAGE ABOUT REWIND AND BACKSPACE SHOULD BE SUPPRESSED.
- NAMELIST I/O LOOPS INFINITELY FOR SOME INPUT.
- "RECORD TOO SHORT" ERROR REPORTED WHEN WRITING AN UNFORMATTED RECORD.
- SEQUENTIAL_INPUT_OUTPUT OPENING SHOULD BE ATTEMPTED IN CASE THE TARGET DIM DOES NOT SUPPORT SEQUENTIAL_UPDATE.
- IF A FILE IS ATTACHED BY THE USER WITHOUT THE -BLOCKED OR -VARIABLE OPTION, AND FORTRAN_IO_ TRIES TO OPEN IT IN RESPONSE TO A KEYED IO REQUEST, IT OPENS THE FILE SEQUENTIAL_UPDATE, WHICH WILL NOT SUPPORT ANY KEYED REQUESTS ON SUCH A FILE.

BUGS FIXED IN FORTRAN I/O

- IF AN UNFORMATTED DIRECT ACCESS WRITE IS THE FIRST REQUEST ON A PREVIOUSLY UNATTACHED & UNOPENED FILE IT FAILS UNLESS THE KEY IS 0.
- LIST-DIRECTED OUTPUT FOR COMPLEX VALUES IS INCORRECT.
- LIST-DIRECTED INPUT DOES NOT ALLOW COMPLEX CONSTANTS.

BUGS FIXED IN NEW_FORTRAN

- o ABSOLUTE VALUE BUILTIN FUNCTIONS DO NOT WORK IF THE ARGUMENT IS A STATEMENT FUNCTION REFERENCE
- o ERROR 419 IS CAUSED BY BAD REF COUNTS PRODUCED FOR COMPLEX ARRAY REFS
- o ALL SUBROUTINES CALLS ARE LIMITED TO 32 OR FEWER ARGUMENTS AND ALL FUNCTION REFERENCES ARE LIMITED TO 31 OR FEWER ARGUMENTS; IF MORE ARE GIVEN, NO MESSAGE IS PRINTED ALTHOUGH THE CODE IS INCORRECT
- o CODE GENERATOR DOES NOT GENERATE RELOCATION INFORMATION FOR OPEN STATEMENT.
- o CODE GENERATOR FAILS TO HANDLE COMMON BLOCK CORRECTLY; THIS IS DUE TO THE CODE GENERATOR HAVING BEEN COMPILED BY THE WRONG PL/I COMPILER.
- o LISTING GENERATOR HAS TROUBLES WITH SOURCE SEGMENTS LONGER THAN 64K.
- o THE INDICATORS ARE NOT SAVED IF THEY ARE NEEDED AFTER A STMT. FUNC. REF.

BUGS FIXED IN NEW_FORTRAN

- THE OPTIMIZER ERRONEOUSLY COLLECTS SUBEXPRESSIONS TAHT ARE COMMON TO SEVERAL STMNT. FUNC. DEFS. AND PLACES THEM WHERE THEY CANNOT BE EXECUTED.
- COMPILER TAKES A FAULT IF THE OPTIMIZER IS USED. (UNINITIALIZED POINTER IN FLOW ANALYSIS.)
- INCORRECT RELOCATION BITS ARE GENERATED FOR INTRA- SEGMENT ARGUMENT LISTS. THIS PREVENTS BINDING.
- INCORRECT CODE IS GENERATED FOR ENTRY ARGUMENTS IF THEY ARE ALSO PARAMETERS OF THE SUBPROGRAM.
- NO RELOCATION INFO STORED FOR AUTOMATIC STORAGE INITIALIZATION TEMPLATE.
- CODE GENERATED FOR LOGICAL STATEMENT FUNCTIONS SHOULD LOAD LOGICAL VALUE INTO A-REG INSTEAD OF INDICATORS.
- CODE GENERATED FOR SIMPLE STATEMENT FUNCTION DEFINITIONS IS INCOMPLETE.
- EXPRESSIONS IN COMPUTED GOTO STATEMENTS SOMETIMES CAUSE A FATAL ERROR; USE A TEMP IN ITS PLACE.
- PARSE ASSIGNS THE WRONG DATA TYPE TO FUNCTION RETURN VALUE SYMBOLS.

BUGS FIXED IN NEW_FORTRAN

- FATAL ERROR 419 BECAUSE CODE GENERATOR FAILS TO SAVE FINAL VALUE FOR DO LOOP INDEX
- ST. FUNC. RETURN ADDRESS TEMP ENDS UP ON FREE LIST AND IS REUSED WHEN FUNC IS REFERENCED.
- COMPILER THINKS DCOS BUILTIN RETURNS A SINGLE PRECISION VALUE.
- COMPILER ERRONEOUSLY RESTRICTS STATEMENT FUNCTION ARGUMENTS FROM BEING CHARACTER DATA TYPE.
- (EXL ONLY) MESSAGE TEXT IS WRONG FOR CHARACTER INITIALIZED BY OCTAL CONSTANT.
- CODE GENERATOR TAKES A FAULT IF AN ERROR OCCURS AND THERE IS MORE THAN ONE PROCEDURE FRAME ACTIVE. (E.G. ARRAY(ARRAY("A")+1). INNERMOST SUBSCRIPT REF IS WRONG OUTERMOST WILL TAKE A FAULT.
- DIVISION OF REAL BY COMPLEX FAILS.
- CODE GENERATOR DOES NOT CREATE PROPER ENTRY VALUE FOR EXTERNAL BUILTIN FUNCTIONS PASSED AS ENTRY VALUES.
- LISTING GENERATOR WILL SOMETIMES FAULT IF BOTH THE -TABLE AND -LIST CONTROL ARGUMENTS ARE SPECIFIED.
- COMPILER SHOULD WARN USER IF A REAL CONSTANT IS LONGER THAN EIGHT DIGITS.

BUGS FIXED IN NEW_FORTRAN

- CODE GENERATOR DOES NOT PRODUCE CORRECT LINKS FOR COMMON BLOCK NAMES OF THE FORM A$B.
- (ONLY FAILS IN >EXL>O) PARSE FAILS TO ALLOW A CHARACTER STRING CONSTANT AS A FORMAT SPECIFICATION.
- CODE GENERATOR OP-TYPE MACRO FAILS FOR COUNTS
- CODE GENERATOR FAILS FOR NAMELIST GROUPS DECLARED IN A MAIN PROGRAM
- EQUIVALENCE PARSER ERRONEOUSLY TREATS THE AUTO ATTR AS A CONFLICT.
- DATA SPEC PARSER OCCASIONALLY STORES WRONG VALUE FOR FIRST MEMBER OF AN ARRAY.
- ENTRY STATEMENT IN MAIN PROGRAM CAUSES COMPILER FAULT.
- CODE GEN PRODUCES WRONG LINK FOR COMMON BLOCK NAME OF FORM A$. SHOULD BE TYPE-3 LINK.
- REFERENCES TO BUILTIN FUNCTIONS MAY NOT BE COMPILED CORRECTLY IF THE ARGUMENTS ARE OF SEVERAL DIFFERENT DATA TYPES.

Tom

MULTICS

TAPE FACILITIES

&

RCP

IMPROVEMENTS

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MR 6.0

NEW FEATURES:

- o LABEL PROCESSING
- o PERIPHERAL ACCOUNTING & BILLING
- o LARGER BUFFER SIZES

IMPROVEMENTS:

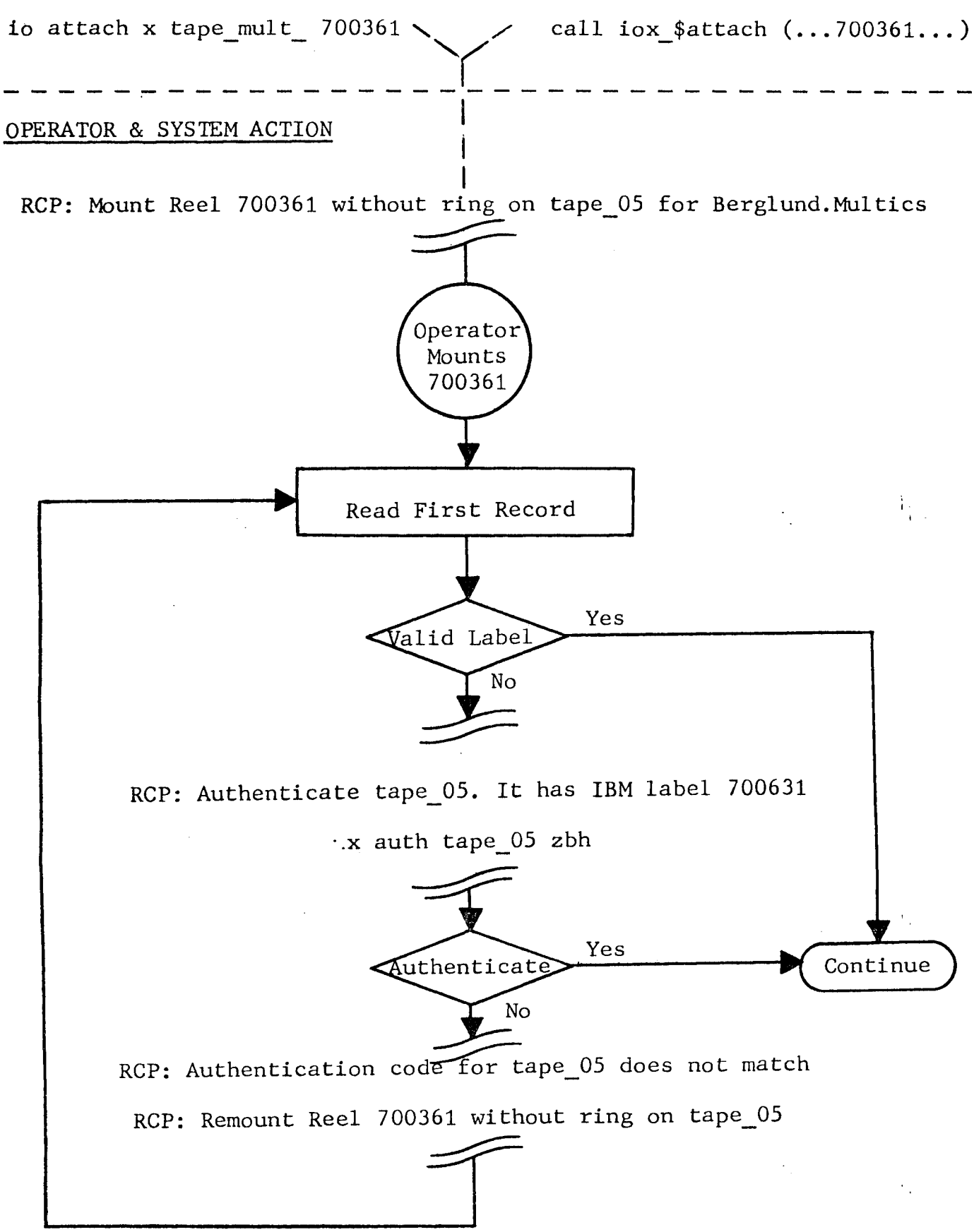
- o TAPE_MULT_ SUPERSEDES TAPE_
- o OLD BACKUP FACILITY NOW USES TAPE_MULT_
- o PERIPHERAL I/O MANUAL NOW AVAILABLE
  - TAPE_MULT_ DESCRIBED

MR 6.0 - NEW FEATURE

LABEL PROCESSING:

- o TYPES
  - MULTICS
  - IBM
  - ANSI
  - GCOS
- o PROGRAMS TO GENERATE LABEL STICKERS
  - MAKE_TAPE_LABELS
  - MAKE_NSTD_LABELS
- o ONLINE TAPE LABEL AUTHENTICATION
  - LOGGED
  - OPERATOR CONTROLLED

MR6.0 TAPE LABEL PROCESSING



MR 6.0 - NEW FEATURE

PERIPHERAL ACCOUNTING & BILLING:

- CAN CHARGE SEPARATELY FOR TAPE & DISK MOUNTS
- CAN CHARGE (ON A PER-SHIFT BASIS) FOR THE USE OF:
  - TAPES
  - DISK
  - LOGICAL VOLUMES

MR 6.0 - NEW FEATURE

LARGER BUFFER SIZES:

- o NEW CAPABILITIES - TAPE_NSTD
  - NEW MAX. SIZE: 176K BYTES
  - OLD MAX. SIZE: 10K BYTES
  - ACCESS CONTROL FOR NEW LARGE BUFFERS

    E.G. MY_DEVICE_BUFFER.ACS

- o PLANNED
  - LARGE BUFFER SIZE CAPABILITIES FOR:
    - TAPE_ANSI_
    - TAPE_IBM_
      (32K BYTE STANDARD)

MR 6.0 - IMPROVEMENTS

TAPE_MULT_:

- TAPE READ PORTION REWRITTEN
- NEW ALGORITHM FOR ERROR RECOVERY

  E.G. GOOD_RECORD, ERROR, EOF, OLD_RECORD, OLD_RECORD
- CORRECTION TO FIRMWARE (VERSION AG)
- BETTER RECORD VALIDATION
  - UID CHECKING

FUTURES

- RESOURCE RESERVATION CAPABILITY
- TAPE REEL MANAGEMENT
- IMPROVED TAPE FACILITY
  - TAPE_IOI_

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RESOURCE CONTROL PACKAGE

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FORUM XXV

OCTOBER 17

1977

PHOENIX, ARIZONA

RON RIEDESEL, MULTICS MARKETING (PHOENIX)

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- WHAT IS RCP?
- RCP OBJECTIVES
- RCP FUNCTIONS
  - RESOURCE CONTROL OPERATIONS
  - SECURITY
  - RESOURCE SELECTION
  - RESOURCE ACCOUNTING, REGISTRATION
- CURRENT STATUS (MR-5.0)
- REQUIRED ENHANCEMENTS
- MR-6.0 ENHANCEMENTS
- FUTURE PLANS
- PERSONAL OBSERVATIONS/QUESTIONS

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WHAT IS RCP?

- AN INTEGRATED MULTICS PACKAGE TO CONTROL UTILIZATION OF RESOURCES:
  - INDIVIDUAL DEVICES
    - TAPE DRIVES
    - DISK UNITS
    - PRINTERS
    - CARD PUNCHES
    - CARD READERS
    - SPECIAL DEVICES
  - STORAGE VOLUMES
    - TAPE REELS
    - REMOVABLE DISK PACKS
    - LOGICAL VOLUMES

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RCP OBJECTIVES

- o DYNAMIC RESOURCE ALLOCATION, CONTROL
- o OPTIONAL PRE-ALLOCATION, RESERVATION
- o ALLOCATION, RESERVATION TO GROUPS AS WELL AS INDIVIDUALS
- o FLEXIBILITY
  - SPECIAL DEVICES
  - SITE SETABLE DEFAULTS, PRIORITIES
  - DYNAMICALLY CHANGEABLE ALGORITHMS
    (E.G. DEVICE SELECTION)
  - PROJECT OR WORKCLASS ASSIGNABLE ALGORITHMS
- o COMPREHENSIVE VOLUME CONTROL, SECURITY
- o AUTOMATIC OPERATION

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RCP FUNCTIONS

- o RESOURCE CONTROL OPERATIONS
  - RESERVATION
  - ASSIGNMENT
  - MOUNTING
  - ATTACHMENT
- o INTEGRATED DEVICE, VOLUME SECURITY
- o RESOURCE SELECTION
- o RESOURCE ACCOUNTING, REGISTRATION

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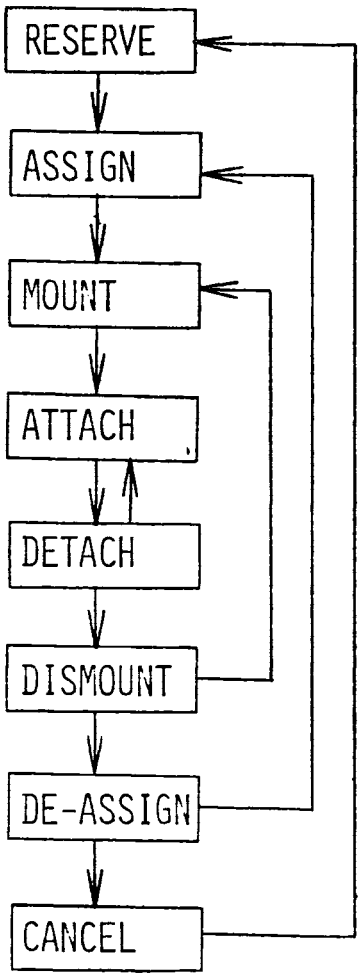
RESOURCE CONTROL OPERATIONS

- o RESERVATION
  - ALLOCATION FOR FUTURE USE
  - SPECIFIC OR GENERIC DEVICE
  - SPECIFIABLE BY TIME PERIOD
  - AVOIDS DEADLOCKING
- o ASSIGNMENT
  - AS RESULT OF REQUEST FOR DEVICE DEDICATION
  - SUBJECT TO ACCESS CONTROL BY DEVICE
  - MAY FOLLOW PRE-RESERVATION OR BE TOTALLY DYNAMIC
  - ALGORITHM USED TO SELECT SPECIFIC DEVICE
- o MOUNTING
  - UNREGISTERED VOLUMES → OPERATOR REQUEST BY EXPLICIT LABEL
  - VOLUME REGISTRATION → OPERATOR REQUEST BY UID, IMPLICIT LABEL
  - VOLUME SECURITY CHECKING
  - LABEL CHECKING TO AVOID ERRORS
- o ATTACHMENT
  - ACTUAL USE
    (EX: "IOCALL ATTACH...")
- o REVERSE OPERATIONS
  - DETACH
  - DISMOUNT
  - DE-ASSIGN
  - CANCEL RESERVATION

RCP CONTROL OPERATIONS



RESERVE GENERIC DEVICE(S)

ASSIGN SPECIFIC DEVICE(S) FROM FREE POOL

MOUNT SPECIFIED VOLUME(S)

ATTACH DEVICE(S) FOR I/O (READ, READ/WRITE)

DETACH DEVICE(S)

DISMOUNT SPECIFIED VOLUME(S)

RELEASE SPECIFIC DEVICE(S) INTO FREE POOL

CANCEL RESERVATION OF GENERIC DEVICE(S)

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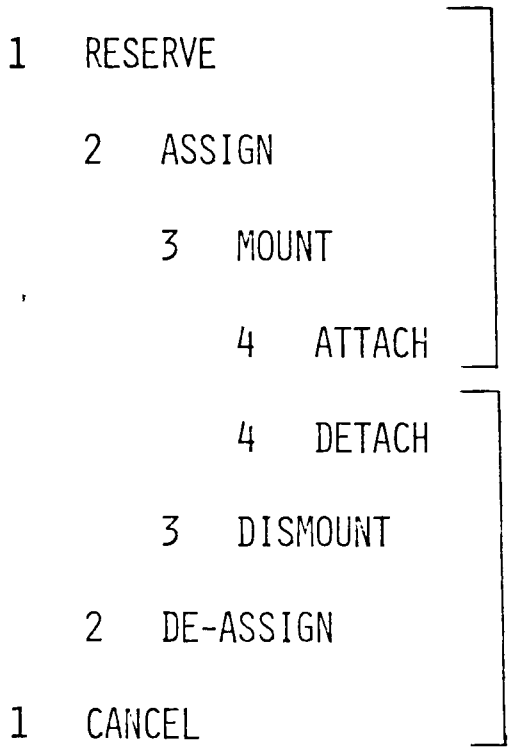
CONTROL OPERATION RELATIONSHIPS



RULES:

A. ANY PRIMARY OPERATION IMPLIES ALL HIGHER LEVEL PRIMARIES

B. ANY HIGH LEVEL REVERSE OPERATIONS IMPLY ALL LOW LEVEL REVERSES

C. IMPLICIT PRIMARY OPERATIONS ⟶ IMPLICIT REVERSE OPERATIONS

D. EXPLICIT PRIMARY OPERATION ⟶ EXPLICIT REVERSE OPERATIONS

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SECURITY AND ACCESS CONTROL

- o DEVICE SECURITY
  - BY DEVICE CLASS
  - BY INDIVIDUAL LINUS
  - ACCESS CONTROL DYNAMICALLY SETABLE
- o VOLUME SECURITY
  - VOLUME REGISTRATION
  - LABEL CHECKING
  - AUTHENTICATION

} TO BE INTEGRATED WITH ACL'S, AIM

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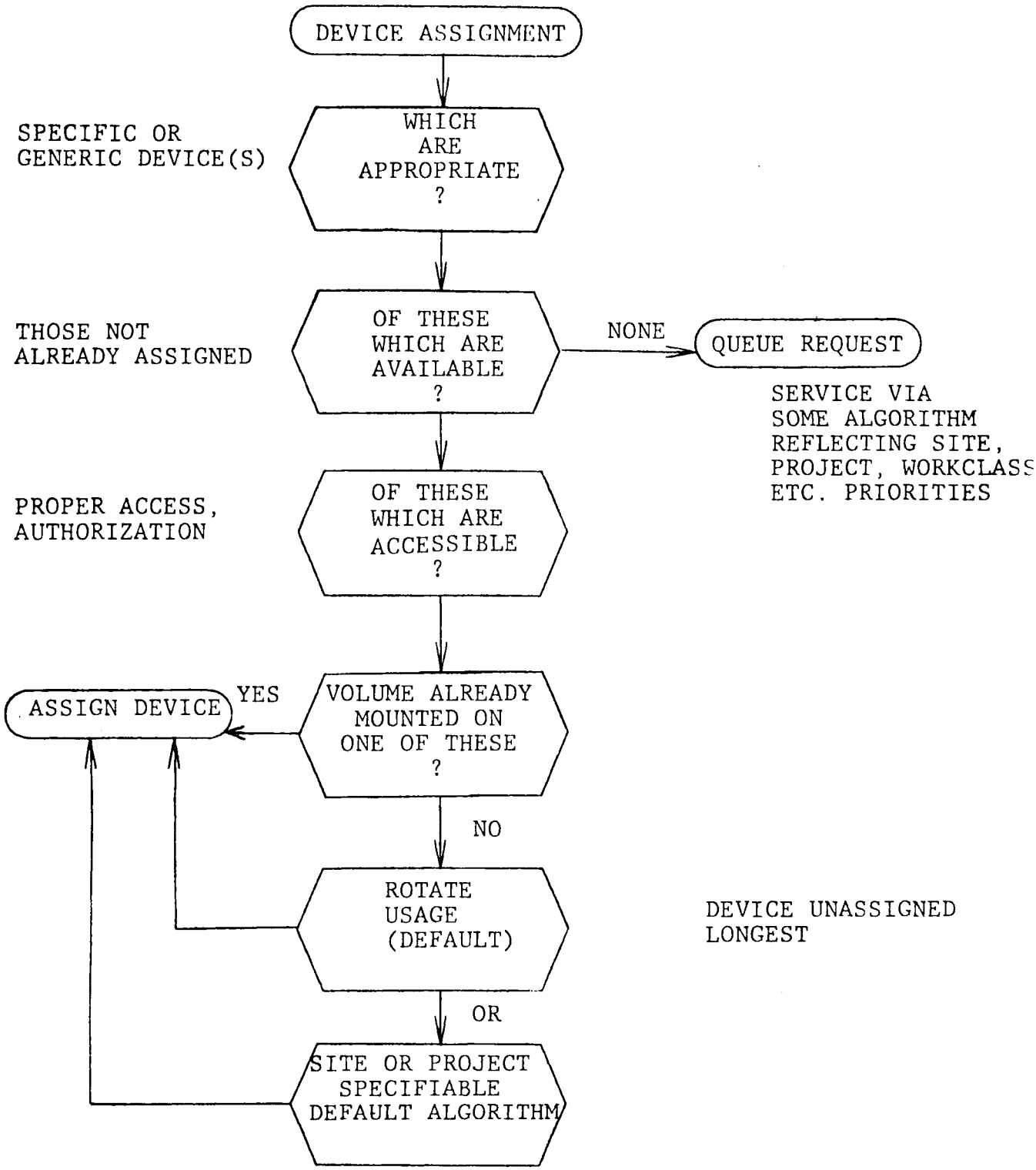

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DEVICE, VOLUME REGISTRATION

- o VOLUME REGISTRATION
  - REGISTRATION NOT REQUIRED
  - PAPER LABEL DATA
  - MAGNETIC LABEL DATA
  - SECURITY INFORMATION
  - CURRENT STATUS

- o DEVICE REGISTRATION
  - CLASS
  - TYPE
  - SYSTEM DESIGNATOR
  - SECURITY INFORMATION
  - CURRENT STATUS

- o UTILIZATION DATA
  - CURRENT STATUS OF DEVICES, VOLUMES
  - PAST HISTORY OF USE, ERRORS
  - ACCOUNTING BY USER, PROJECT FOR BILLING

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RCP HISTORY & CURRENT STATUS

- o MR-3.0 (4Q75) — RCP PHASE 1: I/O DEVICES ONLY

  MAG. TAPE DRIVES
  PRIVATE DISK DRIVES
  OPERATOR'S CONSOLE
  LINE PRINTERS
  CARD PUNCHES, READERS
  SPECIAL DEVICES

- o MR-3.1 (1Q76) — RCP PHASE 1.1: ENHANCED ERROR MESSAGES, ERROR RECOVERY

- o MR-4.0 (2Q76) — RCP PHASE 2.0: NEW STORAGE SYSTEM INTEGRATION

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REQUIRED* ENHANCEMENTS

- o MOUNTABLE LOGICAL VOLUME SUPPORT
- o VOLUME REGISTRATION, LIBRARYING
- o INTEGRATION WITH SECURITY MECHANISMS
  - ACL'S
  - AIM
- o COMPLETE COMPREHENSIVE OPERATOR, USER INTERFACES
- o FLEXIBLE DEVICE SPECIFICATION, PRIORITIZATION

* SCP'S, LETTERS OF REQUIREMENTS HAVE BEEN SUBMITTED BY CURRENT CUSTOMERS

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MR-6.0 ENHANCEMENTS

- LABEL PROCESSING
- PERIPHERAL ACCOUNTING & BILLING
- LARGER BUFFER SIZES

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FUTURE PLANS

- o RESPOND, AS QUICKLY AS POSSIBLE, TO CURRENT CUSTOMER REQUIREMENTS
- o MAJOR RCP EXTENSIONS PLANNED FOR MR-7.0 AND MR-8.0
  - VOLUME REGISTRATION, LIBRARYING
  - IMPLEMENTATION OF GENERATION DATA SET CAPABILITIES
  - IMPROVED TAPE PROCESSING
  - IMPROVED BATCH ADMINISTRATION
  - EXTEND FORMS, I/O CONTROLS
  - COMPLETE OPERATOR, USER INTERFACE

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PERSONAL OBSERVATIONS/QUESTIONS

- o INTEGRATION OF LOAD CONTROL, WORKCLASSES WITH RESOURCE CONTROL?
- o METERING, AUDITING TOOLS FOR RESOURCE UTILIZATION,
  PRIORITY CONTROL NEED TO BE ADDRESSED
- o SHOULD RCP CONTROL REMOTE DEVICES?
  (E.G., PRINTER ON REMOTE TERMINAL CLUSTER)
- o INTEGRATION WITH MDBM?
  - DISTRIBUTED DATA BASES
  - OFFLINE VOLUME SUPPORT
  - 38500 - LIKE DEVICES

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