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Systems

**OS/VS2
System Logic Library
Volume 1**

VS2.03.804
VS2.03.805
VS2.03.807

IBM

Pages numbered as duplicates in this publication must be retained because each of these documents information specific to individual Selectable Units.

This minor revision incorporates the following Selectable Units:

Scheduler Improvements	VS2.03.804
Supervisor Performance #1	VS2.03.805
Supervisor Performance #2	VS2.03.807

The selectable unit to which the information applies, is noted in the upper corner of the page.

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This edition applies to Release 3.7 of OS/VS2 and to all subsequent releases of OS/VS2 until otherwise indicated in new editions or Technical Newsletters. Changes are continually made to the information herein; before using this publication in connection with the operation of IBM systems, consult the latest *IBM System/370 Bibliography*, GC20-0001, for the editions that are applicable and current.

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System Logic Library comprises seven volumes. Following is the content and order number for each volume.

OS/VS2 System Logic Library,

Volume 1 contents: SY28-0713

MVS logic introduction
Abbreviation list
Index for all volumes

Volume 2 contents: SY28-0714

Method of Operation diagrams for
Communications Task
Command Processing
Region Control Task (RCT)
Started Task Control (STC)
LOGON Scheduling

Volume 3 contents: SY28-0715

Method of Operation diagrams for
System Resources Manager (SRM)
System Activity Measurement Activity (MF/1)
JOB Scheduling
—Subsystem Interface
—Master Subsystem
—Initiator/Terminator
—SWA Create Interface
—Converter/Interpreter
—SWA Manager
—Allocation/Unallocation
—System Management Facilities (SMF)
—System Log
—Checkpoint/Restart

Volume 4 contents: SY28-0716

Method of Operation diagrams for
Timer Supervision
Supervisor Control
Task Management
Program Management
Recovery/Termination Management (R/TM)

Volume 5 contents: SY28-0717

Method of Operation diagrams for
Real Storage Management (RSM)
Virtual Storage Management (VSM)
Auxiliary Storage Management (ASM)

Volume 6 contents: SY28-0718

Program Organization

Volume 7 contents: SY28-0719

Directory
Data Areas
Diagnostic Aids

Please note that if you use only one order number, you will only receive that volume. To receive all seven volumes, you must either use all seven form numbers or, simply the following number: SBOF-8210. If you use SBOF-8210, you will receive all seven volumes.

The publication is intended for persons who are debugging or modifying the system. For general information about the use of the MVS system, refer to the publication *Introduction to OS/VS Release 2*, GC28-0661.

How This Publication is Organized

This publication contains six chapters. Following, is a synopsis of the information in each section:

- *Introduction and Master Index* — an overview of each of the functions this publication documents, an abbreviation list of all acronyms used in the publication, and a complete index for all seven volumes.
- *Method of Operation* — a functional approach to each of the subcomponents, using both diagrams and text. Each subcomponent begins with an introduction; all the diagrams and text applying to that subcomponent follow.
- *Program Organization* — a description of module-to-module flow for each subcomponent; a description of each module's function, including entry and exit. The module-to-module flow is ordered by subcomponent. The module descriptions are in alphabetic order without regard to subcomponent.
- *Directory* — a cross-reference from names in the various subcomponents to their place in the source code and in the publication.
- *Data Areas* — a description of the major data areas used by the subcomponents (only those, however, that are not described in *OS/VS Data Areas*, SYB8-0606, which is on microfiche); a data area usage table, showing whether a module reads or updates a data area; a control block overview diagram for each subcomponent, showing the various pointer schemes for the control blocks applicable to each subcomponent; a table detailing data area acronyms, mapping macro instructions, common names, and symbol usage table.

- *Diagnostic Aids* — the messages issued, including the modules that issue, detect, and contain the message; register usage; return codes; wait state codes; and miscellaneous aids.

Corequisite Reading

The following publications are corequisites:

- *OS/VS2 JES2 Logic*, SY28-0622
- *OS/VS Data Areas*, SYB8-0606 (This document is on microfiche.)
- *OS/VS2 System Initialization Logic*, SY28-0623

Contents

Section 1: Introduction	23
Synopsis of Coverage	23
An Overview of Each Subcomponent	28
Communications Task	28
Command Processor	28
Reconfiguration Commands	28
Reconfiguration Commands Control Flow	30
Region Control Task (RCT)	31
Started Task Control (STC)	31
LOGON Scheduling	31
System Resources Manager (SRM)	31
System Activity Measurement Facility (MF/1)	33
Job Scheduler	33
Subsystem Interface	33
Master Subsystem	33
Initiator/Terminator	33
Converter/Interpreter	33
SWA Manager	33
Allocation/Unallocation	34
System Management Facilities (SMF)	34
Checkpoint/Restart (Scheduler Restart)	34
Supervisor Control	34
Supervisor Control Flow	36
Task Management	37
Program Management	37
Recovery/Termination Management (R/TM)	37
RTM1	39
RTM2 - Task Mode Processing	40
Real Storage Management (RSM)	41
Virtual Storage Management (VSM)	41
Address Space Create	41
Storage Protection	41
Auxiliary Storage Management (ASM)	42
ASM Definitions and Formats	42
External Storage	42
Permanent Storage Locator Symbol (S)	42
ASM Control Blocks	43
ASMVT	43
LGVT	43
ASPCT	43
PART	43
PAT	43
ASM Data Sets	43
Summary of ASM Operation	44
Operations Supported by ASM	44
IMMEDIATE Operations	44
I/O Operations	44
TASK MODE Operations	44
Detailed Operation Description	45
Auxiliary Storage Management (ASM) (VS2.03.807)	42
ASM Functions (VS2.03.807)	42
I/O Control (VS2.03.807)	42
I/O Subsystem (VS2.03.807)	43
VIO Control (VS2.03.807)	43
VIO Group Operators (VS2.03.807)	43
Recovery (VS2.03.807)	43
Page Expansion (VS2.03.807)	44
Service Routines (VS2.03.807)	44
ASM Control Blocks (VS2.03.807)	44
ASMVT (VS2.03.807)	44
PART (VS2.03.807)	44
PAT (VS2.03.807)	44
SART (VS2.03.807)	44
SAT (VS2.03.807)	44
IORB (VS2.03.807)	44
LGVT (VS2.03.807)	44
ASMHD (VS2.03.807)	44

LGE (VS2.03.807)	44
ASPCT (VS2.03.807)	45
ASM Data Sets (VS2.03.807)	46.1
Abbreviation List	47
Index	I-1
Master Index	I-5
Section 2: Alphabetic List of Diagrams	13
Section 2: Method of Operation	2-1
Communications Task	2-3
Major Function	2-3
Supporting Functions	2-4
Console Attention	2-4
External Interrupt	2-4
I/O Complete Processing	2-4
Unconditional Message to Inactive Console (QREG0 Processing Routine)	2-5
Console Device Support	2-5
SVC 72	2-6
Method of Operation Diagrams	2-7
1-1. Communication Task Overview	2-12
1-2. Communication Task Processing (IEAVMQWR)	2-14
1-3. Opening a Console	2-18
1-4. Closing a Console	2-22
1-5. WTO and WTOR Macro Instruction Processing Overview (SVC 35)	2-26
1-6. WTO and WTOR Macro Instruction Processing (SVC 35) (IEAVMQWR)	2-28
1-7. Write-to-Programmer Processing Overview (IGC0203E)	2-48
1-8. Write-to-Programmer Processing (IGC0203E)	2-50
1-9. Multiple-Line WTO (MLWTO) Processing (SVC 350 (IEAVMWTO))	2-72
1-10. WTO and WTOR Communication Task Processing Overview (IEAVMQWR, IEAVMWSV)	2-96
1-11. WTO and WTOR Communication Task Processing (IEAVMQWR, IEAVMWSV)	2-98
1-12. Unconditional Message to Inactive Console (QREG0) (IEAVMQR0)	2-114
1-13. Writing Single-Line Messages to a 1052, 1443, 2740, or 3284/3286 Console	2-120
1-14. Displaying Single-Line Messages on Graphics Consoles (DIDOCS)	2-122
1-15. Writing Multiple-Line Messages to a 1052, 1443, 2740, or 3284/3286 Console	2-124
1-16. Displaying Multiple-Line Messages on Graphics Consoles (DIDOCS)	2-128
1-17. I/O Complete Processing	2-130
1-18. DOM Macro Instruction Processing Overview (SVC 87) (IEAVXDOM)	2-138
1-19. DOM Macro Instruction Processing (SVC 87) (IEAVXDOM)	2-140
1-20. DOM Communication Task Processing Overview (IEAVMDOM)	2-152
1-21. DOM Communication Task Processing (IEAVMDOM)	2-154
1-22. DOM Device Support Processing (DIDOCS)	2-166
1-23. External Interrupt Processing (Automatic Console Switch) (IEAVVCRX)	2-168
1-24. Attention Interrupt Processing (Command Request) (IEAVVCRA)	2-174
1-25. Processing Commands From a 1052, 2540, or 2740 Console	2-182
1-26. Processing Typed Commands from a Graphics Console (DIDOCS) (IEECVET1)	2-184
1-27. Processing Light-Pen and PFK Commands from a Graphics Console (DIDOCS) (IEECVETF)	2-186
1-28. Operator-Requested Message Deletion (DIDOCS) (IEECVET8)	2-188
1-29. PFK Definition or Redefinition (DIDOCS) (IEECVETB)	2-190
1-30. Changing Message Deletion Specifications (DIDOCS) (IEECVETA)	2-192
1-31. Erasing or Displaying the PFK Display Line (DIDOCS) (IEECVETB)	2-194
1-32. Erasing/Holding/Framing/Updating Status Displays (DIDOCS) (IEECVEFTP)	2-196
1-33. Roll-Mode Message Deletion (DIDOCS)	2-198
1-34. Communication Task Functional Recovery Routine or ESTAE Controller Overview (IEAVMFRR)	2-200
1-35. Communication Task Functional Recovery Routine or ESTAE Controller (IEAVMFRR)	2-202

1-36. Communication Task Recovery STAR Routine	2-212
Command Processing	2-225
General Considerations	2-225
Command Execution	2-225
Reconfiguration Commands	2-226
Command Processing Modifications	2-226
Command Processing Method-of-Operation Diagram Summary	2-228
Method-of-Operation Diagrams	2-232
2-1. SVC 34 Common Processing/Initialization - Overview (IGC0003D)	2-232
2-2. Creating STAE Environment for SVC 34 Command Processing (IEE0003D)	2-234
2-3. SVC 34 STAE Routine (IEE5103D)	2-236
2-4. SVC 34 General Message Assembly Routine (IEE0503D)	2-238
2-5. Manipulation of Command Control Blocks (QEDIT) (IEE0303D)	2-240
2-6. Command Translation (IEE5403D) and Routing (IEE0403D) Routines	2-242
2-7. Creating CSCB for Task-Creating Commands (IEE0803D)	2-244
2-8. Master Scheduler Wait (IEEVWAIT)	2-246
2-9. Master Scheduler Wait Recovery and Retry (IEEVWAIT)	2-248
2-10. Obtaining a New Virtual Memory (IEE0803D)	2-250
2-11. Cancelling Background (Batch) and Foreground (TSO) Jobs (IEE3703D)	2-254
2-12. System-Initiated Cancelling of TSO User (IKJL4T00)	2-256
2-13. Changing Dump Parameters (IEEMB815)	2-260
2-14. CONTROL Command Processing (IEE6703D)	2-262
2-15. DISPLAY and TRACK Command Preprocessing (IEE3503D)	2-272
2-16. Displaying and Tracking System Status (IEECB800)	2-280
2-17. Displaying Console Status (IEEXEDNA)	2-286
2-18. Displaying CONTROL Command Operands (IEE10110)	2-288
2-19. Displaying a Matrix of System Status (IEEMPDM)	2-290
2-20. Displaying Operator-Action Requests (IEE2903D)	2-292
2-21. Display of Program-Function-Key Definitions (IEE40110)	2-294
2-22. Displaying Unit Status (IEE20110)	2-296
2-22A. Displaying Parameters of Domains (IEEDISPD) (VS2.03.807)	2-297.0
2-23. Dumping Virtual Storage (IEECB800)	2-298
2-24. HALT, SWITCH, and TRACE Command Initialization (IEE1403D)	2-300
2-25. HALT and SWITCH Command Processing (IEE70110)	2-302
2-26. Processing LOG and WRITELOG Commands (IEE1603D)	2-306
2-27. SWAP (IGF2503D) and MODE (IGF2603D) Command Processing	2-311
2-28. STOP/MODIFY Command Processing (IEE0703D)	2-312
2-29. Starting Monitoring Functions (IEE7103D)	2-314
2-30. Routing Messages to Consoles (IEE6303D)	2-318
2-31. Quiescing a System IEEMPS03	2-320
2-32. Replying to Information Requests (IEAVVRPI)	2-324
2-33. RESET Command Processing (IEEMB810)	2-330
2-34. Sending/Saving/Listing Messages (IEEVSEND)	2-332
2-35. Setting Local Time (IEE0603D)	2-336
2-36. Changing IPS Values (IEEMB811)	2-340
2-37. Stopping Periodic Track (Status) Displays (IEE7503D)	2-342
2-37. Unloading I/O Devices (IEEMB813)	2-346
2-39. Routing of VARY Commands (IEE3203D)	2-348
2-40. Changing Console Status, Routing Codes and Command Authorization (IEE3603D)	2-350
2-41. VARY CN Processing (IEECB900)	2-356
2-42. VARY CN Processing (IEECB901)	2-358
2-43. Varying Devices (Console or I/O Units) Online and Offline (IEE4203D)	2-360
2-44. Varying a Range of Device Addresses (IEECB904)	2-364
2-45. VARY HARDCPY Command Processing (IEE4703D)	2-366
2-46. Master Console Switching (IEE4303D)	2-368
2-47. Varying a CPU or Channel Offline or Online (Overview) (IEEVCPU)	2-370
2-48. Varying a CPU Online (IEEVCPU)	2-372
2-49. Varying a CPU Offline (IEEVCPU)	2-374
2-50. Varying a Channel Online (IEEVCPU)	2-376
2-51. Varying a Channel Offline (IEEVCPU)	2-378
2-52. Varying the Path to a Device (IEEVPTH)	2-380
2-53. Varying the Status of Real Storage (IEEMPVST)	2-384
2-54. Teleprocessing (TP) Commands	2-387
2-55. Holding and Releasing Teleprocessing Messages (IEE0803D)	2-388
2-56. Processing Commands With the "NET" Operand	2-391
2-57. Stopping and Restarting (Via an Interrupt) the System (IEESTPRS)	2-392
2-58. Device Information Subroutine (IEEVDEV)	2-396

2-59. Deleting a Virtual Memory (IEAVEMDL)	2-400
2-60. SETDMN Command Processing (IEE8603D) (VS2.03.807)	2-401.0
Region Control Task (RCT)	2-403
Method-of-Operation Diagrams	2-406
3-1. RCT Initialization/Termination Routine (IEAVAR00)	2-406
3-2. RCT Common Processing Routine (IEAVAR01)	2-408
3-3. Quiesce Routine (IEAVAR02)	2-410
3-4. Restore Routine (IEAVAR03)	2-414
3-5. Attention Exit Scheduler Routine (IEAVAR04)	2-416
3-6. STAX Service Routine (IEAVAX00)	2-418
3-7. Attention Exit Prolog Routines (IEAVAR07)	2-420
3-8. Attention Exit Epilog Routine (IEAVAR06)	2-422
3-9. Attention Exit Purge Routine (IEAVAR07)	2-424
3-10. RCT ESTAE Processing (IEAVAR00)	2-426
Started Task Control (STC)	2-429
Method-of-Operation Diagram	2-430
4-1. Started Task Control Processing	2-430
LOGON Scheduling	2-439
Method-of-Operation Diagrams	2-442
5-1. LOGON Initialization (IKJEFLA)	2-442
5-2. LOGON Scheduling (IKJEFLB)	2-444
5-3. LOGON Initialization and Scheduling Recovery Routine (IKJEFLS)	2-446
5-4. LOGON Monitor (IKJEFLC)	2-448
5-5. LOGOFF Processing (IKJEFLD)	2-452
5-6. LOGON/LOGOFF Verification (IKJEFLE, IKJEFLES)	2-454
5-7. LOGON Pre-Prompt Exit Interface (IKJEFLI)	2-460
5-8. LOGON Monitor Recovery (IKJEFLGB)	2-462
5-9. Pre-TMP Exit (IKJEFLJ)	2-464
5-10. Post-TMP Exit (IKJEFLK)	2-466
System Resources Manager (SRM)	3-3
SRM Interface	3-5
Locking Considerations	3-5
Method-of-Operation Diagrams	3-6
6-1. SRM Interface (IRARMINT) (VS2.03.807)	3-6
6-1. SRM Interface (IRARMINT)	3-6
6-1A. SRM Service Routine (IRARMSRV) (VS2.03.807)	3-9.2
6-1B. Obtain/Free SQA Storage (IRARMIO4) (VS2.03.807)	3-9.6
6-1C. Requeue SRM TQE (IRARMIO5) (VS2.03.807)	3-9.8
SYSEVENT Processor	3-11
List of SYSEVENTs (VS2.03.807)	3-11
6-2. SYSEVENT Processor	3-12
SRM Control	3-23
6-3. SRM Control (IRARMCTL)	3-24
6-3. SRM Control (IRARMCTL) (VS2.03.807)	3-24
6-4. Timer Action Analysis (IRARMCAT)	3-26
6-5. Deferred Action Processor (IRARMCEN)	3-28
6-5. Deferred Action Processor (IRARMCEN) (VS2.03.807)	3-28
6-6. Algorithm Processor (IRARMCEL)	3-30
6-6. Algorithm Processor (IRARMCEL) (VS2.03.807)	3-30
6-7. Periodic Entry Point Scheduling (IRARMCET)	3-32
6-7. Periodic Entry Point Scheduling (IRARMCET) (VS2.03.807)	3-32
6-8. Full Analysis (IRARMCAS)	3-34
6-9. Partial Analysis (IRARMCAP)	3-36
6-9. Swap Analysis (IRARMCAP) (VS2.03.807)	3-36
6-10. Control Swap-In (IRARMCSI)	3-40
6-10. Control Swap-In (IRARMCSI) (VS2.03.807)	3-40
6-11. Control Swap-Out (IRARMCSO)	3-42
6-11. Control Swap-Out (IRARMCSO) (VS2.03.807)	3-42
6-11A. Select User for Swap-In (IRARMCPI) (VS2.03.807)	3-43.0
6-11B. Select User for Swap-Out (IRARMCPO) (VS2.03.807)	3-43.2
6-11C. User Evaluation (IRARMCVL) (VS2.03.807)	3-43.4
Resource Use Algorithms	3-45
Storage Management	3-45
I/O Management	3-45
CPU Management	3-45
6-12. Storage Management (IRARMSTM)	3-46
6-12. Storage Management (IRARMSTM) (VS2.03.807)	3-46
6-12. Main Storage Occupancy Analysis (IRARMS2)	3-52
6-14. I/O Management (IRARMIO)	3-54
6-14. I/O Management (IRARMIO) (VS2.03.807)	3-54
6-15. I/O Load Balancing Swap Analysis (IRARMIL2)	3-56

6-16. I/O Load Balancing User I/O Monitoring (IRARMILO)	3-58
6-16. I/O Load Balancing User I/O Monitoring (IRARMILO) (VS2.03.807)	3-58
6-17. CPU Management (IRARMCPM)	3-62
6-17. CPU Management (IRARMCPM) (VS2.03.807)	3-62
6-18. CPU Load Balancing Swap Analysis (IRARMCL2)	3-66
6-18. Resource Monitor Periodic Monitor (IRARMRM1) (VS2.03.807)	3-66
6-18A. Resource Monitor MPL Adjustment Processing (IRARMRM2) (VS2.03.807)	3-67.0
Workload Management	3-69
6-19. Workload Management (IRARMWLM)	3-70
6-19. Swappable User Evaluation (IRARMWM2) (VS2.03.807)	3-70
6-20. Individual User Evaluation (IRARMWM3)(VS2.03.807)	3-73.0
6-21. User Ready Processing (IRARMHIT) (VS2.03.807)	3-73.2
6-22. Initialize for MF/1 (IRARMWR1) (VS2.03.807)	3-73.6
6-23. Collect Data for MF/1 (IRARMWR3) (VS2.03.807)	3-73.8
System Activity Measurement Facility (MF/1)	3-75
Method-of-Operation Diagrams	3-80
7-1. Measurement Facility Control (MFC) Mainline (IRBMFMFC)	3-80
7-2. Input Merge Control (IRBMFINP)	3-82
7-3. Syntax Analyzer (IRBMFANL)	3-84
7-4. List Option Subroutine (MFLISTOP)	3-86
7-5. MFSTART Mainline (IGX00013)	3-88
7-6. Initialization Mainline (MFIMAINL)	3-90
7-7. CPU Activity Initialization (IRBMFICP) or Paging Activity Initialization (IRBMFIPP)	3-96
7-8. Workload Initialization (IRBMFIWK)	3-98
7-9. Channel Initialization (IRBMFIHA)	3-100
7-10. Device Initialization (IRBMFIDV)	3-104
7-11. Data Control (IRBMFDTA)	3-106
7-12. Termination Processor (IRBMFTMA)	3-110
7-13. MF/1 Message Processor (IRBMFMPR)	3-112
7-14. MFDATA SVC Mainline (IGX00014)	3-114
7-15. Interval MG Routine for CPU (IRBMFDPCP)	3-118
7-16. Interval MG Routine for Paging (IRBMFDPP)	3-122
7-17. Interval Routine for Workload (IRBMFDWP)	3-126
7-18. Interval MG Routine for Channels (IRBMFDHP)	3-130
7-19. Interval MG Routine for Devices (IRBMFDDP)	3-134
7-20. MFROUTER SVC Processor (IRBMFEVT)	3-138
7-21. Channel Sampling Module (IRBMFECH)	3-140
7-22. Second CPU Test Channel Sampling Module (IRBMFTCH)	3-142
7-23. Device Sampling Module (IRBMFEDV)	3-144
7-24. Report Generator Control (IRBMFRGM)	3-146
7-25. Report Generators for CPU, Paging, Workload, Channels, and Devices (IRBMFRCR, IRBMFRPR, IRBMFRWR, IRBMFRHR, and IRBMFRDR)	3-150
Job Scheduling Overview	3-153
Subsystem Interface	3-159
Method of Operation Diagram	3-164
8-1. Subsystem Interface	3-164
Master Subsystem	3-169
Method-of-Operation Diagrams	3-172
9-1. Common Request Router (IEFJRASP)	3-172
9-2. Subsystem Determination (IEFJSDTN)	3-174
9-3. Subsystem Initiation (IEFJJOBS)	3-176
9-4. Converter/Interpreter Interface (IEFJCNTL)	3-178
9-5. Pseudo Access Method (IEFJACTL)	3-182
9-6. Subsystem Initiation Message Writer (IEFJWTOM)	3-186
9-7. Data Set Name Assignment (IEFDSNA)	3-188
9-8. Subsystem Job Termination (IEFJJTRM)	3-190
Initiator/Terminator	3-193
Method-of-Operation Diagrams	3-196
10-1. Initiator: Job Initiation	3-196
10-2. Initiator: Step Initiation	3-200
10-3. Initiator: Step and Job Deletion	3-208
10-4. Initiator: Recovery Processing	3-212
SWA Create Interface	3-215
Method-of-Operation Diagram	3-216
11-1. SWA Create Interface (IEFIB600)	3-216
Converter/Interpreter	3-223
Method-of-Operation Diagrams	3-223
12-1. Converter: Initialization (IEFVH1)	3-224

12-2. Converter: Identifying Verbs on JCL Statements	3-226
12-3. Converter: Processing Commands in the Input Stream (IEFVHM)	3-230
12-4. Converter: Processing In-Stream and Cataloged Procedures (IEFVINA)	3-232
12-5. Converter: Processing Symbolic Parameters (IEFVFA, IEFVFB)	3-234
12-6. Converter: Converting Statements to Internal Text (IEFVFA)	3-236
12-7. Converter: Entering Defaults into Internal Text (IEFVFA)	3-240
12-8. Converter: Termination (IEFVHF)	3-242
12-9. Interpreter: Initialization (IEFNB903)	3-246
12-10. Interpreter: Analyzing Parameter Values	3-248
12-11. Interpreter: Creating and Chaining Tables (IEFVGT)	3-252
12-11. Interpreter: Writing Tables into SWA (IEFVHH)	3-256
12-13. Interpreter: Termination (IEFVHN)	3-258
SWA Manager	3-261
Method-of-Operation Diagrams	3-264
13-1. SWA Manager: Move Mode (IEFQB550)	3-264
13-2. SWA Manager: Locate Mode (IEFQB555)	3-266
Allocation/Unallocation	3-269
Introduction to Allocation/Unallocation	3-271
Batch Initialization and Control	3-271
Dynamic Initialization and Control	3-271
JFCB Housekeeping	3-271
Common Allocation Control	3-271
Data Set Requests and Unit Requests	3-271
Order of Processing Requests	3-271
Generic Allocation Control	3-272
Recovery Allocation	3-273
The Retry Situation	3-273
Processing Tape Requests	3-273
Common Unallocation Control	3-275
Volume Mount & Verify (VM&V) Control	3-275
Allocation/Unallocation Module Name Conventions	3-275
Organization of Allocation/Unallocation Method-of-Operation Diagrams	3-275
Selected Terms Used in Allocation/Unallocation	3-276
Method-of-Operation Diagrams	3-280
14-1. Common Allocation Control (IEFAB421)	3-280
14-2. Fixed Device Control (IEFAB430)	3-294
14-3. Specific Volume Allocation Control (IEFAB433)	3-298
14-4. Allocate Request to Unit (IEFAB434)	3-302
14-5. Nonspecific Volume Allocation Control (IEFAB436)	3-308
14-6. JFCB Housekeeping Control (IEFAB451)	3-314
14-7. DD Function Control (IEFAB454)	3-322
14-8. JLOCATE (IEFAB469)	3-334
14-9. Generic Allocation Control (IEFAB471)	3-338
14-10. Allocation Via Algorithm (IEFAB476)	3-348
14-11. Demand Allocation (IEFAB479)	3-354
14-12. Recovery Allocation (IEFAB485)	3-358
14-13. Offline/Allocated Device Allocation (IEFAB486)	3-366
14-14. Common Allocation Cleanup (IEFAB490)	3-378
14-15. Allocation/Volume Mount & Verify (VM&V) Interface (IEFAB492)	3-386
14-16. Volume Mount & Verify (VM&V) Control (IEFAB493)	3-390
14-17. Initiator/Allocation Interface (IEFBB401)	3-396
14-18. Initiator/Unallocation Interface (IEFBB410)	3-402
14-19. Job Unallocation (IEFBB416)	3-410
14-20. SVC 99 Control (IEFDB400)	3-412
14-21. Dynamic Allocation Control (IEFDB410)	3-414
14-22. Dynamic Unallocation Control (IEFDB4A0)	3-416
14-23. Dynamic Concatenation (IEFDB450)	3-418
14-24. Dynamic Deconcatenation (IEFDB460)	3-420
14-25. Dynamic Information Retrieval (IEFDB470)	3-422
14-26. Remove In-Use Attribute (IEFDB480)	3-424
14-27. Ddname Allocation (IEFDB490)	3-428
14-28. Common Unallocation Control (IEFAB4A0)	3-430
14-29. Disposition Processing (IEFAB4A2)	3-440
14-30. Unit Unallocation (IEFAB4A4)	3-444
System Management Facilities (SMF)	3-447
Method-of-Operation Diagrams	3-450
15-1. Writing SMF Records (IEEMB829, IEEMB830)	3-450
15-2. Switching SMF Data Sets (IEEMB829)	3-454
15-3. STAE Exit Processing for SMF (IEEMB825)	3-458
15-4. SMF Cross-Memory POST Error Exit (IEEMB827)	3-460

System Log	3-463
Method-of-Operation Diagrams	3-466
16-1. System Log Initialization (IEEMB803)	3-466
16-2. Terminating the System Log (IEEMB803)	3-470
16-3. Switching Log Data Sets (IEEMB803)	3-472
16-4. Log Writer Processing (IEEMB803)	3-474
16-5. Processing Log Task Abnormal Termination (IEEMB806)	3-476
16-6. Writing Data on the System Log (IEEMB804)	3-480
Checkpoint/Restart	3-483
DSDR Processing	3-483
The Job Journal	3-483
Journal Routines	3-483
Method-of-Operation Diagrams	3-486
17-1. Processing Data Set Descriptor Records (IEFXB609)	3-486
17-2. Job Journal to SWA Merging (IEFXB601)	3-492
17-3. Step Continue Processing (IEFXB601)	3-494
17-4. System Restart Processing (IEFXB601)	3-496
17-5. Automatic Checkpoint Restart (IEFXB601)	3-498
17-6. Automatic Step Restart (IEFXB601)	3-500
17-7. Merge Cleanup (IEFXB601)	3-502
17-8. Updating the Virtual Addresses in SWA (IEFXB601)	3-504
17-9. Journal Merge Reading (IEFXB601)	3-506
17-10. Journal Merge Error Processing (IEFXB601)	3-508
17-11. Restart Interface Processing (IEFXB602)	3-510
17-12. Building a Step Header Record for Job Journal (IEFXB604)	3-512
17-13. Preparing Abended Job Step for Restart (IEFRPREP)	3-516
17-14. Writing Blocks to the Job Journal (IEFXB500)	3-520
17-15. Journal for Restarted Jobs (IEFXB500)	3-525
Timer Supervision	4-3
Method-of-Operation Diagrams	4-6
18-1. TIME Service Routine (IEAVRT01)	4-6
18-2. STIMER Service Routine (IEAVRT00)	4-8
18-3. TTIMER Service Routine (IEAVRT00)	4-10
18-3A. SETDIE Routine (IEAVRT02) (VS2.03.807)	4-11.0
18-4. TQE Enqueue Routine (IEAVRTI0)	4-12
18-5. TQE Dequeue Routine (IEAVRTI0)	4-14
18-6. TQE Purge Routine (IEAVRTI1)	4-16
18-7. Timer Second Level Interrupt Handler (IEAVRTI0)	4-18
18-8. Set Clock Comparator Routine (IEAVRTI0)	4-20
18-9. TQE Processing Routine (IEAVRTI0)	4-22
18-10. Timer Functional Recovery Routine (IEAVRTI1)	4-24
18-11. Set Specific Clock (SSC) Routine (IEAVRTOD)	4-26
18-12. TOD Clock Operator Communication Routine (IEAVRTOD)	4-30
18-13. TOD Clock Synchronization Routine (IEAVRTOD)	4-32
18-14. TOD Clock Status Test Routine (IEAVRTOD)	4-34
18-15. Synchronous Timer Recovery Routine (IEAVRTI1)	4-36
18-16. Asynchronous Timer Recovery Routine (IEAVRTOD)	4-38
Supervisor Control	4-41
Service Manager	4-42
Dispatching Work	4-43
Handling Interruptions	4-44
Interprocessor Communications (IPC)	4-44
Scheduling Exit Routines	4-46
Serializing System Resources	4-58
Supervisor Control Recovery	4-58
Validity Checking	4-59
Method-of-Operation Diagrams	4-54
19-1. Dispatcher (IEAVEDS0)	4-54
19-2. Global SRB Dispatcher (IEAVEDS0)	4-72
19-3. Local SRB Dispatcher (IEAVEDS0)	4-74
19-4. Local Supervisor Dispatcher (IEAVEDS0)	4-76
19-5. Task Dispatcher (IEAVEDS0)	4-78
19-6. Wait Task Dispatcher (IEAVEDS0)	4-82
19-7. Memory Switch (IEAVEMSO)	4-84
19-8. SVC Interruption Handler (IEAVESVC)	4-86
19-9. I/O Interruption Handler (IEAVEIO)	4-94
19-10. External First Level Interruption Handler (IEAVEEXT)	4-98
19-11. Program Check Interruption Handler (PC IH) (IEAVEPC)	4-104
19-12. Restart Interruption Handler (IEAVERES)	4-116
19-13. Signal Service Routines (IPC) (IEAVERI, IEAVERP, IEAVEDR)	4-120
19-14. External Call Second Level Interruption Handler (IEAVEXS)	4-126

19-15. Emergency Signal Second Level Interruption Handler (IEAVEES)	4-128
19-16. Stage 1 Exit Effector (IEAVEF00)	4-130
19-17. Stage 2 Exit Effector (IEAVEEE2)	4-132
19-18. Stage 3 Exit Effector (IEAVEEE0)	4-134
19-19. SCHEDULE Processing (IEAVESCO)	4-138
19-20. PURGEDQ Processing (IEAVEPD0)	4-144
19-21. SETLOCK Processing (IEAVELK)	4-148
19-22. Validity Check Processing (IEAVEVAL)	4-162
19-23. ASCBCHAP Processing (IEAVEAC0)	4-164
19-24. Trace Processing (IEAVTRCE)	4-168
19-25. Queue Verification (IEAVEQV0)	4-170
19-26. Super FRR (IEAVESPR)	4-172
19-27. Address Space/Lock Verification Processing (IEAVELCR)	4-176
19-28. Suspend Routine (IEAVETCL) (VS2.03.807)	4-191.0
19-29. Transfer Control-Transfer Logical (TCTL) (IEAVETCL) (VS2.03.807)	4-191.2
19-30. Resume Routine (IEAVETCL) (VS2.03.807)	4-191.6
Task Management	4-193
Creating and Deleting Subtasks	4-193
Controlling Task Execution	4-196
Direct Control of Tasks	4-196
Indirect Control of Tasks	4-196
Providing Informational Services	4-196
Method-of-Operation Diagrams	4-198
20-1. ATTACH Processing (IEAVEAT0)	4-198
20-2. DETACH Processing (IEAVEED0)	4-206
20-3. CHAP Routine (IEAVECH0)	4-214
20-4. WAIT Processing (IEAVSY50)	4-220
20-5. POST Processing (IEAVSY50)	4-222
20-6. EVENTS Processing (IEAVEVT0)	4-234
20-7. ENQ/Reserve Processing (IEAVENQ1)	4-242
20-8. DEQ Processing (IEAVENQ1)	4-246
20-9. ENQ/DEQ/Reserve Recovery (IEAVENQ1)	4-248
20-10. SPIE Processing (IEAVTB00)	4-250
20-11. EXTRACT Processing (IEAVTB00)	4-254
20-12. EXIT Processing (IEAVE0R)	4-256
20-13. EXIT Prolog Processing (IEAVEEXP)	4-258
20-14. STATUS Processing (IEAVSETS)	4-260
20-15. MODESET Processing (IEAVMODE)	4-268
20-16. TESTAUTH Processing (IEAVTEST)	4-270
Program Management	4-273
Searching For and Scheduling Modules	4-273
JPA Storage Areas	4-273
LPA Storage Areas	4-275
Auxiliary Storage Libraries	4-275
Synchronizing Exit Routines	4-275
Fetching Modules into Storage	4-275
Method-of-Operation Diagrams	4-278
21-1. LINK Routine (IEAVLK00)	4-278
21-2. Routing to Searching Routines (IEAVLK01)	4-284
21-3. Searching the LPA Directory (IEAVLK00)	4-286
21-4. BLDL/Program Fetch Interface (IEAVLK01)	4-288
21-5. SYNCH Routine (IEAVLK00)	4-290
21-6. LOAD Routine (IEAVLK00)	4-292
21-7. DELETE Routine (IEAVLK00)	4-294
21-8. IDENTIFY Routine (IEAVID00)	4-296
21-9. XCTL Routine (IEAVLK00)	4-300
21-10. Overlay Supervisor (IEWSUQVR, IEWSWOVR)	4-306
21-11. Program Fetch (IEWFETCH)	4-308
Recovery/Termination Management (R/TM)	4-319
RTM1 Functions	4-319
SLIH Mode Processing	4-319
Service Mode Processing	4-319
Hardware Error Mode	4-320
RTM2 Functions	4-320
Normal Termination	4-320
Abnormal Termination	4-320
Address Space Termination	4-321
Recovery/Termination Management Support Functions	4-321
STA Services	4-322
Alternate CPU Recovery (ACR)	4-322

SETFRR	4-322
Initializing FRR Stacks	4-322
Dumping	4-322
Formatted Dump–SNAP Dump	4-322
Unformatted Dump–SVC Dump	4-323
CHNGDUMP Operator Command	4-323
Recording Services	4-323
Method-of-Operation Diagrams	4-342
22-1. RTM1 Overview (IEAVTRTM)	4-342
22-2. RTM1 Initialization (IEAVTRT1)	4-344
22-3. Process Hardware Error (IEAVTRT2)	4-348
22-4. Processing SLIH Requests (IEAVTRTM)	4-352
22-5. Routing to FRRs (IEAVTRTS)	4-354
22-6. RTM1 Recursion Processing (IEAVTRTR)	4-362
22-7. Reschedule RTM1 (IEAVTRTM)	4-366
22-8. System-Directed Task Termination (IEAVTRTM)	4-370
22-9. Reschedule Locally Locked Task or SRB (IEAVTRTM)	4-372
22-10. RTM1 Clean-up Processing (IEAVTRTM)	4-374
22-11. RTM1 Exit Processing (IEAVTRT1)	4-376
22-12. RTM2 Overview (IEAVTRT2)	4-378
22-13. RTM2 Initialization (IEAVTRT2)	4-382
22-14. Recursion Processor 1 (IEAVTRT2)	4-384
22-15. Recursion Processor 2 (IEAVTRTE)	4-386
22-16. Recover Task Processing (IEAVTAS1)	4-388
22-17. ABDUMP Processing (IEAVTABD)	4-392
22-18. Synchronize Failing Tasks (IEAVTRTC)	4-396
22-19. Task Purge Processing (IEAVTSKT)	4-398
22-20. Task Purge Resource Managers (IEAVTSKT)	4-402
22-21. Address Space Purge Processing (IEAVTMMT)	4-408
22-22. Address Space Purge Resource Managers (IEAVTMMT)	4-410
22-23. RTM2 Exit Processing (IEAVTRTE)	4-420
22-24. Address Space Termination Processing (IEAVTMTTC)	4-426
22-25. STAE/ESTAE Processing (IEAVSTA0)	4-430
22-26. Alternate CPU Recovery (ACR) Overview (IEAVTACR)	4-436
22-27. FRR Stack Initialization (IEAVTSIN)	4-440
22-28. SETFRR (SETFRR)	4-442
22-29. SVC 51 Overview (IEAVAD00)	4-444
22-30. SNAP Dump Processing (IEAVAD1)	4-446
22-31. SVC Dump Processing (IEAVAD00)	4-452
22-32. Schedule Dump Processing (IEAVTSDX)	4-458
22-33. CHNGDUMP (IEEMB815)	4-462
22-34. Recording Processing (IEAVTRER)	4-466
Real Storage Management (RSM)	5-3
Method-of-Operation Diagrams	5-6
23-1. LSQA/SQA Allocation (IEAVSQA)	5-6
23-2. V=R Region Allocation (IEAVEQR)	5-8
23-3. Freeing a V=R Region (IEAVEQR)	5-12
23-4. Page Release Processing (IEAVRELS)	5-14
23-5. FREEMAIN Release Processing (IEAVRELS)	5-16
23-6. Create Segment (IEAVCSEG)	5-18
23-7. Destroy Segment (IEAVDSEG)	5-20
23-8. Program Check Interruption Extension (IEAVPIX)	5-22
23-9. General Frame Allocation (IEAVGFA)	5-24
23-10. Page I/O Post (IEAVPIOP)	5-28
23-11. Page I/O Completion Processing (IEAVIOCP)	5-30
23-12. Page Services Interface (IEAVPSI)	5-32
23-13. PGFIX/PGLOAD Processor (IEAVFXLD)	5-34
23-14. PGFIX/PGLOAD Root Exit (IEAVFXLD)	5-36
23-15. PGFREE Routine (IEAVFREE)	5-38
23-16. PGOUT Routine (IEAVOUT)	5-40
23-17. Swap-In Processor Routine (IEAVSWIN)	5-42
23-18. Swap-In Root Exit (IEAVSWIN)	5-44
23-18A. Swap-In Post Processor (IEAVSWPP) (VS2.03.807)	5-45.0
23-19. Swap-Out Processor Routine (IEAVSOUT)	5-46
23-20. Swap-Out Root Exit (IEAVSOUT)	5-50
23-20. Swap-Out Completion Routine (IEAVSWPC) (VS2.03.807)	5-50
23-21. Page I/O Initiator (IEAVPIOI)	5-52
23-21. LSQA Swap I/O Initiator (IEAVPIOI) (VS2.03.807)	5-52
23-22. VIO Services Routine (IEAVAMSI)	5-54
23-23. Initialize Address Space Routine (IEAVITAS)	5-58
23-24. Delete Address Space Routine (IEAVDLAS)	5-60

23-25. Page Termination Services (IEAVTERM)	5-62
23-26. Real Frame Replacement (IEAVRFR)	5-64
23-27. Real Storage Reconfiguration Routine(IEAVRCF)	5-68
23-28. PFTE Enqueue/Dequeue Routine (IEAVPFTE)	5-72
23-29. PCB Manager (IEAVPCB)	5-74
23-30. Page Invalidation Routine (IEAVINT)	5-76
23-31. Find Page Routine (IEAVFP)	5-78
23-32. Translate Real to Virtual (IEAVTRV)	5-80
23-33. RSM Functional Recovery Routine (IEAVRCV)	5-82
23-34. RSM Preferred Area Steal (IEAVPREF)	5-84
Virtual Storage Mangement (VSM)	5-87
Subpools	5-88
Method-of-Operation Diagrams	5-94
24-1. GETMAIN (IEAVGM00)	5-94
24-2. FREEMAIN (IEAVGM00)	5-96
24-3. GETPART (IEAVPRT0)	5-98
24-4. FREEPART (IEAVPRT0)	5-100
24-5. Create Address Space (IEAVGCAS)	5-102
24-6. Free Address Space (IEAVGCAS)	5-104
24-7. Task Termination (IEAVGCAS)	5-106
24-8. Build Quickcell Pool Routine (IEAVBLDP)	5-108
24-9. GETCELL Routine (IEAVGTCL)	5-110
24-10. FREECELL Routine (IEAVFRCL)	5-112
24-11. Delete Quickcell Pool (IEAVDELP)	5-114
24-12. CHANGKEY (IEAVCKEY) (VS2.03.805)	5-115.0
Auxiliary Storage Management	5-117
Method-of-Operation Diagrams	5-118
25-1. Auxiliary Storage Management Overview	5-118
25-2. ILRINT00 Overview	5-118
25-3. ACTIVATE	5-122
25-4. GETLGN	5-124
25-5. GETCORE	5-126
25-6. Chain ACE ILRCEP00	5-128
25-7. GETACE	5-130
25-8. ASSIGN	5-132
25-9. FREECORE	5-134
25-10. RELLG	5-136
25-11. RELLP	5-138
25-12. SAVE	5-140
25-13. TRPAGE	5-142
25-14. Input/Output	5-146
25-15. SWAPCHK	5-148
25-16. SAVEACT	5-150
25-17. WTOMSG	5-154
25-18. ARLSEG	5-156
25-19. ILRMON00 Overview	5-158
25-20. GMAGET	5-162
25-21. GMAFREE	5-164
25-22. PROCLG	5-166
25-23. INTMON	5-170
25-24. REVERSER	5-172
25-25. NOAIE	5-174
25-26. QUEIT	5-176
25-27. STARTOP	5-178
25-28. STINDV	5-180
25-29. BLDTSKQ	5-184
25-30. PLPASAVE	5-186
25-31. ILRARLS	5-188
25-32. GETLPME	5-190
25-33. REMOVA	5-192
25-34. MONQIO	5-196
25-35. FINDPE	5-198
25-36. SECCHK	5-200
25-37. QUEREAD	5-202
25-38. GETANIOE	5-204
25-39. QUEWRITE	5-206
25-40. QUEIOE	5-208
25-41. TRPAGE	5-210
25-42. ILRASN00 Overview	5-212
25-43. ASPCTI1	5-216
25-44. ASPCTI2	5-220

25-45. ILRRLP00 Overview	5-222
25-46. RLPSG01	5-224
25-47. SEGRlse	5-226
25-48. CTRUPDTE	5-228
25-49. ILRTRP00 Overview	5-230
25-50. TRPSG02	5-234
25-51. TRPSG03	5-236
25-52. TRPSG04	5-240
25-53. ILRACT00 Overview	5-244
25-54. ACTREEN	5-248
25-55. ACTGETB	5-250
25-56. ACTCOND	5-254
25-57. ACTINPR	5-258
25-58. ACTCACE	5-260
25-59. ACTINIT	5-266
25-60. ACTSLOT	5-270
25-61. ACTFREE	5-274
25-62. ACTCLUP	5-276
25-63. ILRSV00 Overview	5-278
25-64. SAVSG04	5-282
25-65. SAVSG11	5-284
25-66. ADDLSID	5-286
25-67. SAVSG06	5-288
25-68. SAVSG08	5-292
25-69. SAVSG10	5-294
25-70. ILRRLG00 Overview	5-300
25-71. RLGSG01	5-304
25-72. RLGSG02	5-308
25-73. RLGSG03	5-310
25-74. ACTUPDT	5-312
25-75. GETONE	5-314
25-76. PUTONE	5-318
25-77. FINISH	5-320
25-78. ACTGETN	5-322
25-79. GETALLX	5-324
25-80. GETEXTS	5-326
25-81. SVRLGGET	5-328
25-82. GETERASE	5-332
25-83. SAVEPUT	5-334
25-84. PUTASPCT	5-338
25-85. ILRALS00	5-340
25-86. ALSPROC	5-342
25-87. SAVSG061	5-344
25-88. SAVSG062	5-346
25-89. SAVSG063	5-348
25-90. RLGSG04	5-354
25-91. RLGSG05	5-356
25-92. ILRTMC00	5-358
25-93. TMCSG06	5-360
25-94. TMCSG10	5-362
25-95. TMCMSG	5-364
25-96. I/O Request Overview	5-366
25-97. ILRPTM00	5-388
25-98. ILRSRT00 Overview	5-390
25-99. GETWRTQ	5-390
25-100. REPWRTQ	5-392
25-101. PROCPARE	5-394
25-102. BADSORT	5-396
25-103. REPBUFC	5-398
25-104. ILRSRT00	5-400
25-105. INITLZ	5-402
25-106. SORTREAD	5-404
25-107. ADRTTRE	5-406
25-108. CYSCANCYL	5-408
25-109. GETRDCYL	5-410
25-110. GETWCYL	5-412
25-111. BRDMASK	5-414
25-112. GETLOLEC	5-416
25-113. PROCREQS	5-418
25-114. PROCHIT	5-420
25-115. INITBUFC	5-422

25-116. FREEIOE	5-424
25-117. IOCHAIN	5-426
25-118. GETBUFC	5-428
25-119. BILDMSKS	5-430
25-120. WRTUPDTE	5-432
25-121. FINDSLOT	5-434
25-122. SETWRITE	5-436
25-123. GETREAD	5-438
25-124. REMVNODE	5-440
25-125. RCHAINUP	5-442
25-126. IO	5-444
25-127. CLEANUP	5-446
25-128. ILRIOC00 Overview	5-448
25-129. BUFCPROC	5-454
25-130. RECHAIN	5-458
25-131. BADSLOT	5-460
25-132. ADDSLOT	5-464
25-133. COMPBRST	5-466
25-134. NOTREADY	5-468
25-135. Mark Slot Available	5-472
25-136. ILRINT01 Overview	5-474
25-137. ILRINT01	5-476
25-138. ILRFRR00-ILRDET00	5-478
25-139. ILRFRR00-ILRFRR01	5-480
25-140. ILRMON01	5-482
25-141. ILRFRR00-ILRIOB01	5-486
25-142. ILRIOC01	5-488
25-143. ILRTMR01 Overview	5-490
25-144. ILRTMR01	5-492
25-145. ILRTMR01 Error Processing	5-494
25-146. ILREOT00	5-496
25-147. ILREOT00-ILRRETRY	5-498
25-148. ILREOT00-ILRETXR	5-500
25-149. ILRFRR00 Overview	5-502
25-150. ILRFRR00-ILREX01	5-504
25-151. ILRTMR00	5-506
Auxiliary Storage Management (VS2.03.807)	5-117
Overview (VS2.03.807)	5-117
I/O Control (VS2.03.807)	5-119
25.1. ILRPAGIO (VS2.03.807)	5-122
25.2. ILRSWAP (VS2.03.807)	5-130
25.3. ILRSWPDR (VS2.03.807)	5-134
25.4. ILRPAGCM (VS2.03.807)	5-135
25.5. ILRFRSLT (VS2.03.807)	5-149
I/O Subsystem (VS2.03.807)	5-152
25.6. ILRPTM (VS2.03.807)	5-156
25.7. ILRSRT (VS2.03.807)	5-165
25.8. ILRCMP (VS2.03.807)	5-184
25.9. ILRMSG00 (VS2.03.807)	5-195
VIO Control (VS2.03.807)	5-202
25.10. ILRPOS (VS2.03.807)	5-205
25.11. ILRGOS (VS2.03.807)	5-210
25.12. ILRSRBC (VS2.03.807)	5-214
25.13. ILRVIOCM (VS2.03.807)	5-217
25.14. ILRJTERM (VS2.03.807)	5-219
VIO Group Operators (VS2.03.807)	5-222
25.15. ILRACT (VS2.03.807)	5-225
25.16. ILRSAP (VS2.03.807)	5-228
25.17. ILRRLG (VS2.03.807)	5-235
25.18. ILRTMRLG (VS2.03.807)	5-239
25.19. ILRVAMI (VS2.03.807)	5-242
Recovery (VS2.03.807)	5-250
25.20. ILRIOFRR (VS2.03.807)	5-257
25.21. ILRSWP01 (VS2.03.807)	5-270
25.22. ILRSRT01 (VS2.03.807)	5-278
25.23. ILRCMP01 (VS2.03.807)	5-283
25.24. ILRGOS01 (VS2.03.807)	5-288
25.25. ILRSRB01 (VS2.03.807)	5-296
25.26. ILRTMI01 (VS2.03.807)	5-300
25.27. ILRFRR01 (VS2.03.807)	5-322
Service Routines (VS2.03.807)	5-334

25.28. ILRTERMR (VS2.03.807)	5-336
25.29. ILRPEX (VS2.03.807)	5-340
25.30. ILRFMT00, ILRFMTPG, ILRFMTSW, ILRFMTCV (VS2.03.807)	5-341
Page Expansion (VS2.03.807)	5-344
25.31. ILRPGEXP (VS2.03.807)	5-346
25.32. ILROPS00 (VS2.03.807)	5-351
25.33. ILRPREAD (VS2.03.807)	5-364
Section 3: Program Organization	6-0
Module-to-Module Control Flow (See Figure List)	6-1
Communications Task	6-2
Command Processing (includes Reconfiguration Commands)	6-8
Region Control Task (RCT)	6-22
Started Task Control (STC)	6-32
LOGON Scheduling	6-34
System Resources Manager (SRM)	6-36
System Activity Measurement Facility (MF/1)	6-37
Job Scheduling:	
Master Subsystem	6-38
Initiator/Terminator	6-39
SWA Create Interface	6-41
Converter/Interpreter	6-42
SWA Manager	6-45
Allocation/Unallocation	6-46
System Management Facilities (SMF)	6-88
System Log	6-89
Checkpoint/Restart	6-90
Timer Supervision	6-91
Supervisor Control	6-114
Task Management	6-124
Program Management	6-128
Recovery/Termination Management (R/TM)	6-189
Real Storage Management (RSM)	6-130
Virtual Storage Management (VSM)	6-185
Auxiliary Storage Management (ASM)	6-200
Module Descriptions	6-256
Section 4: Directory	7-1
Section 5: Data Areas	7-271
Control Block Overviews (See Figure List)	
Communications Task	7-272
Command Processing (includes Reconfiguration Commands)	7-275
Region Control Task (RCT)	7-278
Started Task Control (STC)	7-279
LOGON Scheduling	7-281
System Resources Manager (SRM)	7-282
System Activity Measurement Facility (MF/1)	7-283
Job Scheduling:	
Subsystem Interface	7-285
Initiator/Terminator	7-286
SWA Create Interface	7-287
Converter/Interpreter	7-288
SWA Manager	7-290
Allocation/Unallocation	7-291
System Management Facilities (SMF)	7-299
System Log	7-300
Checkpoint/Restart	7-301
Timer Supervision	7-302
Supervisor Control	7-303
Task Management	7-304
Program Management	7-305
Recovery/Termination Management (R/TM)	7-306
Real Storage Management (RSM)	7-308
Virtual Storage Management (VSM)	7-310
Auxiliary Storage Management (ASM) (VS2.03.807)	7-311.0
Auxiliary Storage Management (ASM)	7-312
Acronym/Mapping Macro/Common Name Table	7-324
Data Area Usage Table	7-335
Symbol Usage Table	7-337

Section 6: Diagnostic Aids	7-339
ABEND Codes	7-341
Messages and Wait State Codes	7-345
Return Code Table	7-353
Register Usage Table	7-385
Communications Task Diagnostic Aids	7-471
Initial Check	7-471
Console Not Responding to Attention	7-471
Enabled Wait State	7-471
Disabled Wait State	7-472
No Messages on One Console	7-472
Messages Going to Wrong Console	7-472
Truncated Messages	7-472
Console Switching	7-472
Reply Command Problems	7-472
DIDOCs Trace Table	7-473
DIDOCs-In-Operation Bit	7-473
DIDOCs Locking	7-473
Started Task Control (STC) ABEND and Reason Codes	7-474
LOGON Scheduling Diagnostic Aids	7-475
LOGON Work Area Bits That Indicate the Currently Executing Module	7-475
LOGON Scheduling Post Codes	7-475
SWA Manager Reason Codes	7-476
0C4 Abend Code Occurring in IEFAB4FC	7-477
Allocation/Unallocation Reason Codes	7-478
Real Storage Management ABEND Reason Codes	7-484
Auxiliary Storage Management (ASM)	7-486
Recovery/Termination Manager	7-486
Recovery Routines	7-486
Functional Recovery Routines	7-487
ESTAE/ESTAI Routines	7-488
Mainline Communication	7-489
Monitor Calls	7-489
Dumps	7-489
Reading an ASM Dump	7-491
Locating the Audit Trail	7-493
ASM Modules, Macros, and Programs	7-476
Service Programs	7-482
Error Recovery Programs	7-483
Macros	7-485
Mapping Macros	7-486
Auxiliary Storage Management Diagnostic Aids (VS2.03.807)	7-476
Additional ASM Data Areas (VS2.03.807)	7-476
ASPCT and Locating LSIDs of VIO Data Sets (VS2.03.807)	7-478
Relating a Virtual Address to the PART, PAT, and Device (VS2.03.807)	7-479
COD Abend Meanings For ASM (VS2.03.807)	7-481
Recovery Control Blocks (VS2.03.807)	7-481
Serialization (VS2.03.807)	7-486
Page/Swap Data Set Error Action Matrix (VS2.03.807)	7-491

Figures

Figure	1-1	OS/VS2 System Overview	26
Figure	1-2	ASM Communications (VS2.03.807)	42
Figure	1-3	Overview of ASM Processing (VS2.03.807)	43
Figure	1-4	Auxiliary Storage Management Control Block Overview (VS2.03.807)	46
Figure	2-1	Key to Symbols Used in Method-of-Operation Diagrams 2-2,3-2,4-2,5-2	
Figure	2-2	The Communications Task	2-3
Figure	2-3	SVC 72	2-6
Figure	2-4	Communications Task Visual Contents	2-8
Figure	2-5	Command Processing Method-of-Operation Diagram Summary	2-228
Figure	2-6	Region Control Task Visual Contents	2-405
Figure	2-7	LOGON Scheduling Visual Contents	2-441
Figure	2-8	Data Areas Containing LOGON User Information	2-459
Figure	2-9	System Resources Manager (SRM) Visual Contents	3-4
Figure	2-9A	SRM Module/Entry Point Cross Reference (VS2.03.807)	3-3.0
Figure	2-9B	Processing Algorithms and Actions in IRARMCTL (VS2.03.807)	3-23.0
Figure	2-9C	RMEP Algorithm and Action Invocation Flags (VS2.03.807)	3-23.1
Figure	2-10	System Activity Measurement Facility (MF/1) Visual Contents	3-79
Figure	2-11	Job Scheduling: Initiation of the Master Scheduler	3-164
Figure	2-12	Job Scheduling: Initiation of the Job Entry Subsystem	3-165
Figure	2-13	Job Scheduling: START/LOGON/MOUNT Initiation	3-166
Figure	2-14	Job Scheduling: Normal Job Entry and Initiation	3-167
Figure	2-15	Subsystem Interface Summary	3-171
Figure	2-16	Master Subsystem Visual Contents	3-179
Figure	2-17	Initiator/Terminator Visual Contents	3-203
Figure	2-17A	Converter Visual Contents	3-223
Figure	2-17B	Interpreter Visual Contents	3-245
Figure	2-18	General Format of a SWA Control Block and an Example of the JFCB as it Appears in SWA	3-262
Figure	2-19	SWA Manager Visual Contents	3-263
Figure	2-20	Relationship of the Six Major Functions of Allocation/Unallocation	3-267
Figure	2-21	Allocation/Unallocation Functions and Related Method-of-Operation Diagrams	3-270
Figure	2-22	The Division of Generic Device Types into Device Groups	3-272
Figure	2-23	Tape Device Types and Supported Densities	3-274
Figure	2-24	Tape Device Eligibility	3-274
Figure	2-25	Batch and Dynamic Allocation/Unallocation Visual Contents	3-277
Figure	2-26	Common Allocation Visual Contents	3-279
Figure	2-27	Function Map of Common Allocation Parameter List	3-293
Figure	2-28	Function Map of JFCB Housekeeping Parameter List	3-321
Figure	2-29	System Management Facilities (SMF) Recording: Visual Contents	3-449
Figure	2-30	System Log Visual Contents	3-465
Figure	2-31	Job Scheduler Checkpoint/Restart: Visual Contents	3-485
Figure	2-32	Timer Supervision Visual Contents	4-4
Figure	2-33	SRB Scheduling Pointer Structure	4-42
Figure	2-34	Asynchronous Exit Effector Data Structure	4-47
Figure	2-35	Supervisor Control Recovery Data Structure	4-50
Figure	2-36	Supervisor Control Visual Contents	4-51
Figure	2-37	The TCB Ready Queue	4-194
Figure	2-38	The TCB Family Queue	4-195
Figure	2-39	Task Management Visual Contents	4-197
Figure	2-40	STATUS Action Codes and Fields They Change	4-265
Figure	2-41	Control Blocks for Modules in the JPA	4-274
Figure	2-42	Program Management Visual Contents	4-277
Figure	2-43	Real Storage Management Visual Contents	5-4
Figure	2-44	Subpool Assignments	5-89
Figure	2-45	Virtual Storage Management Visual Contents	5-93
Figure	2-46	Page I/O Error Processing	4-324
Figure	2-47	Hardware Error Processing	4-326
Figure	2-48	The Process of Normal Task Termination	4-328
Figure	2-49	Abnormal End-of-Task	4-330
Figure	2-50	Retry	4-331
Figure	2-51	Cancel	4-332
Figure	2-52	The Process of Terminating an Address Space	4-333
Figure	2-53	ABEND/SNAP Dump Processing	4-335
Figure	2-54	SVC Dump Overview	4-336
Figure	2-55	Recovery/Termination Management Visual Contents	4-339
Figure	2-56	Auxiliary Storage Management Visual Table of Contents (VS2.03.807)	5-118

Figure	2-57	I/O Control Overview (VS2.03.807)	5-121
Figure	2-58	I/O Subsystem Overview (VS2.03.807)	5-155
Figure	2-59	VIO Control Overview (VS2.03.807)	5-204
Figure	2-60	VIO Group Operators (VS2.03.807)	5-224
Figure	2-60A	Recovery Routines (VS2.03.807)	5-255
Figure	2-61	Recovery Overview (VS2.03.807)	5-256
Figure	2-62	Service Routines Overview (VS2.03.807)	5-335
Figure	2-63	Page Expansion Overview (VS2.03.807)	5-345
Figure	3-1	WTO and WTOR Processing Module Flow (Communication Task)	6-2
Figure	3-2	DOM Processing Module Flow (Communication Task)	6-4
Figure	3-3	Attention Interrupt Processing Module Flow (Communication Task)	6-5
Figure	3-4	External Interrupt Processing Module Flow (Communication Task)	6-6
Figure	3-5	I/O Complete Processing Module Flow (Communication Task)	6-7
Figure	3-6	Command Processing Program Organization Overview	6-8
Figure	3-7	Region Control Task (RCT) Module Flow	6-22
Figure	3-8	Started Task Control (STC) Module Flow	6-32
Figure	3-9	LOGON Scheduling Module Flow	6-34
Figure	3-10	System Resources Manager (SRM) Module Flow	6-36
Figure	3-10A	System Resources Manager (SRM) Mainline Processing Module Flow (VS2.03.807)	6-36
Figure	3-10B	System Resources Manager (SRM) Command Processing Module Flow (VS2.03.807)	6-36.1
Figure	3-11	System Activity Measurement Facility (MF/1) Module Flow	6-37
Figure	3-12	Master Subsystem Module Flow	6-38
Figure	3-13	Initiator/Terminator Module Flow	6-39
Figure	3-14	SWA Create Interface Module Flow	6-41
Figure	3-15	Converter Module Flow	6-42
Figure	3-16	Interpreter Module Flow	6-44
Figure	3-17	SWA Manager Module Flow	6-45
Figure	3-18	Batch and Dynamic Allocation/Unallocation Module Flow Overview	6-47
Figure	3-19	Common Allocation Module Flow Overview	6-48
Figure	3-20	IEFAB4A0 – Common Unallocation Control	6-49
Figure	3-21	IEFAB421 – Common Allocation Control	6-51
Figure	3-22	IEFAB434 – Allocate Request to Unit	6-53
Figure	3-23	IEFAB436 – Nonspecific Volume Allocation Control	6-55
Figure	3-24	IEFAB451 – JFCB Housekeeping Control	6-56
Figure	3-25	IEFAB454 – DD Function Control	6-57
Figure	3-26	IEFAB469 – JLOCATE	6-60
Figure	3-27	IEFAB471 – Generic Allocation Control	6-61
Figure	3-28	IEFAB476 – Allocation Via Algorithm	6-63
Figure	3-29	IEFAB479 – Demand Allocation	6-64
Figure	3-30	IEFAB485 – Recovery Allocation	6-65
Figure	3-31	IEFAB486 – Offline/Allocated Device Allocation	6-67
Figure	3-32	IEFAB490 – Common Allocation Cleanup	6-71
Figure	3-33	IEFAB491 – Wait Holding Resources	6-73
Figure	3-34	IEFAB493 – VM & V (Volume Mount & Verify) Control	6-74
Figure	3-35	IEFBB401 – Initiator/Allocation Interface	6-75
Figure	3-36	IEFBB410 – Initiator/Unallocation Interface	6-77
Figure	3-37	IEFDB4A0 – Dynamic Unallocation Control	6-80
Figure	3-38	IEFDB400 – SVC 99 Control	6-81
Figure	3-39	IEFDB410 – Dynamic Allocation Control	6-84
Figure	3-40	System Management Facilities (SMF) Recording: Program Organization	6-88
Figure	3-41	System Log Task Program Organization	6-89
Figure	3-42	Checkpoint/Restart Program Organization	6-90
Figure	3-43	Timing Services Module Flow	6-91
Figure	3-44	Interprocessor Communications (IPC) Module Flow	6-114
Figure	3-45	Interruption Handlers Module Flow	6-115
Figure	3-46	Dispatcher and SCHEDULE Module Flow	6-119
Figure	3-47	Supervisor Routines Module Flow	6-120
Figure	3-48	Supervisor Control Recovery Module Flow	6-122
Figure	3-49	ATTACH, DETACH, and ENQ/RESERVE Module Flow	6-124
Figure	3-50	DEQ, CHAP, WAIT, and POST Module Flow	6-125
Figure	3-51	SPIE, EXTRACT, EXIT, and Exit Prolog Module Flow	6-126
Figure	3-52	STATUS, MODESET, and TESTAUTH Module Flow	6-127
Figure	3-53	LINK, SYNCH, LOAD, Program FETCH/BLDL Interface Module Flow	6-128
Figure	3-54	DELETE, IDENTIFY, XCTL Module Flow	6-129
Figure	3-55	Space Allocation/Deallocation Overview Module Flow	6-130
Figure	3-56	Page Fault Processing Overview Module Flow	6-131

Figure 3-57	Page Services Overview Module Flow	6-132
Figure 3-58	SWAP Overview Module Flow	6-133
Figure 3-58A.	Swap-Out Overview (VS2.03.807)	6-133
Figure 3-58B.	Swap-In Overview (VS2.03.807)	6-133.0
Figure 3-59	VIO Services Overview Module Flow	6-134
Figure 3-60	RSM Module Flow – IEAVSQA	6-135
Figure 3-61	RSM Module Flow – IEAVEQR Initial Region Allocation	6-136
Figure 3-62	RSM Module Flow – IEAVEQR Asynchronous Completion and V=R and V=R Clearing	6-138
Figure 3-63	RSM Module Flow – IEAVEQR Free V=R Region	6-140
Figure 3-64	RSM Module Flow – IEAVRELS FREEMAIN Release	6-141
Figure 3-65	RSM Module Flow – IEAVCSEG,IEAVDSEG	6-143
Figure 3-66	RSM Module Flow – IEAVPIX	6-144
Figure 3-67	RSM Module Flow – IEAVGFA	6-145
Figure 3-68	RSM Module Flow – IEAVPIOP	6-147
Figure 3-69	RSM Module Flow – IEAVIOCP	6-148
Figure 3-70	RSM Module Flow – IEAVPSI	6-150
Figure 3-71	RSM Module Flow – IEAVFXLD and IEAVFXLD Root Exit	6-151
Figure 3-72	RSM Module Flow – IEAVFREE	6-153
Figure 3-73	RSM Module Flow – IEAVOUT, IEAVRELS	6-154
Figure 3-74	RSM Module Flow – IEAVSWIN and IEAVSWIN Root Exit	6-157
Figure 3-74	RSM Module Flow – IEAVSWIN, IEAVSWIN Root Exit, and IEAVSWIN Post Routine (VS2.03.807)	6-157
Figure 3-75	RSM Module Flow – IEAVSOUT	6-160
Figure 3-76	RSM Module Flow – IEAVSOUT Root Exit, IEAVPIOI	6-163
Figure 3-76	RSM Module Flow – IEAVPIOI (VS2.03.807)	6-163
Figure 3-77	RSM Module Flow – IEAVAMSI	6-165
Figure 3-78	RSM Module Flow – IEAVITAS	6-169
Figure 3-79	RSM Module Flow – IEAVDLAS	6-171
Figure 3-80	RSM Module Flow – IEAVTERM	6-173
Figure 3-81	RSM Module Flow – IEAVRFR	6-175
Figure 3-82	RSM Module Flow – IEAVRCF	6-178
Figure 3-83	RSM Module Flow – IEAVRCF Offline Interception and Offline and Offline Completion	6-180
Figure 3-84	RSM Module Flow – IEAVPFTE	6-182
Figure 3-85	RSM Module Flow – IEAVPCB	6-183
Figure 3-86	RSM Module Flow – IEAVINV, IEAVFP, IEAVTRV	6-184
Figure 3-87	VSM Module Flow	6-185
Figure 3-88	RTM1 Module Flow and Basic Functions Performed	6-189
Figure 3-89	RTM2 Module Flow and Basic Functions Performed	6-190
Figure 3-90	Address Space Termination Module Flow	6-192
Figure 3-91	R/TM Services Module Flow	6-193
Figure 3-92	R/TM Dumping Services – Formatted Dump Module Flow	6-196
Figure 3-93	R/TM Dumping Services – Synchronous Unformatted Dump Module Flow	6-198
Figure 3-94	R/TM Dumping Services – Scheduled Unformatted Dump Module Flow	6-199
Figure 3-95	Example of Module Flow Diagrams	6-205
Figure 3-95	I/O Control (VS2.03.807)	6-200
Figure 3-96	ASSIGN LGN - Phase I	6-206
Figure 3-96	I/O Subsystem (VS2.03.807)	6-203
Figure 3-97	ASSIGN LGN - Phase II	6-207,208,209
Figure 3-97	VIO Control (VS2.03.807)	6-205
Figure 3-98	TRANSFER LOGICAL PAGE - Phase I	6-210
Figure 3-98	VIO Group Operators (VS2.03.807)	6-208
Figure 3-99	TRANSFER LOGICAL PAGE - Phase II	6-6-211,212,213,214,215,216
Figure 3-99	Recovery (VS2.03.807)	6-210
Figure 3-100	ASSIGN LOGICAL SEGMENT(s)/RELEASE LOGICAL SEGMENT(s) - Phase I	6-217
Figure 3-100	Service Routines (VS2.03.807)	6-211
Figure 3-101	WRITE MESSAGE TO OPERATOR - Phase I	6-218
Figure 3-102	ASSIGN LOGICAL SEGMENT(s) - Phase II	6-219,220,221
Figure 3-103	RELEASE LOGICAL SEGMENT(s) - Phase II	6-222,223,224
Figure 3-104	SAVE LG - Phase I	6-225
Figure 3-105	RELEASE LOGICAL GROUP - Phase I	6-226
Figure 3-106	RELEASE LOGICAL GROUP - Phase I	6-227
Figure 3-107	ACTIVATE LG - Phase I	6-228
Figure 3-108	ACTIVATE, SAVE, and RELEASE LG - Phase II	6-229,230,231
Figure 3-109	INPUT/OUTPUT - Phase I	6-232
Figure 3-110	INPUT/OUTPUT - Phase I	6-233
Figure 3-111	INPUT/OUTPUT-Phase II	6-234,235,236,239

Figure 3-112	I/O COMPLETE - Phase II	6-238,239
Figure 3-113	I/O MONITOR - Phase II	6-240
Figure 3-114	TASK MODE CONTROLLER (Including WRITE MESSAGE - Phase III)	6-241
Figure 3-115	RELEASE LOGICAL GROUP - Phase III	6-242
Figure 3-116	RELEASE LOGICAL GROUP - Phase III	6-243, 244
Figure 3-117	RELEASE LOGICAL GROUP - Phase III	6-245,246
Figure 3-118	ACTIVATE LG - Phase III	6-247
Figure 3-119	ACTIVATE LG - Phase III	6-248
Figure 3-120	ACTIVATE LG - Phase III	6-249
Figure 3-121	ACTIVATE LG - Phase III	6-250
Figure 3-122	ACTIVATE LG - Phase III	6-251
Figure 3-123	ACTIVATE LG - Phase III	6-252
Figure 3-124	SAVE LG - Phase III	6-253
Figure 3-125	SAVE LG - Phase III	6-254,256
Figure 5-1	Communication Task (without TSO) Control Block Overview	7-272
Figure 5-2	Command Processing Control Block Overview	7-275
Figure 5-3	Region Control Task Control Block Overview	7-278
Figure 5-4	Started Task Control (STC) Control Block Overview	7-279
Figure 5-5	LOGON Scheduling Control Block Overview	7-281
Figure 5-6	System Resources Manager (SRM) Control Block Overview	7-282
Figure 5-6	System Resources Manager (SRM) Control Block Overview (VS2.03.807)	7-282
Figure 5-7	System Activity Measurement Facility (MF/1) Control Block Overview	7-283
Figure 5-8	Subsystem Interface Control Block Overview	7-285
Figure 5-9	Initiator/Terminator Control Block Overview	7-286
Figure 5-10	SWA Create Interface Control Block Overview	7-287
Figure 5-11	Converter/Interpreter Control Block Overview	7-288
Figure 5-12	Typical Output of the Converter/Interpreter	7-289
Figure 5-13	SWA Manager Control Block Overview	7-290
Figure 5-14	Common Allocation Control Block Overview	7-291
Figure 5-15	Volume Mount and Verify (VM&V) Control Block Overview	7-292
Figure 5-16	Batch Unallocation and Common Unallocation Control Block Overview	7-293
Figure 5-17	Dynamic Allocation Control Block Overview	7-294
Figure 5-18	JFCB Housekeeping Control Block Overview	7-295
Figure 5-19	Eligible Devices Table (EDT)	7-296
Figure 5-20	Eligible Device List (EDL)	7-297
Figure 5-21	Algorithm Interface Tables	7-298
Figure 5-22	System Management Facilities (SMF) Control Block Overview	7-299
Figure 5-23	System Log Task Control Block Overview	7-300
Figure 5-24	Checkpoint/Restart Control Block Overview	7-301
Figure 5-25	Timer Supervision Control Block Overview	7-302
Figure 5-26	Supervisor Control Block Overview	7-303
Figure 5-27	Task Management Control Block Overview	7-304
Figure 5-28	Program Management Control Block Overview	7-305
Figure 5-29	Real Storage Management Control Block Overview	7-308
Figure 5-30	Virtual Storage Management Control Block Overview	7-310
Figure 5-31	Recovery/Termination Management Control Block Overview	7-306
Figure 5-32	Auxiliary Storage Management Control Block Overview (VS2.03.807)	7-311.0
Figure 6-1	DIDOCs Locking	7-473
Figure 6-2	LOGON Work Area Bits That Indicate the Currently Executing Module	7-475
Figure 6-3	LOGON Scheduling Post Codes	7-475
Figure 6-4	Locating the ASMVT	7-491
Figure 6-4	Locating an LSID from an LPID (VS2.03.807)	7-478
Figure 6-5	Locating the LGVT Entry	7-492
Figure 6-5	Relating the Virtual Address to the PART and PAT (VS2.03.807)	7-479.0
Figure 6-6	Locating EPATH in SRB Mode	7-493
Figure 6-6	Page/Swap Data Set Error Action Matrix (VS2.03.807)	7-491
Figure 6-7	Locating EPATH in Task Mode	7-494

MVS is a virtual storage operating system with multiprogramming, multiprocessing, time sharing (TSO), and a job entry subsystem. The basic purpose of the system is to improve the use of the system's resources and reliability. The publication *Introduction to OS/VS2 Release 2*, GC28-0661 defines the model support, minimum storage requirements, and minimum configuration for the system.

This publication documents the supervisor and scheduler portions of the system, plus the System Resources Manager, System Activity Measurement Facility, and Auxiliary Storage Manager. For convenience, however, Figure 1-1 shows an

overview of the entire system. As the figure's key notes, items in dotted boxes are not documented in this publication.

Synopsis of Coverage

The following list gives a brief synopsis of the subcomponents this publication documents. The list contains the name of the subcomponent and a brief statement of the subcomponent's function. A fuller explanation of each subcomponent follows later in this Introduction.

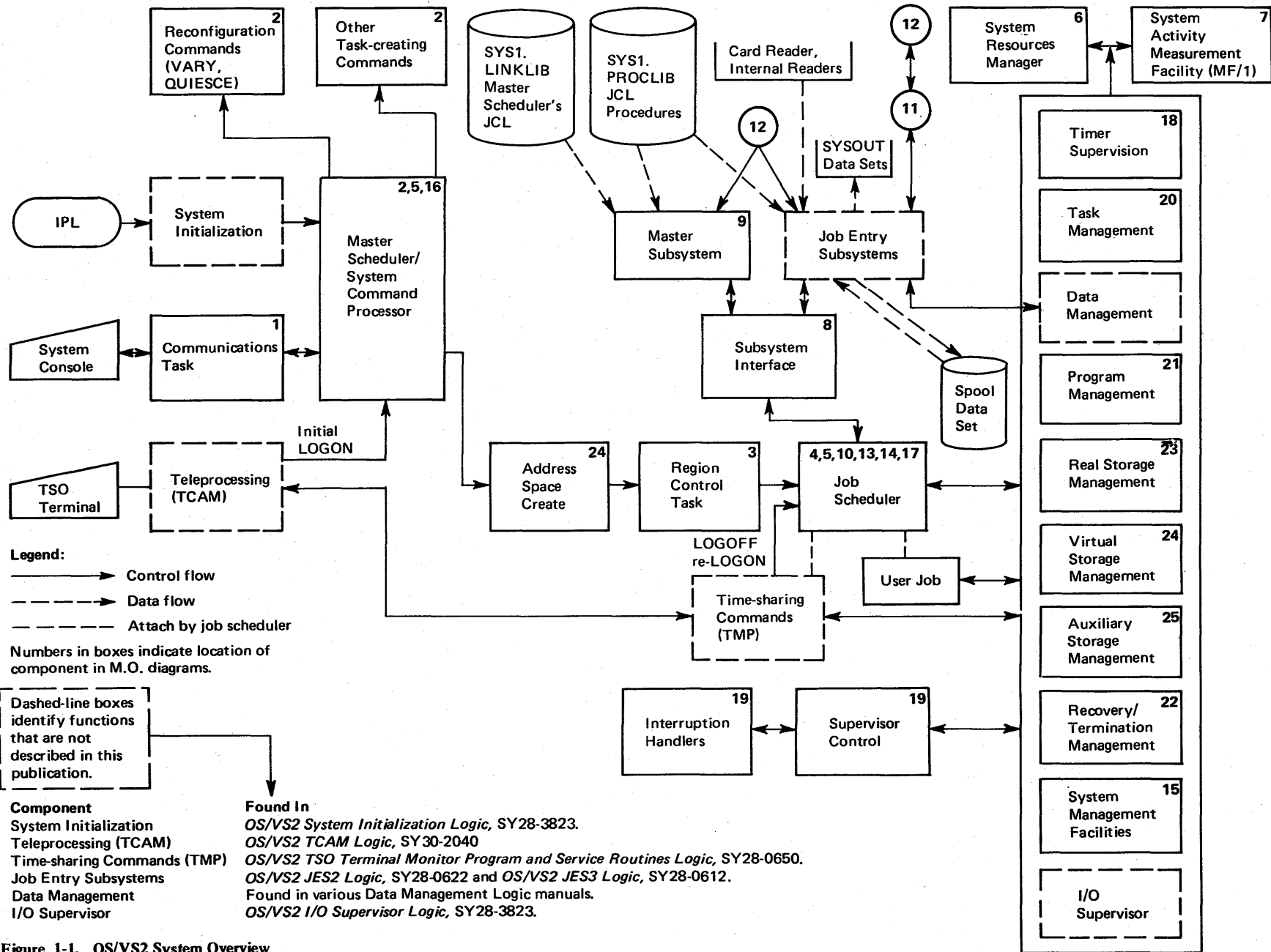


Figure 1-1. OS/VS2 System Overview

COMPONENT	M O Diagram Reference	FUNCTION
Communications Task	1	Controls data transfer between programs and operator consoles.
Command Processor	2	Handles command scheduling and command execution.
Reconfiguration Commands	2	Allows the operator to alter the system configuration by varying the online/offline status of central processor units, channels, device paths, and real storage locations.
Region Control Task (RCT)	3	Attaches other tasks in its address space when RCT is dispatched. For every address space created, one RCT is created and is the only task associated with it.
Started Task Control (STC)	4	Processes jobs begun by START, LOGON, or MOUNT commands.
LOGON Scheduling	5	Verifies the user's authorization against the UADS (user attribute data set) and schedules the user's session.
System Resources Management (SRM)	6	Maintains information about the status of the system, its resources, and its users. It uses information to evaluate the condition and performance of the system, and to decide whether to change the status of the system either to improve system performance or to better some user requirement.
System Activity Measurement Facility (MF/1)	7	Controls the collection, recording, and reporting of system activity measurements.
Subsystem Interface	8	Provides the means used by the control program and data management to communicate with the job entry subsystem and the master subsystem.
Job Scheduler:		Consists of requesting a job from the queue the JES readers build, building control blocks from that job's JCL, and assigning the system resources each job step requires. Job scheduling routines also perform termination processing for jobs and steps.
Master Subsystem	9	
Initiator/Terminator	10	
SWA Create Interface	11	
Converter/Interpreter	12	
SWA Manager	13	
Allocation/Unallocation	14	
System Management		
Facilities (SMF)	15	
System Log	16	
Checkpoint/Restart	17	
Timer Supervisor	18	Provides the means to obtain the date and time of day, measure periods of time, schedule activity, or set the interval timer.
Supervisor Control	19	Includes exit processors, task switching routines, the dispatcher, locking, and inter-processor communications. Supervisor control routines also perform the initial processing of interruptions and pass control to the routines that will handle them. The service manager, using dispatching techniques, is designed to improve system response.
Task Management	20	Creates and deletes subtasks, controls the execution of tasks in one or more address spaces, and provides information services for the requestor.
Program Management	21	Searches for and schedules requested modules, synchronizes exit routines, and brings modules into storage.
Recovery/Termination Management (R/TM)	22	Controls software recovery processing and supplies the system services of normal and abnormal task and address space termination.
Real Storage Management (RSM)	23	Assigns real storage page frames from an available pool when a user must have data in real storage. RSM routines repossess frames when real storage is freed, when a user is terminated or swapped out, or when the pool of available frames is depleted. RSM assigned the appropriate frames for V = R regions.
Virtual Storage Management (VSM)	24	Allocates address spaces and virtual storage within address spaces. The VSM routines record what storage is free and what storage is allocated within every address space in the system.
Address Space Create	24	Creates a new user address space.

Auxiliary Storage
Management (ASM)

25

Supports the dynamic paging requirements of RSM and Virtual Block Processor (VBP). ASM assigns auxiliary storage for all paging, swapping, and temporary data sets (VIO).

An Overview of Each Subcomponent

The following discussion gives an overview of each subcomponent that this publication documents.

Communications Task

The console communications task (comm task) is the system interface to the operator. It provides the I/O device dependent support that reads data from and writes data to the operator consoles.

User/system programs communicate with the operator through WTO (write-to-operator) and WTOR (Write-to-operator with reply) macro instructions. Additional control over messages sent to the operator, especially over messages displayed on a graphics device, is available through the DOM (delete operator messages) macro instruction.

Each WTO, WTOR, and DOM request causes control to be passed to the job entry system responsible for scheduling the job that issued the request. The subsystem is passed a pointer to the WQE (or each WQE in the case of a multi-line WTO), ORE (operator reply element), or DOM control block. The subsystem may delete the WTO or WTOR thus suppressing the printing at any console. Any suppressed message will appear on the hardcopy device if there is one. If the subsystem suppresses a WTOR, it must generate a reply. The subsystem may change the message routing and the message text.

Command Processor

Command processor modules include modules that perform a common function for all commands, and individual command processors (that can consist of more than one module) to handle one or a group of commands.

The common processing modules:

- Establish an ESTAE environment.
- Handle message processing.
- Translate commands.
- Check command authority.
- Route commands to the proper processors.
- Interface with subsystems for command identification.
- Create control blocks.
- Manipulate control block queues.
- Perform recovery functions in the case of failure.

For many commands, these modules store the command in CSCBs (command scheduling control blocks) which are chained together.

Individual command processors handle individual commands based on the command verbs and their specific keywords. In some cases, the processors perform checking and routing services for commands with multiple keywords and operands: an individual processor can pass control to or signal other subcomponents to perform the final processing. In other cases, the processors perform the final processing.

Reconfiguration Commands

System reconfiguration is the process of changing, physically or logically, the type or quantity of units (CPUs, channels, and real storage pages) available to the system. Physical reconfiguration connects or disconnects units from the system. Logical reconfiguration changes system tables to notify the control program of the number and types of units available to it.

Logical reconfiguration can be performed during IPL. It can also be performed as a result of issuing the VARY command, which changes the status of paths, devices, channels, CPUs, or areas of real storage to online or offline. The six reconfiguration commands are QUIESCE, DISPLAY MATRIX, VARY CPU, VARY CHANNEL, VARY PATH, VARY STORAGE; and there are two subroutines, the IEEVDEV device path dependency analysis subroutine, and the stop and restart subroutine.

The QUIESCE command suspends system processing until a system restart is initiated by the operator.

The DISPLAY MATRIX command displays on the system console (optionally) the online/offline status of all CPUs, channels, and devices belonging to the system, and real storage configuration status.

The VARY CPU command takes offline, or brings online, a central processor unit. The CPU's channels and device paths go offline, or come online, along with the CPU.

The VARY CHANNEL command takes offline, or brings online, the specified channel of the indicated CPU. The channel's device paths also go offline or come online.

The VARY PATH command takes offline, or brings online, the specified path to the device through and indicated CPU, channel, and control unit.

The VARY STORAGE command takes offline, or brings online, the specified real storage address locations that can be reconfigured. The device path dependencies analysis subroutine determines for the caller if any operational paths exist to a particular

device and whether a particular CPU or channel is used or necessary to access the device.

The stop and restart subroutine halts system processing by placing in the manual state all central processing units other than the one that is executing the routine. The CPU executing the stop/restart routine is put into the wait state with a wait state reason code. The routine will field a restart interrupt on any CPU and resume processing on all CPUs.

Reconfiguration Commands:

QUIESCE

- | | |
|----------------------------|----------|
| 1) Command Processor | IEEMPS03 |
| 2) Stop and Restart System | IEESTPRS |

DISPLAY MATRIX

- | | |
|----------------------|---------|
| 1) Command Processor | IEEMPDM |
|----------------------|---------|

VARY CPU

- | | |
|--|----------|
| 1) Online/Offline Processor | IEEVCPU |
| 2) CPU Online Wakeup Routine | IEEVWKUP |
| 3) Device Path Dependency Analysis Routine | IEEVDEV |
| 4) CPU Offline Stop Routine | IEEVSTOP |
| 5) Online/Offline Cleanup Processor | IEECLEAN |

VARY CHANNEL

- | | |
|--|----------|
| 1) Online/Offline Command Processor | IEEVCPU |
| 2) Device Path Dependency Analysis Routine | IEEVDEV |
| 3) Test Channel Operative Routine | IEEVTCH |
| 4) Online/Offline Cleanup Processor | IEECLEAN |

VARY PATH

- | | |
|-------------------------------------|---------|
| 1) Online/Offline Command Processor | IEEVPTH |
|-------------------------------------|---------|

VARY STORAGE

- | | |
|---------------------------------------|----------|
| 1) Online/Offline Command Processor | IEEMPVST |
| 2) Validate Real Storage Page Routine | IEEVALST |

Region Control Task (RCT)

The region control task is the highest priority task in an address space; it is swapped out with the user's task. RCTs:

1. Prepare the address space to be swapped out.
2. Prepare the address space for execution after it has been swapped in.
3. Ensure proper scheduling of an attention exit.

When a new address space is created via a START, LOGON, MOUNT command, RCT's initialization routine receives control from the address space creation routine via the dispatcher. When the system resources manager determines that the address space should be swapped out, RCT's common routine is posted, and it, in turn, routes control to Quiesce. Restore processing prepares the address space so that it can once again execute. If an attention exit is requested, the RCT will ensure its proper scheduling. When the initiator, MOUNT command Processor, or time-sharing session ends, the termination routine receives control, performs housekeeping, and then exits so that the address space can be freed.

Started Task Control (STC)

Started task control processes jobs begun by START, LOGON, or MOUNT commands.

It builds internal JCL for the task associated with the command being processed.

The JCL consists of:

- a JOB statement.
- a PROC statement that contains parameters from the START command not recognized as DD parameters.
- a //IEFPROC.IEFRDER DD statement if the DD parameters were coded on the START command or if this is a MOUNT command.

STC then invokes a special function of the master subsystem to determine if JES is the program being started. If it is JES, much of the processing within STC will be skipped. Equivalent function will be performed by the master subsystem when it is called by the initiator to select the job. If the program is not JES, STC then passes the JCL to JES. JES reads the job, scans and spools the JCL, invokes the converter to transform the JCL to internal text, queues the job, and assigns a job identification, which is returned to started task control.

Started task control invokes an initiator to initiate the task. When the job terminates, control returns to the initiator and then to started task control, which deletes its control blocks.

LOGON Scheduling

When a TSO terminal user enters a LOGON command, Started Task Control (STC), eventually gets control. STC passes control to the LOGON Scheduling Task. Once LOGON Initialization is complete, the LOGON Scheduler invokes the LOGON Prompting Task to parse the LOGON command and validate the LOGON data against the User Attribute Dataset (UADS).

After validity checking successfully completes, the LOGON Prompting Task invokes List Broadcast Dataset (LISTBC) while the LOGON Scheduling Task passes control to the Job Scheduling Subroutine (JSS). JSS will pass control to the Pre-TMP Exit, which will terminate the LOGON Prompting Task after LISTBC has finished and then return back to JSS which will then invoke the TMP (terminal monitor program).

When LOGON or LOGOFF is entered by the terminal user, the TMP will terminate. JSS first passes control to the Post-TMP Exit and then eventually JSS will pass control to the LOGON Scheduling Task. The LOGON Scheduling Task invokes the LOGON Prompting Task who will perform the LOGOFF function and parse the command that was entered at the terminal. For a LOGOFF command, the LOGON Prompting Task will terminate and the LOGON Scheduling Task will perform some cleanup and then pass control to STC. If the command was LOGON, this is referred to as a re-LOGON, the LOGON Prompter will start the validation process all over again.

System Resources Manager (SRM)

The System Resources Manager (SRM) is a component in the MVS control program. The SRM has two principle objectives:

- First, to distribute the system's processing resources among individual address spaces in a way that satisfies the installation's response and turnaround time objectives (as specified in SYS1.PARMLIB member IEAIPStxx).
- Second, to optimize the use of the system's CPU, storage and I/O resources by system users (address spaces). This is primarily a system throughput consideration.

SRM receives control whenever a SYSEVENT (system event SVC) is issued. The various types of SYSEVENTs are enumerated in the SRM Method of Operation section.

The SRM's structure consists of five functional groupings:

- The Interface function is the means through which other system components communicate with the SRM, and through which the SRM requests the services of other system components.
- The SYSEVENT Processor analyzes communications to the SRM and translates them into requests for specific SRM services. It also formulates responses as required by the SYSEVENTs.
- The Workload Manager function is designed to accomplish the first SRM objective. It controls the relative rates of system resource usage (service rates) for address spaces, as specified in the IPS (Installation Performance Specification). It exercises this control by influencing the Control function's swapping decisions.
- The Resource Use Algorithms are designed to accomplish the second SRM objective. They consist of I/O, CPU, and Storage Management functions, which monitor the utilization of these resources, and make address space swapping recommendations that will affect their future use, based on system-wide throughput considerations. Also, a monitoring function exists which samples and adjusts the system multiprogramming level (MPL).
- The Control function performs swapping analyses, obtains swap recommendations from other SRM components, and translates these recommendations into specific swapping decisions. It also requests that previously deferred SRM functions be performed when it is possible to do so.

Incorporated in SRM are functions such as:

- The TSO Driver functions available in OS/MVT.
- Automatic Priority Group control.
- Device Allocation for permanent data sets on mountable volumes.
- Page Replacement algorithms.
- Paging rate control.
- Prevention of real page shortages.
- I/O load balancing.

In addition, two previously supported functions are no longer necessary because of SRM. These are:

- Time slicing as a user option.
- Migration to avoid auxiliary page shortages.

The principle tool used by SRM to meet its objectives is address space swapping. The effectiveness of swapping in meeting the goal of maintaining resource utilization within acceptable levels depends largely on the variety of candidates for swap-in available at the time it is determined to swap out a user - on the advice of the Resource Use Routines. Candidates will be available for swap-in if more address spaces are initiated than can simultaneously fit in storage. Only enough additional initiators should be started to keep the CPU and I/O busy, since starting too many can adversely affect turnaround time.

In addition to address space swapping, the SRM uses three other means to achieve its ends:

- Page stealing (disassociating a page from an address space's working set).
- Address space dispatching priority changes (within the APG).
- Device allocation decisions.

The main control block table for SRM is the Resource Manager Control Table (RMCT) which is contained in IRARMCNS and located by a pointer in the CVT (CVTOPCPT). IRARMCNS also contains the following:

- Control tables used by CPU, I/O, Storage, and Resource management routines.
- Constants used by the Control algorithm to determine the criteria and frequency of swap analysis.
- Entry point descriptor tables for various SRM routines, algorithms, and event initiated actions.

Statistics about each address space are found in its associated user control block (OUCB). Other information is found in the SRM user extension block (OUXB) for swapped-in users. (*Note:* a mapping of both the OUCB and the OUXB is found in IRARMCNS). If an address space gets swapped out, some of the data in its OUXB is saved in a SRM user swappable block (OUSB) which is built in LSQA and is swapped out with the address space.

More information about some of the constants in IRARMCNS can be found in the SRM section of *OS/VS2 System Library: Initialization and Tuning Guide*.

System Activity Measurement Facility (MF/1)

MF/1, whose execution is optional, can provide information about the CPU, channels, devices, paging, and workload activity of the system.

MF/1 consists of three functional components:

- Measurement facility control (MFC), which includes initialization, control, and termination.
- System activity report generator (SARG), which includes report writers that format and print reports from the information that the measurement gathering routines of SAMG collect.
- System activity measurement gathering (SAMG), whose routines collect information about system activity for routing to the SMF data set and to the report writers.

Job Scheduler

This discussion is divided as follows:

- Subsystem Interface
- Master Subsystem
- Initiator/Terminator
- SWA Create
- Converter/Interpreter
- SWA Manager
- Allocation/Unallocation
- System Management Facilities (SMF)
- System Log
- Checkpoint/Restart

Subsystem Interface

The subsystem interface is the means for the control program and data management communicate with the job entry subsystem and the master subsystem. A system routine invokes the interface by issuing the IEFSSREQ macro instruction. Interface control blocks pass control and status information via a SSIB SSOB header and a SSOB functional section from the requestor to a subsystem routine. (The control program uses the interface to inform subsystems about requests for processing.)

Master Subsystem

The master subsystem does not process user jobs. It sets up the environment for starting the master scheduler and subsystems. (In these situations, JES is not available, therefore, the master subsystem performs a subset of the JES functions.)

The subsystem initiation process duplicates the services needed to process JCL input to the converter, to provide converter output — in the form of internal text — to an interpreter, and to provide output — in the form of SWA control blocks — to the initiator.

Initiator/Terminator

JES completely controls job selection. JES selects jobs for initiators and tells initiators when to stop. The initiator builds those control blocks necessary to process a job, obtains a region (when required) for a job, interfaces with device allocation and unallocation, attaches each job step or task in succession, and waits for it to complete processing. When the job step/started task completes, the initiator detaches the job step/started task and frees all associated data areas. When a task or all the steps of a job have completed, the initiator deletes the job from the system and frees all job-associated control blocks.

Converter/Interpreter

The converter operates as a JES subroutine. It reads JCL statements (spooled by JES) and cataloged procedures from SYS1.PROCLIB, and converts the JCL statements into internal text. In addition, converter recognizes and processes all commands in the input stream.

The interpreter processes the internal text data set that the converter creates and uses it to create control blocks in the SWA (scheduler work area) for the job.

SWA Manager

Most of the scheduler control blocks reside on a pageable portion of virtual address space called the scheduler work area (SWA). The scheduler components (and others, including data management) access SWA through a set of routines called the SWA manager.

The SWA manager performs the following functions in both move and locate modes as requested by the calling routine:

- Assign
- Read
- Write
- Delete

Whenever a “write” is performed, the SWA manager invokes the portion of Scheduler Restart that performs job journaling. Job journaling decides if it is to perform in this situation.

Allocation/Unallocation

The major functions device allocation performs are:

1. Locating a requested data set's volume and unit information.
2. Resolving relationships between two or more requests.
3. Creating, via data management, new data sets.
4. Assigning I/O devices to the requests.
5. Instructing the operator to mount necessary volumes.
6. Allowing dynamic concatenation and deconcatenation of data sets.

The major functions device unallocation performs are:

1. Directing the processing of a data set's disposition.
2. Releasing data sets, reserved by an initiator, for use by other job steps.
3. Releasing I/O devices for use by other job steps.

System Management Facilities (SMF)

SMF now provides two more exits than it did in MVT: a job purge exit that can be taken when a job is ready to be purged from the system; and an exit that can receive control before a record is written into the SMF data set.

Checkpoint/Restart (Scheduler Restart)

Checkpoint/restart includes two job scheduler functions that allow a failing job to be restarted or terminated. These functions are the job journal and DSDR (data set descriptor record) data set processing. More specifically, an audit trail of control blocks is maintained for each job so that the job's SWA can be reconstructed for any of the following recovery processes:

- Automatic step restart and checkpoint restart.
- Deferred checkpoint/restart.
- System restart.

Timer Supervision

Timer supervision controls the setting and use of the clocks in the system (CPU timer, clock comparator, and the time-of-day clock).

The timing services routines enable the user to:

- Obtain the date and time of day.
- Measure periods of time.
- Schedule activities for specific times of day or time intervals.

The time-of-day clock provides the system with a means of measuring and maintaining real time.

Timer supervision is also responsible for a portion of job step timing. This function involves the detection of job steps that have violated CPU and wait-time limits.

Supervisor Control

Supervisor Control consists of those routines that:

- Perform the initial processing of interruptions and the routing of control to routines that handle them.
- Dispatch tasks or SRBs to the appropriate address space for execution. (Dispatcher-IEAVEDS0)
- Determine the highest priority address space for which work exists and the processor on which it will be dispatched (Memory Switch - IEAVEMS0 and Dispatcher - IEAVEDS0).
- Provide a common mechanism for communicating with another processor in a tightly-coupled multiprocessing environment. (IPC)
- Provide a common mechanism for serializing serially reusable resources between tasks, SRBs, address spaces, and processors (Lock manager - IEAVELK).

The interrupt handlers routines and their functions are:

- SVC interrupt handler that routes control to the requested SVC routine after acquiring any locks required by that routine. The SVC interrupt handler also acts as the extended SVC router for any *extended SVCs*.
- External interrupt handler that receives control on TOD timer and CPU timer interrupts and routes control to the appropriate timer routines. In a multiprocessing environment, Emergency Signal, Malfunction Alerts, and External Call interrupts are handled by the External interrupt handler prior to routing control to the appropriate routines. Control is routed to a Communication Task routine if an interrupt key external interrupt occurs.
- I/O interrupt handler that routes control to the I/O supervisor for I/O interrupts.
- Program Check interrupt handler that processes program checks, page faults, monitor call, and PER type interrupts and routes control to the appropriate routines.

Note: External, I/O, and Program Check interrupt handlers determine if control is to be returned to the interrupted program or the dispatcher, and routes control appropriately.

- Restart interrupt handler that routes control to RTM or returns to the interrupted program.

The dispatcher has four logical levels of dispatching to service the different dispatchable units of work. These levels are:

- A global SRB (service request block) dispatcher
- A local SRB dispatcher
- A local supervisor dispatcher
- A task (TCB) dispatcher

Dispatching proceeds in the other just indicated; global SRBs are dispatched first and tasks running under a TCB are dispatched last. The service manager uses a dispatching technique that allows internal system functions to run enabled, unserialized, and in parallel on an MP system. (**Note:** SRB routines are interruptable but not pre-emptable. That is, they run enabled but control must pass back to the SRB routine after interrupts.)

The dispatcher also effects the transferring of control to a new memory (memory dispatcher) prior to dispatching any SRBs or tasks in that address space. Although Global SRBs are scheduled to run in a specific address space, those services scheduled at a global priority will be executed first without regard to the priority of the address space. Additionally, the dispatcher saves status of any pre-empted work, including accumulating CPU timing for tasks and SRBs.

Two important concepts to keep in mind are the locking services and IPC (interprocessor communications).

The locking services support the MP and global/local supervisor. These services serialize the use of a resource by multiple tasks and CPUs. (One

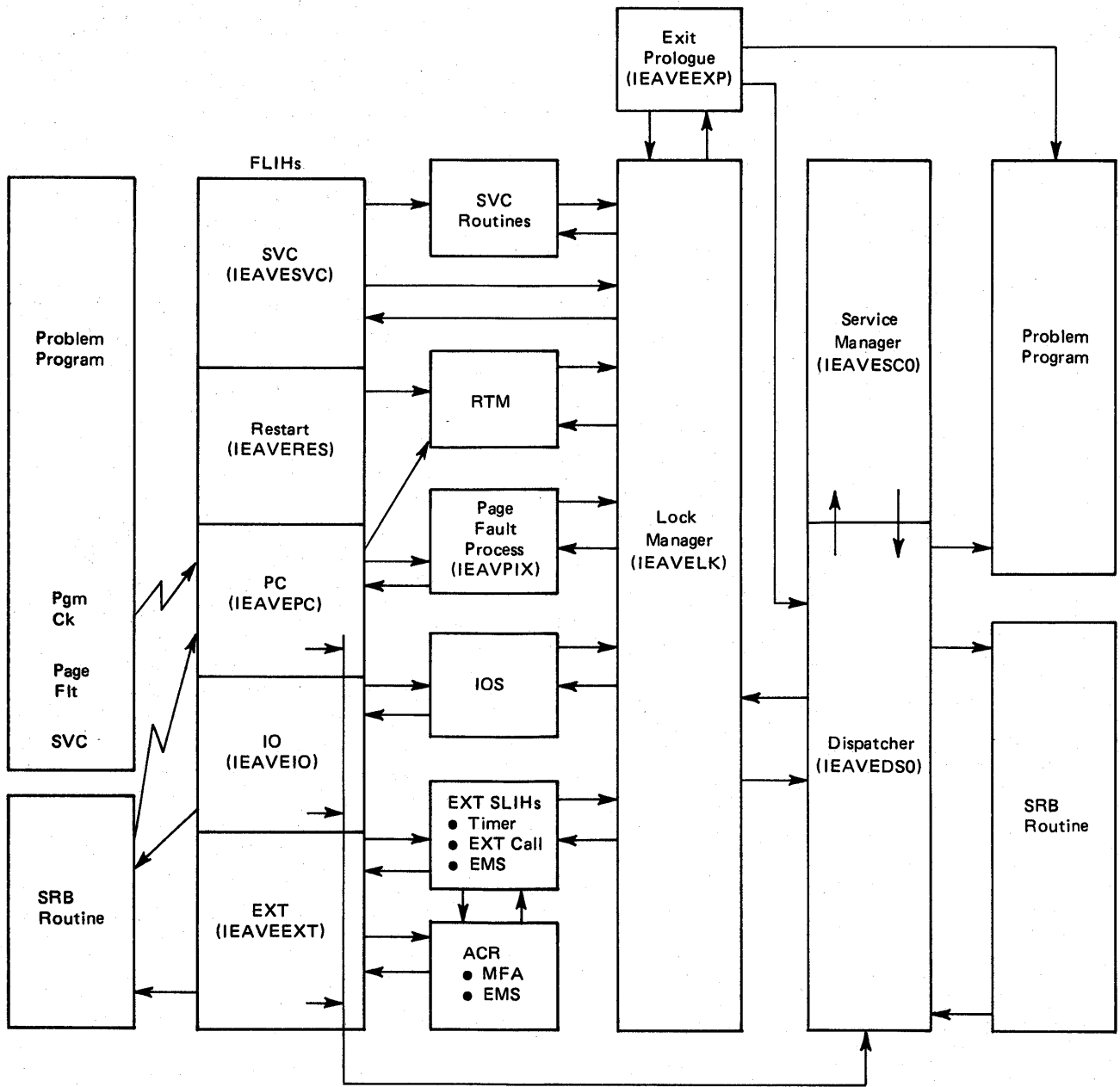
macro instruction, SETLOCK, is provided.) The locking strategy is to have one local lock per address space for functions that use resources local only to one address space and to have a small set of global locks for discrete function that reference multiple address spaces or resources common multiple address spaces. Local lock functions run physically enabled; global locks run disabled. The CMS is an exception; it is an enabled lock. SETLOCK can be used to get any lock by calling IEAVELK. Type 1 SVCs now run enabled under the local lock, allowing I/O interruptions to be processed when received.

To coordinate MP system activities, such as the reading of data from an I/O device connected to only one CPU, the two CPUs must communicate with one another. This interprocessor communication is accomplished through the use of the IPC routines that use the signal processor (SIGP) instruction. Using a SIGP, one CPU can request the status of the other CPU or it can request the other CPU to execute a program. For example, if one CPU has no channel available, it can request the other CPU to initiate an SIO to a particular device. Some but not all SIGP orders appear as external interruptions.

An example of a user of a SIGP order that appears as an External Interrupt is Memory Switch.

New work may be introduced to the system via the SRB being scheduled or a task being made ready by a function executing under the local lock. Whenever the local lock is released or service manager processes the SRB, memory switch may be called to direct the dispatcher to the highest priority work in the system. Memory switch may in turn call the IPC function to SIGP another processor if it is waiting for ready work to dispatch.

Supervisor Control Flow



Task Management

Task management refers to that collection of supervisor services that create and delete subtasks, control the execution of tasks in one or more address spaces, and provide information services to the requester.

There are several new concepts to keep in mind:

1. Each user is associated with an address space and can address only within that address space. An address space is identified by an ASID (address space identifier) and an ASCB (address space control block).
2. A user's control blocks are kept in the user's address space.
3. POST has the cross-memory option. This service allows the posting of an ECB (event control block) in an address space that the user could not otherwise address.
4. Post exit processing results in control being routed to an authorized user routine when an extended ECB is posted.

Program Management

The program manager creates and maintains the control block queues that define the load modules in virtual storage. The program manager loads modules into the system link pack area (LPA) or into the requestor's job pack area (JPA).

The program manager has both common and specialized functions. The common function (LINK, LOAD, XCTL, and DELETE service routines) satisfy macro instruction requests for linkage to a module, or requests to fetch or delete a module. The specialized service routines are for the IDENTIFY and SYNCH macro instructions. Through IDENTIFY, the program manager is informed of an embedded entry point within a module. The SYNCH macro instruction allows the control program to take synchronous exits to a user-written processing program.

The entry point address of each subroutine is contained in the CVT. These routines are used to search for a module in a region's JPA, active LPA, or in the paged LPA directory.

Recovery/Termination Management (R/TM)

The recovery/termination supervisor subcomponents controls software recovery

processing and supplies the system services for normal and abnormal task and address space termination. It also provides recording, SNAP and SDUMP (SVC DUMP) functions.

The recovery objective provides the function and environment to allow recovery processing from abnormal events for control program components, utilities and processors, and all customer applications. Recovery is designed to operate at different levels of control and to satisfy a range of performance objectives. The recovery process is invoked under:

- Program check
- Machine check
- ABEND macro
- CALLRTM macro
- Invalid issuance of an SVC
- I/O error on page-in request
- Restart key

When one of these events occurs, if a recovery exit has been specified, it is invoked causing recovery for the process currently in control. Should that level of control be unable to recover from the incident, should it request termination, or should it fail, the error will be passed (percolated) to the previous level recovery exit. If all recovery routines are unable to recover from the incident, the process is terminated.

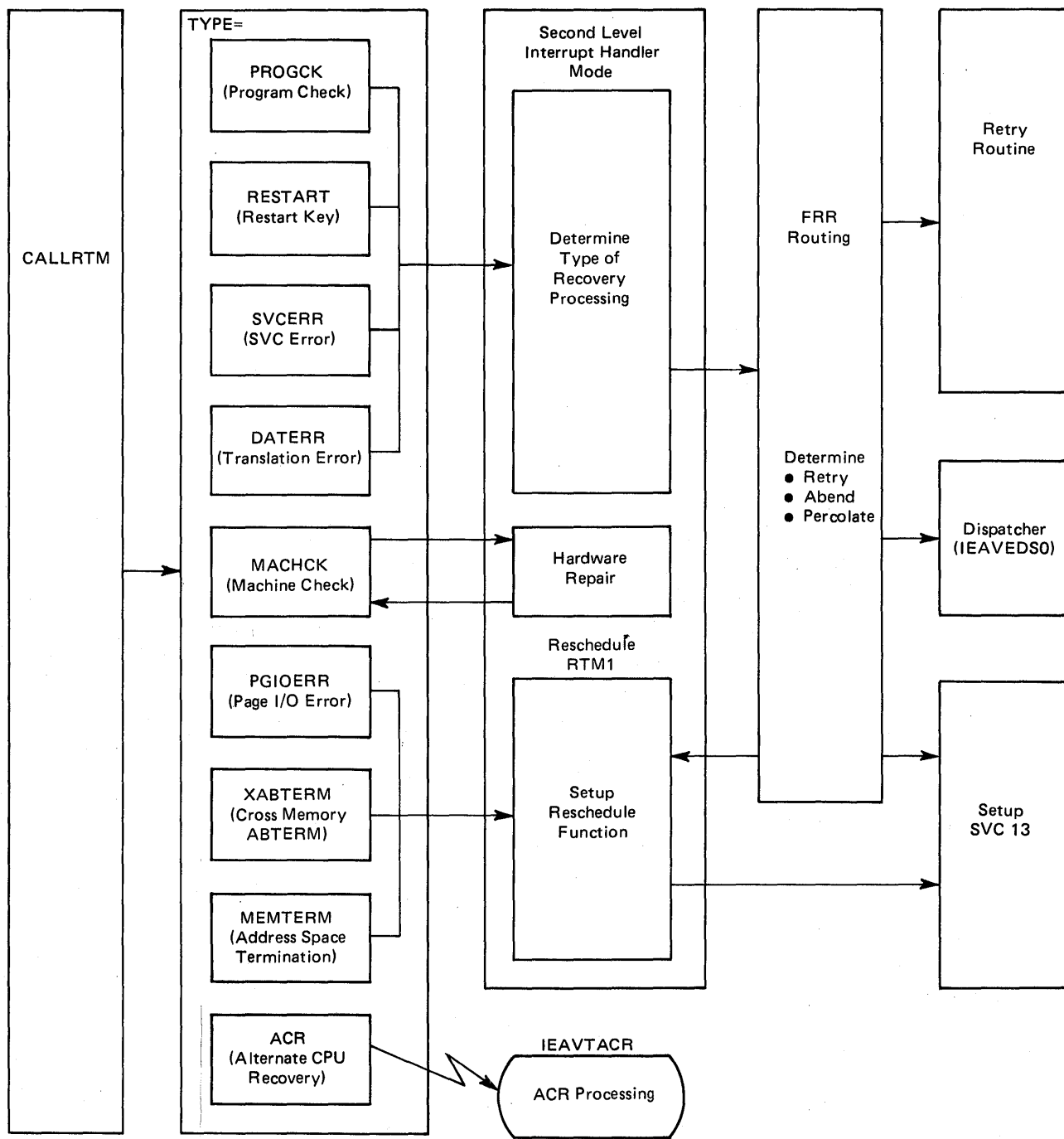
Termination is the process of removing tasks or address spaces from the system and returning allocated resources to an allocatable status. Termination of tasks or address spaces can be either normal or abnormal. Resources are returned to the system by utilizing a resource manager concept.

There are three types of recovery routines:

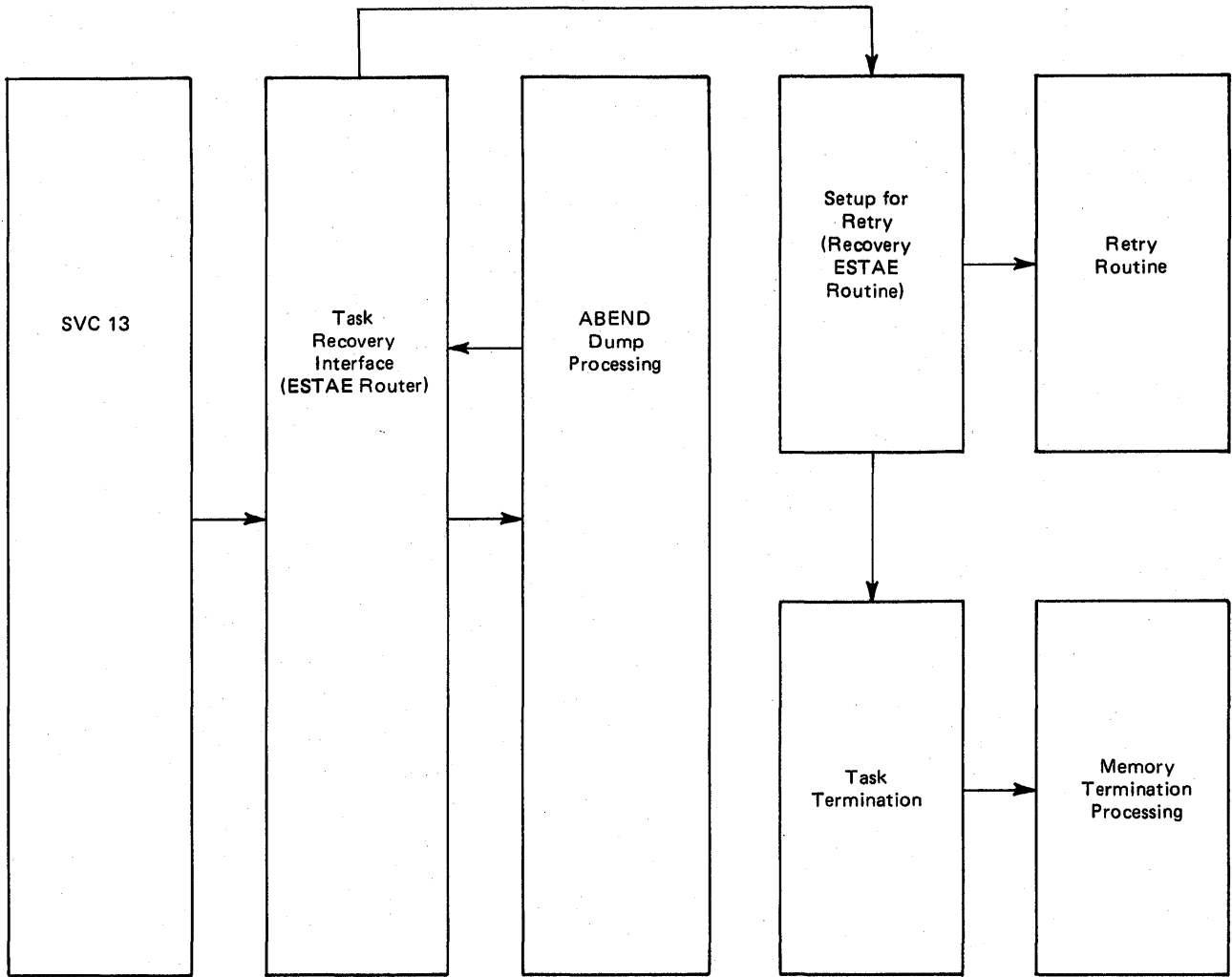
- *Supervisor control program recovery.* These routines handle recovery for critical supervisor routines such as the dispatcher, the lock manager, exit effectors, the first level interrupt handlers.
- *Task recovery routines (STAE/STAI/ESTAE/ESTAI).* Issuing the STAE or ESTAE macro instructions or the ATTACH macro instruction with the STAI or ESTAI parameters allows the user to intercept a scheduled ABEND. Control is given to a user-specified exit routine where the user can diagnose the cause of the ABEND and specify pre-termination processing or specify a retry address if he wants to prevent termination.

- *Functional Recovery Routines (FRRs)*. These are routines established to protect locked, disabled, or SRB mode routines. The SETFRR macro defines an FRR to RTM. Each FRR is placed in a stack in the system, each stack represents a single path through the control program. When a functional recovery routine is invoked, it will run in the state of the system (enabled or disabled) and with the locks that were held at the time of the error or as modified by previous FRRs.

RTM1



RTM2 – Task Mode Processing



Real Storage Management (RSM)

The real storage manager administers the use of a real storage and directs the movement of virtual pages between auxiliary storage and real storage in page size (4096 bytes) blocks. RSM employs the auxiliary storage manager (ASM) to perform the actual paging I/O necessary to transfer pages in and out of real storage.

RSM assigns real storage page frames on request, from a pool of available frames, associating virtual addresses with real storage addresses. Frames are reprocessed upon termination of use, when freed by a user, when a user is swapped out, and when needed to replenish the available pool. A page in real storage is considered pageable unless specified otherwise through the PGFIX function or unless the page is used as a system page that must be resident in real storage. RSM also allocates the appropriate frames for V=R regions.

RSM determines the working set size for the SWAP function and maintains the necessary information to remove the virtual pages of an address space from real storage on swap-out and to reestablish those pages on swap-in. ASM provides the real I/O for this operation.

Virtual Storage Management (VSM)

Virtual storage management keeps track of free and allocated storage for both the system and the user. In addition, VSM performs initialization and clean-up functions for the resources it manages. The system interfaces are CREATE/FREE ADDRESS SPACE to initialize and free address spaces; GET/FREE PART to obtain and free regions; CHANGKEY to alter the protection key of virtual storage; VSM initialization to set up storage at IPL time; and VSM task termination to clean up virtual storage at end of task. Non-region storage is provided for in the system queue area (SQA), common service area (CSA), local SQA (LSQA), and the scheduler work area (SWA). Only system functions request non-region storage, but it can be assigned in behalf of either the system or a specific user. Generally, space assigned in the user's behalf resides in LSQA or SWA, and space assigned for the system resides in SQA. Virtual storage management controls the allocation of storage in each area as directed by requesting GETMAIN and FREEMAIN macro instructions.

VS2 uses the subpool interface to indicate the area (CSA, SQA, SWA, LSQA, or region) for which the virtual storage management service is requested.

All functions except GETMAIN or FREEMAIN for SQA and CSA, and GETPART or FREEPART for V=R regions are processed independently and in parallel by addressing space; that is, a GETMAIN can be in progress in more than one address space at a time.

Address Space Create

This subcomponent consists of command processing routines, address space creation and deletion routines, and the system task control routines.

When a new address space is required, a command processing routine invokes the address space creation routine, who notifies the system resources manager (SRM). Based on factors such as priorities and the number of address spaces already existing, SRM decides whether a new address space is desirable. If not, the address space is not created until SRM finds (or makes) conditions suitable. If a new address space is acceptable, the address space creation routine invokes virtual storage management (VSM) to assign the storage. The address space creation routine builds an LSQA (local system queue area) in the address space. The LSQA will contain the page tables and control blocks needed to operate the region control task (RCT) of this address space.

After the address space is dispatched, the RCT attaches an STC (started task control) task. STC, in turn, attaches the task that processes the command specified; for example, for a LOGON command, this is the LOGON Scheduler, and for a MOUNT command, the MOUNT processor.

Storage Protection

Storage protection is a feature that prevents unauthorized access to virtual storage by all except the intended users. The VS2 system uses the 16 standard protection keys allowed by the PSW format and the hardware. A key-0 program has access to all allocated areas of virtual storage. A non-key-0 program has read-only access to the shared areas of the system (for example, the nucleus, the SQA, and the LSQA) and full access to storage in its own address space.

In Release 1, all pageable system programs were key-0. For MVS, protection keys 0-7 are reserved for system programs (leaving keys 8-15 for user programs). The job scheduler and certain logical parts of data management are assigned non-zero protection keys to isolate and protect them from other system functions and from user programs.

The storage protection key assignments for system programs are as follows:

key 1	-	job scheduler (including JES2/JES3)
keys 2-4	-	reserved
key 5	-	data management (including IOS, auxiliary storage management, block processor, and OPEN/CLOSE/End-of-Volume)
key 6	-	TCAM and VSAM
key 7	-	reserved

Note: Where possible, the control blocks and work areas for a non-key-0 system program have a protection key that matches that of the program.

When system functions require that a non-key-0 program modify key-0 data or that this program branch to key-0 programs, the MODESET macro instruction is used to change the non-key-0 program to key-0. All read-only programs reside in key-0 storage, although some of these programs execute with a non-zero key. Any non-refreshable code residing in the MLPA alters its key to zero before modifying itself.

All user programs occupying virtual=virtual (V=V) storage are assigned a storage protection key of 8. V=V user programs, each occupying a different address space, are totally isolated from each other. An address space has access to only its own segment and page tables for translating virtual address to real. Therefore, a user program cannot reference the virtual pages allocated to another user's address space.

User programs occupying virtual=real (V=R) storage (that is, storage where real addresses are the same as virtual addresses) are not protected by the address translation feature and must have unique protection keys. Keys 9-15 are available to these V=R users.

Auxiliary Storage Management (ASM)

Auxiliary Storage Management (ASM) controls all system direct access storage that is set aside for virtual memory paging and for temporary data sets. In MVS, ASM supports the dynamic paging requirements of Real Storage Management (RSM) and the data set storage and retrieval requirements of the Virtual Block Processor (VBP). ASM permits the addressing of storage that is external to memory in a manner that is independent of the physical location of the storage. It does this by a set of device-independent functions on auxiliary storage that separate the management of ASM's physical storage from the management of the data that may be placed into that storage by other

components. ASM is the sole interface in MVS for paging I/O.

In addition to its logical I/O abilities, ASM's device-independent interface allows a variety of space-management operations to take place in a way that is transparent to data considerations and the user of the host system. For the collection of auxiliary storage under its control, ASM provides dynamic, centralized allocation of space. ASM does this by: (1) using the fastest storage to keep track of allocated space rather than spreading out allocation information among slower auxiliary storage and (2) allocating auxiliary storage only as and when it is actually needed for data, thus making the most efficient use of its storage.

ASM divides its storage into slots, and a slot or more than one slot contains logical groups (LG). Each logical group has its own identification, the logical group number (LGN). A logical group can be written twice to physically separate slots (duplexed) or written only once to however many slots it takes to contain the logical group (simplexed). The logical groups are further subdivided into logical pages (LP) and each logical page has its own identification (LPID). A set of 16 contiguous logical pages is a logical segment.

For its initialization and operation, ASM depends on the services of NIP and VSAM.

ASM Definitions and Formats

The following definitions and formats are used by ASM.

External Storage

The auxiliary storage managed by ASM is a system pool of storage that is external to virtual and real memory. In MVS, this pool consists entirely and exclusively of direct access space that is made up of VSAM data sets. ASM storage is defined by VSAM and the VSAM catalog keeps track of the storage, but ASM doesn't care what makes up the content of the direct access space.

Permanent Storage Locator Symbol (S)

Because the LGN value is only associated with a logical group while that logical group is known to ASM to be in use or active, the LGN's association with a particular logical group is temporary. When a logical group is saved, the saved version becomes permanent and must be identifiable from the active version which still exists until it is released or the job or system fails. This saved version must have an identifier that is separate from the LGN of the active version. The identifier for the saved version

Real Storage Management (RSM)

The real storage manager administers the use of a real storage and directs the movement of virtual pages between auxiliary storage and real storage in page size (4096 bytes) blocks. RSM employs the auxiliary storage manager (ASM) to perform the actual paging I/O necessary to transfer pages in and out of real storage.

RSM assigns real storage page frames on request, from a pool of available frames, associating virtual addresses with real storage addresses. Frames are repossessed upon termination of use, when freed by a user, when a user is swapped out, and when needed to replenish the available pool. A page in real storage is considered pageable unless specified otherwise through the PGFIX function or unless the page is used as a system page that must be resident in real storage. RSM also allocates the appropriate frames for V=R regions.

RSM determines the working set size for the SWAP function and maintains the necessary information to remove the virtual pages of an address space from real storage on swap-out and to reestablish those pages on swap-in. ASM provides the real I/O for this operation.

Virtual Storage Management (VSM)

Virtual storage management keeps track of free and allocated storage for both the system and the user. In addition, VSM performs initialization and clean-up functions for the resources it manages. The system interfaces are CREATE/FREE ADDRESS SPACE to initialize and free address spaces; GET/FREE PART to obtain and free regions; VSM initialization to set up storage at IPL time; and VSM task termination to clean up virtual storage at end of task. Non-region storage is provided for in the system queue area (SQA), common service area (CSA), local SQA (LSQA), and the scheduler work area (SWA). Only system functions request non-region storage, but it can be assigned in behalf of either the system or a specific user. Generally, space assigned in the user's behalf resides in LSQA or SWA, and space assigned for the system resides in SQA. Virtual storage management controls the allocation of storage in each area as directed by requesting GETMAIN and FREEMAIN macro instructions.

VS2 uses the subpool interface to indicate the area (CSA, SQA, SWA, LSQA, or region) for which the virtual storage management service is requested.

All functions except GETMAIN or FREEMAIN for SQA and CSA, and GETPART or FREEPART for V=R regions are processed independently and in parallel by addressing space; that is, a GETMAIN can be in progress in more than one address space at a time.

Address Space Create

This subcomponent consists of command processing routines, address space creation and deletion routines, and the system task control routines.

When a new address space is required, a command processing routine invokes the address space creation routine, who notifies the system resources manager (SRM). Based on factors such as priorities and the number of address spaces already existing, SRM decides whether a new address space is desirable. If not, the address space is not created until SRM finds (or makes) conditions suitable. If a new address space is acceptable, the address space creation routine invokes virtual storage management (VSM) to assign the storage. The address space creation routine builds an LSQA (local system queue area) in the address space. The LSQA will contain the page tables and control blocks needed to operate the region control task (RCT) of this address space.

After the address space is dispatched, the RCT attaches an STC (started task control) task. STC, in turn, attaches the task that processes the command specified; for example, for a LOGON command, this is the LOGON Scheduler, and for a MOUNT command, the MOUNT processor.

Storage Protection

Storage protection is a feature that prevents unauthorized access to virtual storage by all except the intended users. The VS2 system uses the 16 standard protection keys allowed by the PSW format and the hardware. A key-0 program has access to all allocated areas of virtual storage. A non-key-0 program has read-only access to the shared areas of the system (for example, the nucleus, the SQA, and the LSQA) and full access to storage in its own address space.

In Release 1, all pageable system programs were key-0. For MVS, protection keys 0-7 are reserved for system programs (leaving keys 8-15 for user programs). The job scheduler and certain logical parts of data management are assigned non-zero protection keys to isolate and protect them from other system functions and from user programs.

The storage protection key assignments for system programs are as follows:

key 1	- job scheduler (including JES2/JES3)
keys 2-4	- reserved
key 5	- data management (including IOS, auxiliary storage management, block processor, and OPEN/CLOSE/End-of-Volume)
key 6	- TCAM and VSAM
key 7	- reserved

Note: Where possible, the control blocks and work areas for a non-key-0 system program have a protection key that matches that of the program.

When system functions require that a non-key-0 program modify key-0 data or that this program branch to key-0 programs, the MODESET macro instruction is used to change the non-key-0 program to key-0. All read-only programs reside in key-0 storage, although some of these programs execute with a non-zero key. Any non-refreshable code residing in the MLPA alters its key to zero before modifying itself.

All user programs occupying virtual=virtual (V=V) storage are assigned a storage protection key of 8. V=V user programs, each occupying a different address space, are totally isolated from each other. An address space has access to only its own segment and page tables for translating virtual address to real. Therefore, a user program cannot reference the virtual pages allocated to another user's address space.

User programs occupying virtual=real (V=R) storage (that is, storage where real addresses are the same as virtual addresses) are not protected by the address translation feature and must have unique protection keys. Keys 9-15 are available to these V=R users.

Auxiliary Storage Management (ASM)

ASM (Auxiliary Storage Management) keeps track of the auxiliary storage locations of all virtual pages, controls the paging and swapping of virtual pages between real and auxiliary storage, and maintains the necessary copies of VIO data set pages.

There are two callers of ASM: RSM (Real Storage Management) and VBP (Virtual Block Processor). RSM calls ASM to initiate paging and swapping requests; VBP calls ASM to request updates to the information about VIO data sets. The new operator command PAGEADD enables an installation to dynamically add page or swap data sets to the system without having to do another IPL. PAGEADD initializes control blocks so that the new page or swap data set is available to ASM for processing. Figure 1-2 illustrates who communicates with ASM.

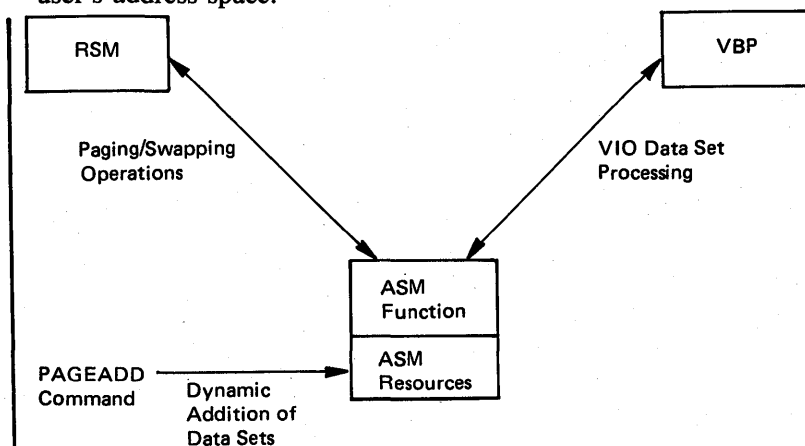


Figure 1-2. ASM Communications

ASM Functions

ASM processing is divided into four major functional sections: I/O Control, I/O Subsystem, VIO Control, and the VIO Group Operators. ASM also includes three other sections: Page Expansion, Recovery, and Service Routines.

I/O Control

I/O Control is the communication link between RSM and the I/O Subsystem for paging requests and between RSM and IOS (I/O Supervisor) for swapping requests. RSM initiates all paging and swapping I/O; the I/O Subsystem and IOS execute this I/O. I/O Control accepts the paging/swapping requests from RSM, determines the type of I/O to

be done and when it can be started, and notifies RSM when the I/O is complete. I/O Control also records the auxiliary storage locations of all virtual pages.

I/O Subsystem

I/O Subsystem communicates with IOS to cause the physical transfer of data between real and auxiliary storage. It allocates auxiliary storage slots, builds paging channel programs, passes them to IOS for execution, processes I/O completion, and manages the page data sets.

VIO Control

VIO Control coordinates all the ASM processing required to support VIO data sets (called logical groups by ASM). Operations on a logical group are

classified as group operations and page operations. VBP initiates group-related operations, and VIO Control passes them to the VIO Group Operators to be processed. RSM initiates page-related operations and I/O Control and VIO Control jointly process them.

VIO Group Operators

The VIO Group Operators maintain the logical group information VBP requires. The VIO Group Operators perform all processing necessary to create, save, restore, and delete a logical group. These operators are invoked only by VIO Control as the result of requests from VBP.

Figure 1-3 illustrates the major functional sections of ASM processing.

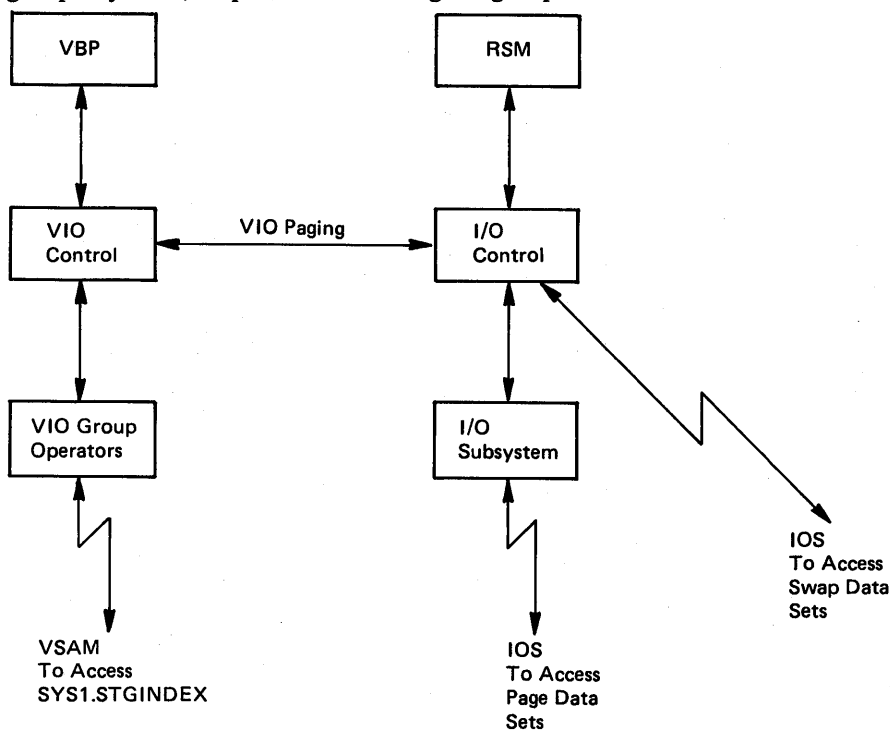


Figure 1-3. Overview of ASM Processing

Recovery

Recovery provides the mechanism to handle any errors that occur during normal ASM processing. Recovery classifies errors into two groups: errors detected during mainline processing, called determinate errors; and errors detected by recovery itself, called indeterminate errors. A determinate error does not prevent continuation of ASM processing. It is recorded in SYS1.LOGREC and processing is resumed. For indeterminate errors, recovery assesses the severity of the error in terms

of how much damage it could do to ASM control blocks, to the code, and to the process in progress, and then takes appropriate action. Possible recovery actions include recording the error with module id and ASM status information, clean-up of ASM resources where possible, conversion of the error to a failure indication such as a return code to the caller of ASM, and termination of a task or address space if necessary.

Page Expansion

Page Expansion gives the user the ability to add page or swap data sets to the system without having to do another IPL. This function is available to the installation through the PAGEADD operator command. This command causes the specified page or swap data sets to be opened and the control blocks necessary for ASM processing to be initialized.

Service Routines

Service Routines include: an ASM control block formatting facility, which is invoked by the system dump-printing facility; an address space termination resource manager, whose main function is to reclaim auxiliary storage resources from an address space that is terminating; and a pool extender routine for adding storage to a virtual storage pool.

ASM Serialization

For a description of the serialization of ASM processing, see the Diagnostic Aids section in Volume 7.

ASM Control Blocks

Following is a description of some of the most important ASM control blocks.

ASMVT — Auxiliary Storage Management Vector Table

The ASMVT is ASM's extension to the CVT. It contains all global flags, slot counts, and save areas used by ASM routines. It also contains addresses of the main control blocks (PART, SART, LGVT), the cell pools, the message buffers, and the error record.

PART — Page Activity Reference Table

The PART contains information relating to the page data sets in use. It is managed and used mainly by the I/O Subsystem. The PART consists of a header and an entry (PARTE) for each page data set. The header contains the write request queue. It also contains the addresses of two circular queues of PARTEs, one for page data sets on moveable-head devices and one for page data sets on fixed-head devices. Each PARTE contains flags, a read queue, the address of the appropriate write queue, and addresses of control blocks (including the PAT) related to that page data set.

PAT — Page Allocation Table

The PAT describes the 4096-byte slots on the page data set with which it is associated. The PAT is built when a page data set is opened. It contains a

header followed by cylinder maps of the entire data set.

SART — Swap Activity Reference Table

The SART contains information relating to the swap data sets in use. It is used by the swap routines of I/O Control. The SART consists of a header section and entry (SARTE) for each swap data set. The header contains the addresses of two circular queues of SARTEs, one for swap data sets on fixed-head devices and one for swap data sets on movable-head devices. The SARTE contains flags and addresses of control blocks associated with that swap data set.

SAT — Swap Allocation Table

The SAT describes the swap sets (which are multiples of 4096-byte slots) on the swap data set with which it is associated. It contains a header followed by cylinder maps of the entire data set.

IORB — I/O Request Block

The IORB is the control block used by ASM to track I/O requests. It contains the addresses of other control blocks (IOSB, SRB), the address of an 18-word save area for use by IOS, and flags. When a page or swap data set is opened, the IORB is built and chained from the PARTE or SARTE associated with the data set.

LGVT — Logical Group Vector Table

The LGVT is a table of addresses to in-use LGEs (Logical Group Elements). It contains a header and entries (LGVTEs). The header contains the LGVT size and the address of the first available LGVTE. An in-use LGVTE contains the address of the LGE for that logical group and the address space owning the logical group.

ASMHD — Auxiliary Storage Management Header

The ASMHD is address-space related. It is built in SQA immediately following the RSMHD (RSM header). ASMHD is used by I/O Control to manage paging and swapping I/O, and VIO data set operations for each private address space. It contains flags, counts, swap queues, and the queue of LGEs for this address space.

LGE — Logical Group Element

The LGE is the focal point for controlling all operations on a logical group. VIO Control is the principal user of this control block. An LGE is built for each logical group created for VIO. It contains a process queue, flags, counts, and the address of the associated ASPCT.

ASPCT — Auxiliary Storage Page Correspondence Table

The ASPCT is used to record the auxiliary storage locations (called LSIDs, Logical Slot Identifiers) of VIO data set pages. One ASPCT is created for each

logical group assigned by ASM. The ASPCT address is maintained in the LGE for the logical group.

Figure 1-4 on the next page depicts an overview of ASM control blocks.

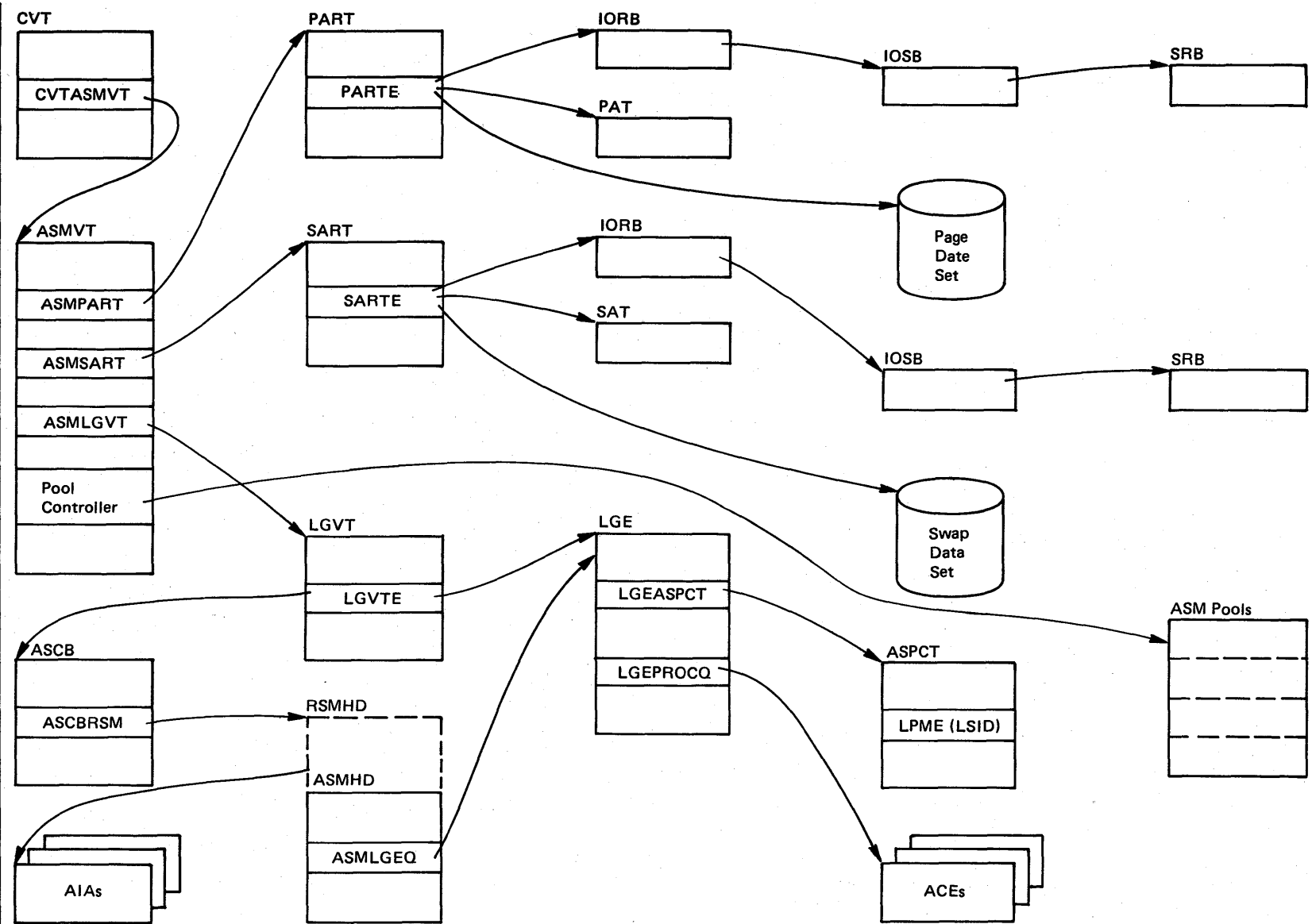


Figure 1-4. Auxiliary Storage/Management Control Block Overview

ASM Data Sets

ASM has three types of direct access data sets that are required for maximum function and performance. These types are: page data sets, swap data sets, and SYS1.STGINDEX (ASM's VIO journaling data set).

Page Data Sets

Page data sets are single VSAM data sets that make up the page space portion of auxiliary storage. They are defined, formatted, and cataloged as VSAM PAGESPACES. (Further discussion of page data set definition can be found in the *OS/VS2 MVS System Programming Library: System Generation Reference*. A discussion of how to determine the size of page data sets can be found in the *OS/VS2 Initialization and Tuning Guide*.) ASM uses this page space to store the contents of pageable virtual pages and VIO data set pages. Each data set is formatted in 4096-byte records called slots. A slot is allocated dynamically by ASM whenever a page must be moved out of real storage.

ASM has four page data set classifications, based on data set content and use. The four types of page data sets are:

- PLPA (Pageable Link Pack Area) Page Data Set.
- Common Page Data Set.
- Duplex Page Data Set (optional).
- Local Page Data Sets.

There is only one PLPA data set, one Common data set, and, if specified, one Duplex data set. One page data set of each type (except the Duplex data set) must be supplied to ASM at IPL. All page data sets are named by the installation. A maximum of 64 page data sets is allowed.

PLPA, Common, and Duplex Page Data Sets The PLPA page data set contains the pageable LPA pages of the system, the TPARTBLE, and the Quick Start Record (QSR). This page data set is filled during a cold start IPL and becomes effectively a read-only data set once PLPA has been built, the only exception being overflow from the Common page data set described later in this section.

The Common page data set provides space for the non-PLPA virtual pages in the system common area.

The Duplex page data set is an optional data set supplied by the user when a secondary copy of the common area is desired.

ASM provides for overflow from the PLPA data set to the Common data set if the PLPA data set

becomes full during IPL. If the Common data set should ever become full and PLPA is not full, it will overflow to the PLPA data set. If both data sets should become full, ASM will not overflow to Local data sets. If duplexing is active, system operation continues as long as the Duplex data set is operational. If duplexing is not active or if the Duplex data set is not operational, system operation is terminated. (For more information, see the Error Action Matrix in Diagnostics Aids in Volume 7.)

Local Page Data Sets The Local page data sets provide space for each private address space's unique pages, VIO data sets, and LSQA pages if there are no Swap data sets available.

To ensure that there are enough pages for the current system workload, ASM reserves a number of slots on the Local page data sets for each address space and each VIO data set as they are created. This "reserve" is not an actual allocation of slots, but an anticipation of the number of auxiliary slots an address space or VIO data set will require at some future time. This is done to prevent the system from becoming overloaded. When there are no more page data set slots available to be reserved the system will not allow new address spaces or new VIO data sets to be created.

In order to monitor page data set slot usage, ASM maintains a series of slot counts for its own use and for use by SRM (System Resources Manager) and MF/1 (Measurement Facility 1). For each data set, ASM maintains in its related PART a count of slots available for allocation (PARESLTA) and a count of the bad slots (PARERRCT). Additionally, the following system-wide counts are maintained in the ASMT:

ASMSLOTS	—	The total number of slots in all open Local page data sets.
ASMERRS	—	The total number of bad slots detected by ASM on Local page data sets.
ASMVSC	—	The total number of slots allocated to VIO data set pages that are paged out to Local page data sets.
ASMNVSC	—	The total number of slots allocated to private area (non-VIO) pages that are paged out to Local page data sets.

The following two counts are subsets of the above global counts. They are maintained on an address space basis in each ASCB.

ASCBVSC	—	The total number of slots allocated to VIO data set pages for each address space.
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ASCBNVSC — The total number of slots allocated to private area (non-VIO) pages for each address space.

Swap Data Sets

Swap data sets are single VSAM data sets that make up the swap space portion of auxiliary storage. They are defined, formatted, and cataloged as VSAM PAGESPACES. (Further discussion of swap data set definition can be found in the *OS/VS2 MVS System Programming Library: System Generation Reference*. A discussion of how to determine the size of swap data sets can be found in the *OS/VS2 Initialization and Tuning Guide*.) The swap data sets are formatted in 4096-byte slots, but ASM utilizes them in groups of 12 slots. These groups are referred to as swap sets.

Swap space is used by ASM to store and retrieve the set of LSQA pages belonging to an address space. LSQA pages are critical to an address space since they must be in real storage before any other processing can occur. The swap data sets are designed to process these pages quickly. Thus they are written and read in groups (swap sets) instead of as individual pages.

Swap data sets are optional. If none are supplied swapping is done to Local page data sets, which may degrade swap performance. A maximum of 25 swap data sets is allowed.

SYS1.STGINDEX

The SYS1.STGINDEX data set is a key-sequenced VSAM data set used to store information (ASPCTs) for journaled VIO data sets. It is made up of fixed length control intervals (in the data portion), each containing one keyed record. The key consists of 12 bytes, the first eight of which are assigned by ASM for each ASPCT. The next four bytes of the key are used if ASPCT extensions have been

created and must be written to SYS1.STGINDEX. ASM assigns keys in such a fashion as to take advantage of VSAM techniques for reclaiming space freed by deleted records.

ASM Initialization makes use of the REUSE option of VSAM to clear SYS1.STGINDEX when the IPL type is other than warm start. SYS1.STGINDEX must be defined and cataloged before an IPL is performed. However, if ASM initialization is unable to open the data set, system initialization is not cancelled. A message is written to the console informing the installation that SYS1.STGINDEX is not operational. VIO journaling-related request will be rejected. If a warm start is in progress, ASM informs the operator of any problem and does not continue processing in quick start (CVIO) mode until so directed by the operator. In taking these actions, ASM's objective is to allow the system to become operational in order that the installation may diagnose and correct the problem with the data set before doing another IPL.

Data Set Usage

Each page and swap data set must be defined and cataloged on a direct access storage device (DASD) before being supplied to ASM via the PAGE and SWAP system parameters. It is recommended that page and swap data sets be allocated from clean DASD volumes or a volume containing the necessary amount of contiguous free space. All page and swap data sets opened by ASM Initialization remain open for the life of the IPL. They may not be closed or varied off-line. Additional page and/or swap data sets can be added to the system via the PAGEADD console command without having to re-IPL the system.

Abbreviation List

- ABDA (ABDUMP work area)
ABDPL (ABDUMP parameter list)
ABDUMP (snap dump)
ABDUMP parameter list (ABDPL)
ABDUMP work area (ABDA)
ABEND (abnormal end)
ABP (actual block processor)
ACA (auxiliary storage management control area)
ACB (access method control block)
ACE (auxiliary storage management control element)
ACR (alternate CPU recovery)
ACT (account tables)
ACR (alternate CPU recovery)
AFC (available frame count)
AFM (allocation function map)
AFMP (allocation function map)
AFQ (available frame queue)
AIA (auxiliary storage management I/O request area)
AIE (auxiliary storage management I/O control element)
ALCWA (allocation work area)
AMB (access method block)
AMBL (access method block list)
AMWA (access method work area)
APF (authorized program facility)
APG (automatic priority group)
AQE (allocated queue element)
AQMRB (allocation queue manager request block)
ASCB (address space control block)
ASID (address space identifier)
ASM (auxiliary storage manager)
ASMI (auxiliary storage management interface routine)
ASMM (auxiliary storage management monitor routine)
ASMRL (auxiliary storage management request list – main work queue)
ASMTV (auxiliary storage management vector table)
ASPCT (address space page correspondence table)
ASVT (address space vector table)
ASWA (allocation ESTAE work area)
ASXB (address space extension block)
ATB (attention table entries)
ATCOM (allocation/termination communications area)
- BASEA (master scheduler resident data area)
BCMSG (SYS1.BROADCAST data set)
BRKELEM (break element)
BUFC (buffer control block for VSAM)
- CAT (channel availability table)
cathode ray tube (CRT)
CCA (configuration control array)
CCH (channel check handler)
CCT (CPU control table)
CCW (channel command word)
CDE (contents directory entry)
CIB (command input buffer)
CIWA (common internal work area)
CMS (cross memory services)
CPA (channel program area for VSAM)
CPAB (cell pool anchor block)
CPID (cell pool identifier)
CPU (central processing unit)
CPU control table (CCT)
CQE (console queue element)
cross memory services (CMS)
CRT (cathode ray tube)
CSA (common service area)
- CSCB (command scheduling control block)
CSD (common system data area)
CSECT (control section)
CSOA (command scan output area)
CSPL (command scan parameter list)
CSW (channel status word)
CVT (communications vector table)
CXSA (comm task SVRB extended save area)
- DASD (direct access storage device)
DAT (dynamic address translation)
DCB (data control block)
DCM (display control module)
DD (data definition)
DD name (data definition name)
DDR common control block (DDRCOM)
DDR (dynamic device reconfiguration)
DDRCOM (DDR common control block)
DEB (data extent block)
DECB (data event control block)
DEVNAMT (device name table)
DEVTAB (device table)
DIDOCS (device independent display operator console support)
DOM (delete operator message)
DOMC (delete operator message control block)
DPL (delete operator message parameter list)
DQE (descriptor queue element)
DSAB (data set association block)
DSCB (data set control block)
DSDR (data set descriptor record)
DSDRP (data set descriptor record processing)
DSENQ (data set enqueue table)
DSNT (data set name table)
DSP (device support processor)
DSS (Dynamic Support System)
- EBCDIC (extended binary coded decimal interchange code)
EC (extended control)
ECB (event control block)
ECT (environment control table)
EDB (extent definition block)
EDL (eligible device list)
EDT (eligible device table)
EED (extended error descriptor)
EIL (event indication list)
EP (entry point)
EPA (external parameter area)
EPAL (external parameter area, locate mode)
EPAM (external parameter area, move mode)
EPFP (extended precision floating point)
ERP (error recovery program)
ESD (external symbol dictionary)
ESDID (external symbol dictionary ID)
ESR (extended SVC router)
ESSLIH (emergency signal SLIH)
ESTA (extended STAE parameter list, ESTAE-ESTAI-ESTAR services)
ESTAE-ESTAI-ESTAR services (ESTA)
- FBQE (free block queue element)
FLIH (first level interrupt handler)
FOE (fix ownership element)
FQE (free queue element)
FRR (functional recovery routine)

FRRS (functional recovery routine stack)

GDA (global data area)
GFA (general frame allocation)
GMT (Greenwich Mean Time)
GSDA (global system duplex area)
GTF (Generalized Trace Facility)

HC (hardcopy)

ICB (interruption control block)
ICT (input/output control table)
ID (identifier)
IEDQTCX (TCAM CVT extension)
IEFPARAM (initiator parameter list)
INVT (initial NIP vector table)
I/O (input/output)
IOB (input/output block)
IOC (input/output complete)
IOCX (input/output supervisor communication extension table)
IOMB (input/output management block)
IOS (input/output supervisor)
IOSB (input/output supervisor block)
IPL (initial program loader)
IPC (interprocessor communication)
IPS (installation performance specification(s))
IQE (interruption queue element)
IRB (interruption request block)

JACT (job account table)
JCL (job control language)
JCLS (job control language string)
JCT (job control table)
JES (job entry subsystem)
JESCT (job entry subsystem control table)
JFCB (job file control block)
JSCB (job step control block)
JSEL (job scheduling entrance list)
JSOL (job scheduling options list)
JSR (journal service routine)
JSTCB (job step TCB)
JSWA (job scheduling work area)
JSXL (job scheduling exit list)

K (1024 bytes)

LCA (log control area LCE (LOGON communication element))
LCCA (logical configuration communications area)
LCT (linkage control table)
LDA (local data area)
LG (logical group)
LGID (logical group identifier for ASM)
LGN (logical group number)
LGV (logical group vector table)
LPA (link pack area)
LPDE (link pack directory entry)
LPID (logical page identifier)
LRB (LOGREC record block)
LSID (logical slot identifier for ASM)
LSPL (local service priority list)
LSQA (local system queue area)
LWA (LOGON work area)

MAXPN (maximum RPN value declared or implied for a logical group)

MC (monitor call)
MCH (machine check handler)
MCHEAD (monitor call tables head)
MCRWSA (monitor call routing work/save area)
MCS (multiple console support)
MCT (main storage control table)
MEL (merge entrance list)
MFA (malfunction alert)
MIH (missing interruption handler)
MLPA (modified link pack area)
MLWTO (multiple line write-to-operator)
MP (multiprocessing)
MPL (monitor parameter list)
MQE (monitor queue element)
MSRDA (master scheduler resident data area)
MSS (mass storage system)
MSSC (mass storage system communicator)
MUG (multi-unit generic)

NEL (interpreter entrance list)
NIP (nucleus initialization program)
NIPM (nucleus initialization program mainline function or routine)
NIP parameter address table (PARMTAB)
NIP parameter area (NIPPAREA)
NIP vector table (NVT)
NIPPAREA (NIP parameter area)
NIP parameter area (NIPPAREA)
NVT (NIP vector table)

OLTEP (online test executive program)
OPSVT (system resources manager performance specification vector table)
ORE (operator reply element)
OS/VS2 (Operating System with Virtual Storage 2)
OUCB (system resources manager user control block)
OUXB (system resources manager user extension block)

PARMTAB (NIP parameter address table)
PART (paging activity reference table)
PAT (page assignment table)
PCB (page control block)
PCCA (physical communications configuration area)
PCCAVT (PCCA vector table)
PCCB (private catalog control block)
PCI (program-controlled interrupt)
PCT (performance characteristics table)
PDI (passed data set information)
PDS (partitioned data set)
PER (program event recording)
PFK (program function key)
PFT (page frame table)
PFTE (page frame table entry)
PGT (page table)
PGTE (page table entry)
PICA (program interruption communications area)
PIE (program interruption element)
PIOP (page I/O post)
PIRL (purge I/O request list)
PLC (program level control)
PLH (placeholder)
PLPA (pageable link pack area)
PPT (program properties table)
PRB (program request block)
PRLIST (permanently resident reserved list)
PSA (prefixed storage area)
PSLIST (public/storage list)

PSW (program status word)
PVT (page vector table)
PWA (processor work area)

QCB (queue control block)
QDB (queue descriptor block)
QEL (queue element)
QMPA (queue manager parameter area)
QSR (quick start record)

RB (request block)
RBA (relative byte address or relative block address)
RBN (real block number)
RCA (RSM recovery communication area)
RCB (recording control block)
RCBSRB (recording task SRB)
RCT (region control task, routing control table)
RCTD (region control task data area)
RDCM (resident display control module)
RIM (resource initialization module)
RLCT (system resources manager logical Channel table)
RLD (relocation dictionary)
RMCT (system resources manager control table)
RMEP (system resources manager algorithm entry point block)
RMPL (system resources manager parameter list)
RMPT (system resources manager parameter table)
RMS (recovery management support)
RMTR (resources manager termination routine)
RPL (request parameter list)
RPN (relative page number)
RRPL (recovery routine parameter list)
RSM (real storage management)
RSMHD (real storage management header)
RSN (relative slot number)
RSVT (recovery stack vector table)
RTCT (recovery/termination control table, recovery/termination management control table)
RTCTECB (recording task ECB)
R/TM (recovery/termination management)
RRPL (recovery routine parameter list)
RTCA (recovery/termination communication area)
RTMCB (recovery/termination management control block)
RTMCT (recovery/termination management control table, recovery/termination control table)
RMT1 work area (RTM1WA)
RTM1WA (RMT1 work area)
RMT2 work area (RTM2WA)
RTM2WA (RMT2 work area)
RVT (recovery management support secondary communications vector table)

S/370 (System/370)
SALLOC (storage allocation)
SCA (SPIE control area)
SCB (STAE control block)
SCT (step control table)
SCVT (secondary communications vector table)
SDT (start descriptor table)
SDWA (STAE diagnostic work area)
SGT (segment table)
SGTE (segment table entry)
SIC (system-initiated cancel)
SIRB (system interrupt request block)
SLIH (second level interrupt handler)
SLIP (serviceability level indication process)
SLOT (scheduler look-up table)
SMCA (system management control area)
SMF (system management facilities)

SPCT (swap control table)
SPE (system parameter element)
SPIE (specify program interruption element)
SPIE control area (SCA)
SPL (service priority list)
SPQE (subpool queue element)
SQA (system queue area)
SQS (system queue space)
SRB (service request block)
SRM (system resources manager)
SSCVT (subsystem communications vector table)
SSIB (subsystem identification block)
SSOB (subsystem options block)
SSVT (subsystem vector table)
STAE (set task asynchronous exit)
STAE control block (SCB)
STAE exit parameter list (STEPL)
STAX (set terminal attention exit)
STC (started task control)
STCINRDR (started task control internal reader)
STEPL (initiator/terminator STAE exit parameter list)
SVA (SWA virtual address)
SVC (supervisor call)
SVRB (supervisor request block)
SWA (scheduler work area)
SWA virtual address (SVA)
SWAP control table (SPCT)
SYSGEN (system generation)

TAIE (terminal attention interrupt element)
TAXE (terminal attention exit element)
TCAM (telecommunications access method)
TCAM CVT extension (IEDQTCX)
TCB (task control block)
TCTIOT (timing control table I/O table)
TCWA (TOD clock work area)
TDCM (pageable display control module)
TFRRPARAM (timer functional recovery routine parameter list)
TIOC (terminal input-output coordinator)
TIOC reference pointer table (TIOCRPT)
TIOCRPT (TIOC reference pointer table)
TIOT (task input-output table)
TLB (translation lookaside buffer)
TOD (time-of-day)
TOD clock work area (TCWA)
TPC (timer work area)
TQE (timer queue element)
TRE (track request element)
TSB (terminal status block)
TSO (time sharing option)
TSOINRDR (time sharing option internal reader)

UADS (user attribute data set)
UCB (unit control block)
UCM (unit control module)
UCME (unit control module entry)
UCMI (unit control module identifier)
UIC (unreferenced interval count)
UPT (user profile table)

V=R (virtual equals real)
VAT (virtual address table)
VBN (virtual block number)
VBP (virtual block processor)
VIO (virtual input/output)
VM&V (volume mount and verify)
VSAM (virtual storage access method)
VSL (virtual subarea list)

VSM (virtual storage management)
VS2 (see OS/VS2)
VTAM (virtual teleprocessing access method)
VTOC (volume table of contents)
VUT (volume unload table)

WMPGV (performance group vector table)
WMST (workload manager specification table)
WPL (WTO, WTOR, MLWTO, WTP parameter list
definition block, write parameter list)
WQE (write queue element)
WSAG (global work/save vector table)

WSAVT (work/save area vector table)
WSCT (workload manager control table)
WTO (write-to-operator)
WTOR (write-to-operator with reply)
WTP (write-to-programmer)
WWB (write wait block)

XCSLIH (external call second level interrupt handler)
XPT (external page table)
XPTE (external page table entry)
XSA (extended save area)

- abbreviations 1-47, 7-324
- abbreviations used in ASM PLM 1-47
- ABDUMP initialization (See **OS/VS2 System Initialization Logic**)
- access control block (see ACB)
- access method, pseudo (see pseudo access method)
- account tables (see ACT)
- address space (see also memory)
 - creation
 - overview 1-41
 - region control task 1-31
- affinity (see CPU affinity)
- allocate from groups picked by algorithm (see IEFAB478 object module)
- allocate function control (see IEFDB410 object module)
- allocation queue manager (see IEFAB4FA object module)
- allocation queue manager request block (see AQMRB)
- allocation work area (see ALCWA)
- APF (see authorized program facility)
- ASM (see auxiliary storage manager)
- asynchronous exits (see exit asynchronous)
- attributes, user (see VAPS)
- automatic priority group (see APG)
- auxiliary storage manager I/O request area (see AIA)
- available queue element (see AQE)

- BASEA (see MSRDA)
- broadcast data set (see SYS1.BROADCAST)

- channel availability table (see CAT)
- checking timer hardware status bytes
 - overview 1-34
- checkpoint/restart
 - overview 1-34
- clock, TOD (see TOD clock)
- coefficients, resource (see resource factor coefficient)
- command, reconfiguration (see reconfiguration commands)
- command processors
 - common functions 1-28
 - CSCB 1-28
 - individual command processor functions 1-28
- communications, interprocessor (see also SIGP instruction) 1-34
- communications task
 - overview 1-28
- comparator, clock (see clock comparator)
- control, common allocation (see common allocation control)
- control blocks (see data areas)
- converter/interpreter
 - overview 1-33
- corequisite publications iv (preface)

- DEQ macro instruction (see ENQ/DEQ/RESERVE routine)
- device allocation/unallocation (see allocation/unallocation)
- devices, generic (see generic allocation control)
- direct access data set (see DADSM)
- dispatcher
 - SRB
 - global, concept of 1-34
 - local, concept of 1-34
 - dispatcher, division of, concept 1-34
 - dispatcher, overview 1-34
- DOM (delete operator message) ID entries

- DWWIN
 - dynamic support system (see DSS)

- ECCDB
 - end of task (see EOT)
- ENQ macro instruction (see ENQ/DEQ/RESERVE routine)
- EPAL (external parameter area locate mode, see EPA)
- EPAM (external parameter area move mode, see EPA)
- error recursion (see recursion processing of errors)
- ESTAE
 - relationship to recovery/termination 1-37
- ESTAI (see also error recovery, error processing)
 - relationship to recovery/termination 1-37
- ESTAR
 - relationship to recovery/termination 1-37
- exclusive control (see XCTL routine)
- exit, attention (see attention exit)
- exit handling (see EXIT routine)
- external parameter area (see EPA)
- external parameter area locate mode (see EPA)
- external parameter area move mode (see EPA)

- faults (see page faults)
- fetch (see program fetch)
- frame (see page frame)
- FRR (see functional recovery routine)
- full analysis (see system resources manager)
- functional recovery routine (see also termination conditions)
 - relationship to recovery/termination 1-37

- generation data group (see GDG)
- global SRB
 - overview 1-34

- HIPO (see Method-of-Operation section)
- housekeeping (see JFCB housekeeping)

- IDENTIFY macro instruction
 - relationship to program management 1-37
- IEAVPFTE object module
- IEEMSER (see MSRDA)
- initiator/terminator
 - general functions 1-33
 - overview 1-33
 - relationship to JES 1-33
- input stream (see converter)
- input options for MF/1 (see options, MF/1)
- installation performance specifications (see IPS values)
- in-stream procedures (see JCL statements)
- instructions (see also macro instructions)
- integrity (see data set integrity processing)
- interpreter (see also converter/interpreter)
 - functions overview 1-33

- job control language (see JCL)
- job scheduler
 - division of coverage 1-33
- job step allocation (see step allocation)
- journal (see job journal)
- JPA (job pack area)
 - use by program management, overview 1-37

- link pack area (see LPA)
- local SRB, overview of 1-34
- local supervisor dispatcher, overview of 1-34
- lock manager (see SETLOCK)
- locking services/considerations
 - overview 1-34
 - set lock, overview 1-34
- log data set (see system log)
- log hardcopy (see hardcopy of system log)
- log, system (see system log)
- logical reconfiguration (see reconfiguration commands)
- LOGON (see also LOGOFF)
 - scheduling
 - overview 1-31
- LOGON, TSO serialization
 - scheduling (overview) 1-31
- LPA (link pack area)
 - program management use (overview) 1-37
- LSQA
 - contents and creation (overview) 1-41

- master JCL
- master subsystem
 - overview 1-33
- mounting a volume (see volume mount & verify)
- MP (see multi-processor system)
- MSS
- multi-unit generic (see MUG)

- new address space (see address space)

- Operation (see Method of Operation Section)
- operator console (see console)
- Organization (see Program Organization Section)
- OS/VS2 Release 2
 - overview diagram 1-24
 - purpose 1-23

- page free request (see PGFREE)
- page load (see PGLOAD)
- parse (see IKJPARSE)
- path, device (see device path)
- PFK (see program function key)
- pool (see quick cell)
- processors, command (see command processing)
- program management overview 1-37
- programmer, writing to (see WTP)
- prompting exit (see pre-prompt exit, LOGON)

- real frame (see page frame)
- real storage manager
 - relationship to auxiliary storage manager (overview) 1-41
- reconfiguration commands
 - logical reconfiguration (overview) 1-28
- recording, error (see error recording)
- recovery, error (see error recovery ESTAI)
- recovery, FRR (see functional recovery routine)
- recovery/termination (R/TM) 4-319
 - types of recovery routines (overview) 1-37
- requests, allocation
- requests, region (see region requests)
- resources manager (see system resources manager)
- restarting (see restart)
- RSM (see real storage manager)
- R/TM (see recovery termination)

- SCHEDULE macro instruction (see also PURGEDQ)
 - overview 1-34
- scheduler (see job scheduler)
- screen image buffer (see SIB)
- second level interrupt handler (see SLIH)
- SETLOCK macro instruction, general overview 1-34
- SIB (screen image buffer)
- signal processor (see SIGP instruction)
- SIGP instruction
 - overview 1-34
- single line message (see WTO)
- SMF (System Measurement Facility)
 - new exits (general overview) 1-34
- space, address (see address space)
- SRB (service request block) (see also dispatcher)
 - global
 - overview 1-34
 - local
 - overview 1-34
- stack, FRR (see FRR stack)
- START/LOGON/MOUNT overview
 - functions, relationship to RCT, and relationship to STC 1-31
- statement (see JCL statement)
- status, console (see console status)
- STC (started task control)
 - overview 1-33
 - relationship to JES, LOGON, and START 1-31
- STEPL (STAE exit parameter list)
- STOP MONITOR command
- storage management (see real storage manager, virtual storage management, system resources manager)
- stream, input (see converter)
- subsystem interface
 - overview 1-33
- SVC interruptions (see supervisor interruptions handler)
- SVC 109 (see extended SVC routing)
- SVC 116 (see extended SVC routing)
- SVC 122 (see extended SVC routing)
- SVCIH (see supervisor interruption handler)
- SWA manager
 - overview 1-33
- System Activities Measurement Facility (see MF/1)
- system log data set (see system log)
- System Measurement Facility (see SMF)
- system parameter library (see SYS1.PARMLIB)
- system reconfiguration (see reconfiguration commands)
- system resources manager (SRM) (see also workload manager) 1-31
 - functions assumed from VS2 Release 1 1-31
 - functions no longer supported from VS2 Release 1 1-31
 - new functions of SRM, compared to VS2 Release 1 1-31
 - overview of SRM 1-31
- system, stopping (see stopping)
- system trace (see trace, system)
- system trace termination (see trace termination)

- task
 - dispatcher
 - overview 1-37
- task management
 - post cross-memory option (overview) 1-37
- TCB (task control block)
 - dispatcher use of (general) 1-37
- terminator (see initiator/terminator)
- text, internal (see converter, internal text)
- timer second level interrupt handler (see timer SLIH)
- TIOT manager control routine

TPCA (see TPC)
TSO LOGON (see LOGON)

unit affinity (see allocating affinity requests)
unit, allocating request to (see allocating requests to units)
user, swapping (see swap-in, swap-out)

values, IPS (see IPS values)
virtual storage management (VSM)
 non-region storage 1-41

volume serial number (see VOLSER)
volume, specific allocation (see specific volume allocation control)
volume unload control (see IEFAB494 object module)
volunit table
VSM (see virtual storage management)
VS2 system overview 1-24

write-to-programmer (see WTP)

- abbreviations 1-47, 7-324
- abbreviations used in ASM PLM 1-47
- ABDUMP 4-392, 4-381
- ABDUMP initialization (See **OS/VS2 System Initialization Logic**)
- ABEND
 - codes, list of 7-341
 - in communication task 2-143
 - in RCT 2-426
 - in started task control 2-431
 - in SWA manager move mode 3-265
 - intentional 5-82
- ABEND function 7-477
- ABENDED jobstep, preparing for restart 3-516
- abnormal end of SMF writer function 3-460
- abnormal end of task 4-330
- abnormal termination of log task 3-476
- ABTERM request 4-370
- ACB (access control block)
 - creation for pseudo access method 3-178
 - in converter/interpreter interface 3-178
 - in JFCB housekeeping control 3-318
 - in JLOCATE 3-333
 - in pseudo access method 3-184
 - in subsystem initiation message writer 3-186
 - in SWA create interface 3-216
- access control block (see ACB)
- access method, pseudo (see pseudo access method)
- account tables (see ACT)
- accounting information, updating for terminal user 2-466
- ACE (ASM control element) (**VS2.03.807**)
 - in save, activate, and release processing 5-203, 5-222 (**VS2.03.807**)
 - in transfer page processing 5-202 (**VS2.03.807**)
- ACR introduction 4-322
- ACR overview processing 4-436
- acronym/mapping macro/common name table 7-324
- ACT (account tables)
 - in interpreter 3-254
 - in job deletion 3-208
 - in step deletion 3-208
- ACTFACE diagram 5-258
- ACTCLUP diagram 5-276
- ACTCOND diagram 5-254
- ACTFREE diagram 5-274
- ACTGETB diagram 5-250
- ACTGETN diagram 5-322
- ACTINIT diagram 5-266
- ACTINPR diagram 5-258
- action/algorithm scheduling in SRM 3-23,3-23.2 (**VS2.03.807**)
- action queue, deferred, in SRM 3-28
- action requests, operator, displaying 2-292
- ACTIVATE diagram 5-122
- ACTIVATE LG request (**VS2.03.807**)
 - functional description 5-222 (**VS2.03.807**)
 - initial processing of 5-203 (**VS2.03.807**)
 - recovery for 5-252 (**VS2.03.807**)
- active subsystem
 - notification 3-172
 - requests 3-172
- ACTREEN diagram 5-248
- ACTSLOT diagram 5-270
- ACTUPDT diagram 5-312
- ADDLSID diagram 5-286
- address, return, for TIME requests 4-6
- address, translating real to virtual 5-80
- address space (see also memory)
 - activity, checking for 2-410
 - clean-up 5-104
 - control blocks (see ASCB)
 - in VSM address space creation 5-102
 - creation
 - overview 1-41
 - processing 2-250
 - region control task 1-31
 - dispatching 4-85
 - error recovery 5-103
 - extension block (see ASXB)
 - identifier (see ASID)
 - initialization
 - in VSM address space creation 5-102
 - processing 5-58
 - lock verification 4-176
 - master scheduler, rescheduling R/TM in 4-368
 - obtaining storage 5-102
 - priorities in 4-84
 - swap-out preparation 2-410
 - switching 4-84
 - termination
 - conditions in super FRR 4-172
 - in purging timer queue elements 4-17
 - processing 4-333, 4-426
 - requester routine 4-428
 - vector table (see ASVT)
 - verifying 4-176
- address space queue elements, dequeuing 5-105
- address validity checking 4-162
- addresses, virtual in SWA, updating 3-504
- ADDLSLOT diagram 5-464
- affinity (see CPU affinity)
- affinity processor
 - flowchart 6-54
 - function 3-304-3-305
 - module description 6-311
- affinity removed
 - flowchart 6-52, 6-54, 6-62, 6-64-6-65
 - function 3-304, 3-298, 3-368
 - module description 6-312
- affinity requests, allocating 3-300
- AIA (auxiliary storage manager I/O request area)
 - in completion processing 5-119, 5-153 (**VS2.03.807**)
 - in deleting an address space 5-60
 - in general frame allocation 5-24
 - in page I/O initiation 5-52
 - in page I/O post 5-28
 - in page processing 5-119 (**VS2.03.807**)
 - in swap processing 5-119 (**VS2.03.807**)
 - in VIO completion processing 5-202 (**VS2.03.807**)
 - in VIO data set processing 5-203 (**VS2.03.807**)
 - in VIO services 5-56
- ALCWA (allocation work area)
 - in allocate request to unit 3-304, 3-306
 - in allocating offline devices 3-376
 - in allocation via algorithm 3-348
 - in common allocation cleanup 3-378
 - in common allocation control 3-280
 - in demand allocation 3-355
 - in fixed device control 3-294
 - in generic allocation control 3-338
 - in nonspecific volume allocation control 3-308
 - in recovery allocation 3-358
 - in specific volume allocation 3-298

algorithm/action scheduling in SRM 3-23, 3-23.2, 3-23.3 (VS2.03.807)

algorithm, allocating via 3-348
 cover/reduce algorithm 3-349
 interface to SRM 3-351
 multi-unit requests 3-349
 UCB candidates list 3-351

algorithm tables
 in allocate request to unit 3-304-3-306
 in allocating offline devices 3-366
 in allocation via algorithm 3-339
 in common allocation cleanup 3-378-3-379
 in demand allocation 3-355
 in generic allocation control 3-342, 3-344
 in multi-unit request processing 3-366
 in nonspecific volume allocation control 3-312
 in recovery allocation 3-358
 in specific volume allocation 3-298

algorithms, SRM 3-30
 in periodic entry point scheduling 3-32
 scheduling 3-23, 3-23.2, 3-23.3 (VS2.03.807)

alias-named data sets, processing 3-332-3-333

all active subsystem notification 3-172-3-173

allocate catalog control
 flowchart 6-39, 6-60
 function 3-336
 module description 6-309

allocate from groups picked by algorithm (see IEFAB478 object module)

allocate function control (see IEFDB410 object module)

allocate request to unit 3-302

allocate subsystem data sets
 flowchart 6-51
 module description 6-311

allocate via the algorithm
 flowchart 6-63
 function 3-348
 module description 6-315

allocate VIO data sets
 flowchart 6-51
 function 3-280-3-281
 module description 6-311

allocate within a generic
 flowchart 6-62
 function 3-342, 3-344, 3-346
 module description 6-315

allocating affinity requests
 in allocating requests to units 3-304
 in allocating requests to specify volumes 3-300
 in allocation recovery 3-358

allocating direct-access request 3-294

allocating non-specific volume requests 3-308

allocating permanently resident volume requests 3-294

allocating region space 5-98

allocating reserved volume requests 3-294

allocating system log 3-472

allocating teleprocessing requests 3-286

allocating a unit /
 building a VM&V request block 3-302
 unloading a volume 3-302

allocating volumes and units to requests 3-280

allocation common ESTAE exit routine (IEFAB4ED) (VS2.03.804)
 error processing 3-291-3-413 (VS2.03.804)
 module description 6-306 (VS2.03.804)

allocation environment, current, providing information about 3-422

allocation ESTAE exit for job/step
 module description 6-307

allocation message routine
 flowchart 6-72, 6-77

function 3-380-3-381
 module description 6-306

allocation queue manager (see IEFAB4FA object module)

allocation queue manager request block (see AQMRB)

allocation resource manager
 module description 6-307

allocation retry routine for job/step
 module description 6-307

allocation/termination communication area
 module description 6-319

allocation/unallocation 3-269
 affinity request 3-300
 catalog search 3-334
 common allocation clean-up 3-378
 common control (see also common allocation control) 3-280
 common control for unallocation 3-430
 common unallocation functions 3-402
 DD function control 3-322
 DD-related message text
 module description 6-319

ddname allocation
 flowchart 6-83
 function 3-412, 3-428
 module description 6-324

demand allocation 3-355

device, offline, allocation of 3-366

disposition processing 3-440

dynamic allocation control 3-414

dynamic environment, current, providing information about 3-423

dynamic information retrieval 3-422

dynamic unallocation control 3-416

fixed device control 3-294

function map, building (in initiator/unallocation interface) 3-404

generic device type control 3-317

installation routine verification (in SVC 99 control) 3-412

insufficient space for V=R region 5-98

interface to initiator
 allocation 3-396
 (see also IEFBB401 object module)
 unallocation 3-402

introduction to allocation/unallocation 3-269

ISAM request error checking (in common allocation cleanup) 3-380

JES2 notified of unallocation of data set and associated resources 3-438-3-439

JFCB housekeeping control 3-314

JLOCATE, functions of 3-334

major functions of allocation/unallocation 3-271

messages, module description of 6-310

mount equalization for MSS volumes 3-291, 3-350, 3-370

MSS interface to obtain preferred UCB list to update UCB candidate list 3-371, 3-377

offline device allocation 3-366

overview of allocation/unallocation 3-269

passed data set information, obtaining 3-334

processing job step (SVC 99 control) 3-412

reason codes 7-468

reattempted allocation, criteria for 3-378

recovery 3-358

remove in-use attribute 3-424

remove in-use processing 3-424

requests (see requests, allocation)

requests to unit 3-302

retry 3-378

RSM V=R region 5-98

SRM interface

- in common allocation clean-up 3-382
- in non-specific volume allocation 3-312
- step allocation control
 - flowchart 6-75
 - function 3-398
 - module description 6-320
- step initiator
 - in initiator/allocation interface 3-396
 - in step initiation 3-200
- step-related message text
 - module description 6-319
- storage, virtual 5-94
- SVC 99 control 3-412
- SWA tables for dynamic allocation building
 - flowchart 6-85
 - module description 6-323
- termination error, processing 3-382
- unit unallocation 3-444
- via algorithm 3-348
- volume list (in disposition processing, IEFAB4A2) 3-440
- volume mount and verify (VM&V)
 - interface 3-386
 - processing 3-390
- WTO message module for AVR and common allocation
 - module description 6-309
- OC4 ABEND code occurring in IEFAB4FC 7-467
- allocation of virtual storage (GETMAIN processing) 5-94
- allocation work area (see ALCWA)
- ALSPROC diagram 5-342
- ALTCPREC SYSEVENT code (33)
 - processing in SRM SYSEVENT code processor 3-18
- alternate CPU recovery (ACR)
 - in synchronous timer recovery 4-36
 - introduction 4-322
 - module description 6-279
 - overview processing 4-436
- alternate disposition message routine
 - flowchart 6-49
 - function 3-443
 - module description 6-305
- alternation of SWA subpool 3-267
- AMDPRDM program 7-479
- AMWA (access method work area)
 - in converter/interpreter interface 3-178
 - in pseudo access method 3-184
 - in subsystem initiation 3-176
- analyzer, MF/1 syntax 3-86
- APF (see authorized program facility)
- APG (automatic priority group)
 - changing priorities in 3-62
 - in step initiation 3-205
- AQE (available queue element)
 - in FREEMAIN 5-97
 - in VSM task termination 5-106
- AQMRB (allocation queue manager request block)
 - in generic allocation control 3-338
- ARLSEG diagram 5-156
- ASCB (address space control block)
 - in ASCBCHAP processing 4-164
 - in attention exit prolog and epilog 2-422
 - in attention exit purge 2-424
 - in attention exit scheduler 2-418
 - in cancelling TSO, system-initiated cancel 2-256
 - in CPU management (SRM) 3-62
 - in deleting an address space 5-60
 - in deleting a virtual memory 2-400
 - in dispatcher 4-56
 - in dispatching the wait task 4-82
 - in DOM macro instruction processing 2-144
 - in dynamic allocation control 3-414
 - in establishing timer intervals using STIMER 4-8
 - in exit processing (IEAVEOR) 4-256
 - in exit prolog 4-258
 - in EXTRACT processing 4-254
 - in freeing an address space 5-104
 - in global SRB dispatcher 4-72
 - in initializing an address space 5-58
 - in I/O interrupt handler 4-94
 - in LOGON
 - monitor 2-448
 - post-TMP exit 2-466
 - pre-prompt exit 2-460
 - scheduling 2-444
 - verification 2-456
 - in memory switching 4-84
 - in obtaining a new virtual memory 2-250
 - in page I/O initiation 5-52
 - in POST processing 4-222
 - in program check interrupt handler 4-112
 - in PURGEDQ 4-144
 - in purging timer queue elements 4-16
 - in quiesce processing 2-410
 - in RCT common processing 2-408
 - in RCT ESTATE processing 2-426
 - in RCT initialization/termination 2-406
 - in restore processing 2-414
 - in resume processing 4-192.5, 4-192.9 (VS2.03.807)
 - in routing to FRRs 4-354
 - in RTM1 rescheduling 4-366
 - in SCHEDULE processing 4-140
 - in SETLOCK processing 4-154
 - in SMF cross-memory post error exit 3-460
 - in SRM interface 3-6
 - in SRM service routine (IRARMSRV) 3-9.2 (VS2.03.807)
 - in stage 3 exit effector 4-134
 - in started task control 2-430
 - in starting MONITOR functions 2-316
 - in STATUS processing 4-260
 - in STAX service routine 2-416
 - in step initiation 3-200
 - in stopping and restarting the system via interrupt 2-392
 - in stopping MONITOR functions 2-316
 - in storage management (SRM) 3-46
 - in storage management (IRARMSTM) 3-46 (VS2.03.807)
 - in supervisor routine dispatching 4-76
 - in suspend routine 4-192 (VS2.03.807)
 - in SVC interrupt handler 4-88
 - in SVC 87 processing 2-144
 - in SVC 99 control 3-412
 - in swap-in
 - control 3-40
 - root exit 5-44
 - in swap-out
 - control 3-42
 - processing 5-46
 - in swappable user evaluation (IRARMWM2) 3-70 (VS2.03.807)
 - in SYSEVENT processing in SRM SYSEVENT code processor 3-11
 - in task dispatching 4-78
 - in TQE processing 4-22
 - in TQE purge routine 4-16
 - in user evaluation (IRARMCVL) 3-43.4 (VS2.03.807)
 - in validity check processing 4-162
 - in varying a CPU offline 2-374
 - in VSM task termination 5-106
 - in WAIT processing 4-220
 - in WTO and WTOR macro instruction processing 2-32

- in WTP (write-to-programmer) processing 2-52
- ASCB priority
 - adding 4-164
 - deleting 4-164
 - in ASCBCHAP processing 4-164
 - in step initiation 3-200
- ASCBCHAP processing 4-164
- ASID (address space identifier)
 - in job unallocation 3-410
- ASM (see auxiliary storage manager)
- ASMCNSTS SYSEVENT code (27)
 - processing in SRM SYSEVENT code processor 3-17
- ASMHD (auxiliary storage management header) (VS2.03.807)
 - description of 1-44 (VS2.03.807)
 - overview diagram 1-46 (VS2.03.807)
 - in VIO data set processing 5-202 (VS2.03.807)
- ASMSTAGQ (ASM staging queue) (VS2.03.807)
 - in page processing 5-119 (VS2.03.807)
 - in VIO data set processing 5-202 (VS2.03.807)
- ASMVT (auxiliary storage management vector table) (VS2.03.807)
 - description of 1-44 (VS2.03.807)
 - in interval measurement gathering routine for paging 3-122
 - in resource monitor periodic monitoring (IRARMRM1) 3-66 (VS2.03.807)
 - in storage management (IRARMSTM) 3-46 (VS2.03.807)
 - in storage management (SRM) 3-48
 - overview diagram 1-46 (VS2.03.807)
- ASPCT (auxiliary storage page correspondence table) (VS2.03.807)
 - description of 1-45 (VS2.03.807)
 - in save, activate, and release processing 5-202 (VS2.03.807)
 - in VIO completion processing 5-203 (VS2.03.807)
 - in VIO data set processing 5-222 (VS2.03.807)
 - overview diagram 1-46 (VS2.03.807)
 - use in locating LSIDs of VIO data sets 7-478 (VS2.03.807)
- ASPECT1 diagram 5-216
- ASPECT2 diagram 5-220
- ASSIGN
 - flowchart 6-10
 - processing 3-264
- ASSIGN diagram 5-132
- ASSIGN LGN
 - MO diagram of 5-216
 - processing of 5-202 (VS2.03.807)
 - recovery for 5-252 (VS2.03.807)
- assign processing in VIO services 5-54
- ASSIGN/LOCATE processing 3-266
- ASSIGN/START processing 3-264
- assignment of CPU task affinity
 - flowchart 6-39
 - function 3-201, 3-199
 - module description 6-325
- ASVT (address space vector table)
 - in address space lock verification 4-176
 - in obtaining a new virtual memory 2-250
 - in starting monitoring procedures 2-316
 - in stopping monitoring procedures 2-316
 - in TQE processing 4-22
 - repairing 4-178
 - verifying 4-178
- ASXB (address space extension block)
 - in attention exit prolog and epilog 2-420
 - in attention exit purge 2-424
 - in attention exit scheduler 2-418
 - in cancelling TSO, system initiated 2-256
- in CHAP processing 4-214
- in DETACH routine 4-210
- in I/O interrupt handler 4-94
- in LOGON initialization 2-442
- in quiesce processing 2-410
- in RCT common processing 2-408
- in RCT ESTAE processing 2-426
- in RCT initialization/termination 2-406
- in rescheduling locally locked task or SRBs 4-372
- in restore processing 2-414
- in routing to FRRs 4-354
- in SMF cross memory post error exit 3-460
- in stage 3 exit effector 4-134
- in STAX service routine 2-416
- in supervisor routine dispatching 4-76
- in validity check processing 4-162
- in VSM address space creation 5-102
- asynchronous exits (see exit asynchronous)
- asynchronous timer recovery 4-38
- ATA (ASM tracking area) (VS2.03.807)
 - in recovery processing 5-250 (VS2.03.807)
- ATCA
 - in allocation/volume mount and verify (VM&V) interface 3-388
 - in volume mount and verify (VM&V) 3-394
- ATTACH macro instruction
 - in LOGON scheduling 2-444
- ATTACH processing 4-198
- attention exit
 - cancelling 2-418
 - deleting 2-464
 - during LOGOFF 2-452
 - during LOGON 2-448
 - eliminating at task termination 2-424
 - flowchart 6-34
 - level determination 2-418
 - module description 6-336
 - prolog/epilog 2-420
 - purge 2-424
 - scheduling 2-418
 - in region control task common processing 2-408
- attention exit message text
 - flowchart 6-34
 - module description 6-337
- attention interrupt processing (see also SVC 72) 2-174
- attention pending bit 2-182
- attributes, system 2-452
- attributes, user (see VAPS)
- authority, for commands 2-242
- authorization checking (TESTAUTH) 4-270
- authorization for CHAP 4-214
- authorized program facility (APF)
 - TESTAUTH routine 4-270
- automatic checkpoint/restart
 - message module description 6-334
 - processing 3-498
 - SWA create interface 3-216
- automatic deletion 2-122
- automatic priority group (see APG)
- automatic step restart 3-500
- auxiliary page shortage 3-48
- auxiliary storage, freeing 5-16
- auxiliary storage management (ASM) (VS2.03.807)
 - ABEND COD meanings 7-481 (VS2.03.807)
 - communications diagram 1-42 (VS2.03.807)
 - control block description 1-44 (VS2.03.807)
 - control block overview diagram 1-46, 7-311.0 (VS2.03.807)
 - data set usage 1-46.2 (VS2.03.807)
 - diagnostic aids 7-476 (VS2.03.807)
 - introduction to MOS 5-117 (VS2.03.807)

- module descriptions 6-338 (VS2.03.807)
- overview introduction 1-42 (VS2.03.807)
- program organization diagrams 6-200 (VS2.03.807)
- recovery 5-250 (VS2.03.807)
- recovery control blocks 7-481 (VS2.03.807)
- serialization and lock usage 7-486 (VS2.03.807)
- VTOC 5-118 (VS2.03.807)
- auxiliary storage manager (ASM)
 - relationship to real storage manager 5-3
- auxiliary storage manager I/O request area (see AIA)
- auxiliary storage management visual table of contents 5-117
- available queue element (see AQE)
- available space, returning virtual region space to 5-100
- AVQLOW SYSEVENT code (23)
 - processing in SRM storage management (IRARMSTM) 3-49
 - processing in SRM SYSEVENT code processor 3-16
- AVQOK SYSEVENT code (24)
 - processing in SRM storage management (IRARMSTM) 3-49
 - processing in SRM SYSEVENT code processor 3-16
- AVR (automatic volume recognition)
 - in generic allocation
 - flowchart 6-61
 - function 3-340, 3-341
 - module description 6-315
- BADSLOT diagram 5-460
- BASEA (see MSRDA)
- batch allocation
 - in common allocation control 3-280
- batch jobs, cancelling 2-254
- BLDL/program fetch interface 4-288
- BLDTSKQ diagram 5-184
- BRINGIN SYSEVENT (44)
 - processing in SRM SYSEVENT processor 3-21
- broadcast data set (see SYS1.BROADCAST)
- BSAM
 - closing a console 2-22
 - command processing routine (SVC 34) 2-182
 - processing commands from a non-graphic console 2-182
 - writing messages to a non-graphic console
 - multiple line 2-124
 - single line 2-120
- BUFLPROC diagram 5-454
- build eligible devices list (EDL)
 - flowchart 6-51
 - function 3-282-3-283
 - module description 6-311
- build SWA tables for dynamic allocation request
 - flowchart 6-85
 - module description 6-323
- build TCTIOT routine
 - module description 6-325
- building console displays 2-292
- building step header record for job journal 3-512
- calculating a time interval
 - in checking a time interval using TTIMER 4-10
- CALLRTM macro instruction
 - in initialization of RTM 4-344
- overview 4-342
- CANCEL command
 - processing
 - flowchart 6-10
 - function 2-254
 - module description 6-301
 - R/TM processing for 4-332
- CANCEL ECB 2-258
- cancellation
 - time limit checking 4-16
- cancelling jobs
 - background (batch) 2-254
 - foreground (TSO) 2-254
- cancelling a time interval
 - in checking a time interval using TTIMER 4-10
- cancelling a TSO user, system initiated 2-256
- CAT (channel availability table)
 - in MF/1 channel sampling module 3-140
- catalog, allocating (see SVC 99) 3-337
- catalog, implied by data set names 3-334
- catalog, master 3-335
- catalog, private, searching 3-334
- catalog processing 3-204
- catalog searching 3-334
- catalog unallocation control
 - flowchart 6-49, 6-60
 - function 3-336, 3-318, 3-432
 - module description 6-308
- cataloged procedures 3-232
- CCT
 - in CPU load balancing swap analysis 3-66
 - in CPU management (SRM) 3-62
 - in CPU management (IRARMCMPM) 3-62 (VS2.03.807)
 - in resource monitor periodic monitoring (IRARMRM1) 3-66 (VS2.03.807)
 - in storage management (SRM) 3-48
- CDE (contents directory entry)
 - in BLDL/program fetch interface 4-288
 - in DELETE routine 4-294
 - in IDENTIFY routine 4-296
 - in LINK routine 4-278
 - in LOAD routine 4-292
 - in program fetch 4-308
 - in routing to searching routines 4-284
 - in searching the LPA directory 4-286
- chain ACE diagram 5-128
- change ddname/JES3 exit (IEFDB4FB)
 - flowchart 6-82, 6-84, 6-85
 - function 3-418-3-419
 - module description 6-321
- change key routine (see CHANGKEY routine) (VS2.03.805)
- changing dispatchability indicators 4-260
- changing dump parameters 2-260
- changing IPS values 2-340
- changing system mask with MODESET 4-268
- CHANGKEY routine (VS2.03.805)
 - flowchart 6-188 (VS2.03.805)
 - function 5-88 (VS2.03.805)
 - introduction 41 (VS2.03.805)
 - module description 6-260 (VS2.03.805)
- channel, logical
 - analysis of I/O load 3-56
 - imbalance 3-54
 - in I/O management 3-54
- channel, measurement
 - MF/1 initialization for 3-100
- channel
 - varying offline 2-378, 2-370
 - varying online 2-376, 2-370
- channel availability table (see CAT)
- channel data collected by MF/1
 - interval 3-130
 - sampling 3-140
 - second CPU 3-142
- channel reconfiguration hardware interface to IOS
 - from VARY CPU online 2-372
 - from VARY channel online 2-376
 - from VARY channel offline 2-378

- CHAP processing 4-214
- check, machine
 - in synchronous timer recovery 4-36
- checking timer components 4-36
- checking timer hardware status bytes
 - overview 1-34
- checking timer interval using TTIMER 4-10
- checkpoint data set 3-486
- checkpoint/restart
 - ABENDED job step, preparing for restart 3-516
 - automatic
 - in SWA create interface 3-216
 - processing 3-498
 - data set descriptor records processing 3-486, 3-483
 - deferred 3-216
 - dynamic allocation interface 3-486
 - header record 3-489
 - in step initiation 3-202
 - job journal writing 3-520
 - overview 1-34
- CHNGDUMP command
 - flowchart 6-193, 6-10
 - function 2-260
 - module description 6-295
- CIB (command input block)
 - in measurement facility control 3-80
- CIB (command input buffer)
 - in command processing overview 2-232
 - in command routing 2-242
 - in command translation 2-242
 - in creating CSCB 2-244
 - in job initiation 3-196
 - in MODIFY command processing 2-312
 - in STOP command processing 2-312
 - in SVC 34
 - initialization 2-232
 - STAE routine 2-236
 - in task creation commands 2-244
- CIWA (common internal work area)
 - in PGFIX/PGLOAD 5-34
 - in PGFREE 5-38
 - in PGOUT 5-40
- clean-up processing
 - in common allocation 3-378
 - in volume mount & verify (VM & V) 3-394
- clock, TOD (see TOD clock)
- clock comparator
 - in asynchronous timer recovery 4-38
 - in timer functional recovery routine 4-24
- interruption type 4-18
- setting 4-20
- COD ABEND meanings for ASM 7-481 (VS2.03.807)
- codes
 - ABEND, list of 7-341
 - wait state, list of 7-345
- coefficients, resource (see resource factor coefficient)
- collect data for MF/1 (IRARMWR3) 3-73.8 (VS2.03.807)
- command, light-pen 2-186
- command, PFK 2-186
- command, reconfiguration (see reconfiguration commands)
- command, typed 2-184
- command authority
 - checking 2-242
 - varying 2-350
- command identification 2-242
- command mode 2-186
- command processing
 - by master scheduler IEEVWAIT 2-246
 - ESTAE creation/exit routine 2-280, 2-298, 2-330, 2-340, 2-346, 2-350
 - from a 1052, 2540, or 2740 console 2-182
 - in the input stream 3-230
 - RESET 2-330
- command processing routine (SVC 34) 2-232
- command processors
 - common functions 1-28
 - CSCB 1-28
 - individual command processor functions 1-28
- command routing 2-242
- command scan 2-454
- command scheduler router
 - flowchart 6-9, 6-89, 6-193
 - function 2-242, 2-232
 - module description 6-299
- command syntax
 - verification of 2-184
- command translation 2-242
- commands
 - CONTROL
 - DIDOCS processing 2-184, 2-188
 - processing 2-262
 - DISPLAY 2-280
 - DISPLAY NET 2-391
 - DISPLAY TP 2-387
 - display preprocessing 2-272
 - displaying system status 2-280
 - HALT
 - initialization 2-300
 - processing 2-302
 - HALT NET 2-391
 - HALT TP 2-387
 - HOLD 2-387
 - HOLD TP 2-387
 - in the input stream 3-230
 - K 2-184
 - LOGON 2-439
 - MODE 2-311
 - RESET 2-330
 - routing 2-242
 - RELEASE 2-388
 - RELEASE TP 2-387
 - SETDMN 2-230, 2-401.0 (VS2.03.807)
 - STOP/MODIFY processing 2-312
 - SWAP 2-311
 - SWITCH
 - initialization 2-300
 - processing 2-302
 - TRACK 2-280
 - preprocessing 2-272
 - translating 2-242
 - VARY 2-370-2-385
 - WRITELOG START 3-466
- comment or continuation statement processing 3-226
- common allocation clean-up
 - called by 3-378
 - common allocation parameter list, building 3-378
 - flowchart 6-71-6-72, 6-48, 6-52
 - functions 3-378
 - module description 6-317
 - requests excluded (see also requests, allocation) 3-378
- common allocation control
 - called by 3-280
 - fixed device control 3-290
 - flowchart 6-47-6-48, 6-51, 6-72
 - function 3-280
 - function map 3-430
 - generic allocation control, use with 3-288
 - module description 6-310
 - order of allocation 3-280
 - parameter list, function map 3-280
 - recovery, occasions for use 3-288
 - serialization of 3-282

- waiting for devices 3-280
- common allocation ESTAE exit
 - module description 6-307
- common allocation parameter list
 - building 3-378
- common I/O active queue 5-38
- common page data set (ASM) (VS2.03.807)
 - description of 1-46.1 (VS2.03.807)
 - error matrix 7-491 (VS2.03.807)
 - overflow processing 5-152 (VS2.03.807)
- common request router
 - processing
 - flowchart 6-38
 - function 3-172
 - module description 6-327
 - request block construction 3-412
- common unallocation ESTAE exit
 - module description 6-306
- common unallocation functions 3-430
- communications, interprocessor (see also SIGP instruction) 1-34
- communications task
 - attention interrupt processing 2-174
 - closing a console 2-22
 - console attention 2-4
 - overview 2-4
 - processing 2-174
 - console command processing 2-182
 - light-pen and PFK input 2-186
 - typed input from a graphic device 2-184
 - console device support 2-5
 - console queueing routine 2-26
 - console switch routine 2-170, 2-134
 - device service routine, use of 2-178, 2-130, 2-110
 - diagnostic aids for 7-461
 - displaying multiple-line messages 2-128
 - displaying single-line messages 2-122
 - displays, DIDOCS 2-196
 - DOM device support processing (DIDOCS) 2-166
 - DOM macro instruction overview 2-138
 - DOM macro instruction processing 2-140
 - DOM processing 2-154
 - DOM processing overview 2-152
 - ESTAE routine 2-202, 2-200
 - external interrupt processing 2-168, 2-4
 - FRR
 - function 2-202
 - module description 6-273
 - use of 4-415
 - functional overview 2-3, 2-12
 - functional recovery 2-202, 2-200
 - I/O complete processing 2-130, 2-4
 - major functions 2-3
 - message deletion (DIDOCS)
 - changing specifications 2-192
 - operator requested 2-188
 - roll mode 2-198
 - multiple-line WTO (MLWTO) processing 2-72
 - opening a console 2-18
 - operator interrupt key processor 2-168
 - overview 1-28
 - overview of functions 2-3, 2-12
 - PFK definition or redefinition 2-190
 - PFK display line 2-194
 - posting 2-140
 - recovery (STAR) routine 2-212
 - REPLY=YES function 2-3
 - single-line WTO and WTOR service routine 2-28
 - STAR routine 2-212
 - supporting function 2-4
 - SVC 34 initialization and processing 2-232
 - SVC 35 processing 2-26
 - SVC 72 processing 2-164, 2-6
 - SVC 87 processing 2-140
 - unconditional message to operator 2-114, 2-5
 - wait service routine 2-97-2-99
 - writing multiple-line messages 2-124
 - writing single-line messages 2-120
 - WTO and WTOR
 - macro instruction 2-28
 - overview 2-3, 2-96
 - processing 2-98, 2-110
 - WTP (write-to-programmer)
 - overview 2-48
 - processing 2-50
- comparator, clock (see clock comparator)
- COMPBRST diagram 5-466
- completion code, saving by post-TMP exit 2-466
- components, timer
 - checking machine-check validity
 - in synchronous timer recovery 4-36-4-37
 - error count of component in error in CSD 4-37
 - in establishing TQE using STIMER 4-9
 - initialization verification
 - in synchronous timer recovery 4-36-4-37
 - verifying usability of 4-9
- composite consoles
 - switching by IEE4303D 2-368-2-369
- COMWA (converter/interpreter common work area)
 - converter use of in
 - identifying verbs or JCL statements 3-226
 - initialization 3-224
 - processing commands in the input stream 3-230
 - processing in-stream and cataloged procedures 3-232
 - termination 3-242
 - interpreter use of in initialization 3-246
- concatenation, dynamic
 - flowchart 6-82
 - function 3-418
 - module description 6-323
- condensed dump (VS2.03.805)
 - flowchart 6-196 (VS2.03.805)
 - function 4-393,4-394 (VS2.03.805)
- CONFIGCH SYSEVENT code (29)
 - processing in SRM SYSEVENT code processor 3-17
- console
 - closing 2-22
 - CONTROL command processing 2-262
 - device support 2-5
 - display
 - building replies for operator requests 2-292-2-293
 - matrix of system status 2-290-2-291
 - varying 2-350-2-351
 - dump routine 2-298
 - graphics console, processing types commands from 2-184
 - message routing 2-318
 - opening 2-18
 - status, console, displaying 2-286-2-287
 - switching
 - overview 2-4
 - processing by IEE4303D 2-368-2-369
 - varying online and offline 2-360
- console commands, reading
 - light-pen input 2-186-2-187
 - typed input 2-184-2-185
- console device buffer
 - in displaying single line messages on a graphic console 2-122
- console operand processor
 - flowchart 6-20

- function 2-354
- module description 6-302, 6-304
- continuation statement processing 3-226-3-229
- continuing system trace 2-300-2-301
- control, common allocation (see common allocation control)
- control block overviews 7-272
- control blocks (see data areas)
- CONTROL C,D and V command handlers
 - flowchart 6-10
 - function 2-266
 - module description 6-304
- CONTROL command
 - DIDOCS processing to delete messages 2-184, 2-189
 - displaying operands 2-288-2-289
 - operator-requested message deletion (in DIDOCS) 2-188-2-189
 - processing 2-262-2-271
 - syntax checker routine 2-186, 2-192
- control vector table (CVT) 7-481
- conversational command mode
 - in processing light-pen and PFK commands 2-186-2-187
- conversion, time interval unit 4-10
- conversion, timer unit
 - in establishing timer intervals using STIMER 4-8
 - in processing TIME requests 4-6
- conversion of bit mask
 - flowchart 6-39
 - function 3-200-3-201
 - module description 6-325
- converter (see also interpreter)
 - command verb validation routine
 - flowchart 6-43
 - function 3-230, 3-228
 - module description 6-332
 - comment or continuation validation routine
 - flowchart 6-42
 - function 3-226
 - module description 6-331
 - converting statements to internal text 3-236-3-239
 - entering defaults into internal text 3-240-3-241
 - error messages
 - processing by subsystem initiation message writer 3-186-3-187
 - get routine
 - flowchart 6-42
 - function 3-226
 - module description 6-331
 - identifying verbs on JCL statements 3-226-3-229
 - initialization
 - flowchart 6-42
 - function 3-224-3-225
 - module description 6-333
 - instream procedure routines
 - flowchart 6-42
 - function 3-232
 - module description 6-333, 6-334
 - NULL statement or end-of-file processor
 - flowchart 6-42
 - module description 6-332
 - pre-scan routine
 - flowchart 6-42
 - function 3-228
 - module description 6-332
 - processing commands in the input stream 3-230-3-231
 - processing in-stream and cataloged procedures 3-232-3-233
 - processing symbolic parameters 3-234-3-235
 - pseudo-access method 3-182-3-185
 - scan routine
 - flowchart 6-43
 - function 3-236, 3-240, 3-234, 3-226
 - module description 6-331
 - SWA manager interface routine
 - flowchart 6-44, 6-42
 - function 3-233
 - module description 6-333
 - symbolic parameter routine
 - flowchart 6-43
 - function 3-234
 - module description 6-331
 - termination routine
 - flowchart 6-43
 - function 3-242-3-243
 - module description 6-332
 - test and store utility routine
 - flowchart 6-44
 - function 3-252
 - module description 6-331
 - use by master subsystem 3-178-3-181
 - verb identifier routine
 - flowchart 6-42
 - function 3-226, 3-228, 3-232, 3-238
 - module description 6-332
- converter/interpreter
 - interface 3-178-3-181
 - message module
 - flowchart 6-42, 6-44
 - module description 6-331
 - operator message module
 - flowchart 6-44, 6-42
 - function 3-258-3-259
 - module description 6-333
 - overview 1-33
- converting an allocation in dynamic allocation control 3-414
- COPYDMDT SYSEVENT code (VS2.03.807)
 - code processor 3-11 (VS2.03.807)
 - processing in SRM SYSEVENT 3-22 (VS2.03.807)
- prerequisite publications iv (preface)
- count table
 - in allocation via algorithm 3-350
 - in common allocation control 3-280
 - in demand allocation 3-355
 - in fixed device control 3-294
 - in nonspecific volume allocation control 3-312
 - in specific volume allocation 3-300
- cover/reduce algorithm
 - flowchart 6-63, 6-67, 6-73
 - function 3-366, 3-348, 3-374, 3-280
 - module description 6-316
- CPAB (cell pool address block)
 - in building a cell pool 5-108
 - in deleting a cell pool 5-114
 - in FREECELL routine 5-112
 - in GETCELL routine 5-110
- CPU
 - varying a CPU offline 2-374-2-375
 - varying a CPU online 2-372-2-373
- CPU activity initialization in MF/1 3-96
- CPU affinity
 - in dispatching local supervisor routines 4-76
 - in job initiation 3-199
 - in step initiation 3-201
- CPU dependencies, in memory switching 4-84
- CPU hold routine error recovery
 - in timer FRR 4-24
- CPU load balancing swap analysis 3-66
- CPU management in SRM 3-62
- CPU manual state in quiescing the system 2-323
- CPU measurements in MF/1

- in interval MG routine 3-118-3-121
- CPU recovery, alternate
 - in synchronous timer recovery 4-36
- introduction 4-322
- overview processing 4-436
- CPU signaling (signal service routines-IPC) 4-120
- CPU timer error recovery 4-38
- CPU timer interruption type, determining 4-18
- CPU utilization (VS2.03.807)
 - in CPU management (IRARMCPM) 3-63, 3-64 (VS2.03.807)
- CPU varying
 - offline 2-374-2-375
 - online 2-372-2-373
 - overview 2-370
- CQE (console queue element)
 - building 2-102-2-103
 - consolidating 2-112
 - deleting 2-113
 - in control command processing 2-266
 - in QREG0 2-116
 - in unconditional message to inactive console processing 2-116
 - in writing messages to a non-graphic console
 - multiple line 2-124
 - single line 2-120
 - in WTO and WTOR communications task processing 2-102-2-103
- CQE queue
 - writing messages to a non-graphic console
 - multiple line 2-124
 - single line 2-120
- creating a new address space 2-250
- CRI (catalog return information)
 - in DD function control 3-322-3-330
 - in JLOCATE 3-334
- cross-memory posting of master scheduler
 - in CSCB creation for task-creating commands 2-244-2-245
- cross-memory posting of SMF error exit 3-460
- cross-memory post requests 4-222
- CSCB (command scheduling control block)
 - creation 2-244-2-245
 - in allocation/initiator interface 3-398
 - in cancelling background and foreground jobs 2-254-2-255
 - in cancelling TSO, system initiated 2-256-2-257
 - in changing console status, routing codes, and command authorization 2-350
 - in changing IPS values 2-340
 - in creating task commands 2-244
 - in displaying control command operands 2-288
 - in displaying a matrix of system status 2-290
 - in displaying program function key definition 2-294
 - in displaying and tracking system status 2-280
 - in displaying unit status 2-296
 - in EXTRACT routine 4-255
 - in HALT and SWITCH command
 - initialization 2-300
 - processing 2-302
 - in initiator/allocation interface 3-398
 - in job initiation 3-196
 - in listing messages 2-332
 - in LOGON
 - LOGON monitor 2-448, 2-450
 - LOGON monitor recovery 2-462
 - LOGON/LOGOFF verification 2-456
 - pre-prompt exit interface 2-460
 - in master scheduler wait 2-246
 - in master scheduler wait recovery and retry 2-248
 - in modify command processing 2-312
 - in obtaining new virtual memories 2-250
 - in quiescing a system 2-320
 - in RESET command processing 2-330
 - in saving and sending messages 2-332
 - in started task control 2-433
 - in step initiation 3-200
 - in stop command processing 2-312
 - in stopping periodic track (status) displays 2-344
 - in SVC 34 STAE routine 2-236
 - in SWA create interface 3-216
 - in switch and HALT command
 - initialization 2-300
 - processing 2-302
 - in tracking and displaying system status 2-280
 - in unloading I/O devices 2-346
 - in varying a CPU or channel offline or online 2-370
 - in varying devices offline and online 2-360
 - in varying the path to a device 2-380
 - in varying the status of real storage 2-384
 - replacement during LOGON 2-448
- CSCB and ASCB creation routine
 - flowchart 6-11-6-18
 - function 2-244, 2-250, 2-300, 2-348, 2-388
 - module description 6-300
- CSCB chain processing 2-244
- CSCB scan
 - normal
 - in master scheduler wait 2-246
 - retry
 - in master scheduler wait recovery and retry 2-248
- CSD (common system data area)
 - in common allocation control 3-282
 - in CPU management (IRARMCPM) 3-62 (VS2.03.807)
 - in displaying a matrix of system status 2-290
 - in MF/1 channel initialization 3-100
 - in quiescing a system 2-320
 - in set clock comparator routine 4-20
 - in setting a specific TOD clock 4-26
 - in signal service routines (IPC) 4-120
 - in status processing 4-262
 - in stopping and restarting the system via interrupt 2-394
 - in varying a CPU offline 2-374
 - in varying a CPU online 2-372
- CTRUPDTE diagram 5-228
- current allocation environment, providing information about 3-422
- CVT (communication vector table)
 - in address space lock verification 4-176, 4-178
 - in allocation/initiator interface 3-396
 - in allocation/volume mount and verify (VM&V) interface 3-388
 - in ASCBCHAP processing 4-164, 4-166
 - in attention exit prolog and epilog 2-422
 - in attention exit scheduler 2-418
 - in attention interrupt processing 2-174
 - in building a step header record for the job journal 3-512
 - in cancelling TSO, system initiated 2-258
 - in changing command authorization 2-350
 - in changing console status, routine codes, and command authorization 2-352
 - in common request router 3-172
 - in console switching 2-368
 - in data set name assignment 3-188
 - in delete operator message processing 2-154
 - in deleting a quick cell pool 5-114
 - in deleting a virtual memory 2-400
 - in displaying the console status 2-286
 - in displaying information requests 2-324
 - in displaying a matrix of system status 2-290

- in displaying operator action requests 2-292
- in displaying unit status 2-296
- in DOM macro instruction 2-144, 2-148
- in emergency signal second level interrupt handler 4-128
- in ENQ/DEQ/RESERVE routine 4-242
- in external interrupt processing 2-168
- in FREECELL routine 5-112
- in freeing an address space 5-104
- in GETCELL routine 5-110
- in initiator/allocation interface 3-396
- in initiator/unallocation interface 3-404
- in interrupt processing 2-174, 2-168
- in interval measurement gathering routine for workload 3-126
- in LOGON
 - initialization 2-442
 - LOGON/LOGOFF verification 2-456
 - monitor 2-448
 - pre-prompt exit interface 2-460
- in master scheduler wait 2-246
- in master scheduler wait recovery and retry 2-248
- in memory switch processing 4-84
- in merging job journal to SWA 3-492
- in MF/1 channel initialization 3-100
- in MF/1 CPU activity initialization 3-96
- in MF/1 device initialization 3-104
- in MF/1 paging activity initialization 3-96
- in MF/1 second CPU test channel sampling module 3-142
- in MF/1 termination processor 3-110
- in obtaining a new virtual memory 2-250
- in processing TIME requests 4-6
- in PURGEDQ processing 4-144
- in quiesce routine processing 2-410
- in quiescing a system 2-320
- in RCT common processing routine 2-408
- in RESET command processing 2-330
- in restart interrupt handler 4-116
- in restore routine processing 2-414
- in RSM functional recovery routine 5-83
- in RTM1 exit processing 4-376
- in SCHEDULE processing 4-138
- in set clock comparator routine 4-20
- in setting local time 2-338
- in STAE exit processing for SMF 3-458
- in starting and stopping monitoring functions 2-314
- in STAX service routine 2-416
- in stopping and restarting the system via interrupt 2-392
- in subsystem determination 3-174
- in subsystem interface 3-164
- in SVC interruption handler 4-90
- in SVC 34 STAE routine 2-236
- in SVC 87 processing 2-144, 2-148
- in switching SMF data sets 3-454
- in timer SLIH (second level interrupt handler) 4-18
- in TOD clock operator communication routine 4-30
- in TOD clock status test routine 4-34
- in TOD clock synchronization routine 4-32
- in TQE dequeue routine 4-14
- in TQE enqueue routine 4-12
- in TQE processing routine 4-22
- in unallocation/initiator interface 3-404
- in unloading I/O devices 2-346
- in VARY HARDCPY processing 2-366
- in varying a CPU online 2-372
- in varying devices offline and online 2-360
- in varying the status of real storage 2-384
- in volume mount and verify (VM&V) 3-394
- in writing blocks to the job journal 3-520

- in writing SMF records 3-450
- in XCTL routine 4-300
- CVTDATE field, use of in TQE processing routine 4-22
- CXSA (comm task SVRB extended save area)
 - in external interrupt processing 2-168
 - in processing typed commands from a graphic console (DIDOCs) 2-184

DADSM

- allocation interface 3-304
- parameter list in allocate request to unit 3-304
- VM&V interface 3-386
- DAIRFAIL (IKJEFFI8) (VS2.03.810)
 - failure in dynamic allocation 3-486 (VS2.03.810)
- Data Area section 7-271
 - acronym/mapping macro/common name table 7-324
 - control block overviews 7-272
 - data area usage table 7-335
 - data control (IRBMFDTA) in MF/1 3-106
 - data definition (see DD function control) 4-12
 - data management interpreter exit routine
 - flowchart 6-44
 - module description 6-328
 - data set assignment 3-188
 - data set descriptor record processor (see also checkpoint/restart)
 - in SWA create interface
 - flowchart 6-41, 6-90
 - function 3-486, 3-216, 3-217
 - module description 6-334
 - data set enqueue parameter list building
 - flowchart 6-39
 - function 3-198-3-199
 - module description 6-324
 - data set name (see also DSN resolution)
 - in data set tree processing 3-198-3-199
 - data set name assignment
 - flowchart 6-38
 - function 3-188
 - module description 6-326
 - data set name resolution
 - flowchart 6-57
 - function 3-324
 - module description 6-314
 - data set reservation/release
 - flowchart 6-59, 6-84
 - module description 6-305
 - data set tree structure processing in job and step initiation
 - flowchart 6-39
 - function 3-198-3-199
 - module description 6-324
 - data sets, releasing
 - in common unallocation control 3-432-3-433
 - data sets, SMF 3-454
 - DCB (data control block)
 - in BLDL/program fetch interface 4-288
 - in converter/interpreter interface 3-178
 - in data set descriptor records processing 3-486
 - in program fetch (building a DCB) 4-311
 - in routing to searching routines (use of DCB operand) 4-285
 - in switching SMF data sets 3-454
 - in writing SMF records 3-450
 - resolution in DD function control
 - flowchart 6-59
 - function 3-330-3-331
 - module description 6-313-6-314
 - DCM (display control module)
 - in CONTROL command processing 2-262
 - in displaying console status 2-286

- in displaying single line messages on a graphic console 2-122
- in DOM device support processing (DIDOCS) 2-166
- in processing light-pen and PFK commands on a graphic console 2-186
- in processing typed commands from a graphic console 2-184
- DD function control (IEFAB454)
 - DCB resolution 3-331
 - DISP resolution 3-332-3-333
 - GDG (generation data group) processing 3-324-3-325
 - processing
 - flowchart 6-47, 6-57-6-59
 - function 3-322
 - module description 6-313
 - volume/unit resolution 3-328-3-331
- DD preparation
 - flowchart 6-56
 - function 3-314-3-315
 - module description 6-313
- DD processing control
 - flowchart 6-56
 - function 3-324, 3-314
 - module description 6-313
- ddname allocation 3-428, 3-412
- ddname generation routine
 - flowchart 6-57, 6-58
 - module description 6-321
- ddname and relative position number
 - informing the JES3 subsystem 3-418-3-419
- ddname search routine
 - flowchart 6-80, 6-82-6-85
 - function 3-416, 3-418, 3-420
 - module description 6-321
- DEB (data extent block)
 - BLDL/program fetch interface, in 4-288
 - deconcatenation, dynamic 3-420
 - step initiation, in 3-204
- deconcatenation routine
 - flowchart 6-82, 6-84
 - function 3-420
 - module description 6-324
- defaults, converter, entering into JCL internal text 3-240
- DEFER option, in STAX service routine 2-416
- deferred action processor (IRARMCEN) in SRM 3-28
- deferred action queue (VS2.03.807)
 - in deferred action process 3-28 (VS2.03.807)
- deferring algorithms in SRM 3-23 (VS2.03.807)
- deferred requests (in general frame allocation) 5-24
- deferred restart job determination (in SWA create interface) 3-217
- DELETE subroutine
 - in SWA manager move mode 3-265
- deleting messages
 - DIDOCS processing 2-166
 - operator messages 2-154
- deleting a virtual memory 2-400
- DELETE/LOCATE function in SWA manager locate mode 3-266-3-267
- demand allocation
 - processing
 - flowchart 6-64, 6-48, 6-61, 6-73
 - function 3-355
 - module description 6-316
 - use with generic allocation 3-407
- demand requests
 - definition 3-355
 - operator replies 3-375
 - processing 3-375, 3-377
 - volunit entry, updating 3-372, 3-373
- DEQ macro instruction (see ENQ/DEQ/RESERVE routine)
- dequeueing address space queue elements 5-105
- dequeueing POST queue elements 5-100
- dequeueing region control blocks 5-104-5-105
- dequeueing TQEs (timer queue element)
 - in checking a time interval using TTIMER 4-10
 - in TQE Dequeue routine 4-14
 - in TQE Purge routine 4-16-4-17
- dequeueing WAIT queue elements 5-100
- DETACH processing 4-206
- determinate errors 7-477
- determination of subsystem name 3-175
- determine device requirements
 - flowchart 6-51
 - function 3-282-3-283
 - module description 6-310
- determining device requests
 - for request not yet allocated 3-289
- DEVALLOC SYSEVENT code (28)
 - processing in SRM SYSEVENT code processor 3-17
- device addresses, varying a range of 2-364
- device allocation defaults module
 - module description 6-313
- device allocation/unallocation (see allocation/unallocation)
- device data collected by MF/1 3-145
- device end post handler
 - flowchart 6-74
 - function 3-394
 - module description 6-317
- device groups no longer needed, determining 3-372
- device groups that must remain serialized 3-373
- device "hierarchical-offline" status, checking 2-373
- device information subroutine
 - flowchart 6-19
 - function 2-396
 - module description 6-297
- device interrupt routine
 - module description 6-324
- device path
 - varying 2-380
- device sampling in MF/1
 - initialization 3-104
 - processing 3-145
- device selections from JES3 3-284-3-285
- device support processor for 1052, 1443, 2540, 2740, or DIDOCS
 - in attention interrupt processing 2-180
 - in DOM processing 2-164
 - in I/O complete processing 2-132
- devices, generic (see generic allocation control)
- devices, I/O, varying online and offline 2-360
- devices, waiting for
 - in common allocation control 3-289
 - devices waiting to be made ready 2-292
- DEVNAMT (device name table), deleting
 - in displaying unit status 2-296
- DF code on restart interrupt 4-116
- diagnostic aids 7-476
- dictionary entry routine
 - flowchart 6-44
- dictionary search routine
 - flowchart 6-44
- DIDOCS (device independent display operator console support)
 - cleanup module
 - module description 6-291-6-292
 - function 2-24
 - command analyzer
 - module description 6-290
 - function 2-184

- diagnostic aids 7-463
- DOM processing 2-166
- interface to CONTROL command 2-262
- light-pen and cursor detect analyzer 2-186
- message deletion module (see IEECVET6, IEECVET7, IEECVET8, IEECVET9 object modules)
- message module
 - module description 6-288-6-291
 - function 2-188, 2-122
- message output module, module description 6-290
- message output module, inline 2-122
- message processor, inline multiple-line
 - module description 6-292
 - function 2-128
- message processor, single-line
 - module description 6-293
 - function 2-128, 2-122
- open/close module 2-18, 2-22
- PFK definition processor
 - module description 6-291
 - function 2-190, 2-194
- PFK-entered command processor
 - module description 6-291
 - function 2-186
- register usage table 7-353
- return codes table 7-375
- roll mode processor 2-198, 2-122
- router module (see IEECVET1 object module)
- status display processor
 - module description 6-292, 6-293
 - function 2-128, 2-190, 2-196
- timer interceptor 2-198, 2-192
- use in displaying single line messages on a graphic console 2-122
- use in processing light-pen and PFK command 2-186
- use in processing typed commands from a graphic console 2-184
- 2250 device I/O module (see IEECVETP object module)
- 2260 device I/O module (see IEECVETR object module)
- 2740 console device support processor
 - description 6-293
 - function 2-120, 2-122, 2-118, 2-124, 2-182
- 3066 device I/O module (see IEECVETH object module)
- 3277 device and model 158 system console I/O module (see IEECVETU object module)
- 3284/3286 console device support processor (see IEECVETW object module)
- DIE TQE (VS2.03.807)**
 - defined 4-3 (VS2.03.807)
 - in TQE processing 4-22, 4-23 (VS2.03.807)
- direct access data set (see DADSM)
- direct access label read
 - flowchart 6-61, 6-74
 - function 3-340, 3-394
 - module description 6-309
- direct read
 - in pseudo access method 3-182
- direct signal routine 4-125
- direct write
 - in pseudo access method 3-182
- directory, LPA searching 4-286
- directory, module 7-1
- DISP (disposition) information (see also disposition processing)
 - completing in JFCB R IN SIOT 3-322
- DISP (disposition) resolution (see also disposition processing)
 - associated with commands in the input stream 3-231
 - in DD function control 3-333
- dispatchability, changing (STATUS processing) 4-261
- dispatcher
 - local supervisor dispatcher 4-76
 - processing 4-54
 - SRB
 - global, concept of 1-34
 - local, concept of 1-34
 - queues 4-54
 - task dispatcher 4-78
 - wait task dispatcher 4-82
 - dispatcher, division of, concept 1-34
 - dispatcher, overview 1-34
 - dispatching
 - local SRBs 4-74
 - local supervisor routines 4-76
 - priority, changing
 - in CHAP 4-214
 - in CPU management 3-62
 - the wait task 4-82
 - with address space switch 4-85
 - DISPLAY C,K processor
 - flowchart 6-11
 - function 2-288
 - module description 6-300
 - DISPLAY command processing 2-272, 2-280
 - DISPLAY DMN command 2-228, 2-297.0 (VS2.03.807)
 - DISPLAY matrix command processor
 - flowchart 6-11
 - function 2-290
 - module description 6-295
 - DISPLAY NET command, modules invoked 2-391
 - display of program function key definitions
 - flowchart 6-11
 - function 2-288, 2-294
 - module description 6-300
 - DISPLAY R command processing 2-292
 - DISPLAY TP command processing 2-387
 - DISPLAY/TRACK router
 - flowchart 6-11, 6-17
 - function 2-272, 2-274
 - module description 6-301
 - display track, stopping 2-342
 - displaying console status 2-286
 - displaying control command operands 2-288
 - displaying operator action requests
 - flowchart 6-11
 - function 2-292
 - module description 6-301
 - displaying single line messages on a graphic console 2-122
 - displaying system status 2-280
 - CPU model and serial numbers, obtaining 2-291
 - reconfigurable storage units defined to the system, finding 2-291
 - displaying unit status 2-296
 - disposition message routine
 - flowchart 6-49
 - function 3-443
 - module description 6-305
 - disposition messages
 - module description 6-310
 - disposition processing control
 - flowchart 6-49, 6-78
 - function 3-440
 - module description 6-305
 - disposition processing in IEFAB4A2 (see also DISP resolution, DISP information) 3-440
 - in common unallocation control (IEFAB4A0) 3-430
 - in DD function control (IEFAB454)
 - flowchart 6-59
 - function 3-332-3-333
 - module description 6-313
 - DMDT (domain descriptor table) (VS2.03.807)

- in resource monitor MPL adjustment processing (IRARMRM2) 3-67.0 (VS2.03.807)
- in resource monitor periodic monitoring (IRARMRM1) 3-66 (VS2.03.807)
- in swap analysis (IRARMCAP) 3-36 (VS2.03.807)
- DOM (delete operator message)
 - communications task processing 2-154
 - communications task processing overview 2-3, 2-152
 - macro instruction
 - overview 2-138
 - processing 2-140
 - setting up ESTAE routine for protection during JES execution 2-158
- DOM (delete operator message) control table
 - use in DOM device support processing 2-166
- DOM count in VM&V (volume mount and verify) tables 3-391
- DOM (delete operator message) ID entries
 - in allocation/volume mount and verify (VM&V) interface 3-388
 - in volume mount and verify (VM&V) 3-392-3-393
- DOM device support processing 2-166
- DOM (delete operator message) element table
 - use in DOM device support processing 2-166
- DOM (delete operator message) macro instruction
 - overview 2-138
 - service routine processing 2-140
 - subsystem exit routine, use of 2-148
 - UCMDECB, posting the 2-148
- DOM (delete operator message) parameter list
 - in DOM macro instruction (SVC 87) 2-143
- domains (VS2.03.807)
 - definition/description 3-3 (VS2.03.807)
 - of work indicated in IPS 3-3 (VS2.03.807)
- DOMC (delete operator message control block)
 - in delete operator message processing 2-154, 2-152
 - in DOM macro instruction 2-141, 2-138-2-139
- DONTSWAP SYSEVENT code (code 41)
 - exception to authorization 3-5
 - in SYSEVENT processor 3-20
 - in workload manager 3-71
- double-threaded queues, verifying for a supervisor recovery routine 4-170
- DQE (descriptor queue element)
 - in freeing a virtual region 5-101
 - in SVC 34 STAE routine 2-236
 - in VSM address space creation 5-102
- DSAB (data set association block)
 - in allocate request to unit 3-302
 - in allocating offline devices (IEFAB486) 3-368
 - in allocation via algorithm 3-348
 - in allocation/initiator interface 3-396
 - in common allocation cleanup 3-378
 - in common allocation control 3-280
 - in common unallocation control 3-434
 - in ddname allocation 3-428
 - in demand allocation 3-355
 - in dynamic allocation control 3-414
 - in dynamic concatenation 3-418
 - in dynamic deconcatenation 3-420
 - in dynamic information retrieval 3-422
 - in dynamic unallocation control 3-416
 - in fixed device control (IEFAB430) 3-294
 - in generic allocation control (IEFAB471) 3-342
 - in initiator/allocation interface 3-396
 - in initiator/unallocation interface 3-402
 - in LOGON initialization 2-442
 - in recovery allocation (IEFAB485) 3-360
 - in remove in-use attribute routine (IEFDB480) 3-424
 - in SVC 99 control (IEFDB400) 3-412
 - in unit unallocation processing (IEFAB4A4) 3-446
- DSAB entry checks made (in ddname allocation) 3-428
- DSAB QDB (data set association block queue descriptor block)
 - in allocation/initiator interface 3-396
 - in common allocation cleanup 3-380
 - in ddname allocation 3-428
 - in dynamic allocation control 3-414
 - in dynamic concatenation 3-418
 - in dynamic deconcatenation 3-420
 - in dynamic information retrieval 3-422
 - in dynamic unallocation control 3-416
 - in initiator/allocation interface 3-396
 - in initiator/unallocation interface 3-402
 - in nonspecific volume allocation control 3-310
 - in remove in-use attribute routine 3-424
 - in SVC 99 control (IEFDB400) 3-412
 - in unallocation/initiator interface 3-402
 - in unit unallocation processing 3-446
- DSCB (data set control block)
 - in switching SMF data sets 3-454
- DSDR (data set descriptor record)
 - checkpoint/restart, processing of 3-483
- DSENQT (data set enqueue table)
 - in DD function control (IEFAB454) 3-332
 - in interpreter
 - creating and chaining tables 3-254
 - initialization 3-246
 - in step initiation 3-200
- DSN resolution in data set tree processing 3-198-3-199
- dname search routine
 - flowchart 6-80
 - function 3-416
 - module description 6-321
- DSNT (data set name table)
 - in DD function control 3-326
- DSS
 - action on restart interrupt 4-116
 - system restart procedure with 2-395
- DTMVT (measurement vector table for trace and report data, see also INMVT, MFMVT, STMVT, TMMVT)
 - in MFDATA SVC mainline 3-114
 - in MF/1 report generator control (IRBMFRGM) 3-148
- DUMDOMCB
 - in DOM macro instruction (SVC 87) processing 2-144
- dump, ABEND, processing overview 4-335
- DUMP command processing 2-298
- dump for SVC 34 STAE 2-236
- dump data set
 - use in dumping virtual storage 2-298
- dumping virtual storage 2-298
- dump parameters, changing via CHNGDUMP command 2-260
- dumps 7-479
 - ILREOT00 7-480
 - ILRTMR00 7-480
 - ILRTMR01 7-480
- dump reading 7-481
- dump, SNAP, processing overview 4-335
- dump, SVC, overview 4-336-4-337
- dump task
 - attaching by region control task 2-406
 - detaching by region control task 2-406
- duplex page data set (ASM) (VS2.03.807)
 - description of 1-46.1 (VS2.03.807)
 - error matrix 7-491 (VS2.03.807)
 - overflow processing 5-152 (VS2.03.807)
- DWWIN
 - in interval measurement gathering routine for workload 3-126
 - in MF/1 workload initialization 3-98
- dynamic allocation

- convert routine
 - flowchart 6-84
 - function 3-414
 - module description 6-323
- DAIRFAIL processing 3-486 (VS2.03.810)
- ESTAE exit
 - function 3-413
 - module description 6-322
- function validity checker
 - flowchart 6-84
 - function 3-414
 - module description 6-323
- installation exit
 - flowchart 6-81
 - module description 6-322
- interface routine (see IEFDB4D00 object module)
- JFCB DCB field update
 - flowchart 6-84, 6-85
 - module description 6-323
- normal error subroutine
 - flowchart 6-87
 - module description 6-323
- processing 3-414
- set DSABDCBM mask bits subroutine
 - module description 6-307
- SVC 99 control (IEFDB400) 3-412
(see also IEFDB400 object module)
- dynamic allocation request for unit and volume, processing 3-280
- dynamic concatenation
 - criteria for 3-418
 - processing 3-418
- dynamic deconcatenation
 - criteria for 3-420
 - processing 3-420
- dynamic information retrieval
 - flowchart 6-82
 - function 3-422
 - module description 6-324
- dynamic support system (see DSS)
- dynamic unallocation 3-416

ECB (event control block)

- in converter/interpreter interface 3-180
- in DETACH routine 4-208
- in LOGON scheduling 2-444
- in master scheduler wait 2-247
- in overlay supervisor 4-306
- in page services interface 5-32
- in PGFIX/PGLOAD root exit 5-36
- in POST processing 4-222
- in real storage reconfiguration 5-70
- in swap-out control 3-43
- in WAIT processing 4-220
- in V=R region allocation 5-10
- region control task processing routine 2-409

ECB parameter on DETACH 4-208

ECCDB

- in MF/1 channel interval measurement gathering routine 3-130
- in MF/1 channel initialization 3-100
- in MF/1 channel sampling module 3-140
- in MF/1 second CPU test channel sampling module 3-142

ECCED

- in MF/1 channel interval measurement gathering routine 3-130
- in MF/1 channel initialization 3-100
- in MF/1 channel sampling module 3-140

ECCPE

- in MF/1 channel initialization 3-100
- in MF/1 channel sampling module 3-140

ECT

- in LOGON monitor 2-449
- in LOGON pre-prompt exit interface 2-460
- in LOGON verification 2-459

EDDCD

- in interval measurement gathering routine for devices 3-134
- in MF/1 device initialization 3-104

EDDDDB

- in interval measurement gathering routine for devices 3-134
- in MF/1 device initialization 3-104

EDDED

- in interval measurement gathering routine for devices 3-134
- in MF/1 device initialization 3-104
- in MF/1 device sampling module 3-144

EDIT verb 7-479

EDL (eligible device list)

- building 3-122, 3-283
- contents 3-283
- in allocating offline devices 3-366
- in allocation via algorithm 3-348
- in common allocation cleanup 3-382
- in common allocation control 3-282
- in demand allocation 3-355
- in fixed device control 3-294
- in generic allocation control 3-338
- in nonspecific volume allocation control 3-312
- in recovery allocation 3-358
- in specific volume allocation 3-298

EDT

- in allocate request to unit 3-302
- in allocating offline device 3-366
- in common allocation control 3-280
- in generic allocation control 3-338
- in JFCB housekeeping control 3-316
- in recovery allocation 3-360

EED

- in processing hardware errors 4-348
- in rescheduling locally locked task or SRB 4-372
- in R/TM clean up processing 4-375
- in RTM1 rescheduling 4-366
- in system directed task termination 4-370

eligible units, determining

- in specific volume allocation control 3-298-3-299

eliminate ineligible groups and generics

- flowchart 6-53, 6-62-6-68
- function 3-348, 3-362, 3-366
- module description 6-316

embedded entry point, in IDENTIFY 4-297

emergency signal SLIH 4-128

emergency signal interruption determination 4-98

end of task (see EOT)

end-of-task/address space ESTAE routine (ILREOT00) 7-1

ENQ/DEQ/RESERVE routine 4-242

ENQ/DEQ routine for allocation

- flowchart 6-55, 6-64, 6-71
- function 3-386, 3-357, 3-312
- module description 6-308

ENQ macro instruction (see ENQ/DEQ/RESERVE routine)

ENQRLSE SYSEVENT code (21)

- processing in SRM SYSEVENT code processor 3-16

enqueue parameter list, use of in job initiation 3-198-3-199

enqueueing a TQE 4-12

enqueueing on volume serial number 3-312

enqueueing a V=R request on the wait queue 5-98
 entry point scheduling in SRM, periodic 3-32
 entry point summary for SRM (VS2.03.807)
 control function (IRARMCTL) 3-43.6 (VS2.03.807)
 CPU management (IRARMCPM) 3-65.0 (VS2.03.807)
 functional recovery routine (IRARMERR) 3-9.13
 (VS2.03.807)
 interface function (IRARMINT) 3-9.0 (VS2.03.807)
 I/O management (IRARMIOM) 3-61.0 (VS2.03.807)
 MF/1 interface (IRARMWAR) 3-73.10 (VS2.03.807)
 resource monitor (IRARMRMR) 3-67.2 (VS2.03.807)
 service routine (IRARMSRV) 3-9.13 (VS2.03.807)
 storage management (IRARMSTM) 3-51.2
 (VS2.03.807)
 sysevent processor (IRARMEVT) 3-22.6 (VS2.03.807)
 workload manager (IRARMWLM) 3-73.4 (VS2.03.807)
 environment current allocation, providing information
 about (IEFDB470) 3-422
 EOT (end of task)
 abnormal (ABEND) 4-330
 determination in exit prolog 4-258
 invocation by EXIT processing 4-257
 normal 4-328
 EPA (external parameter area)
 format 3-523
 in allocation/initiator interface 3-396
 in dynamic allocation control 3-414
 in dynamic unallocation control 3-416
 in initiator/allocation interface 3-396
 in JFCB housekeeping control 3-318
 in remove in-use attribute routine 3-426
 in SWA manager locate mode 3-266
 in SWA manager move mode 3-264
 EPAL (external parameter area locate mode, see EPA)
 EPAM (external parameter area move mode, see EPA)
 EPARM
 in SVC 35 (WTO and WTOR) 2-30
 EPATH (recovery audit trail area) (VS2.03.807)
 contents descriptor 7-484 (VS2.03.807)
 in recovery processing 5-250 (VS2.03.807)
 EPFA
 in full analysis (IRARMCAS) 3-34
 enqueue, of TQE 4-12
 error codes
 set in dynamic concatenation (IEFDB450) 3-418
 error messages
 in getting a virtual region 5-99
 processing by subsystem initiation message writer
 3-186-3-187
 error processing (see also error recovery ESTAE processing)
 abnormal end-of-task (ABEND) 4-330
 for hardware errors 4-326
 for page I/O errors 4-324
 in allocation via algorithm 3-351
 in allocation recovery 3-365
 in common allocation clean-up 3-378
 in common allocation control 3-307
 in DD function control 3-333
 in demand allocation 3-355
 in fixed device allocation control 3-297
 in FREEMAIN 5-97
 in generic allocation control 3-341
 hardware 4-348
 in initiator/allocation interface 3-399
 in JFCB housekeeping control 3-317, 3-319
 in JLOCATE (IEFAB469) 3-337, 3-335
 in job journal merge 3-508
 in LOGOFF 2-452-2-453
 in LOGON monitor 2-451
 in master scheduler wait recovery and retry
 (IEEVWAIT) 2-248
 in non-specific volume allocation control 3-313, 3-377
 in offline/allocated device allocation 3-369
 paging I/O post 5-29
 in specific volume allocation control 3-301
 in subsystem initiation
 IEFJCNTL 3-177
 IEFJJOB 3-177
 in volume mount and verify 3-395
 error recording
 in timer functional recovery routine 4-24
 RCT 2-426
 error recovery (FRRs)
 description 7-477
 MO diagram 5-502
 error recovery (see also error processing, ESTAE
 processing)
 address space create 5-103
 allocating virtual storage in GETMAIN 5-95
 attention exit
 prolog/epilog 2-423
 purge 2-425
 clock comparator
 in asynchronous timer recovery 4-39
 in timer error recovery 4-24
 CPU timer
 in asynchronous timer recovery 4-39
 in free address space routine 5-105
 LOGON monitor 2-462
 LOGON pre-prompt exit interface 2-461
 quiesce 2-413
 RCT ESTAE processing 2-426
 restore 2-415
 Timer FRR 4-24
 TOD clock
 in asynchronous timer recovery 4-39
 error recursion (see recursion processing of errors)
 error, syntax, detecting in converter (IEFVFA) 3-234
 error, user exit
 in checking a time interval using TTIMER 4-11
 in establishing timer intervals using STIMER 4-9
 in processing TIME requests 4-7
 errors, hardware, processing of 4-348
 ESR (extended SVC routing) 4-86-4-87, 4-44
 establishing timer intervals using STIMER 4-8
 ESTAE
 for SWA create interface 3-217
 for communication task 2-202, 2-200
 in converter initialization 3-224
 in interpreter initialization 3-246
 in job initiation 3-196
 in TIME service routine 4-7
 in started task control 2-430
 RCT 2-426
 relationship to recovery/termination 1-37
 service routine 4-430
 ESTAE/ESTAI routines 7-478
 ESTAI (see also error recovery, error processing)
 relationship to recovery/termination 1-37
 ESTAR
 relationship to recovery/termination 1-37
 ETXR parameter
 on ATTACH 4-201
 on DETACH 4-207
 event-driven MF/1 functions
 in MFROUTER 3-138
 in MF/1 termination processor (IRBMFTMA) 3-110
 event table, description of in EVENTS routine
 4-237-4-239
 chaining in task management control block overview
 7-304
 EVENTS processing 4-234

- error processing 4-240-4-241
- synopsis of 4-196
- EVENTS ECB
 - processing in POST routine 4-225
- exclusive control (see XCTL routine)
- exclusive data set attribute
 - handling in initiator 3-199
- exchange swap 3-23.0, 3-36 (VS2.03.807)
- EXCP macro instruction
 - use in processing typed commands from a graphic console 2-185
 - use in displaying single line message on a graphic console 2-123
- EXEC statement
 - in interpreter 3-257
 - in started task control processing 2-433
- EXEC test dependency codes message text
 - module description 6-334
- exit, asynchronous scheduling in stage-3 exit effector 4-134
- exit, attention (see attention exit)
- exit effectors
 - stage 1 4-130
 - stage 2 4-132
 - stage 3 4-134
 - stage 3 switch, checking 4-132
 - use in task dispatching 4-78
- exit handling (see EXIT routine)
- exit, initiator 3-200-3-201
- exit, LOGON
 - post-TMP 2-466
 - pre-prompt 2-460
 - pre-TMP 2-464
- EXIT prolog
 - EOT determination 4-258
 - force dispatch switch 4-259
 - passing control to EXIT routine 4-259
 - processing 4-258
- EXIT routine 4-256
- exit processing, RTM1 4-376
- exit, asynchronous, processing in task dispatcher 4-79
- exit, user error
 - in checking a time interval using TTIMER 4-11
 - in establishing timer intervals using STIMER 4-9
 - in processing TIME requests 4-7
- express swap-in 3-23.0, 3-36 (VS2.03.807)
- extended SVC routing (ESR) 4-86-4-87, 4-44
- extension block address 3-521 (VS2.03.807)
- external call second level interrupt handler 4-126
- external first level interrupt processor (see also external interrupt processing)
 - codes 4-98
 - processing 4-98
- external interrupt processing 2-168, 4-98
- external old PSW 4-99
- external parameter area (see EPA)
- external parameter area locate mode (see EPA)
- external parameter area move mode (see EPA)
- EXTRACT macro instruction processing 4-254

- faults (see page faults)
- FBQE (free block queue element)
 - in FREEMAIN 5-97
 - in VSM address space creation 5-102
- fetch (see program fetch)
- FETCHLIB 3-204
- find page routine 5-78
- FINDPE diagram 5-378
- FINISH diagram 5-320
- first level interrupt handler
 - external 4-98
- five functional groups in SRM 3-3 (VS2.03.807)
- fixed device control (IEFAB430)
 - count fields updated 3-294
 - direct access UCB use 3-294
 - processing
 - flowchart 6-52
 - function 3-294
 - module description 6-311
 - use with common allocation control 3-283
 - use with nonspecific volume allocation control 3-297
- FLIH (first level interrupt handler)
 - external 4-98
- FOE (fixed ownership element)
 - in PGFIX/PGLOAD 5-34
 - in PGFREE 5-38
- force dispatching switch, setting in exit prolog 4-259
- foreground jobs, cancelling 2-254-2-255
- FQE (free queue element)
 - in VSM address space creation 5-102
- frame (see page frame)
- frame, page, allocation of 5-24
- FRECELL routine processing 5-112
- FREECORE diagram 5-134
- freeing a virtual region (FREEPART routine) 5-100
- freeing a V=R region 5-12
- freeing an address space 5-104
- freeing pages 5-14
- freeing TQE space in TTIMER routine 4-10
- FREEMAIN processing (freeing virtual storage) 5-96
- FREEMAIN release processing 5-16
- FRR 7-477
- FRR (see functional recovery routine)
- FRR stack
 - in dispatching local SRBs 4-74
 - initialization 4-440
 - in I/O interrupt handler 4-95
 - in restart interrupt handler 4-118
 - in routing to FRRs 4-354
- FRRWA (RCT FRR work area)
 - in attention exit prolog and epilog 2-420
 - in attention exit purge 2-424
 - in attention exit scheduler 2-418
 - in STAX service routine 2-416
- full analysis (see system resources manager)
- functional recovery routines 7-477
- function codes
 - in subsystem interface 3-161
 - in SWA manager move mode 3-264
 - in SWA manager locate mode 3-266
 - used by JES2 and JES3 3-161
- functional recovery routine (see also termination conditions)
 - for communications task 2-202
 - for SRM 3-9, 3-7
 - relationship to recovery/termination 1-37
 - routing to 4-354
 - RSM 5-82
 - SLIP processing 4-356-4-357
 - "SUPER" (supervisor control) 4-172
 - use by LINK routine 4-282-4-283
 - use by SPIE 4-251
 - use by XCTL 4-304

- GDA (global data area)
 - in freeing an address space 5-104
 - in GETMAIN 5-95
 - in deleting a quickcell 5-114
 - in FREECORE 5-112
 - in GETCELL 5-110
- GDG (generation data group) processing

- flowchart 6-57
- function 3-323-3-325
- module description 6-314
- GDGALL requests, processing 3-325
- GDGNT (generation data group name table)
 - in DD function control 3-324
 - in JLOCATE 3-334
- general trace facility (GTF) 7-479
- generation data group (see GDG)
- generic allocation control (IEFAB471)
 - AVR 3-341
 - flowchart 6-61-6-62
 - function 3-338
 - module description 6-314-6-315
- generic processing, build tables for
 - flowchart 6-61
 - function 3-338-3-339
 - module description 6-315
- generic table build processing 3-338
- GET
 - in pseudo access method 3-184
- GETACE diagram 5-130
- GETALLX diagram 5-324
- GETANIDE diagram 5-384
- GETCELL routine processing 5-110
- GETCORE diagram 5-126
- GETERASE diagram 5-332
- GETEXTS diagram 5-326
- GETIOE diagram 5-380
- GETLGN diagram 5-124
- GETLINE macro instruction, issued by LOGON/LOGOFF
 - verification 2-455
- GETLPME diagram 5-190
- GETMAIN processing 5-94
- GETONE diagram 5-314
- GETPART/FREEPART routine 5-98-5-101
- getting a virtual region 5-98
- GFA (general from allocation) queue
 - in PGFREE routine 5-39
- global SRB
 - dispatcher 4-74
 - overview 1-34
- global storage
 - freed when task terminates 5-106
- GMAFREE diagram 5-164
- GMAGET diagram 5-162
- GMT (Greenwich Mean Time)
 - in processing TIME requests 4-6
 - timer interval requests in STIMER routine 4-9
- graphics console
 - commands processing
 - light pen and PFK commands 2-186
 - typed commands 2-184
 - deleting messages from 2-166
 - displaying single line messages 2-122
- group ID list
 - in allocation via algorithm 3-348
- group lock/unlock ESTAE exit (IEFAB4E7) (VS2.03.804)
 - flowchart 6-78 (VS2.03.804)
 - function 3-411 (VS2.03.804)
 - module description 6-307 (VS2.03.804)
- group lock/unlock interface (IEFAB4EC) (VS2.03.804)
 - flowchart 6-78 (VS2.03.804)
 - function 3-411 (VS2.03.804)
 - module description 6-306 (VS2.03.804)
- GSA (global save area)
 - in stopping and restarting the system via interrupt 2-392
- GSMQ (global service manager queue)
 - in dispatcher 4-54
 - in PURGEDQ 4-144
 - in SCHEDULE processing 4-138
- GSPACE/FSPACE service routines
 - module description 6-309
- GSPL (global service priority list)
 - dispatching global SRBs 4-72
 - in PURGEDQ 4-144
 - in dispatcher 4-54
 - in SCHEDULE processing 4-142
- GWT
 - in step initiation 3-200
- HALT command
 - initialization 2-300
 - processing 2-302
- HALT EOD and switch-SMF processor
 - flowchart 6-12, 6-17, 6-89
 - function 2-302
 - module description 6-304
- HALT NET command 2-391
- HALT TP command 2-387
- hardcopy informational message module
 - flowchart 6-18
 - function 2-366
 - module description 6-302
- hardcopy system log
 - saving 2-307
- hardware error processing 4-348, 4-326
- hardware status bytes, timer, checking 4-39
- header record for job journal, step, building 3-512
- high order synchronization in TOD clock status test routine 4-35
- HIPO (see Method-of-Operation section)
- HOLD parameter of LOGOFF command 2-455
- HOLD TP command 2-388
- housekeeping (see JFCB housekeeping)
- housekeeping ESTAE exit
 - module description 6-306
- HSKPWA (JFCB housekeeping work area)
 - in DD function control 3-322
 - in JFCB housekeeping control 3-314
 - in JLOCATE 3-334
- ICBME object module
 - function 3-350-3-351, 3-377
- ICB2AIR object module
 - function 4-406-4-407, 4-416-4-417
- ICT
 - in I/O load balancing swap analysis (SRM) 3-56
 - in I/O management (SRM) 3-54
 - in storage management (SRM) 3-48
- ID, message
 - use in DOM device support processing 2-167
- identification of commands in command processing (IEE5403D) 2-242
- IDENTIFY macro instruction
 - relationship to program management 1-37
- IDENTIFY routine 4-296
- IDACAT11 object module
 - function in JLOCATE 3-337
- IEACVET1 object module
 - function 2-181
- IEAQWAIT object module
 - flowchart 6-118
- IEATLEXT object module
 - flowchart 6-103
 - function 4-23
- IEAVAD0A object module
 - flowchart 6-197
 - module description 6-256
- IEAVAD0B object module
 - flowchart 6-197

module description 6-257
 IEAVAD0C object module
 flowchart 6-197
 module description 6-257
 IEAVAD0D object module
 flowchart 6-197
 module description 6-257
 IEAVAD00 object module
 flowchart 6-198
 module description 6-257
 IEAVAD01 object module
 flowchart 6-196-6-197
 module description 6-257
 IEAVAD02 object module
 flowchart 6-196
 module description 6-257
 IEAVAD03 object module
 flowchart 6-196
 module description 6-257
 IEAVAD05 object module
 flowchart 6-196
 module description 6-257
 IEAVAD06 object module
 flowchart 6-196
 module description 6-257
 IEAVAD07 object module
 flowchart 6-196
 module description 6-258
 IEAVAD08 object module
 flowchart 6-196
 module description 6-258
 IEAVAD11 object module
 flowchart 6-197
 module description 6-258
 IEAVAD31 object module
 flowchart 6-197
 module description 6-258
 IEAVAD51 object module
 flowchart 6-197
 module description 6-258
 IEAVAD71 object module
 flowchart 6-197
 module description 6-258
 IEAVAMSI object module
 flowchart 6-134, 6-165-6-168
 function 5-55
 module description 6-258
 IEAVAR00 object module
 flowchart 6-22, 6-23
 function 2-427, 2-407
 module description 6-259
 IEAVAR01 object module
 flowchart 6-23
 function 2-409
 module description 6-259
 IEAVAR02 object module
 flowchart 6-23-6-26
 function 2-413
 module description 6-259
 IEAVAR03 object module
 flowchart 6-27, 6-23
 function 2-415
 module description 6-259
 IEAVAR04 object module
 flowchart 6-28, 6-23
 function 2-419
 module description 6-259
 IEAVAR05 object module
 flowchart 6-29-6-30
 function 2-421, 2-423
 module description 6-259
 IEAVAR06 object module
 flowchart 6-30
 function 2-423
 module description 6-259
 IEAVAR07 object module
 flowchart 6-31
 function 2-425
 module description 6-259
 IEAVAX00 object module
 flowchart 6-31
 function 2-417
 module description 6-260
 IEAVBLDP object module
 flowchart 6-183
 function 5-74
 module description 6-260
 IEAVCARR object module
 function 5-105, 5-103, 5-107
 module description 6-260
 IEAVCKEY object module (VS2.03.805)
 flowchart 6-188 (VS2.03.805)
 function 5-88, 5-93, 5-116 (VS2.03.805)
 module description 6-260 (VS2.03.805)
 IEAVCKRR object module 6-260 (VS2.03.805)
 IEAVCSEG object module
 flowchart 6-130, 6-136, 6-143, 6-185
 function 5-19
 module description 6-260
 IEAVDELP object module
 flowchart 6-188
 module description 6-260
 IEAVDLAS object module
 flowchart 6-171, 6-174
 function 5-60-5-62
 module description 6-260
 IEAVDSEG object module
 flowchart 6-140, 6-142, 6-143
 function 5-20
 module description 6-260
 IEAVEAC0 object module
 flowchart 6-120, 6-158, 6-163
 function 4-164, 5-52
 module description 6-260
 IEAVEADV object module
 flowchart 6-100
 IEAVEAT0 object module
 flowchart 6-124
 function 4-198
 module description 6-261
 IEAVECBV object module
 flowchart 6-122
 IEAVECH0 object module
 flowchart 6-125
 function 4-214
 module description 6-261
 IEAVEDR object module
 flowchart 6-114, 6-127
 function 4-124
 module description 6-261
 IEAVEDSR object module
 flowchart 6-122
 function 4-172
 module description 6-261
 IEAVEDS0 object module
 flowchart 6-119, 6-120, 6-124-6-127
 function 4-54
 module description 6-261
 IEAVEED0 object module
 flowchart 6-124
 function 4-206
 module description 6-261

IEAVEEEP object module
 module description 6-261
 IEAVEEER object module
 flowchart 6-122
 module description 6-261
 IEAVEEE0 object module
 flowchart 6-120
 function 4-134
 module description 6-262
 IEAVEEE2 object module
 flowchart 6-120
 function 4-132
 module description 6-262
 IEAVEES object module
 flowchart 6-114, 6-118
 function 4-128
 module description 6-262
 IEAVEEXP object module
 flowchart 6-124-6-129
 function 4-258
 module description 6-262
 IEAVEEXT object module
 flowchart 6-114, 6-118, 6-184
 function 4-99
 module description 6-262
 IEAVEE1R object module
 function 4-103
 module description 6-262
 IEAVEE2R object module
 module description 6-263
 IEAVEE3R object module
 function 4-103
 module description 6-263
 IEAVEF00 object module
 flowchart 6-120
 function 4-130
 module description 6-263
 IEAVEIO object module
 flowchart 6-117
 function 4-94
 module description 6-263
 IEAVEIOR object module
 function 4-98
 module description 6-263
 IEAVEIPR object module
 flowchart 6-114
 function 4-125
 module description 6-263
 IEAVELCR object module
 flowchart 6-122
 function 4-177
 module description 6-263
 IEAVELK object module
 flowchart 6-121
 function 4-148
 module description 6-263
 IEAVELKR object module
 flowchart 6-121
 function 4-161
 module description 6-263
 IEAVEMCR object module
 flowchart 6-13, 6-14, 6-16, 6-21
 function 2-250
 module description 6-264
 IEAVEMDL object module
 function 2-400
 module description 6-264
 IEAVEMIN object module
 flowchart 6-8, 6-21
 module description 6-264
 IEAVEMRQ object module
 flowchart 6-13, 6-14, 6-16
 function 2-251, 2-245
 module description 6-264
 IEAVEMSI object module
 flowchart 6-114
 function 4-126
 IEAVEMSO object module
 flowchart 6-119
 function 4-84
 module description 6-264
 IEAVENQ1 object module
 flowchart 6-124, 6-125
 function 4-242
 module description 6-264
 IEAVEOR object module
 function 4-256
 module description 6-264
 IEAVEPC object module
 flowchart 6-115
 function 4-104
 module description 6-264
 IEAVEPCR object module
 function 4-115
 module description 6-265
 IEAVEPDR object module
 flowchart 6-121
 function 4-145
 module description 6-265
 IEAVEPDO object module
 flowchart 6-121
 function 4-144
 module description 6-265
 IEAVEQR object module
 flowchart 6-136-6-137
 function 5-8
 module description 6-265
 IEAVEQV0 object module
 flowchart 6-122
 function 4-170
 module description 6-266
 IEAVERER object module
 function 4-119
 module description 6-266
 IEAVERES object module
 flowchart 6-117
 function 4-116
 module description 6-266
 IEAVERI object module
 flowchart 6-114
 function 4-120
 module description 6-266
 IEAVERP object module
 flowchart 6-114
 function 4-122
 module description 6-266
 IEAVESCR object module
 flowchart 6-121, 6-122
 function 4-142
 module description 6-266
 IEAVESCO object module
 function 4-138
 module description 6-267
 IEAVESPR object module
 flowchart 6-122
 function 4-172
 module description 6-267
 IEAVESVC object module
 flowchart 6-116
 function 4-86
 module description 6-267
 IEAVESVR object module

function 4-93
 module description 6-267
IEAVETCL (VS2.03.807)
 function (resume) 4-192.5 (VS2.03.807)
 function (suspend) 4-192 (VS2.03.807)
 module description 6-267 (VS2.03.807)
 special entry 4-81 (VS2.03.807)
IEAVET6E (VS2.03.807)
 function 4-92.1-4-93.0 (VS2.03.807)
IEAVEVAL object module
 function 4-162
 module description 6-267
IEAVEVRR object module
 flowchart 6-122
 function 4-178-4-179
 module description 6-268
IEAVEVTO
 flowchart 6-127
 function 4-234
 module description 6-268
IEAVEXS object module
 flowchart 6-114, 6-118
 function 4-126
 module description 6-268
IEAVFP object module
 flowchart 6-184
 function 5-78
 module description 6-268
IEAVFRCL object module
 flowchart 6-188
 function 5-112
 module description 6-268
IEAVFREE object module
 flowchart 6-132
 function 5-38
 module description 6-268
IEAVFXLD object module
 flowchart 6-151
 function 5-34
 module description 6-268
IEAVGCAS object module
 flowchart 6-187
 function 5-102-5-107
 module description 6-269
IEAVGFA object module
 flowchart 6-145-6-146
 function 5-24
 module description 6-269
IEAVGFRR object module
 function 5-95, 5-97
 module description 6-269
IEAVGM00 object module
 flowchart 6-185
 function 5-94-5-97
 module description 6-269
IEAVGPRR object module
 function 5-99, 5-101
 module description 6-269
IEAVGTCL object module
 flowchart 6-188
 function 5-110
 module description 6-270
IEAVID00 object module
 flowchart 6-129
 function 4-296
 module description 6-270
IEAVINV object module
 flowchart 6-184
 function 5-76
 module description 6-270
IEAVIOCP object module
 flowchart 6-132-6-134
 function 5-30
 module description 6-270
IEAVITAS object module
 flowchart 6-169
 function 5-58
 module description 6-270
IEAVLK00 object module
 flowchart 6-148-6-129
 function 4-278, 4-290, 4-292, 4-294, 4-300
 module description 6-270
IEAVLK01 object module
 flowchart 6-128-6-129
 function 4-286-4-289
 module description 6-271
IEAVLK02 object module
 flowchart 6-129
 module description 6-272
IEAVLK03 object module
 function 4-280-4-281
 module description 6-272
IEAVMASV object module
 module description 6-272
IEAVMDOM object module
 flowchart 6-4
 function 2-154
 module description 6-272
IEAVMDSV object module
 flowchart 6-5, 6-7
 function 2-110, 2-178, 2-130
 module description 6-272
IEAVMED2 object module
 module description 6-273
IEAVMFRR object module
 function 2-202
 module description 6-273
 use of 4-415
IEAVMNTR object module
 flowchart 6-14
 function 2-314
 module description 6-273
IEAVMODE object module
 flowchart 6-127
 function 4-268
 module description 6-273
IEAVMQR0 object module
 flowchart 6-3
 function 2-114
 module description 6-273
IEAVMQR object module
 flowchart 6-3, 6-5, 6-7
 function 2-97-2-99
 module description 6-273
 use of 2-168, 2-130, 2-154, 2-176
IEAVMWSV object module
 flowchart 6-2
 function 2-26
 module description 6-274
IEAVMWTO object module
 flowchart 6-2
 function 2-72
 module description 6-274
 use of 2-34
IEAVOUT object module
 flowchart 6-279
 function 5-40
 module description 6-274
IEAVPCB object module
 function 5-74
 module description 6-274
IEAVPFTE object module

flowchart 6-135-6-141, 6-145-6-148, 6-154, 6-160,
 6-165-6-178, 6-182
 function 5-72
 module description 6-274
IEAVPIOI object module
 flowchart 6-133, 6-163-6-164
 function 5-52
 module description 6-274
IEAVPIOP object module
 flowchart 6-132-6-133
 function 5-28
 module description 6-274
IEAVPIX object module
 flowchart 6-131
 function 5-22
 module description 6-274
IEAVPREF object module
 flowchart 6-135
 function 5-84, 6-145
 module description 6-275
IEAVPRT0 object module
 flowchart 6-130, 6-185
 function 5-98-5-101
 module description 6-275
IEAVPSI object module
 flowchart 6-132, 6-134
 function 5-32
 module description 6-275
IEAVRCF object module
 flowchart 6-178-6-179
 function 5-68
 module description 6-275
IEAVRCV object module
 function 5-82
 module description 6-275
IEAVRELS object module
 flowchart 6-130, 6-132
 function 5-14
 module description 6-275
IEAVRFR object module
 flowchart 6-175-6-177
 function 5-64
 module description 6-276
IEAVRSET object module
 flowchart 6-173
IEAVRTI0 object module
 flowchart 6-101-6-105
 function 4-18
 in SETDIE routine 4-11.1 (VS2.03.807)
 module description 6-276
IEAVRTI1 object module
 flowchart 6-98-6-100
 function 4-36, 4-17, 4-24
 module description 6-276
IEAVRTOD object module
 flowchart 6-106-6-108, 6-109, 6-111, 6-112
 function 4-38, 4-34, 4-32, 4-30
 module description 6-276
IEAVRT00 object module
 flowchart 6-93-6-97
 function 4-10, 4-8
 module description 6-277
IEAVRT01 object module
 flowchart 6-91-6-92
 function 4-6, 4-9
 module description 6-277
IEAVRT02 object module (VS2.03.807)
 flowchart 6-133 (VS2.03.807)
 function 4-3, 4-4, 4-11.0-4-11.1 (VS2.03.807)
 module description 6-277 (VS2.03.807)
IEAVSETS object module
 flowchart 6-127
 function 4-260
 module description 6-277
IEAVSOUT object module
 flowchart 6-160-6-162, 6-164
 function 5-46, 5-50
 module description 6-277
IEAVSQA object module
 function 5-6-5-7
 module description 6-277
IEAVSSNQ (entry name)
 flowchart 6-160
 function 4-266
IEAVSTAA object module
 function 2-212
 module description 6-277
IEAVSTA0 object module
 flowchart 6-193
 function 4-430
 module description 6-278
IEAVSUSP object module
 flowchart 6-145
IEAVSWCH object module
 flowchart 6-6
 function 2-170, 2-134
 module description 6-278
IEAVSWIN object module
 flowchart 6-133, 6-157-6-159, 6-147
 function 5-42, 5-44
 module description 6-278
IEAVSWPC object module (VS2.03.807)
 flowchart 6-133, 6-164 (VS2.03.807)
 function 5-4, 5-50-5-51.0 (VS2.03.807)
 module description 6-278 (VS2.03.807)
IEAVSWPP object module (VS2.03.807)
 flowchart 6-159 (VS2.03.807)
 function 5-4, 5-45.0-5-45.1 (VS2.03.807)
 special recovery check 5-82-5-83 (VS2.03.807)
IEAVSY50 object module
 flowchart 6-125
 function 4-222
 module description 6-278
IEAVTABD object module
 flowchart 6-190
 function 4-392, 4-381
 module description 6-278
IEAVTABI object module
 function (see OS/VS2 System Initialization Logic)
 module description 6-279
IEAVTACR object module
 flowchart 6-194
 function 4-436
 module description 6-279
IEAVTAS1 object module
 flowchart 6-190
 function 4-388
 module description 6-279
IEAVTAS2 object module
 flowchart 6-190
 function 4-388
 module description 6-279
IEAVTAS3 object module
 flowchart 6-190
 function 4-390
 module description 6-279
IEAVTB00 object module
 flowchart 6-126
 function 4-250, 4-254
 module description 6-279
IEAVTCTL object module (VS2.03.807)
 flowchart (VS2.03.807)

function 4-51, 4-192.1 (VS2.03.807)
 in stage 3 exit effector 4-135 (VS2.03.807)
 module description (VS2.03.807)

IEAVTERM object module
 flowchart 6-173-6-174, 6-192
 function 5-62
 module description 6-280

IEAVTEST object module
 flowchart 6-127
 function 4-270
 module description 6-280

IEAVTMMT object module
 flowchart 6-191
 function 4-410
 module description 6-280

IEAVTMRM object module
 function 4-416
 module description 6-280

IEAVTMSI object module
 module description 6-280

IEAVTMTC object module
 flowchart 6-192
 function 4-426
 module description 6-280

IEAVTMTR object module
 flowchart 6-192
 function 4-428
 module description 6-280

IEAVTPMT object module
 flowchart 6-190
 module description 6-281

IEAVTRCE object module
 function 4-168
 module description 6-281

IEAVTRER object module
 flowchart 6-195
 function 4-466
 module description 6-281

IEAVTRET object module
 flowchart 6-195
 function 4-468
 module description 6-281

IEAVTRML object module
 module description 6-281

IEAVTRTC object module
 flowchart 6-190
 function 4-380-4-381
 module description 6-282

IEAVTRTE object module
 flowchart 6-191
 function 4-380-4-381
 module description 6-282

IEAVTRTH object module
 flowchart 6-189
 function 4-348, 4-342
 module description 6-282

IEAVTRTM object module
 flowchart 6-189
 function 4-366, 4-370, 4-352, 4-371, 4-343
 module description 6-282

IEAVTRTR object module
 flowchart 6-189
 function 4-360-4-361, 4-356-4-357, 4-362-4-363
 module description 6-282

IEAVTRTS object module
 flowchart 6-189
 function 4-354
 module description 6-283

IEAVTRT1 object module
 flowchart 6-120-6-122, 6-151, 6-157, 6-189, 6-193, 6-199
 function 4-344, 4-376, 4-342

module description 6-283

IEAVTRT2 object module
 flowchart 6-190
 function 4-382, 4-385
 module description 6-284

IEAVTRV object module
 flowchart 6-184
 function 5-80
 module description 6-284

IEAVTSBP object module
 module description 6-284

IEAVTSDI object module
 module description 6-284

IEAVTSDR object module
 module description 6-284

IEAVTSDT object module
 flowchart 6-199
 function 4-460
 module description 6-284

IEAVTSDX object module
 flowchart 6-198-6-199
 function 4-458
 module description 6-285

IEAVTSIN object module
 flowchart 6-193
 function 4-440
 module description 6-285

IEAVTSKT object module
 flowchart 6-191
 function 4-398
 module description 6-285

IEAVVCRA object module
 flowchart 6-5
 function 2-174
 module description 6-285

IEAVVCRX object module
 flowchart 6-6
 function 2-168
 module description 6-285

IEAVVCTR object module
 flowchart 6-3-6-5, 6-7
 function 2-168, 2-22, 2-130, 2-174
 module description 6-285

IEAVVRP1 object module
 module description 6-285

IEAVVRP2 object module
 module description 6-285

IEAVVWTO object module
 flowchart 6-2
 function 2-28
 module description 6-286

IEAVXDOM object module
 flowchart 6-4
 function 2-140
 module description 6-286

IEAV1052 object module
 flowchart 6-3
 function 2-22, 2-18, 2-120, 2-124, 2-182, 2-174

IEAV1443 object module
 flowchart 6-3
 function 2-124, 2-120, 2-18, 2-22

IEAV2540 object module
 function 2-18, 2-22, 2-182

IEA0PT01 object module
 function 4-222, 4-223

IEA0PT03 object module (VS2.03.805)
 function 4-222, 4-223 (VS2.03.805)

IEA1FIND object module
 function 2-81

IEDAY3 object module
 flowchart 6-13

module description 6-286
IED1303D object module
 flowchart 6-11, 6-12
 function 2-300, 2-348, 2-388
IEEAB400 object module
 flowchart 6-75-6-77
 module description 6-286
IEEAB401 object module
 flowchart 6-50, 6-75-6-77
 module description 6-286
IEECB800 object module
 flowchart 6-11, 6-17
 function 2-280
 module description 6-286
IEECB801 object module
 flowchart 6-11, 6-17
 function 2-284-2-285
 module description 6-286
IEECB860 object module
 function 2-280, 2-298, 2-330, 2-340, 2-346, 2-350
 module description 6-287
IEECB866 object module
 flowchart 6-12
 function 2-298
 module description 6-287
IEECB900 object module
 flowchart 6-19
 function 2-356-2-357
 module description 6-287
IEECB901 object module
 function 2-358-2-359
 module description 6-287
IEECB904 object module
 flowchart 6-18
 function 2-364
 module description 6-287
IEECLEAN object module
 flowchart 6-19
 function 2-370-2-371
 module description 6-287
IEECVETA object module
 function 2-186, 2-192
 module description 6-287
IEECVETC object module
 module description 6-287
IEECVETD object module
 function 2-188, 2-122
 module description 6-287
IEECVETE object module
 module description 6-288
IEECVETF object module
 function 2-186
 module description 6-288
IEECVETG object module
 function 2-18, 2-22
 module description 6-288
IEECVETH object module
 flowchart 6-4
 function 2-122, 2-166, 2-128, 2-184, 2-188, 2-184, 2-192,
 2-194, 2-198, 2-196
 module description 6-288
IEECVETJ object module
 function 2-198, 2-122
 module description 6-288
IEECVETK object module
 function 2-198, 2-192
 module description 6-288
IEECVETP object module
 flowchart 6-4
 function 2-192, 2-194, 2-198, 2-196, 2-188, 2-184, 2-122,
 2-128, 2-166
 module description 6-289
IEECVETR object module
 flowchart 6-4
 function 2-166, 2-122, 2-22, 2-184, 2-188, 2-198, 2-196,
 2-194, 2-192
 module description 6-289
IEECVETU object module
 flowchart 6-4
 function 2-192, 2-194, 2-188, 2-196, 2-198, 2-184, 2-122,
 2-128, 2-166
 module description 6-289
IEECVETW object module
 flowchart 6-3, 6-7
 function 2-124, 2-120, 2-22, 2-18, 2-174
 module description 6-289
IEECVET1 object module
 flowchart 6-4, 6-5, 6-7
 function 2-22, 2-122, 2-166, 2-128, 2-184, 2-198, 2-186
 module description 6-289
IEECVET2 object module
 function 2-122
 module description 6-290
IEECVET3 object module
 module description 6-290
IEECVET4 object module
 function 2-184
 module description 6-290
IEECVET6 object module
 function 2-188
 module description 6-290
IEECVET7 object module
 flowchart 6-4
 function 2-166
 module description 6-291
IEECVET8 object module
 function 2-188
 module description 6-291
IEECVET9 object module
 function 2-188, 2-122
 module description 6-291
IEECVFTA object module
 function 2-186
 module description 6-291
IEECVFTB object module
 function 2-190, 2-194
 module description 6-291
IEECVFTD object module
 module description 6-291
IEECVFTG object module
 function 2-24
 module description 6-291
IEECVFTL object module
 function 2-128
 module description 6-292
IEECVFTM object module
 function 2-128
 module description 6-292
IEECVFTN object module
 function 2-196
 module description 6-292
IEECVFTO object module
 function 2-128
 module description 6-292
IEECVFTP object module
 function 2-196
 module description 6-292
IEECVFTQ object module
 function 2-128
 module description 6-292
IEECVFTT object module
 module description 6-293

IEECVFT1 object module
 function 2-190
 module description 6-293
 IEECVFT2 object module
 function 2-128, 2-122
 module description 6-293
 IEEC2740 object module
 flowchart 6-2, 6-3, 6-7
 function 2-120, 2-20, 2-22, 2-18, 2-124, 2-182
 module description 6-293
 IEEDISPD object module (VS2.03.807)
 flowchart 6-11, 6-36.1 (VS2.03.807)
 module description 6-293 (VS2.03.807)
 IEEJB840 object module
 flowchart 6-2
 function 2-48
 module description 6-294
 IEEMB803 object module
 flowchart 6-89
 function 3-466, 3-470, 3-474, 3-472
 module description 6-294
 IEEMB804 object module
 flowchart 6-89
 function 3-480
 module description 6-294
 IEEMB805 object module
 module description 6-294
 IEEMB806 object module
 flowchart 6-89
 function 3-476
 module description 6-294
 IEEMB807 object module
 function 3-472, 3-468
 module description 6-294
 IEEMB810 object module
 flowchart 6-15
 function 2-330
 module description 6-294
 IEEMB811 object module
 flowchart 6-16
 function 2-340
 module description 6-294
 IEEMB812 object module
 flowchart 6-16, 6-36
 function 2-340
 module description 6-294
 IEEMB813 object module
 flowchart 6-18
 function 2-346
 module description 6-294
 IEEMB814 object module
 flowchart 6-16
 function 2-340
 module description 6-294
 IEEMB815 object module
 flowchart 6-193, 6-10
 function 2-260
 module description 6-295
 IEEMB822 object module
 flowchart 6-88
 module description 6-295
 IEEMB825 object module
 flowchart 6-88
 function 3-458
 module description 6-295
 IEEMB826 object module
 flowchart 6-88
 module description 6-295
 IEEMB827 object module
 flowchart 6-88
 function 3-460
 module description 6-295
 IEEMB828 object module
 flowchart 6-88
 module description 6-295
 IEEMB829 object module
 flowchart 6-88
 function 3-450-3-451, 3-456, 3-452, 3-454
 module description 6-295
 IEEMB830 object module
 flowchart 6-88
 function 3-452, 3-450-3-451
 module description 6-295
 IEEMB860 object module
 flowchart 6-88
 function 2-135
 module description 6-295
 IEEMPDM object module
 flowchart 6-11
 function 2-290
 module description 6-295
 IEEMPS03 object module
 flowchart 6-14
 function 2-320
 module description 6-296
 IEEMPVST object module
 flowchart 6-19
 function 2-384
 module description 6-296
 IEEMSER (see MSRDA)
 IEEPALTR object module
 flowchart 6-11
 function 2-294-2-295
 module description 6-296
 IEEPGEXP (VS2.03.807)
 program organization overview 6-14 (VS2.03.807)
 IEEPRTN load module
 flowchart 6-34
 IEEPRTN2 object module
 flowchart 6-32
 function 2-436
 module description 6-296
 IEEPRWI2 object module
 flowchart 6-32
 function 2-430
 module description 6-296
 IEESB601 object module
 flowchart 6-32
 function 2-436
 module description 6-296
 IEESB605 object module
 flowchart 6-32-6-33
 function 2-434, 2-436
 module description 6-296
 IEESB606 object module
 flowchart 6-21
 IEESB665 object module
 flowchart 6-33
 function 2-430
 module description 6-296
 IEESB670 object module
 flowchart 6-33
 function 2-434
 module description 6-297
 IEESTPRS object module
 flowchart 6-14
 function 2-392
 module description 6-297
 IEEVALST object module
 flowchart 6-19
 function 2-384
 module description 6-297

IEEVCPU object module
 flowchart 6-19
 function 2-370, 2-372, 2-374, 2-376, 2-378
 module description 6-297

IEEVDEV object module
 flowchart 6-19
 function 2-396
 module description 6-297

IEEVIOPM object module
 function 2-396

IEEVIPL object module
 module description 6-297

IEEVJCL object module
 function 2-432
 module description 6-297

IEEVMNT1 object module
 flowchart 6-32
 function 2-430, 2-432
 module description 6-297

IEEVMNT2 object module
 flowchart 6-32
 module description 6-297

IEEVMSG object module
 module description 6-298

IEEVPTH object module
 flowchart 6-19
 function 2-380
 module description 6-298

IEEVSEND object module
 flowchart 6-15
 function 2-332
 module description 6-298

IEEVSMSG object module
 flowchart 6-32

IEEVSND2 object module
 flowchart 6-15
 function 2-335
 module description 6-298

IEEVSND3 object module
 flowchart 6-15
 function 2-335
 module description 6-298

IEEVSND4 object module
 flowchart 6-15
 function 2-332
 module description 6-298

IEEVSND5 object module
 flowchart 6-15
 function 2-335
 module description 6-298

IEEVSND6 object module
 flowchart 6-15
 function 2-335
 module description 6-298

IEEVSND8 object module
 flowchart 6-15
 function 2-335
 module description 6-298

IEEVSND9 object module
 flowchart 6-15
 module description 6-298

IEEVSTAR object module
 flowchart 6-32
 function 2-432, 2-431
 module description 6-299

IEEVSTOP object module
 function 2-374
 module description 6-299

IEEVVRP1 object module
 function 2-324-2-327

IEEVVRP2 object module
 function 2-326-2-327

IEEVWAIT object module
 flowchart 6-89
 function 2-246, 2-294, 2-300
 module description 6-299

IEEVWKUP object module
 flowchart 6-19
 function 2-372, 2-374
 module description 6-299

IEEXEDNA object module
 flowchart 6-11
 function 2-286
 module description 6-299

IEE0003D object module
 flowchart 6-9
 function 2-234, 2-232
 module description 6-299

IEE00110 object module
 flowchart 6-11
 function 2-288, 2-294
 module description 6-299

IEE0303D object module
 flowchart 6-9
 function 2-240, 2-232
 module description 6-299

IEE0403D object module
 flowchart 6-9, 6-89, 6-193
 function 2-242, 2-232
 module description 6-299

IEE0503D object module
 flowchart 6-10, 6-14, 6-15
 function 2-238, 2-298, 2-330, 2-340
 module description 6-300

IEE0603D object module
 flowchart 6-16
 function 2-336
 module description 6-300

IEE0703D object module
 flowchart 6-14, 6-16
 function 2-312
 module description 6-300

IEE0803D object module
 flowchart 6-11-6-18
 function 2-244, 2-250, 2-300, 2-348, 2-388
 module description 6-300

IEE10110 object module
 flowchart 6-11
 function 2-288
 module description 6-300

IEE11110 object module
 function 2-288
 module description 6-300

IEE12110 object module
 module description 6-300

IEE1403D object module
 flowchart 6-12, 6-17
 function 2-300
 module description 6-300

IEE1603D object module
 flowchart 6-12, 6-20, 6-89
 function 2-306
 module description 6-300

IEE20110 object module
 flowchart 6-11
 function 2-296
 module description 6-300

IEE21110 object module
 function 2-296
 module description 6-300

IEE22110 object module
 function 2-296

module description	6-301	flowchart	6-9
IEE2303D object module		function	2-236
flowchart	6-20	module description	6-302
function	2-352	IEE5403D object module	
module description	6-301	flowchart	6-9
IEE23110 object module		function	2-242, 2-232
function	2-296	module description	6-302
module description	6-301	IEE5503D object module	
IEE2903D object module		flowchart	6-16, 6-17
flowchart	6-11	function	2-314, 2-344
function	2-292	module description	6-303
module description	6-301	IEE5603D object module	
IEE3103D object module		flowchart	6-14
flowchart	6-20	module description	6-303
module description	6-301	IEE5703D object module	
IEE3203D object module		flowchart	6-18
flowchart	6-18	function	2-366
function	2-348	module description	6-303
module description	6-301	IEE5903D object module	
IEE3303D object module		flowchart	6-14
flowchart	6-18	module description	6-303
function	2-350, 2-352	IEE6303D object module	
module description	6-301	flowchart	6-14
IEE3503D object module		function	2-318
flowchart	6-11, 6-17	module description	6-303
function	2-272, 2-274	IEE6403D object module	
module description	6-301	flowchart	6-14
IEE3603D object module		function	2-318
flowchart	6-18	module description	6-303
function	2-350	IEE6503D object module	
module description	6-301	flowchart	6-16
IEE3703D object module		function	2-336
flowchart	6-10	module description	6-303
function	2-254	IEE6603D object module	
module description	6-301	function	2-336
IEE40110 object module		module description	6-303
flowchart	6-11	IEE6703D object module	
function	2-294	flowchart	6-10, 6-17
module description	6-302	function	2-262, 2-344
IEE4103D object module		module description	6-303
flowchart	6-18	IEE6803D object module	
function	2-366	flowchart	6-10
module description	6-302	function	2-270
IEE4203D object module		module description	6-303
flowchart	6-20	IEE6903D object module	
function	2-352, 2-360	flowchart	6-10
module description	6-302	function	2-268, 2-270
IEE4303D object module		module description	6-303
flowchart	6-18	IEE70110 object module	
function	2-368, 2-348	flowchart	6-12, 6-17, 6-89
module description	6-302	function	2-302
IEE4403D object module		module description	6-304
flowchart	6-20	IEE7103D object module	
function	2-352	flowchart	6-14, 6-16
module description	6-302	function	2-314
IEE4603D object module		module description	6-304
flowchart	6-20	IEE7203D object module	
function	2-360	flowchart	6-18
module description	6-302	function	2-366
IEE4703D object module		module description	6-304
flowchart	6-18	IEE7303D object module	
function	2-366, 2-348	function	2-354
module description	6-302	module description	6-304
IEE4803D object module		IEE7503D object module	
function	2-354	flowchart	6-10, 6-11, 6-17
module description	6-302	function	2-262, 2-342, 2-274
IEE4903D object module		module description	6-304
flowchart	6-20	IEE7703D object module	
function	2-354	flowchart	6-10
module description	6-302	function	2-266
IEE5103D object module		module description	6-304

IEE7803D object module
 flowchart 6-10
 function 2-266
 module description 6-304
 IEE8603D object module (VS2.03.807)
 flowchart 6-16, 6-36.1 (VS2.03.807)
 module description 6-304 (VS2.03.807)
 IEE90110 object module
 flowchart 6-12, 6-17, 6-89
 function 2-304
 module description 6-304
 IEE9403D object module
 flowchart 6-10, 6-12, 6-14
 function 2-300-2-301
 module description 6-304
 IEFAB4A0 object module
 flowchart 6-49-6-50
 function 3-430
 function map for 3-430
 module description 6-304
 IEFAB4A2 object module
 flowchart 6-49, 6-78
 function 3-440
 module description 6-305
 IEFAB4A3 object module
 flowchart 6-49
 module description 6-305
 IEFAB4A4 object module
 flowchart 6-50
 function 3-444
 module description 6-305
 IEFAB4A6 object module
 flowchart 6-50, 6-75
 function 3-396-3-397
 module description 6-305
 IEFAB4A8 object module
 flowchart 6-50
 function 3-436-3-437
 module description 6-305
 IEFAB4B0 object module
 flowchart 6-49
 function 3-443
 module description 6-305
 IEFAB4B2 object module
 flowchart 6-49
 function 3-443
 module description 6-305
 IEFAB4DC object module
 flowchart 6-59, 6-84
 module description 6-305
 IEFAB4DD object module
 module description 6-305
 IEFAB4DE object module
 module description 6-306
 IEFAB4EA object module
 module description 6-306
 IEFAB4EB object module
 flowchart 6-59-6-60
 function 3-334-3-335
 module description 6-306
 IEFAB4EC object module (VS2.03.804)
 flowchart 6-78 (VS2.03.804)
 function 3-411 (VS2.03.804)
 module description 6-306 (VS2.03.804)
 IEFAB4ED object module (VS2.03.804)
 flowchart 6-78 (VS2.03.804)
 function 3-291-3-413 (VS2.03.804)
 module description 6-306 (VS2.03.804)
 IEFAB4EE object module
 flowchart 6-72, 6-77
 function 3-380-3-381
 module description 6-306
 IEFAB4EF object module
 flowchart 6-49, 6-56, 6-60
 function 3-336-3-337, 3-314-3-315
 module description 6-306
 IEFAB4E0 object module
 flowchart 6-61
 function 3-340-3-341
 module description 6-306
 IEFAB4E1 object module
 module description 6-306
 IEFAB4E2 object module
 module description 6-306
 IEFAB4E3 object module
 module description 6-307
 IEFAB4E4 object module
 module description 6-307
 IEFAB4E5 object module
 module description 6-307
 IEFAB4E6 object module
 module description 6-307
 IEFAB4E7 object module (VS2.03.804)
 flowchart 6-78 (VS2.03.804)
 function 3-411 (VS2.03.804)
 module description 6-307 (VS2.03.804)
 IEFAB4E8 object module
 module description 6-307
 IEFAB4E9 object module
 module description 6-307
 IEFAB4FA object module
 flowchart 6-50, 6-61, 6-66, 6-68, 6-71-6-73
 function 3-341, 3-346, 3-388, 3-290, 3-378, 3-435, 3-372
 module description 6-307
 IEFAB4FC object module
 flowchart 6-49-6-53, 6-64, 6-65, 6-68, 6-75, 6-77,
 6-81-6-84
 function 3-396, 3-398, 3-418, 3-436
 module description 6-308
 IEFAB4FD object module
 flowchart 6-49, 6-60, 6-71, 6-72, 6-75-6-77
 function 3-380, 3-398, 3-400
 module description 6-308
 IEFAB4FE object module
 flowchart 6-75, 6-77, 6-81
 function 3-396, 3-412
 module description 6-308
 IEFAB4F0 object module
 flowchart 6-55, 6-64, 6-71
 function 3-386, 3-357, 3-312
 module description 6-308
 IEFAB4F1 object module
 flowchart 6-52
 module description 6-308
 IEFAB4F2 object module
 flowchart 6-54, 6-62, 6-64-6-65
 function 3-368-3-369
 module description 6-308
 IEFAB4F3 object module
 flowchart 6-69-6-72, 6-75-6-77
 module description 6-308
 IEFAB4F4 object module
 flowchart 6-49, 6-60
 function 3-336, 3-318, 3-432
 module description 6-308
 IEFAB4F5 object module
 flowchart 6-39, 6-60
 function 3-336
 module description 6-309
 IEFAB4F6 object module
 module description 6-309
 IEFAB4F7 object module

flowchart 6-49, 6-59, 6-56-6-60, 6-75, 6-77, 6-84
 function 3-316, 3-412, 3-418, 3-400, 3-322
 module description 6-309
 IEFAB4F8 object module
 flowchart 6-61, 6-74
 function 3-340, 3-394
 module description 6-309
 IEFAB4F9 object module
 flowchart 6-61, 6-80
 function 3-340, 3-418
 module description 6-309
 IEFAB4M4 object module
 module description 6-309
 IEFAB4M5 object module
 module description 6-309
 IEFAB4M6 object module
 module description 6-310
 IEFAB4M7 object module
 module description 6-310
 IEFAB4M9 object module
 module description 6-310
 IEFAB4UV object module
 module description 6-310
 IEFAB421 object module
 flowchart 6-47-6-48, 6-51, 6-72
 function 3-280
 module description 6-310
 IEFAB422 object module
 flowchart 6-51
 function 3-282-3-283
 module description 6-310
 IEFAB423 object module
 flowchart 6-51
 function 3-282-3-283
 module description 6-310
 IEFAB424 object module
 flowchart 6-51
 function 3-282-3-283
 module description 6-311
 IEFAB425 object module
 flowchart 6-52
 function 3-286-3-287
 module description 6-311
 IEFAB426 object module
 flowchart 6-51
 function 3-282-3-283
 module description 6-311
 IEFAB427 object module
 flowchart 6-51
 module description 6-311
 IEFAB428 object module
 flowchart 6-49, 6-51-6-54, 6-62, 6-64-6-65, 6-68
 function 3-280-3-281, 3-302-3-303
 module description 6-311
 IEFAB430 object module
 flowchart 6-52
 function 3-294
 module description 6-311
 IEFAB431 object module
 flowchart 6-51
 function 3-280-3-281
 module description 6-311
 IEFAB432 object module
 flowchart 6-54
 function 3-304-3-305
 module description 6-311
 IEFAB433 object module
 flowchart 6-53, 6-62, 6-64-6-65
 function 3-298
 module description 6-311
 IEFAB434 object module
 flowchart 6-48, 6-53-6-54, 6-52, 6-55, 6-62-6-65, 6-73
 function 3-302
 module description 6-312
 IEFAB435 object module
 flowchart 6-53
 function 3-302
 module description 6-312
 IEFAB436 object module
 flowchart 6-55, 6-48, 6-52, 6-62-6-65
 function 3-308
 module description 6-312
 IEFAB438 object module
 flowchart 6-51
 function 3-282-3-283
 module description 6-312
 IEFAB440 object module
 flowchart 6-55, 6-63, 6-68, 6-70, 6-72-6-73
 function 3-350, 3-310
 module description 6-312
 IEFAB441 object module
 flowchart 6-53, 6-54, 6-68
 function 3-368, 3-302
 module description 6-312
 IEFAB442 object module
 flowchart 6-52, 6-54, 6-62, 6-64-6-65
 function 3-304, 3-298, 3-368
 module description 6-312
 IEFAB445 object module
 module description 6-313
 IEFAB451 object module
 flowchart 6-47, 6-56
 function 3-314
 module description 6-313
 IEFAB452 object module
 flowchart 6-56
 function 3-324, 3-314
 module description 6-313
 IEFAB453 object module
 flowchart 6-56
 function 3-314-3-315
 module description 6-313
 IEFAB454 object module
 flowchart 6-47, 6-57-6-59
 function 3-322
 module description 6-313
 IEFAB455 object module
 flowchart 6-60
 function 3-334
 module description 6-313
 IEFAB456 object module
 flowchart 6-57
 function 3-324
 module description 6-313
 IEFAB457 object module
 flowchart 6-58
 function 3-326
 module description 6-313
 IEFAB458 object module
 flowchart 6-59
 function 3-330-3-331
 module description 6-313
 IEFAB459 object module
 flowchart 6-59
 function 3-332-3-333
 module description 6-314
 IEFAB461 object module
 flowchart 6-57
 function 3-323-3-325
 module description 6-314
 IEFAB463 object module
 flowchart 6-58

function 3-326, 3-328
 module description 6-314
 IEFAB464 object module
 flowchart 6-58
 function 3-328, 3-330
 module description 6-314
 IEFAB466 object module
 flowchart 6-60
 function 3-326, 3-334
 module description 6-314
 IEFAB469 object module
 flowchart 6-47, 6-60
 function 3-334
 module description 6-314
 IEFAB470 object module
 flowchart 6-56
 function 3-316-3-317
 module description 6-314
 IEFAB471 object module
 flowchart 6-61-6-62
 function 3-338
 module description 6-314
 IEFAB472 object module
 flowchart 6-61
 function 3-338-3-339
 module description 6-315
 IEFAB473 object module
 flowchart 6-61
 function 3-340, 3-341
 module description 6-315
 IEFAB474 object module
 flowchart 6-63, 6-67
 function 3-348, 3-366
 module description 6-315
 IEFAB475 object module
 flowchart 6-62
 function 3-342, 3-344, 3-346
 module description 6-315
 IEFAB476 object module
 flowchart 6-63
 function 3-348
 module description 6-315
 IEFAB477 object module
 flowchart 6-63, 6-67
 function 3-360, 3-348, 3-368
 module description 6-315
 IEFAB478 object module
 flowchart 6-63, 6-73
 function 3-370, 3-350, 3-290
 module description 6-315
 IEFAB479 object module
 flowchart 6-64, 6-48, 6-61, 6-73
 function 3-355
 module description 6-316
 IEFAB48A object module
 flowchart 6-69
 function 3-374-3-375
 module description 6-316
 IEFAB480 object module
 flowchart 6-63, 6-67, 6-73
 function 3-366, 3-348, 3-374, 3-280
 module description 6-316
 IEFAB481 object module
 flowchart 6-53, 6-62-6-68
 function 3-348, 3-362, 3-366
 module description 6-316
 IEFAB485 object module
 flowchart 6-48, 6-65-6-66, 6-52
 function 3-358
 module description 6-316
 IEFAB486 object module
 flowchart 6-67-6-69, 6-48
 function 3-366
 module description 6-316
 IEFAB487 object module
 flowchart 6-69
 function 3-374, 3-364
 module description 6-316
 IEFAB488 object module
 flowchart 6-69
 function 3-374, 3-376
 module description 6-317
 IEFAB489 object module
 flowchart 6-70
 function 3-377
 module description 6-317
 IEFAB49A object module
 flowchart 6-74, 6-71
 function 3-394, 3-388
 module description 6-317
 IEFAB49B object module
 flowchart 6-74
 function 3-394
 module description 6-317
 IEFAB49C object module
 flowchart 6-50, 6-53, 6-61, 6-63, 6-65-6-67, 6-73
 function 2-346, 3-340, 3-358, 3-304, 3-368, 3-410
 module description 6-317
 IEFAB490 object module
 flowchart 6-71-6-72, 6-48, 6-52
 function 3-378
 module description 6-317
 IEFAB491 object module
 flowchart 6-73, 6-48, 6-52
 function 3-280, 3-366
 module description 6-317
 IEFAB492 object module
 flowchart 6-71
 function 3-386
 module description 6-318
 IEFAB493 object module
 flowchart 6-48, 6-50, 6-53, 6-61, 6-63, 6-65-6-68, 6-71,
 6-73, 6-74, 6-78
 function 3-390
 module description 6-318
 IEFAB494 object module
 flowchart 6-50, 6-51, 6-53, 6-63, 6-65-6-68, 6-73-6-74,
 6-78
 function 3-390
 module description 6-318
 IEFAB495 object module
 flowchart 6-74
 function 3-392
 module description 6-318
 IEFAB496 object module
 function 3-394
 module description 6-318
 IEFAB498 object module
 flowchart 6-74, 6-71
 function 3-390, 3-388, 3-394
 module description 6-318
 IEFAB499 object module
 flowchart 6-50-6-51, 6-53, 6-54, 6-61, 6-63, 6-65-6-67,
 6-73-6-74, 6-78
 function 3-392
 module description 6-318
 IEFAB820 object module
 flowchart 6-39
 function 3-206
 module description 6-319
 IEFACRT object module
 flowchart 6-77

IEFBB4M1 object module
 module description 6-319
 IEFBB4M2 object module
 module description 6-319
 IEFBB4M3 object module
 module description 6-319
 IEFBB4M4 object module
 module description 6-319
 IEFBB4M5 object module
 module description 6-319
 IEFBB401 object module
 flowchart 6-75-6-76
 function 3-396
 module description 6-319
 IEFBB402 object module
 flowchart 6-75
 function 3-396
 module description 6-320
 IEFBB404 object module
 flowchart 6-75
 function 3-398
 module description 6-320
 IEFBB410 object module
 flowchart 6-77-6-79, 6-47, 6-40
 function 3-402, 3-404
 module description 6-320
 IEFBB412 object module
 flowchart 6-77
 function 3-406, 3-414
 module description 6-320
 IEFBB414 object module
 flowchart 6-77
 function 3-404-3-405
 module description 6-320
 IEFBB416 object module
 flowchart 6-78
 function 3-410
 module description 6-320
 IEFDB4A0 object module
 flowchart 6-80-6-81, 6-47
 function 3-416
 module description 6-320
 IEFDB4A1 object module
 flowchart 6-80
 function 3-416, 3-426
 module description 6-321
 IEFDB4D0 object module
 flowchart 6-81
 function (see OS/VS2 Terminal Monitor Program and
 Service Routines Logic)
 module description 6-321
 IEFDB4FA object module
 flowchart 6-80
 function 3-416
 module description 6-321
 IEFDB4FB object module
 flowchart 6-82, 6-84, 6-85
 function 3-418-3-419
 module description 6-321
 IEFDB4FC object module
 flowchart 6-80, 6-82-6-85
 function 3-416, 3-418, 3-420
 module description 6-321
 IEFDB4FD object module
 flowchart 6-57-6-58, 6-84
 module description 6-321
 IEFDB4FE object module
 flowchart 6-82, 6-84, 6-86
 module description 6-321
 IEFDB4FF object module
 flowchart 6-82-6-84
 function 3-424, 3-420, 3-422, 3-428, 3-418, 3-416
 module description 6-321
 IEFDB4F8 object module
 flowchart 6-87
 module description 6-322
 IEFDB4F9 object module
 flowchart 6-82, 6-87, 6-89
 function 3-418
 module description 6-322
 IEFDB400 object module
 flowchart 6-81-6-83, 6-47, 6-49, 6-56, 6-60
 function 3-412
 module description 6-322
 IEFDB401 object module
 flowchart 6-81
 module description 6-322
 IEFDB402 object module
 function 3-413
 module description 6-322
 IEFDB403 object module
 module description 6-322
 IEFDB410 object module
 flowchart 6-47, 6-84-6-86
 function 3-414, 3-412
 module description 6-322
 IEFDB411 object module
 flowchart 6-84
 function 3-414
 module description 6-322
 IEFDB412 object module
 flowchart 6-84
 function 3-414
 module description 6-323
 IEFDB413 object module
 flowchart 6-85-6-87
 function 3-414
 module description 6-323
 IEFDB414 object module
 flowchart 6-85
 module description 6-323
 IEFDB417 object module
 flowchart 6-84, 6-85
 module description 6-323
 IEFDB418 object module
 flowchart 6-87
 module description 6-323
 IEFDB450 object module
 flowchart 6-82
 function 3-418
 module description 6-323
 IEFDB460 object module
 flowchart 6-82, 6-84
 function 3-420
 module description 6-323
 IEFDB470 object module
 flowchart 6-82
 function 3-422
 module description 6-324
 IEFDB480 object module
 flowchart 6-83
 function 3-424
 module description 6-324
 IEFDB481 object module
 flowchart 6-83
 function 3-416, 3-426
 module description 6-324
 IEFDB490 object module
 flowchart 6-83
 function 3-412
 module description 6-324
 IEFDPOST object module

module description 6-324
 IEFDSLST object module
 flowchart 6-39
 function 3-198-3-199
 module description 6-324
 IEFDSTBL object module
 flowchart 6-39
 function 3-198-3-199
 module description 6-324
 IEFIB600 object module
 flowchart 6-41
 function 3-216
 module description 6-324
 IEFIB605 object module
 flowchart 6-41
 function 3-216
 module description 6-324
 IEFIB620 object module
 flowchart 6-40
 module description 6-324
 IEFIB621 object module
 flowchart 6-40
 module description 6-325
 IEFIB645 object module
 flowchart 6-41
 function 3-216-3-217
 module description 6-325
 IEFIB650 object module
 module description 6-325
 IEFIB660 object module
 module description 6-325
 IEFICATL object module
 flowchart 6-39
 module description 6-325
 IEFICPUA object module
 flowchart 6-39
 function 3-201, 3-199
 module description 6-325
 IEFIIC object module
 flowchart 6-39
 function 3-196
 module description 6-325
 IEFIMASK object module
 flowchart 6-39
 function 3-200-3-201
 module description 6-325
 IEFIRECM object module
 function 4-415
 module description 6-325
 IEFISEXR object module
 module description 6-325
 IEFI922B object module
 flowchart 6-40
 module description 6-326
 IEFJACTL object module
 flowchart 6-38
 function 3-182, 3-184
 module description 6-326
 IEFJCDLT object module
 flowchart 6-38
 function 3-176-3-177
 module description 6-326
 IEFJCNTL object module
 flowchart 6-38
 function 3-177, 3-179
 module description 6-326
 IEFJDIRD object module
 flowchart 6-38
 function 3-182-3-183
 module description 6-326
 IEFJDSNA object module
 flowchart 6-38
 function 3-188
 module description 6-326
 IEFJDWRT object module
 flowchart 6-38
 function 3-182-3-183
 module description 6-326
 IEFJJCLS object module
 flowchart 6-38
 function 3-176-3-177
 module description 6-326
 IEFJJJOBS object module
 flowchart 6-38
 function 3-176
 module description 6-326
 IEFJJTRM object module
 flowchart 6-38
 function 3-190
 module description 6-327
 IEFJRASP object module
 flowchart 6-38
 function 3-172
 module description 6-327
 IEFJREAD object module
 flowchart 6-38
 function 3-184-3-185
 module description 6-327
 IEFJRECM object module
 function 4-415
 module description 6-327
 IEFJSDTN object module
 flowchart 6-38
 function 3-174
 module description 6-327
 IEFJSREQ object module
 flowchart 6-38-6-39, 6-2
 function 3-161-3-167
 module description 6-327
 IEFJSWT object module
 flowchart 6-32
 function 2-436-2-437
 IEFJWRTE object module
 flowchart 6-38
 function 3-184-3-185
 module description 6-327
 IEFJWTO object module
 flowchart 6-38
 function 3-186
 module description 6-327
 IEFNB901 object module
 flowchart 6-44
 module description 6-328
 IEFNB903 object module
 flowchart 6-44, 6-41
 function 3-246
 module description 6-328
 IEFPARAM (initiation parameter list)
 in step initiation 3-202
 IEFQB550 object module
 flowchart 6-45, 6-90
 function 3-264
 module description 6-328
 IEFQB555 object module
 flowchart 6-45
 function 3-266
 module description 6-328
 IEFQB580 object module
 flowchart 6-45
 function 3-264
 module description 6-328
 IEFQB585 object module

flowchart 6-45
 function 3-264
 module description 6-328
 IEFRRPREP object module
 flowchart 6-90
 function 3-516
 module description 6-328
 IEFSDPPT object module
 module description 6-328
 IEFSD060 object module
 module description 6-328
 IEFSD061 object module
 module description 6-329
 IEFSD062 object module
 module description 6-329
 IEFSD064 object module
 module description 6-329
 IEFSD066 object module
 module description 6-329
 IEFSD101 object module
 flowchart 6-39
 function 3-200-3-201
 module description 6-329
 IEFSD102 object module
 flowchart 6-39
 function 3-200-3-201
 module description 6-329
 IEFSD103 object module
 flowchart 6-39
 module description 6-329
 IEFSD160 object module
 flowchart 6-39
 function 3-196
 module description 6-329
 IEFSD161 object module
 flowchart 6-39
 function 3-196, 3-198
 module description 6-329
 IEFSD162 object module
 flowchart 6-39
 function 3-200
 module description 6-329
 IEFSD164 object module
 flowchart 6-40
 function 3-208
 module description 6-329
 IEFSD166 object module
 flowchart 6-40
 function 3-210
 module description 6-330
 IEFSD263 object module
 flowchart 6-39
 function 3-206
 module description 6-330
 IEFSMFIE object module
 flowchart 6-39
 function 3-200-3-201
 module description 6-330
 IEFTB721 object module
 flowchart 6-79
 module description 6-330
 IEFTB722 object module
 flowchart 6-79
 module description 6-330
 IEFTB723 object module
 flowchart 6-79
 module description 6-330
 IEFUJI object module
 module description 6-330
 IEFUJV object module
 flowchart 6-43
 module description 6-330
 IEFUSI object module
 module description 6-330
 IEFUTL object module
 module description 6-330
 IEFVDA object module
 flowchart 6-44
 function 3-248-3-249
 module description 6-330
 IEFVDBSD object module
 flowchart 6-44
 module description 6-330
 IEFVEA object module
 flowchart 6-44
 function 3-248-3-249
 module description 6-330
 IEFVFA object module
 flowchart 6-43
 function 3-236, 3-238, 3-240, 3-234, 3-226
 module description 6-331
 IEFVFB object module
 flowchart 6-43
 function 3-234
 module description 6-331
 IEFVGI object module
 flowchart 6-44
 IEFVGK object module
 flowchart 6-44
 function 3-250
 module description 6-331
 IEFVGM object module
 flowchart 6-42, 6-44
 module description 6-331
 IEFVGS object module
 flowchart 6-44
 IEFVGT object module
 flowchart 6-44
 function 3-252
 module description 6-331
 IEFVHA object module
 flowchart 6-42
 function 3-226
 module description 6-331
 IEFVHC object module
 flowchart 6-42
 function 3-226
 module description 6-331
 IEFVHCB object module
 flowchart 6-42
 function 3-226, 3-228, 3-232, 3-238
 module description 6-331
 IEFVHE object module
 flowchart 6-44
 function 3-248
 module description 6-332
 IEFVHEB object module
 flowchart 6-42
 function 3-228
 module description 6-332
 IEFVHF object module
 flowchart 6-43
 function 3-242-3-243
 module description 6-332
 IEFVHH object module
 flowchart 6-44
 function 3-256
 module description 6-332
 IEFVHL object module
 flowchart 6-42
 module description 6-332
 IEFVHM object module

- flowchart 6-43
- function 3-230, 3-228
- module description 6-332
- IEFVHN object module
 - flowchart 6-44
 - function 3-258
 - module description 6-332
- IEFVHQ object module
 - flowchart 6-44, 6-42
 - function 3-233
 - module description 6-333
- IEFVHR object module
 - flowchart 6-44, 6-42
 - function 3-258-3-259
 - module description 6-333
- IEFVH1 object module
 - flowchart 6-42
 - function 3-224-3-225
 - module description 6-333
- IEFVINA object module
 - flowchart 6-42
 - function 3-232
 - module description 6-333
- IEFVINB object module
 - flowchart 6-42
 - function 3-232
 - module description 6-333
- IEFVINC object module
 - flowchart 6-42
 - function 3-232
 - module description 6-333
- IEFVIND object module
 - flowchart 6-42
 - module description 6-333
- IEFVINE object module
 - flowchart 6-42
 - module description 6-333
- IEFVJA object module
 - flowchart 6-44
 - function 3-248
 - module description 6-334
- IEFVKMSG object module
 - module description 6-334
- IEFXB500 object module
 - flowchart 6-39, 6-90
 - function 3-521, 3-202, 3-524, 3-520, 3-512, 3-518
 - module description 6-334
- IEFXB590 object module
 - function 3-525
- IEFXB601 object module
 - flowchart 6-41, 6-90
 - function 3-492, 3-496, 3-498-3-509, 3-216, 3-494
 - module description 6-334
- IEFXB602 object module
 - flowchart 6-90
 - function 3-510-3-511
 - module description 6-334
- IEFXB603 object module
 - module description 6-334
- IEFXB604 object module
 - flowchart 6-39, 6-90
 - function 3-512, 3-514, 3-202
 - module description 6-334
- IEFXB609 object module
 - flowchart 6-41, 6-90
 - function 3-486, 3-216
 - module description 6-334
- IEFXB610 object module
 - flowchart 6-90
 - function 3-487
 - module description 6-334

- IEFXVNSL object module
 - flowchart 6-61
 - module description 6-334
- IEL (initiator entrance list)
 - in job initiation 3-196
 - in LOGON pre-TMP exit 2-464
- IEWSUOVR
 - module description 6-335
- IEWSVOVR
 - module description 6-335
- IEZDCODE object module
 - flowchart 6-42
 - module description 6-335
- IEZNCODE object module
 - flowchart 6-42
 - module description 6-335
- IGC0Z03F object module
 - module description 6-335
- IGC0001F
 - flowchart 6-25
 - function 2-410-2-413
- IGC0001G
 - flowchart 6-27
 - function 2-414-2-415
- IGC0003D object module
 - function 2-294-2-295
- IGC0009C object module
 - flowchart 6-22, 6-29
 - function 2-420-2-421
- IGC003 4-328-4-329
- IGC125 object module
 - function 4-234, 4-236
- IGC0203E object module
 - function 2-50, 2-36
- IGFPWMSG object module
 - flowchart 6-195
- IGF2503D object module
 - flowchart 6-17
 - function 2-311
 - module description 6-335
- IGF2603D object module
 - flowchart 6-14
 - function 2-311
 - module description 6-335
- IGX00013 object module
 - flowchart 6-37
 - function 3-82, 3-80, 3-91
 - module description 6-335
- IGX00014 object module
 - flowchart 6-37
 - function 3-114
 - module description 6-335
- IHSA (interrupt local supervisor save area)
 - in dispatcher processing 4-56
 - in dispatching local supervisor routines 4-76
 - in external call FLIH 4-100
 - in I/O interrupt handler 4-94
 - in program check interruption handler 4-112
 - in rescheduling locally locked tasks or SRBs 4-372
 - in SETLOCK 4-152
- IKJEES20 object module
 - function 2-332-2-333
 - module description 6-335
- IKJEFFI8 object module 3-486 (VS2.03.810)
- IKJEFLA object module
 - flowchart 6-34
 - function 2-442
 - module description 6-335
- IKJEFLB object module
 - flowchart 6-34-6-35
 - function 2-444

module description 6-336
 IKJEFLC object module
 flowchart 6-34
 function 2-448
 module description 6-336
 IKJEFLCM object module
 module description 6-336
 IKJEFLD object module
 module description 6-336
 IKJEFLE object module
 flowchart 6-34
 function 2-454, 2-450, 2-456
 module description 6-336
 IKJEFLEA object module
 flowchart 6-34
 function 2-450, 2-454, 2-456
 module description 6-336
 IKJEFLF object module
 flowchart 6-10
 function 2-256, 2-254
 module description 6-336
 IKJEFLG object module
 flowchart 6-34
 module description 6-336
 IKJEFLGB object module
 flowchart 6-34
 function 2-462, 2-450, 2-456, 2-461
 module description 6-336
 IKJEFLGH object module
 flowchart 6-34
 module description 6-336
 IKJEFLGM object module
 function 2-450-2-451
 module description 6-337
 IKJEFLGN object module
 module description 6-337
 IKJEFLH object module
 flowchart 6-34
 function 2-450-2-451
 module description 6-337
 IKJEFLI object module
 flowchart 6-34
 function 2-460
 module description 6-337
 IKJEFLJ object module
 flowchart 6-35
 function 2-464, 2-466
 module description 6-337
 IKJEFLK object module
 flowchart 6-35
 function 2-466
 module description 6-337
 IKJEFLM object module
 flowchart 6-34
 function 2-452, 2-448
 module description 6-337
 IKJEFLLM object module
 module description 6-337
 IKJEFLPA object module
 flowchart 6-34
 module description 6-337
 IKJEFLPO object module
 module description 6-337
 IKJEFLS object module
 flowchart 6-34
 function 2-447
 module description 6-338
 IKJL4T00 object module
 flowchart 6-10
 function 2-256, 2-258
 module description 6-338
 IKJL4T01 object module
 flowchart 6-10
 function 2-257
 IKJL4T02 object module
 flowchart 6-10
 function 2-257
 IKJPARSE 2-454
 IKJSCAN 2-454, 2-458
 IKJ5803D object module
 flowchart 6-15
 module description 6-338
 ILRACT object module (VS2.03.807)
 functional description 5-222 (VS2.03.807)
 MO diagram 5-225 (VS2.03.807)
 module description 6-338 (VS2.03.807)
 program organization 6-208 (VS2.03.807)
 recovery for 5-252 (VS2.03.807)
 ILRACT00 diagram 5-244
 ILRALS00 diagram 5-340
 ILRASN00 overview diagram 5-212
 ILRASNLS diagram 5-188
 ILRCMP object module (VS2.03.807)
 functional description 5-153 (VS2.03.807)
 MO diagram 5-184 (VS2.03.807)
 module description 6-338 (VS2.03.807)
 program organization 6-204 (VS2.03.807)
 recovery for 5-252 (VS2.03.807)
 ILRCMPAE (entry point in ILRCMP) (VS2.03.807)
 functional description 5-153 (VS2.03.807)
 MO diagram 5-186 (VS2.03.807)
 ILRCMPDI (entry point in ILRCMP) (VS2.03.807)
 functional description 5-153 (VS2.03.807)
 MO diagram 5-185 (VS2.03.807)
 ILRCMPNE (entry point in ILRCMP) (VS2.03.807)
 functional description 5-153 (VS2.03.807)
 MO diagram 5-187 (VS2.03.807)
 ILRCMP01 object module (VS2.03.807)
 functional description 5-252 (VS2.03.807)
 MO diagram 5-283 (VS2.03.807)
 module description 6-338 (VS2.03.807)
 program organization 6-210 (VS2.03.807)
 ILREOT00 diagram 5-496
 ILREOT00-ILRETXR diagram 5-500
 ILREOT00-ILRRETRY diagram 5-498
 ILRFMTCV object module (VS2.03.807)
 functional description 5-334 (VS2.03.807)
 module description 6-338 (VS2.03.807)
 program organization 6-212 (VS2.03.807)
 ILRFMTPG object module (VS2.03.807)
 functional description 5-334 (VS2.03.807)
 module description 6-339 (VS2.03.807)
 program organization 6-212 (VS2.03.807)
 ILRFMTSW object module (VS2.03.807)
 functional description 5-334 (VS2.03.807)
 module description 6-339 (VS2.03.807)
 program organization 6-212 (VS2.03.807)
 ILRFMT00 object module (VS2.03.807)
 functional description 5-334 (VS2.03.807)
 MO diagram 5-341 (VS2.03.807)
 module description 6-338 (VS2.03.807)
 program organization 6-212 (VS2.03.807)
 ILRFRR00 overview diagram 5-502
 ILRFRR00-ILRDET00 diagram 5-478
 ILRFRR00-ILRFRR01 diagram 5-480
 ILRFRR00-ILRIOB01 diagram 5-486
 ILRFRR00-ILRPEX01 diagram 5-504
 ILRFRR01 object module (VS2.03.807)
 functional description 5-254 (VS2.03.807)
 module description 6-339 (VS2.03.807)
 program organization 6-210 (VS2.03.807)
 ILRFRSLT object module (VS2.03.807)

MO diagram 5-149 (VS2.03.807)
 module description 6-339 (VS2.03.807)
 program organization 6-209 (VS2.03.807)
ILRGOS object module (VS2.03.807)
 flowchart 6-169, 6-170 (VS2.03.807)
 functional description 5-202 (VS2.03.807)
 MO diagram 5-210 (VS2.03.807)
 module description 6-339 (VS2.03.807)
 program organization 6-206 (VS2.03.807)
 recovery for 5-252 (VS2.03.807)
ILRGOS01 object module (VS2.03.807)
 functional description 5-252 (VS2.03.807)
 MO diagram 5-288 (VS2.03.807)
 module description 6-339.1 (VS2.03.807)
 program organization 6-210 (VS2.03.807)
ILRINT00 overview diagram 5-120
ILRINT01 diagram 5-476
ILRINT01 overview diagram 5-474
ILRIOC00 overview diagram 5-448
ILRIOC01 diagram 5-488
ILRIOFRR object module (VS2.03.807)
 functional description 5-250 (VS2.03.807)
 MO diagram 5-257 (VS2.03.807)
 module description 6-339.1 (VS2.03.807)
 program organization 6-210 (VS2.03.807)
ILRJTERM object module (VS2.03.807)
 flowchart 6-40 (VS2.03.807)
 function 3-211 (VS2.03.807)
 functional description 5-203 (VS2.03.807)
 MO diagram 5-219 (VS2.03.807)
 module description 6-339.1 (VS2.03.807)
 program organization 6-207 (VS2.03.807)
 recovery for 5-253 (VS2.03.807)
ILRMON01 diagram 5-482
ILRMSG00 object module (VS2.03.807)
 functional description 5-153 (VS2.03.807)
 in overflow processing 5-152 (VS2.03.807)
 MO diagram 5-195 (VS2.03.807)
 module description 6-339.1 (VS2.03.807)
 program organization 6-203 (VS2.03.807)
 recovery for 5-253 (VS2.03.807)
ILROPS00 object module (VS2.03.807)
 in PAGEADD processing 5-344 (VS2.03.807)
 MO diagram 5-351 (VS2.03.807)
 module description 6-339.1 (VS2.03.807)
ILRPAGCM object module (VS2.03.807)
 functional description 5-119 (VS2.03.807)
 MO diagram 5-135 (VS2.03.807)
 module description 6-339.1 (VS2.03.807)
 program organization 6-202 (VS2.03.807)
 recovery for 5-251 (VS2.03.807)
ILRPAGIO object module (VS2.03.807)
 flowchart 6-131, 6-132, 6-134, 6-146, 6-154, 6-162 (VS2.03.807)
 functional description 5-119 (VS2.03.807)
 MO diagram 5-122 (VS2.03.807)
 module description 6-339.1 (VS2.03.807)
 program organization 6-200, 6-201 (VS2.03.807)
 recovery for 5-251 (VS2.03.807)
ILRPEX object module (VS2.03.807)
 functional description 5-334 (VS2.03.807)
 MO diagram 5-340 (VS2.03.807)
 module description 6-339.2 (VS2.03.807)
 program organization 6-213 (VS2.03.807)
ILRPGEXP object module (VS2.03.807)
 (see also IIEPGEXP) (VS2.03.807)
 functional description 5-344 (VS2.03.807)
 MO diagram 5-346 (VS2.03.807)
 module description 6-339.2 (VS2.03.807)
 recovery for 5-253 (VS2.03.807)
ILRPOS (VS2.03.807)
 flowchart 6-163 (VS2.03.807)
 functional description 5-202 (VS2.03.807)
 MO diagram 5-205 (VS2.03.807)
 module description 6-339.2 (VS2.03.807)
 program organization 6-205 (VS2.03.807)
 recovery for 5-250, 5-253 (VS2.03.807)
ILRPREAD object module (VS2.03.807)
 in PAGEADD processing 5-344 (VS2.03.807)
 MO diagram 5-364 (VS2.03.807)
 module description 6-339.2 (VS2.03.807)
 recovery for 5-254 (VS2.03.807)
ILRPTM object module (VS2.03.807)
 functional description 5-152 (VS2.03.807)
 MO diagram 5-156 (VS2.03.807)
 module description 6-339.2 (VS2.03.807)
 program organization 6-203 (VS2.03.807)
 recovery for 5-252 (VS2.03.807)
ILRPTM00 diagram 5-388
ILRGIO00 overview diagram 5-370
ILRRLG object module (VS2.03.807)
 functional description 5-222 (VS2.03.807)
 MO diagram 5-235 (VS2.03.807)
 module description 6-339.2 (VS2.03.807)
 program organization 6-209 (VS2.03.807)
 recovery for 5-252 (VS2.03.807)
ILRRLG00 overview diagram 5-300
ILRRLP00 overview diagram 5-222
ILRSAV object module (VS2.03.807)
 functional description 5-222 (VS2.03.807)
 MO diagram 5-228 (VS2.03.807)
 module description 6-339.3 (VS2.03.807)
 program organization 6-208 (VS2.03.807)
 recovery for 5-252 (VS2.03.807)
ILRSAV00 overview diagram 5-278
ILRSRBC object module (VS2.03.807)
 functional description 5-203 (VS2.03.807)
 MO diagram 5-214 (VS2.03.807)
 module description 6-339.3 (VS2.03.807)
 program organization 6-207, 6-211 (VS2.03.807)
 recovery for 5-253 (VS2.03.807)
ILRSR01 object module (VS2.03.807)
 functional description 5-253 (VS2.03.807)
 MO diagram 5-296 (VS2.03.807)
 module description 6-339.3 (VS2.03.807)
 program organization 6-210 (VS2.03.807)
ILRSRT object module (VS2.03.807)
 functional description 5-152 (VS2.03.807)
 MO diagram 5-165 (VS2.03.807)
 module description 6-339.3 (VS2.03.807)
 program organization 6-203 (VS2.03.807)
 recovery for 5-252 (VS2.03.807)
ILRSRT00 overview diagram 5-390
ILRSRT01 object module (VS2.03.807)
 functional description 5-252 (VS2.03.807)
 MO diagram 5-278 (VS2.03.807)
 module description 6-339.3 (VS2.03.807)
 program organization 6-210 (VS2.03.807)
ILRSWAP (VS2.03.807)
 flowchart 6-163 (VS2.03.807)
 functional description 5-119 (VS2.03.807)
 MO diagram 5-130 (VS2.03.807)
 module description 6-339.3 (VS2.03.807)
 program organization 6-200, 6-201 (VS2.03.807)
 recovery for 5-250, 5-251 (VS2.03.807)
ILRSWPDR object module (VS2.03.807)
 functional description 5-119 (VS2.03.807)
 MO diagram 5-134 (VS2.03.807)
 module description 6-339.3 (VS2.03.807)
 program organization 6-201 (VS2.03.807)
 recovery for 5-250, 5-251 (VS2.03.807)
ILRSWP01 object module (VS2.03.807)

functional description 5-251 (VS2.03.807)
 MO diagram 5-270 (VS2.03.807)
 module description 6-339.3 (VS2.03.807)
 program organization 6-210 (VS2.03.807)

ILRTERMR (VS2.03.807)
 exit in address space termination 4-426 (VS2.03.807)
 flowchart 6-192 (VS2.03.807)
 functional description 5-334 (VS2.03.807)
 MO diagram 5-336 (VS2.03.807)
 module description 6-339.4 (VS2.03.807)
 program organization 6-211 (VS2.03.807)
 recovery for 5-253 (VS2.03.807)

ILRTMCO0 diagram 5-358
ILRTMI01 object module (VS2.03.807)
 functional description 5-253 (VS2.03.807)
 MO diagram 5-300 (VS2.03.807)
 module description 6-339.4 (VS2.03.807)
 program organization 6-210 (VS2.03.807)

ILRTMRLG object module (VS2.03.807)
 functional description 5-223 (VS2.03.807)
 MO diagram 5-239 (VS2.03.807)
 module description 6-339.4 (VS2.03.807)
 program organization 6-209 (VS2.03.807)
 recovery for 5-253 (VS2.03.807)

ILRTMR00 diagram 5-506
ILRTMR01 diagram 5-492
ILRTMR01 error processing diagram 5-494
ILRTMR01 overview 5-490

ILRTRPAG (entry point in ILRPOS) (VS2.03.807)
 functional description 5-202 (VS2.03.807)
 MO diagram 5-209 (VS2.03.807)
 program organization 6-205 (VS2.03.807)
 recovery for 5-250, 5-251 (VS2.03.807)

ILRTRP00 overview 5-230

ILRVIOCM object module (VS2.03.807)
 functional description 5-203 (VS2.03.807)
 MO diagram 5-217 (VS2.03.807)
 module description 6-339.4 (VS2.03.807)
 program organization 6-207 (VS2.03.807)
 recovery for 5-251 (VS2.03.807)

ILRVSA MI object module (VS2.03.807)
 functional description 5-223 (VS2.03.807)
 in save, activate, and release processing 5-222 (VS2.03.807)
 MO diagram 5-242 (VS2.03.807)
 module description 6-339.4 (VS2.03.807)
 program organization 6-208 (VS2.03.807)
 recovery for 5-252 (VS2.03.807)

IMCB (SRM user I/O measurement control table)
 in I/O management (SRM) 3-54
 in SYSVENT processing in SRM SYSEVENT code processor 3-13

IN queue for SRM (VS2.03.807)
 definition 3-23 (VS2.03.807)
 in CPU management (IRARMC PM) 3-62 (VS2.03.807)
 in resource monitor periodic monitoring (IRARMRM1) 3-67 (VS2.03.807)
 in select user for swap-out (IRARMCPO) 3-43.2 (VS2.03.807)
 in storage management (IRARMSTM) 3-46 (VS2.03.807)
 in swap analysis (IRARMCAP) 3-36 (VS2.03.807)
 in swappable user evaluation (IRARMWM2) 3-70 (VS2.03.807)

INCOA (common option area for input source options, see also MF COA, STCOA, TMCOA)
 in MF/1 input merge control 3-84
 in MF/1 list option module 3-88
 in MF/1 syntax analyzer 3-86

incorrect address for MIC or STCK request in a TIME request 4-6-4-7

indeterminate errors 7-477
 information request replies 2-324
 information subroutine, device 2-396
INITATT SYSEVENT code (10)
 in work load manager 3-73
 processing in SRM SYSEVENT code processor 3-13
INITDET (SYSEVENT code 11)
 in I/O management 3-54-3-55
 in workload manager 3-70-3-71
 processing in SRM SYSEVENT code processor 3-13
 initialize for MF/1 (IRARMWR1) 3-73.6 (VS2.03.807)
 initialize BUFC diagram 5-410
 initialization
 primary job entry subsystem
 in master scheduler wait 2-246-2-247
 system log
 in master scheduler wait 2-246-2-247
 timer component
 in synchronous timer recovery 4-36-4-37
 initiation
 of the master scheduler 3-176-3-177
 data set name assignment 3-188-3-189
 of a subsystem 3-176-3-177
 data set name assignment 3-188-3-189
 step 3-200
 notify subsystem of step initiation 3-202
 initiator attach interface routine
 flowchart 6-39
 module description 6-330
 initiator attach module
 flowchart 6-39
 function 3-206
 module description 6-330
 initiator builder of completion code interface 3-458
 initiator control initialization
 flowchart 6-39
 function 3-196
 module description 6-329
 initiator data set enqueue
 flowchart 6-39
 function 3-200-3-201
 module description 6-330
 initiator device allocation interface routine
 flowchart 6-39
 function 3-200
 module description 6-329
 initiator ESTAE exit routine
 flowchart 6-40
 module description 6-325
 initiator interface control and interface to allocate catalog
 flowchart 6-39
 function 3-196
 module description 6-325
 initiator job initiation 3-196
 initiator job select routine
 flowchart 6-39
 function 3-196, 3-198
 module description 6-329
 initiator message module
 module description 6-325
 initiator recovery processing 3-212
 initiator recovery retry routine
 flowchart 6-40
 module description 6-325
 initiator resource manager
 function 4-415
 module description 6-326
 initiator SMF exit 3-200-3-201
 initiator subroutine, invoking 2-436-2-437
 initiator subsystem ESTAE exit
 module description 6-326

- initiator/allocation interface 3-396
 - (see also IEFBB401 object module)
- initiator/LOGON interface 2-464
- initiator/terminator
 - general functions 1-33
 - overview 1-33
 - processing 3-193
 - relationship to JES 1-33
 - SWA subpool for 3-267
- initiator/unallocation interface
 - functions 3-402
 - when called 3-402
- inline output bit, checking by DIDOCS 2-123
- input stream (see converter)
- INMVT (measurement vector table for temporary input options, see also DTMVT, MFMVT, STMVT, TMMVT)
 - in MF/1 input merge control 3-84
 - in MF/1 syntax analyzer 3-86
- input to MF/1, analyzing 3-86
- input options for MF/1 (see options, MF/1)
- installation performance specifications (see IPS values)
- installation resource manager list, module description 6-281
- in-stream procedures (see JCL statements)
 - director entry build, directory search, processing 3-232-3-233
- instructions (see also macro instructions)
- insufficient space for V=R region allocation 5-98-5-99
- integrity (see data set integrity processing)
- intentional ABENDs, handling in RSM FRR 5-82-5-83
- interface, subsystem 3-159
- internal text
 - converting JCL to 3-236
 - data set, getting JCL statement from 3-249
 - entering defaults into 3-240
- interpreter (see also converter/interpreter)
 - creating and chaining tables 3-252
 - DSENG table processor
 - flowchart 6-44
 - module description 6-331
 - enqueue routine
 - flowchart 6-44
 - function 3-256
 - module description 6-332
 - error messages
 - processing by subsystem initiation message writer 3-186-3-187
 - ESTAE, setting up 3-246
 - EXEC statement processor
 - flowchart 6-44
 - function 3-248-3-249
 - module description 6-331
 - functions overview 1-33
 - get and route routine
 - flowchart 6-44
 - function 3-248
 - module description 6-332
 - get key/positional utility routine
 - flowchart 6-44
 - function 3-250
 - module description 6-331
 - initialization 3-246
 - flowchart 6-44, 6-41
 - function 3-246
 - module description 6-328
 - instream procedure routines
 - flowchart 6-42
 - module description 6-335
 - interface to SWA create 3-216
 - job statement processor
 - flowchart 6-44
 - function 3-248
 - module description 6-334
 - parameter values, analyzing 3-248
 - pseudo access method 3-182-3-185
 - termination
 - flowchart 6-44
 - function 3-258
 - module description 6-333
 - use by master subsystem 3-178-3-181
 - writing tables into SWA 3-256
- interprocessor communications 4-120
- interrupt, attention 2-174
 - (see also attention interruption exit)
- interrupt, external 2-168, 4-98
- interrupt handlers (see supervisor interrupt handler, SLIH, FLIH)
 - SVC 4-86
- interrupt, to stop system 2-392
- interval, MF/1
 - in MFDATA SVC mainline 3-114
 - timed (in MFSTART mainline) 3-82
- interval, timing
 - calculating
 - in checking a time interval using TTIMER 4-10
 - cancelling
 - in checking a time interval using TTIMER 4-10
 - converting unit 4-10
 - in establishing timer intervals using STIMER 4-8
- interval-driven MF/1 routines
 - for data (IRBMFDTA) 3-106
 - for CPU (IRBMFDPCP) 3-118
 - for devices 3-134
 - for paging (IRBMFDPP) 3-126
 - for workload (IRBMFDWP) 3-126
 - initialization of in MF1MAINL 3-90
 - termination processor (IRBMFTMA) 3-110
- INTMON diagram 5-170
- input/output diagram 5-146
- I/O completion
 - page I/O post 5-28
 - processing in comm task 2-130
- I/O control (ASM) (VS2.03.807)
 - introduction 1-42 (VS2.03.807)
 - introduction to MOs 5-119 (VS2.03.807)
 - overview diagram 5-121 (VS2.03.807)
 - program organization 6-200 (VS2.03.807)
- I/O devices
 - unloading 2-346
 - varying online and offline 2-360
- I/O error processing 5-29
- I/O interrupt handler 4-94
- I/O interruption processing 4-94
- I/O load balancing in SRM
 - swap analysis (IRARMIL2) 3-56
 - user I/O monitoring (IRARMILO) 3-58
- I/O management in SRM (IRARMIOM) 3-54
- I/O old PSW 4-94
- I/O paging queues, checking by PGFREE routine 5-38
- I/O request overview diagram 5-366
- I/O subsystem (ASM) (VS2.03.807)
 - introduction 1-43 (VS2.03.807)
 - introduction to MOs 5-152 (VS2.03.807)
 - overview diagram 5-155 (VS2.03.807)
 - program organization 6-200 (VS2.03.807)
- I/O supervisor, going to from I/O interrupt handler 4-94
- IOE (I/O Request Element) (VS2.03.807)
 - in page processing 5-119 (VS2.03.807)
- IORB (I/O Request Block) (VS2.03.807)
 - description of 1-44 (VS2.03.807)
 - in completion processing 5-119 (VS2.03.807)
 - in swap processing 5-153 (VS2.03.807)

overview diagram 1-46 (VS2.03.807)

IOS UCB LUT (I/O supervisor unit control block logical unit table)

- in allocating offline devices 3-374
- in common allocation control 3-282
- in fixed device control 3-294
- in generic allocation control 3-340
- in JFCB housekeeping control 3-316
- in job unallocation 3-410
- in recovery allocation 3-358

IOSB

- in attention interrupt processing 2-174

IOSGEN macro instruction

- use for displaying system status 2-291

IPC (interprocessor communications) 4-120-4-125

IPS scanner message module

- flowchart 4-466
- function 2-340
- module description 6-294

IPS values

- changing in master scheduler (SET IPS) 2-340
- keyword scanner
 - flowchart 6-16
 - function 2-340
 - module description 6-294

IQARIH00 object module

- flowchart 6-117

IQE (interrupt queue element)

- in ATTACH routine (obtaining storage for IQE) 4-200
- in attention exit scheduler 2-418
- in DETACH routine (freeing IQE) 4-206
- in stage 2 exit effector 4-132
- in stage 3 exit effector 4-134

IRARMCAP

- function 3-36

IRARMCAP entry point in **IRARMCTL** (VS2.03.807)

- function 3-36, 3-43.6 (VS2.03.807)

IRARMCAS

- function 3-34

IRARMCAT

- function 3-26

IRARMCEL

- function 3-30

IRARMCEL entry point in **IRARMCTL** (VS2.03.807)

- function 3-30, 3-43.6 (VS2.03.807)

IRARMCEN

- function 3-28

IRARMCEN entry point in **IRARMCTL** (VS2.03.807)

- function 3-28, 3-43.6 (VS2.03.807)

IRARMCET

- function 3-32

IRARMCET entry point in **IRARMCTL** (VS2.03.807)

- function 3-32, 3-43.6 (VS2.03.807)

IRARMCNS object module

- module description 6-338
- module description 6-339.4 (VS2.03.807)

IRARMCL2

- function 3-66

IRARMCP1 entry point in **IRARMCTL** (VS2.03.807)

- function 3-43.0, 3-43.6 (VS2.03.807)

IRARMCPM object module

- flowchart 6-36
- function 3-62
- module description 6-338

IRARMCPM object module (VS2.03.807)

- entry point summary 3-65.0 (VS2.03.807)
- flowchart 6-36 (VS2.03.807)
- function 3-62 (VS2.03.807)
- module description 6-339.4 (VS2.03.807)

IRARMCPO entry point in **IRARMCTL** (VS2.03.807)

- function 3-43.2, 3-43.7 (VS2.03.807)

IRARMCSI

- function 3-40

IRARMCSI entry point in **IRARMCTL** (VS2.03.807)

- function 3-40, 3-43.6 (VS2.03.807)

IRARMCSO

- function 3-42

IRARMCSO entry point in **IRARMCTL** (VS2.03.807)

- function 3-42, 3-43.6 (VS2.03.807)

IRARMCTL object module

- flowchart 6-36
- function 3-24
- module description 6-338

IRARMCTL object module (VS2.03.807)

- entry point summary 3-43.6 (VS2.03.807)
- flowchart 6-36 (VS2.03.807)
- function 3-24, 3-43.6 (VS2.03.807)
- module description 6-339.4 (VS2.03.807)

IRARMCVL entry point in **IRARMCTL** (VS2.03.807)

- function 3-43.4, 3-43.7 (VS2.03.807)

IRARMERR object module

- flowchart 6-36
- function 3-9
- module description 6-338

IRARMERR object module (VS2.03.807)

- entry point summary 3-9.13 (VS2.03.807)
- flowchart 6-36 (VS2.03.807)
- function 3-5 (VS2.03.807)
- module description 6-339.5 (VS2.03.807)

IRARMEVT object module

- flowchart 6-36, 6-194, 6-198
- function 3-12
- module description 6-338
- overview of functions 3-11

IRARMEVT object module (VS2.03.807)

- entry point summary 3-22.6 (VS2.03.807)
- flowchart 6-36, 6-36.1 (VS2.03.807)
- function 3-12 (VS2.03.807)
- module description 6-339.5 (VS2.03.807)

IRARMHIT entry point in **IRARMWLM** (VS2.03.807)

- function 3-73.2, 3-73.4 (VS2.03.807)

IRARMIL0 entry point in **IRARM10M** (VS2.03.807)

- function 3-58, 3-61.0 (VS2.03.807)

IRARMIL2

- function 3-56

IRARMINT object module

- flowchart 6-36, 6-102, 6-185
- function 3-6
- module description 6-338

IRARMINT object module (VS2.03.807)

- entry point summary 3-9.0 (VS2.03.807)
- flowchart 6-36, 6-36.1 (VS2.03.807)
- function 3-6 (VS2.03.807)
- module description 6-339.5 (VS2.03.807)

IRARM10M object module

- flowchart 6-36
- function 3-54
- module description 6-339

IRARM10M object module (VS2.03.807)

- entry point summary 3-61.0 (VS2.03.807)
- flowchart 6-36 (VS2.03.807)
- function 3-54 (VS2.03.807)
- module description 6-339.5 (VS2.03.807)

IRARM10P entry point in **IRARMEVT** (VS2.03.807)

- entry point description 3-22.6 (VS2.03.807)
- flowchart 6-16, 6-36.1 (VS2.03.807)
- module description 6-339.5 (VS2.03.807)

IRARM104 entry point in **IRARMSRV** (VS2.03.807)

- function 3-9.6, 3-9.13 (VS2.03.807)

IRARM105 entry point in **IRARMSRV** (VS2.03.807)

- function 3-9.8, 3-9.13 (VS2.03.807)

IRARMMSG object module

module description 6-339
 module description 6-339.5 (VS2.03.807)
IRARMMS2
 function 3-52
IRARMRMR object module (VS2.03.807)
 entry point summary 3-67.3 (VS2.03.807)
 flowchart 6-36 (VS2.03.807)
 function 3-45.1 (VS2.03.807)
 module description 6-339.5 (VS2.03.807)
IRARMRM1 entry point in IRARMRMR (VS2.03.807)
 function 3-66, 3-67.2 (VS2.03.807)
IRARMRM2 entry point in IRARMRMR (VS2.03.807)
 function 3-67.0, 3-67.2 (VS2.03.807)
IRARMSET object module
 flowchart 6-36
 function 3-32
 module description 6-339
 module description 6-339.5 (VS2.03.807)
IRARMSRV object module
 flowchart 6-36
 function 3-48, 3-32, 3-42, 3-40, 3-6
 module description 6-339
IRARMSRV object module (VS2.03.807)
 entry point summary 3-9.13 (VS2.03.807)
 flowchart 6-36 (VS2.03.807)
 function 3-9.2 (VS2.03.807)
 module description 6-339.5 (VS2.03.807)
IRARMSTM object module
 flowchart 6-36
 function 3-46
 module description 6-339
IRARMSTM object module (VS2.03.807)
 entry point summary 3-51.2 (VS2.03.807)
 flowchart 6-36 (VS2.03.807)
 function 3-46 (VS2.03.807)
 module description 6-339.6 (VS2.03.807)
IRARMWAR object module
 flowchart 6-36
 function 3-70
 module description 6-339
IRARMWAR object module (VS2.03.807)
 entry point summary 3-73.10 (VS2.03.807)
 flowchart 6-36 (VS2.03.807)
 function 3-69 (VS2.03.807)
 module description 6-339.6 (VS2.03.807)
IRARMWLM object module
 flowchart 6-36
 function 3-70
 module description 6-339
IRARMWLM object module (VS2.03.807)
 entry point summary 3-73.4 (VS2.03.807)
 flowchart 6-36 (VS2.03.807)
 module description 6-339.6 (VS2.03.807)
IRARMWM2 entry point in IRARMWLM (VS2.03.807)
 function 3-70, 3-73.4 (VS2.03.807)
IRARMWM3 entry point in IRARMWLM (VS2.03.807)
 function 3-73.0, 3-73.4 (VS2.03.807)
IRARMWR1 entry point in IRARMWAR (VS2.03.807)
 function 3-73.6, 3-73.10 (VS2.03.807)
IRARMWR3 entry point in IRARMWAR (VS2.03.807)
 function 3-73.8, 3-73.10 (VS2.03.807)
IRB (interruption control block)
 in DETACH routine 4-206
 in stage 1 exit effector 4-130
 in stage 3 exit effector 4-134
 in XCTL routine 4-302
IRBMFALL object module
 flowchart 6-37
 function 3-80-3-81
 module description 6-339
IRBMFANL object module
 flowchart 6-37, 6-36
 function 3-86
 module description 6-339
IRBMFCNV object module
 function 3-147, 3-151
 module description 6-340
IRBMFDCEP object module
 flowchart 6-37
 function 3-118
 module description 6-340
IRBMFDDEP object module
 flowchart 6-37
 function 3-134
 module description 6-340
IRBMFDEA object module
 function 3-106-3-107
 module description 6-340
IRBMFDHP object module
 flowchart 6-37
 function 3-130
 module description 6-340
IRBMFDPP object module
 function 3-122
 module description 6-340
IRBMFDTA object module
 flowchart 6-37
 function 3-106
 module description 6-340
IRBMFDWP object module
 flowchart 6-37
 function 3-126
 module description 6-340
IRBMFECH object module
 flowchart 6-37
 function 3-140
 module description 6-340
IRBMFEDV object module
 flowchart 6-37
 function 3-144
 module description 6-341
IRBMFEVT object module
 flowchart 6-37, 6-103, 6-114
 function 3-138
 module description 6-341
IRBMFFUR object module
 flowchart 6-37
 module description 6-341
IRBMFICP object module
 flowchart 6-37
 function 3-96
 module description 6-341
IRBMFIDV object module
 flowchart 6-37
 function 3-104
 module description 6-341
IRBMFIHA object module
 flowchart 6-37
 function 3-100
 module description 6-341
IRBMFINP object module
 flowchart 6-37
 function 3-84
 module description 6-341
 use of 3-80, 3-86
IRBMFIOI object module
 flowchart 6-37
 function 3-95, 3-111
 module description 6-341
IRBMFIPG object module
 flowchart 6-37
 function 3-96

- module description 6-341
- IRBMFIPP
 - function 3-96
- IRBMFIWK object module
 - flowchart 6-37
 - function 3-98
 - module description 6-341
- IRBMFLCV object module
 - module description 6-342
- IRBMFLDV object module
 - module description 6-342
- IRBMFLHV object module
 - module description 6-342
- IRBMFLMV object module
 - module description 6-342
- IRBMMLPV object module
 - module description 6-342
- IRBMMLTV object module
 - module description 6-342
- IRBMMLWV object module
 - module description 6-342
- IRBMFMFC object module
 - flowchart 6-37
 - function 3-80
 - module description 6-342
- IRBMFMLN object module
 - flowchart 6-37
 - module description 6-342
- IRBMFMMPR object module
 - flowchart 6-37
 - function 3-112
 - module description 6-342
- IRBMFRCR object module
 - flowchart 6-37
 - function 3-150
 - module description 6-343
- IRBMFRDR object module
 - flowchart 6-37
 - function 3-150
 - module description 6-343
- IRBMFRGM object module
 - flowchart 6-37
 - function 3-146
 - module description 6-343
- IRBMFRHR object module
 - flowchart 6-37
 - function 3-150
 - module description 6-343
- IRBMFRPR object module
 - flowchart 6-37
 - function 3-150
 - module description 6-343
- IRBMFRWR object module
 - flowchart 6-37
 - function 3-150
 - module description 6-343
- IRBMFSAR object module
 - flowchart 6-37
 - function 3-147
 - module description 6-343
- IRBMFSDE object module
 - flowchart 6-37
 - function 3-82-3-83
 - module description 6-343
- IRBMFTCH object module
 - flowchart 6-37
 - function 3-142
 - module description 6-343
- IRBMFTMA object module
 - flowchart 6-37
 - function 3-110
- module description 6-343
- IRBMFTRM object module
 - function 3-111
 - module description 6-344
- ISTCFF3D object module
 - flowchart 6-18
 - function 2-348
- ISTRAMA1 object module
 - function 4-404-4-405
- ISV (internal service value) (VS2.03.807)
 - in individual user evaluation (IRARMWM3) 3-73.0 (VS2.03.807)
 - in swappable user evaluation (IRARMWM2) 3-70 (VS2.03.807)
- item, defined in MF/1 syntax analyzer 3-86
- JCL data set reading from 3-226
- JCL statement (see also converter)
 - comment, checking for 3-226
 - continuation, checking for 3-226
 - converting statements to internal text 3-236
 - DD processing 3-229
 - EXEC processing 3-229
 - identifying verbs on 3-226-3-229
 - merging from JCL data set and procedure library 3-229
 - null processing 3-229
- JCL, building in LOGON verification 2-457
- JCL text, building in STC 2-432
- JCL to JCLS conversion
 - flowchart 6-38
 - function 3-176-3-177
 - module description 6-327
- JCLS (JCL set)
 - building in started task control 2-433
- JCLS to SWA conversion
 - flowchart 6-38
 - function 3-177, 3-179
 - module description 6-326
- JCT (job control table)
 - in ABENDED job restart preparation 3-516
 - in allocation/initiator interface 3-396
 - in automatic checkpoint/restart 3-498
 - in building a step header record for the job journal 3-512
 - in DD function control 3-322
 - in dynamic allocation control 3-414
 - in dynamic unallocation 3-416
 - in initiator/allocation interface 3-396
 - in initiator/unallocation interface 3-402
 - in interpreter
 - creating and chaining tables 3-252
 - writing tables into SWA 3-256
 - in JLOCATE 3-334
 - in job deletion 3-208
 - in job initiation 3-196
 - in job unallocation 3-410
 - in merge cleanup 3-502
 - in started task control 2-430
 - in step continue processing 3-494
 - in step deletion 3-208
 - in step initiation 3-200
 - in SVC 99 control 3-412
 - in unallocation/initiator interface 3-402
- JCTX (job control table extension) (VS2.03.804)
 - SWA manager ID 3-261 (VS2.03.804)
 - writing tables into SWA 3-256,3-257 (VS2.03.804)
- JES exit in converting JCL statements to internal text 3-238-3-239
- JESCT (job entry subsystem control table)

- in common request router 3-172
- in data set name assignment 3-188
- in subsystem determination 3-174
- in subsystem interface 3-159
- JES2/3
 - function codes 3-161
 - notified of step initiation 3-202
 - system interface 3-171-3-191
- JES3
 - flags used by common unallocation control 3-430
 - interface routine
 - flowchart 6-51
 - function 3-282-3-283
 - module description 6-310
 - multi-unit, nonspecific volume requests, checking 3-382
 - valid K commands that are routable with L=CCA operand 2-265
- JES3 console
 - system commands routing exclusion 2-277
 - TRACK command invalid 2-277
- JFCB (job file control block)
 - DCB information in, completion 3-322
 - DISP information in, completing 3-322
 - in allocate request to unit 3-302
 - in allocating offline devices 3-366
 - in allocation via algorithm 3-348
 - in allocation/initiator interface 3-396
 - in allocation/volume mount and verify (VM&V) interface 3-386
 - in common allocation cleanup 3-378
 - in common allocation control 3-280
 - in common unallocation 3-432
 - in data set descriptor records, processing 3-486
 - in data set name assignment 3-188
 - in DD function control 3-322
 - in demand allocation 3-355
 - in disposition processing 3-440
 - in dynamic allocation control 3-414
 - in dynamic information retrieval 3-422
 - in fixed device control 3-294
 - in generic allocation control 3-338
 - in initiator/allocation interface 3-396
 - in initiator/unallocation interface 3-402
 - in interpreter 3-252
 - in JFCB housekeeping control 3-314
 - in JLOCATE 3-334
 - in job unallocation 3-410
 - in nonspecific volume allocation control 3-308
 - in recovery allocation 3-358
 - in SVC 99 control 3-414
 - in switching SMF data sets 3-454
 - in unallocation/initiator interface 3-402
 - in volume mount and verify (VM&V)/allocation interface 3-386
 - in writing SMF records 3-450
- JFCB housekeeping
 - flowchart 6-47, 6-56
 - functions 3-314
 - module description 6-313
 - STPCAT request processing 3-314
- JFCBE (job file control block extension for 3800 printer) (VS2.03.810)
 - in checkpoint/restart 3-483, 3-499, 3-501, 3-522, 3-523, 3-525 (VS2.03.810)
 - in interpreter 3-245, 3-249, 3-255 (VS2.03.810)
- JFCBX (job file control block extension)
 - in allocation/initiator interface 3-396
 - in common allocation control 3-280
 - in disposition processing 3-440
 - in dynamic allocation control 3-414
 - in initiator/allocation interface 3-396
- in initiator/unallocation interface 3-402
- in interpreter 3-245 (VS2.03.810)
- in SVC 99 control 3-412
- in unallocation/initiator interface 3-402
- JLOCATE (IEFAB469) processing 3-334
- JMR (job management record)
 - in converter initialization 3-224
 - in converter termination 3-242
 - in interpreter, initialization 3-246
 - in interpreter, writing tables into SWA 3-256
 - in SWA create interface 3-216
- JNLPARM
 - in writing blocks to the job journal 3-520
- job account table, use in step and job deletion (initiator) 3-208
- job control language (see JCL)
- job entry subsystem (JES)
 - interface 3-159
 - LOGON use 2-454
 - processing 2-430
- job initiation 3-196
- job journal
 - building step header record for 3-512
 - changes for VS2 Release 3 3-483
 - errors during reconstruction 3-508
 - in step initiation 3-202-3-203
 - journal for restarted jobs 3-524
 - journal merge error processing 3-508
 - journal merge reading 3-506
 - journal merge cleanup 3-502-3-503
 - merging job step entries onto the SWA 3-494, 3-492
 - overview 3-483
 - step header record, building 3-512
 - writing
 - blocks to 3-520-3-523
 - in preparing ABENDED job for restart 3-518-3-519
- JOB statement, checking 3-249
- JOBCAT DD statement, processing 3-249
- JOBLIB
 - in interpreter 3-249
 - in step initiation 3-204
- job control language build routine
 - function 2-432
 - module description 6-297
- job delete routine
 - flowchart 6-40
 - function 3-210
 - module description 6-330
- jobname for started tasks, processing 2-433
- job scheduler
 - division of coverage 1-33
 - overview 3-153
- job scheduling subroutine and recovery exit
 - flowchart 6-32-6-33
 - function 2-434, 2-436
 - module description 6-296, 6-297
- job select routine
 - flowchart 6-39
 - function 3-196, 3-198
 - module description 6-329
- job status indicators
 - in SWA create interface 3-216-3-217
 - setting in JSCB and JCT by step initiator 3-203
- job status messages text
 - module description 6-319
- job step, ABENDED, preparing for restart 3-516
- job step allocation (see step allocation)
- job step time limit, checking in TQE processing routine 4-23
- job termination
 - for a subsystem 3-190

- job time limit, calculating in step initiator 3-202
- job unallocation
 - functions 3-410
 - interface with initiator 3-402
 - parameter list for initiator interface 3-402
- JOBSELCT SYSEVENT code (8)
 - in workload manager 3-71
 - processing in SRM SYSEVENT code processor 3-13
- JOBTERM SYSEVENT code (9)
 - in workload manager 3-71
 - processing in SRM SYSEVENT code processor 3-13
- journal (see job journal)
- journal merge
 - loading journal merge routine 3-246
 - processing 3-492
- journal merge routine
 - flowchart 6-41, 6-90
 - function 3-492, 3-496, 3-498-3-509, 3-216, 3-494
 - module description 6-334
- journal write routine
 - flowchart 6-39, 6-90
 - function 3-520, 3-202, 3-524, 3-512, 3-518
 - module description 6-334
- JPA (job pack area)
 - use by program management, overview 1-37
- JSCB (job step control block)
 - in ABENDED job restart preparation 3-516
 - in allocation/initiator interface 3-396
 - in automatic step restart 3-500
 - in building a step header record for the job journal 3-512
 - in common allocation cleanup 3-378
 - in common allocation control 3-280
 - in data set descriptor records processing 3-486, 3-492
 - in dname allocation control 3-428
 - in dynamic allocation 3-414
 - in dynamic concatenation 3-418
 - in dynamic deconcatenation 3-420
 - in dynamic information retrieval 3-422
 - in dynamic unallocation control 3-416
 - in initiator/allocation interface 3-396
 - in initiator/unallocation interface 3-402
 - in JFCB housekeeping control 3-314
 - in JLOCATE 3-334
 - in job initiation 3-196
 - in journal merge error processing 3-508
 - in LINK routine 4-278
 - in log initialization 3-466
 - in LOGON
 - initialization 2-442
 - pre-prompt exit interface 2-458
 - in merge cleanup 3-502
 - in merging job journal to SWA 3-492
 - in nonspecific volume allocation control 3-308
 - in obtaining a new virtual memory 2-250
 - in remove in-use control routine 3-424
 - in remove in-use attribute 3-424
 - in restart interface processing 3-510
 - in started task control 2-430
 - in subsystem interface 3-159
 - in SVC 99 control 3-412
 - in SWA create interface 3-216
 - in SWA manager locate mode 3-266
 - in system restart processing 3-496
 - in TESTAUTH routine 4-270
 - in unallocation/initiator interface 3-402
 - in updating virtual addresses in SWA 3-504
 - in writing blocks to the job journal 3-520
 - in writing SMF records 3-450
 - in WTP (write to programmer) processing 2-50
 - in WTP (write to programmer) requests 2-48
- JSCB build routine
 - flowchart 6-21
- JSEL (job scheduling entrance list)
 - in LOGOFF 2-452
 - in LOGON
 - initialization 2-442
 - monitor 2-448
 - monitor recovery 2-454
 - pre-prompt exit interface 2-458
 - pre-TMP exit 2-464
 - scheduling 2-444
 - verification 2-454
 - in started task control 2-430
- JSOL (job scheduling options list)
 - in LOGON scheduling 2-444
 - in started task control 2-430
- JSWA (job scheduling work area)
 - in started task control 2-430
- JSSL (job scheduling exit list)
 - in LOGOFF 2-452
 - in LOGON
 - initialization 2-442
 - pre-TMP exit 2-464
 - scheduling 4-378
 - in started task control 2-430
- K command
 - DIDOCs processing 2-184
 - K A and K T command handler
 - flowchart 6-10
 - function 2-268, 2-270
 - module description 6-303
- keyword processing
 - in converting JCL statements to internal text 3-236
 - in parameter value analysis 3-248-3-249
- LCA (log control area)
 - in HALT command processing 2-302
 - in log initialization 3-466
 - in processing log and WRITELOG commands 2-306
 - in switch command processing 2-302
 - in terminating the system log 3-470
 - in writing data on the system log 3-480
- LCCA (logical communications configuration area)
 - in CPU load balancing swap analysis 3-66
 - in CPU management (SRM) 3-62
 - in dispatcher 4-54
 - in dispatching local SRBs 4-74
 - in external call FLIH 4-98
 - in global SRB dispatcher 4-72
 - in I/O interrupt handler 4-94
 - in interval measurement gathering routine for CPU 3-118
 - in memory switching 4-84
 - in MFDATA mainline 3-114
 - in page invalidation 5-76
 - in program check interruption handler 4-104
 - in program interruption extension 5-22
 - in quiescing a system 2-320
 - in restart interrupt handler 4-116
 - in resume routine 4-192.9 (VS2.03.807)
 - in routing to FRRs 4-354
 - in RTM2 initialization 4-344
 - in SCHEDULE processing 4-138
 - in SETLOCK 4-148
 - in SLIH processing 4-352
 - in supervisor interruption handler 4-86
 - in synchronous timer recovery 4-36
 - in varying a CPU offline 2-374
 - in varying a CPU online 2-372

- LCH
 - in I/O load balancing swap analysis 3-56
 - in I/O management (SRM) 3-54
- LCT (linkage control table)
 - in ABENDED job restart preparation 3-516
 - in allocation/initiator interface 3-396
 - in building a step header record for the job journal 3-512
 - in converter/interpreter interface 3-178
 - in initiator/allocation interface 3-396
 - in initiator/unallocation interface 3-402
 - in job initiation 3-196
 - in job deletion 3-208
 - in LOGON post-TMP exit 2-466
 - in LOGON pre-TMP exit 2-464
 - in step continue processing 3-494
 - in step deletion 3-208
 - in step initiation 3-200
 - in subsystem initiation 3-176
 - in SWA create interface 3-216
 - in SWA manager locate mode 3-266
 - in unallocation/initiator interface 3-402
- LDA (local data area)
 - in freeing a virtual region 5-100
 - in FREEMAIN 5-96
 - in getting a virtual region 5-98
 - in VSM address space creation 5-102
- LGE (logical group entry) (VS2.03.807)
 - in VIO data set processing 5-202 (VS2.03.807)
- LGE process queue (VS2.03.807)
 - in save, activate, and release processing 5-203 (VS2.03.807)
 - in transfer page processing 5-203 (VS2.03.807)
 - in VIO completion processing 5-203 (VS2.03.807)
 - in VIO data set processing 5-202 (VS2.03.807)
- LGVT (logical group vector table) (VS2.03.807)
 - description of 1-44 (VS2.03.807)
 - in VIO data set processing 5-202 (VS2.03.807)
 - overview diagram 1-46 (VS2.03.807)
- LGVTE (logical group vector table entry) (VS2.03.807)
 - description of 1-44, 5-202 (VS2.03.807)
- level of attention exit, determining 2-418-2-419
- light pen command processing 2-186
- limit priority, use of by CHAP 4-215
- LINK macro instruction (see also link routine)
 - functional recovery routine 4-282-4-283
 - macro instruction parameters, processing according to 4-284, 4-288
 - processing 4-278
 - use of BLDL/program fetch 4-288
 - use of the searching routines 4-284, 4-286
- link pack area (see LPA)
- link routine
 - branch to in XCTL routine 4-302
- LISTBC use during LOGON 2-451
- listing messages 2-332
- listing MF/1 options 3-88
- LLE (link list entry)
 - in delete routine 4-294
 - in load routine 4-292
- load balancing in SRM swap analysis
 - CPU 3-62
 - I/O 3-56
- LOAD processing 4-292
- loading modules
 - in LOAD routine 4-292
 - in program fetch 4-308
- local I/O active queue, in PGFREE routine 5-38
- local page data sets (ASM) (VS2.03.807)
 - description of 1-46.1 (VS2.03.807)
 - error matrix 7-491 (VS2.03.807)
- local SRB, overview of 1-34
- local supervisor dispatcher, overview of 1-34
- local time
 - processing TIME requests 4-6
 - setting local time 2-336
 - TOD clock operator communications 4-31
- locally locked task, rescheduling 4-372
- locating specific volume request 3-298
- locating the audit trail 7-483
- lock manager (see SETLOCK)
- lock, SRM 3-25
- locking services/considerations
 - for address space 4-176
 - in SRM 3-5
 - overview 1-34
 - refreshing lock 4-176
 - set lock, overview 1-34
 - verifying 4-176
- LOG and WRITELOG command processor
 - flowchart 6-12, 6-20, 6-89
 - function 2-306
 - module description 6-300
- LOG command processing 2-306, 2-308
- log data set (see system log)
- log hardcopy (see hardcopy of system log)
- log, system (see system log)
- log task abnormal termination, processing
 - flowchart 6-89
 - function 3-476
 - module description 6-294
- logical reconfiguration (see reconfiguration commands)
- LOGOFF (see also LOGON)
 - cleanup 2-452
 - LOGON/LOGOFF verification 2-454
 - message text
 - module description 6-337
 - processing 2-452
 - release of serial resources 2-452
- LOGON (see also LOGOFF)
 - attention exit preparation 2-449
 - attention exit scheduling 2-418
 - attention key, effect of 2-449
 - data areas 7-281
 - diagnostic aids 7-465
 - error processing 2-451
 - ESTAI exit
 - loading 4-380
 - processing 2-462
 - information routine
 - flowchart 6-34
 - function 2-450-2-451
 - module description 6-337
 - initialization
 - flowchart 6-34
 - function 2-442
 - module description 6-336
 - installation exit interface
 - flowchart 6-34
 - function 2-460
 - module description 6-337
 - LISTBC use 2-451
 - LOGON/LOGOFF verification 2-454
 - mail 2-451
 - message handler and text
 - function 2-450-2-451
 - module description 6-337
 - monitor 2-448
 - monitor recovery 2-462
 - notices 2-451
 - post-TMP exit
 - flowchart 6-35

- function 2-466
- module description 6-337
- pre-prompt exit interface
 - function 2-460
 - module description 6-336
- pre-TMP exit
 - flowchart 6-35
 - function 2-464, 2-466
 - module description 6-337
- processing a new LOGON command 2-450
- program organization 6-34-6-35
- prompter recovery exit
 - flowchart 6-34
 - function 2-462, 2-450, 2-456, 2-461
- prompting monitor
 - flowchart 6-34
 - function 2-448
 - module description 6-336, 6-337
- reconnect parameter, rejection of 2-457
- release of user id resources 2-453
- scheduling
 - error processing in RTM2 4-380
 - overview 1-31
 - processing
 - flowchart 6-34-6-35
 - function 2-444
 - module description 6-336
 - recovery and retry routine
 - flowchart 6-34
 - function 2-447
 - module description 6-338
- STACK use 2-449
- STAX use 2-449
- submitting commands in the background 2-454-2-456
(VS2.03.813)
- synchronization module
 - flowchart 6-13
 - module description 6-286
- time and date processor
 - flowchart 6-34
 - module description 6-337
- user information, from SYS1.UADS or LOGON
 - parameters, where stored 2-459
 - utility routines, loading 2-444-2-445
- verification of command
 - flowchart 6-34
 - function 2-454, 2-450, 2-456
 - module description 6-336
- LOGON command (see also start/logon/mount overview)
 - CSCB creation (IEE0803D) 2-244
 - in started task control 2-430-2-431
- LOGON, TSO serialization
 - in master scheduler wait 2-246-2-247
 - scheduling (overview) 1-31
 - user id resources
 - issuing ENQ and DEQ for 2-444-2-445
 - release of 2-453
- long wait processing in the SRM 3-49
- low storage verification and refresh 4-176
- LPA (link pack area)
 - directory, searching 4-286-4-287
 - program management use (overview) 1-37
- LPDE (link pack directory entry)
 - in searching the LPA directory 4-286
- LPME (logical-to-physical mapping entry) (VS2.03.807)
 - in VIO data set processing 5-202 (VS2.03.807)
- LRB (LOGREC record block)
 - in synchronous timer recovery 4-36
- LSID (logical slot identifier) (VS2.03.807)
 - locating via the LPID 7-478 (VS2.03.807)
 - in page processing 5-119 (VS2.03.807)
 - in VIO completion processing 5-202 (VS2.03.807)
 - in VIO data set processing 5-202 (VS2.03.807)
- LSMQ (local service manager queue)
 - in dispatcher 4-54
 - in PURGEDQ 4-144
 - in SCHEDULE processing 4-138
- LSPL (local service priority list)
 - in obtaining a new virtual memory 2-250
 - in PURGEDQ 4-144
 - in SCHEDULE processing 4-138
- LSQA
 - allocation 5-6-5-7
 - allocation of virtual storage in GETMAIN routine 5-94-5-95
 - contents and creation (overview) 1-41
 - stealing a frame if no preferred area frame is on available frame queue 5-7
- LSQA control blocks, setting up
 - in VSM address space creation 5-102-5-103
- LSQA pages (VS2.03.807)
 - flowchart 6-162 (VS2.03.807)
 - function 5-48 (VS2.03.807)
- LSQA storage
 - freed when task terminates 5-106-5-107
- LSQA swap I/O initiator (VS2.03.807)
 - function 5-52 (VS2.03.807)
 - module description 6-274 (VS2.03.807)
- LWA (logon work area)
 - cancelling TSO, system initiated 2-256
 - in LOGOFF processing 2-452
 - in LOGON
 - initialization 2-442
 - monitor 2-448
 - monitor recovery 2-462
 - post-TMP exit 2-466
 - pre-prompt exit interface 2-458
 - pre-TMP exit 2-464
 - scheduling 2-444
 - verification 2-454
- machine check
 - in synchronous timer recovery 4-36-4-37
- mail in LOGON 2-451
- mainline communication 7-479
- main storage occupancy analysis (IRARMMS2) 3-52
- mainline, initialization MF1 3-90
- major name
 - in ENQ/DEQ/RESERVE 4-243
 - in job initiation 3-198-3-199
 - in LOGON scheduler (SYS1IKJUA) 2-445
- major QCB 4-242
- manipulation of channel command control blocks by
 - program fetch 4-311
- manual state, placing CPU in 2-321
- mark slot available diagram 5-472
- master address space, rescheduling R/TM in 4-368-4-369
- master catalog, searching in JLOCATE (IEFAB469) 3-334-3-335
- master console
 - changing console status 2-350
 - external interrupt processor (IEAVVCRX) 2-168
 - functional overview 2-4
 - switching 2-368
- master JCL
 - conversion to SWA control blocks in
 - converter/interpreter interface 3-178
 - in data set name assignment 3-188-3-189
 - in sybsystem initiation 3-176-3-177
- master scheduler
 - base initialization

- module description 6-297
- posting
 - in CSCB creation 2-244
 - in task creation commands 2-244
- region initialization
 - flowchart 6-88
 - function 2-135
 - module description 6-295
- resident data area (see MSRDA)
- SVC 110 router
 - flowchart 6-11
 - function 2-288, 2-294
 - module description 6-299
- wait recovery and retry (IEEVWAIT) 2-248
- wait routine
 - flowchart 6-89
 - function 2-246, 2-294, 2-300
 - module description 6-299
- master subsystem
 - common request router 3-172
 - converter/interpreter interface 3-178
 - in data set name assignment 3-188
 - in started task control 2-430
 - in subsystem determination 3-174
 - in subsystem initiation 3-176
 - in subsystem initiation message writer 3-186
 - in subsystem job termination 3-190
 - interface overview 3-159
 - overview 1-33
 - pseudo access method 3-182
- master TOD clock value calculation 4-32-4-33
- master wait 2-246
- MCH (machine check handler) use of RTM1 4-348
- MCH logrec buffer 4-349
- MCH WTO routine
 - flowchart 6-195
- MCT
 - in main storage occupancy analysis 3-52
 - in resource monitor MPL adjustment processing (IRARMRM2) 3-67.0 (VS2.03.807)
 - in resource monitor periodic monitoring (IRARMRM1) 3-66 (VS2.03.807)
 - in storage management (SRM) 3-46
 - in storage management (IRARMSTM) 3-46 (VS2.03.807)
 - in swap-in control 3-40
 - in timer action analysis 3-26
- MGCR macro instruction, issuance by LOGON monitor to chain a new CSCB 2-451
- MEL (merge entrance list)
 - in automatic checkpoint/restart 3-498
 - in automatic step restart 3-500
 - in merging job journal to SWA 3-492
 - in step continue processing 3-494
 - in SWA create interface 3-216
- MEMCREAT SYSEVENT code (6)
 - in SRM interface 3-7
 - processing in SRM SYSEVENT code processor 3-12
- MEMDEL SYSEVENT code (7)
 - processing in SRM SYSEVENT code processor 3-12
- memory (see also address space, cross memory, virtual memory)
 - deletion 2-400
 - priority, changing 4-164
 - switching 4-84
 - termination purges 4-410
- merge of MF/1 options (see also options, MF/1)
 - in MF/1 control 3-80
- merge cleanup for restart or step continue processing 3-502
- merging job step entries in job journal 3-494

- message compression routine for allocation
 - flowchart 6-69-6-72, 6-75-6-77
 - module description 6-308
- message deletion (DIDOCS)
 - DOM processing 2-166
- message handling for SVC 34 (IEE0503D) 2-238
- message id
 - use in DOM device support processor (DIDOCS) 2-166
- message module (DIDOCS) 2-188, 2-122
- message processor for MF/1 (IRBMFMPR) 3-112
- message protect key
 - use in DOM device support processor (DIDOCS) 2-166
- message routing
 - changing 2-350
 - to consoles 2-318
- message waiting bit, setting in DIDOCS 2-122
- messages
 - deleting (in DIDOCS) 2-166
 - during LOGOFF 2-452-2-453
 - during LOGON (mail and notices) 2-451
 - list of 7-345
 - listing 2-332
 - sending and saving 2-332
 - unconditional to inactive console 2-114
- method of operation (ASM)
 - ACTCACE 5-260
 - ACTCLUP 5-276
 - ACTCOND 5-254
 - ACTFREE 5-274
 - ACTGETB 5-250
 - ACTGETN 5-322
 - ACTINIT 5-266
 - ACTINPR 5-258
 - ACTIVATE 5-122
 - ACTREEN 5-248
 - ACTSLOT 5-270
 - ACTUPDT 5-312
 - ADDLSID 5-286
 - ADDSLOT 5-464
 - ALSPROC 5-342
 - ASPCTI1 5-216
 - ASPCTI2 5-220
 - ASSIGN 5-132
 - auxiliary storage management overview 5-118
 - auxiliary storage management visual table of contents 5-117
 - BADSL0T 5-460
 - BLDTSKQ 5-184
 - BUFCPROC 5-454
 - chain ACE 5-128
 - FINDPE 5-378
 - FINISH 5-320
 - FREECORE 5-134
 - GETALLX 5-324
 - GETCORE 5-126
 - GETERASE 5-332
 - GETEXTS 5-326
 - GETIOE 5-380
 - GETLGN 5-124
 - GETONE 5-314
 - GMAFRGET 5-162
 - ILRACT00 5-244
 - ILRALS00 5-340
 - ILRASN00 overview 5-212
 - ILREOT00 5-496
 - ILREOT00-ILRETXR 5-500
 - ILREOT00-ILRRETRY 5-498
 - ILRFRR00 overview 5-502
 - ILRFRR00-ILRDET00 5-478

ILRFRR00-ILRFRR01 5-480
 ILRFRR00-ILRIOB01 5-486
 ILRFRR00-ILRPEX01 5-504
 ILRINT00 overview 5-120
 ILRINT01 5-476
 ILRINT01 overview 5-474
 ILRIOC00-ILRIOC01 5-488
 ILRIOC00 overview 5-448
 ILRMON00 overview 5-158
 ILRMON01 5-482
 ILRPTM00 5-388
 ILRQIO00 overview 5-370
 ILRRLG00 overview 5-300
 ILRRLP00 overview 5-222
 ILRSV00 overview 5-278
 ILRSRT00 overview 5-390
 ILRTMC00 5-360
 ILRTMC00 overview 5-358
 ILRTMR00 5-506
 ILRTMR01 5-492
 ILRTMR01 error processing 5-494
 ILRTMR01 overview 5-490
 ILRTRP00 overview 5-230
 input/output 5-146
 INTIALIZE BUFC 5-410
 INTMON 5-170
 I/O request overview 5-366
 mark slot available 5-472
 movehead 5-446
 NOAIE 5-174
 prepare for a write 5-418
 process request 5-430
 PROCLG 5-166
 PUTASPCT 5-338
 PUTONE 5-318
 QUEIOE 5-382
 QUEIT 5-176
 QUESWAP 5-374
 RECHAIN 5-458
 RECHAIN 5-438
 RELLG 5-136
 RELLP 5-138
 REMOVA 5-192
 REVERSER 5-172
 RLGSG01 5-304
 RLGSG02 5-308
 RLGSG03 5-310
 RLGSG04 5-354
 RLGSG05 5-356
 RLPSG01 5-224
 SAVE 5-140
 SAVEACT 5-150
 SAVEPUT 5-334
 SAVSG04 5-282
 SAVSG06 5-288
 SAVSG08 5-292
 SAVSG10 5-294
 SAVSG11 5-284
 SAVSG061 5-344
 SAVSG062 5-346
 SAVSG063 5-348
 select I/O request 5-402
 sort rotation 5-434
 STARTOP 5-178
 STINDV 5-180
 SVRLGGET 5-328
 SWAPCHK 5-148
 TRPAGE 5-142
 TRPSG02 5-234
 TRPSG03 5-236
 TRPSG04 5-240

MF/1

binary to channel conversion routine
 function 3-147
 module description 6-340
 channel event data sampling module
 flowchart 6-37
 function 3-140
 module description 6-340
 channel interval measurement gathering routine
 flowchart 6-37
 function 3-130
 module description 6-340
 channel measurements
 initialization
 flowchart 6-37
 function 3-100
 module description 6-341
 sampling 3-140, 3-142
 channel report generator
 flowchart 6-37
 function 3-150
 module description 6-343
 channel report language parts table
 module description 6-342
 CPU measurement
 initialization
 flowchart 6-37
 function 3-96
 module description 6-341
 gathering
 flowchart 6-37
 function 3-118
 module description 6-340
 interval 3-118-3-121
 CPU report generator
 flowchart 6-37
 function 3-150
 module description 6-343
 CPU report language parts table
 module description 6-342
 data control routine
 flowchart 6-37
 function 3-106
 module description 6-340
 data control ESTAE recovery routine
 function 3-106-3-107
 module description 6-340
 device event data sampling module
 flowchart 6-37
 function 3-144
 module description 6-341
 device interval measurement gathering routine
 flowchart 6-37
 function 3-134
 module description 6-340
 device measurements
 initialization routine
 flowchart 6-37
 function 3-104
 module description 6-341
 interval 3-134
 sampling 3-144
 device report generator
 flowchart 6-37
 function 3-150
 module description 6-343
 device report language parts table
 module description 6-342
 dynamic allocation
 flowchart 6-37
 function 3-80-3-81

- module description 6-339
- event driven measurement routines
 - calling from MFROUTER 3-139
- flowchart, inter-module 6-37
 - function 3-111
 - module description 6-344
- general resource resource release routine
 - function 3-111
 - module description 6-344
- initialization (mainline) 3-90
- initialization
 - for channel measurement 3-100
 - for CPU activity 3-96
 - for device measurement 3-104
 - for paging activity measurement 3-96
 - for workload measurement 3-98
- input merge control
 - flowchart 6-37
 - function 3-84
 - module description 6-341
- interval notification 4-22
- IOS initialization/termination routine
 - flowchart 6-37
 - function 3-95, 3-111
 - module description 6-341
- list option module 3-88
- lock release FRR
 - module description 6-341
- mainline initialization 3-90
- measurement facility control module
 - flowchart 6-37
 - function 3-80
 - module description 6-342
- measurement facility control mainline error analysis
 - flowchart 6-37
 - module description 6-342
- merge of options 3-84, 3-80
- message processor
 - flowchart 6-37
 - function 3-112
 - module description 6-342
- message processor language parts table
 - module description 6-342
- MFC (measurement facility control) module 3-80
- MFDATA SVC mainline 3-114
- MFROUTER SVC processor
 - flowchart 6-37, 6-103, 6-114
 - function 3-138
 - module description 6-341
- MFSTART mainline processor
 - ESTAE routine
 - flowchart 6-37
 - function 3-82-3-83
 - module description 6-343
- options, listing 3-88
- options, merging 3-84, 3-80
- overview of MF/1 3-75
- paging activity initialization 3-96
- paging measurements
 - initialization
 - flowchart 6-37
 - function 3-96, 3-92
 - module description 6-341
 - interval measurement gathering routine
 - function 3-122
 - module description 6-340
- paging report language parts table
 - module description 6-342
- paging report generator
 - flowchart 6-37
 - function 3-150
- module description 6-343
- recovery routine, ESTAE 3-83
- report generation
 - control ESTAE routine
 - flowchart 6-37
 - function 3-147
 - module description 6-343
 - control module
 - flowchart 6-37
 - function 3-146
 - module description 6-343
 - modules for CPU, paging, workload, channels, and devices 3-150
 - report header language parts table
 - module description 6-342
 - SARG function 3-77, 3-75
 - second CPU test channel sampling module
 - flowchart 6-37
 - function 3-142
 - module description 6-343
- SMF-related records
 - for channels 3-133
 - for CPU 3-119
 - for devices 3-135
 - for paging 3-123
- START parameters, processing of 3-81
- stopping MF/1 3-81
- syntax analyzer
 - flowchart 6-37, 6-36
 - function 3-86
 - module description 6-339
- SYSEVENT code (WKLDINIT) issued 3-99
- termination
 - in measurement facility control 3-81
 - processing
 - flowchart 6-37
 - function 3-110
 - module description 6-343
- visual table of contents 3-79
- workload measurement
 - initialization 3-98
 - interval measurement gathering routine
 - flowchart 6-37
 - function 3-126
 - module description 6-340
 - report generator
 - flowchart 6-37
 - function 3-150
 - module description 6-343
 - report language parts table
 - module description 6-342
- MFA (malfunction alert) interrupt processing 4-98
- MFC (measurement facility control), IRBMFMFC in MF/1 3-80
- MFCOA (measurement facilities common options area, see also INCOA, STCOA, and TMCOA)
 - in input merge control 3-84
 - in mainline initialization of MF/1 3-90
 - in measurement facility control 3-80
 - in MFSTART mainline 3-82
 - in MF/1 data control 3-106
 - in MF/1 report generator control 3-146
- MFDATA SVC routine (MF/1)
 - flowchart 6-37
 - function 3-114
 - module description 6-335
 - processing 3-114
- MFIMAINL
 - flowchart 6-37
 - function 3-90
- MFLISTOP

- flowchart 6-37
- function 3-88
- MFMTV (measurement vector table for problem state options, see also DTMVT, INMVT, STMVT, TMMVT)
 - in input merge control 3-84
 - in mainline initialization of MF/1 3-90
 - in measurement facility control 3-80
 - in MFSTART mainline 3-82
 - in MF/1 report generator control 3-146
- MFPCT (problem control table)
 - in measurement facility control 3-80
 - in MF/1 data control 3-106
- MFPMA (problem measurement area, see also TMPMA)
 - in input merge control 3-84
 - in mainline initialization of MF/1 3-90
 - in MF/1 report generator control 3-146
- MFROUTER service routine (IRBMFEVT) 3-138
 - MF/1 channel initialization 3-100
- MFSEL (subtask elements table)
 - in MF/1 report generator control 3-146
- MFSTART mainline (MF/1)
 - flowchart 6-37
 - function 3-82, 3-80, 3-91
 - module description 6-335
- midnight value in TQE 4-22
- minor QCB 4-242
- minor name (rname)
 - in ENQ/RESERVE 4-243
 - in job initiation enqueue parameter list 3-198-3-199
- MLWTO (multiple line write to operator)
 - deleting from graphic console 2-166
 - functional overview 2-3
 - processing 2-72
- MODE command processing
 - flowchart 6-14
 - function 2-311
 - module description 6-335
- MODESET routine, processing 4-268
- MODIFY command processing
 - flowchart 6-14, 6-16
 - function 2-312
 - module description 6-300
 - module descriptions 6-256
 - module directory 7-1
 - module-to-module control flow 6-2-6-199
- monitor calls 7-479
- MONITOR command
 - flowchart 6-14, 6-16
 - function 2-314
 - module description 6-304
 - operand validity according to source of command 2-315
- MOUNT (see also start/logon/mount overview)
 - processing in started task control 2-430-2-431
- MOUNT command syntax check routine
 - flowchart 6-32
 - function 2-430, 2-432
 - module description 6-297
- mount control blocks
 - building and contents
 - flowchart 6-74
 - function 3-392-3-393
 - module description 6-318
- mount equalization for MSS volumes 3-291, 3-350, 3-370
- mount failure for MSS volume 3-387
- mount message, building, issuing; and verifying volumes 3-392-3-395
- mounting a volume (see volume mount & verify)
- MOVEHEAD diagram 5-446
- move-out processing in VIO services routine 5-56-5-57
- MP (see multi-processor system)

- MP vary command preprocessor
 - flowchart 6-18
 - function 2-350
 - module description 6-301
- MSGRT and CONTROL command message modules
 - flowchart 6-14
 - module description 6-303
- MSGRT command handlers
 - flowchart 6-14
 - function 2-318
 - module description 6-303
- MSRDA or BASEA (master scheduler resident data area)
 - in allocation/initiator interface 3-398
 - in common allocation control 3-280
 - in HALT and SWITCH command processing 2-304
 - in initiator/allocation interface 3-398
 - in listing messages 2-332
 - in log initialization 3-466
 - in log task abnormal termination 3-478
 - in master scheduler wait 2-246
 - in master scheduler wait recovery and retry 2-249
 - in MODIFY command processing 2-312
 - in its module relationships (see IEEMSER) 7-1
 - in processing LOG and WRITELOG commands 2-306
 - in RESET command processing 2-330
 - in saving messages 2-332
 - in sending messages 2-332
 - in setting local time 2-336
 - in starting monitoring procedures 2-314
 - in STOP command processing 2-312
 - in stopping monitoring procedures 2-314
 - in SVC 34 STAE routine 2-236
 - in SWITCH command processing 2-304
 - in terminating the system log 3-470
 - in TOD clock operator communication 4-30
 - in VSM address space creation 5-102
 - in writing data on the system log 3-480
- MSS
 - allowing multiprocessor operation in VARY CPU online 2-372-2-373
 - allowing uniprocessor operation in VARY CPU offline 2-374-2-375
 - mount equalization 3-291, 3-350, 3-370
 - no AVR processing 3-341
 - preprocessor
 - flowchart 6-10, 6-12, 6-14
 - function 2-300-2-301
 - module description 6-304
- MSS cleanup
 - in address space purge resource managers 4-416-4-417
 - in task purge resource manager 4-406-4-407
- MSS commands
 - posting MSS from HALT command 2-301
- MUG (multi-unit generic)
 - ensuring each request is allocated to a single generic 3-366
 - not successfully handled by algorithm 3-367
- multi-processor system
 - starting via interrupt 2-393
 - stopping via interrupt 2-393
- multiprogramming level (VS2.03.807)
 - definition/description 3-3 (VS2.03.807)
 - management to 3-3, 3-23 (VS2.03.807)
 - in resource monitor periodic monitoring 3-66 (VS2.03.807)
 - in resource monitor MPL adjustment processing 3-67.0 (VS2.03.807)
 - sampling and adjusting 3-66, 3-67.0 (VS2.03.807)
- multi-unit generic (see MUG)
- multi-unit/multi-generic requests processing
 - flowchart 6-63, 6-67

- function 3-348, 3-366
- module description 6-315
- multi-unit requests
 - tape data sets, processing 3-380
 - unsuccessful processing 3-379
 - within a generic 3-317
- multiple device type determination
 - flowchart 6-58
 - function 3-326, 3-328
 - module description 6-314
- multiple line write to operator WTO service routine 2-72
(See also MLWTO)
- multiple request for the same unit
 - processing in fixed device control 3-299
- MVCA
 - in allocation/volume mount and verify (VM&V) interface 3-388
 - in volume mount and verify (VM&V) 3-392
- MVCA chain processor
 - flowchart 6-74, 6-71
 - function 3-390, 3-388, 3-394
 - module description 6-319
- MVCAX
 - in allocation/volume mount and verify (VM&V) interface 3-394
- NEL (interpreter entrance list)
 - creation by master subsystem 3-178
 - in converter
 - initialization 3-224
 - processing commands in the input stream 3-230
 - termination 3-242
 - in SWA create interface 3-216
- NET (VTAM) command processing 2-391
- new address space (see address space)
- NEWIPS SYSEVENT code (32)
 - in workload manager 3-71
 - processing in SRM SYSEVENT code processor 3-18
- NIOWAIT SYSEVENT code (3)
 - in SRM storage management 3-47
 - processing in SRM SYSEVENT code processor 3-12
- NOAIE diagram 5-174
- non-cancellable property as indicated in PPT 3-201
- non-conversational mode in PFR-entered command processing 2-186
- nonpreemptable SVC (VS2.03.807)
 - in I/O interruption handler 4-96 (VS2.03.807)
 - in SVC interruption handler 4-86 (VS2.03.807)
- nonreclaimable frames (VS2.03.807)
 - in general frame allocation 5-25 (VS2.03.807)
- nonshareable device allocation 3-359
- nonspecific volume allocation
 - allocation recovery 3-358
 - processing (IEFAB436) 3-308
 - types of requests
 - public volumes 3-308, 3-356
 - storage volumes 3-308
 - use with fixed device control in allocating to permanently resident or reserved volumes 3-296-3-297
 - use with generic allocation in allocating to private volume or public volume 3-344-3-345
- non-swappable property as indicated in PPT 3-200
- normal dynamic allocation control
 - flowchart 6-85-6-87
 - function 3-414
 - module description 6-323
- normal EOT processing 4-328-4-329
- "not ready" devices (in recovery allocation) 3-364-3-365
- NOTREADY diagram 5-468
- notices from LOGON monitor 2-448
- notification
 - of address space termination or task termination 4-400, 4-424
 - to active subsystem (function codes) 3-161
 - null assignment in VIO services routine 5-55
- obtain DSORG routine
 - flowchart 6-82, 6-84, 6-86
 - module description 6-322
- obtaining space for TQE (timer queue elements)
 - in establishing timer intervals using STIMER 4-8
- occupancy analysis of main storage in SRM 3-52
- offline/allocated device allocation 3-366
 - operator interface 3-374
 - processing
 - flowchart 6-67-6-69, 6-48
 - function 3-366
 - module description 6-316
- offline allocation requests 3-366
- offline console status, causing 2-353
- offlines/allocateds, processing
 - flowchart 6-69
 - function 3-374-3-375
 - module description 6-316
- OFFLINE,S (MSS command)
 - flowchart 6-18
- OKSWAP SYSEVENT code (42)
 - in SRM interface 3-7
 - in workload manager 3-71
 - processing in SRM SYSEVENT code processor 3-20
- online console status, causing 2-353
- ONLINE,S (MSS command)
 - flowchart 6-18
- open checkpoint data set routine
 - flowchart 6-90
 - function 3-487
 - module description 6-335
- OPEN processing 3-204
- OPEN/CLOSE module (DIDOCs) 2-18, 2-22
- operands, of CONTROL command, displaying 2-288
- operating system, stopping 2-300, 2-394
- Operation (see Method of Operation Section)
- operator action requests, displaying 2-292
- operator cancelled jobs
 - processing in common allocation cleanup 3-382
- operator TOD clock communication routine 4-30
- operator commands
 - processing typed commands from a graphics console 2-184
- operator console (see console)
- operator message deletion (DOM) 2-152, 2-154, 2-138, 2-140, 2-166
- operator restart interrupt handler, functions 4-116
- operator SEND command main control
 - flowchart 6-15
 - function 2-332
 - module description 6-298
- options for MF/1
 - in channel initialization 3-100
 - in CPU initialization 3-96
 - in device initialization 3-104
 - in the MFDATA SVC Mainline 3-114
 - in paging initialization 3-96
 - in workload initialization 3-98
 - listing 3-88
 - merging on input 3-84
 - validity checking 3-86
- ORE (operator reply element, see also WWB)
 - in communications task recovery (STAR) 2-218

- in delete operator message (DOM) processing 2-139
- in displaying information requests 2-324
- in displaying operator-action requests 2-292
- in SVC 35 processing 2-42, 2-46
- in WTO and WTOR macro instruction processing 2-42, 2-46
- Organization (see Program Organization Section)
- OS/VS2 Release 2
 - overview diagram 1-24
 - purpose 1-23
- OUCB (system resources manager use control block)
 - in control swap-in (IRARMCSI) 3-40 (VS2.03.807)
 - in CPU load balancing swap analysis 3-66
 - in CPU management (IRARMCPM) 3-64 (VS2.03.807)
 - in deferred action processing 3-28
 - in deleting a virtual memory 2-400
 - in individual user evaluation (IRARMWM3) 3-73.0 (VS2.03.807)
 - in partial analysis 3-36
 - in SRM interface 3-9
 - in storage management (IRARMSTM) 3-46 (VS2.03.807)
 - in swap-in control 3-40
 - in swap-out control 3-42
 - in swappable user evaluation (IRARMWM2) 3-70 (VS2.03.807)
 - in timer action analysis 3-26
 - in user evaluation (IRARMCVL) 3-43.4 (VS2.03.807)
 - in user ready processing (IRARMHIT) 3-73.2 (VS2.03.807)
 - in workload management 3-70
- OUSB (system resources manager user swappable block)
 - in deleting a virtual memory 2-400
- output pending bit (UCMPF) 2-122
- OUT queue for SRM (VS2.03.807)
 - definition 3-23.0 (VS2.03.807)
 - in resource monitor periodic monitoring (IRARMRM1) 3-67 (VS2.03.807)
 - in select user for swap-in (IRARMCPI) 3-45.0 (VS2.03.807)
 - in swap analysis (IRARMCAP) 3-36 (VS2.03.807)
 - in swappable user evaluation (IRARMWM2) 3-70 (VS2.03.807)
 - in user ready processing (IRARMHIT) 3-73.2 (VS2.03.807)
- OUXB (system resources manager user extension block)
 - in control swap-in (IRARMCSI) 3-40 (VS2.03.807)
 - in CPU management (SRM) 3-62
 - in deleting a virtual memory 2-400
 - in individual user evaluation (IRARMWM3) 3-73.0 (VS2.03.807)
 - in I/O management (IRARMiom) 3-54 (VS2.03.807)
 - in SRM interface 3-9
 - in control swap-in 3-41
 - in storage management (IRARMSTM) 3-46 (VS2.03.807)
 - in swappable user evaluation (IRARMWM2) 3-70 (VS2.03.807)
 - in SYSEVENT processing in SRM SYSEVENT code processor 3-12
 - in user evaluation (IRARMCVL) 3-43.4 (VS2.03.807)
 - in user ready processing (IRARMHIT) 3-73.2 (VS2.03.807)
 - in workload management 3-70
- overlay supervisor processor
 - module description 6-335
- override processing in interpreter
 - in creating and chaining tables 3-254
 - in writing tables into SWA 3-257
- overlay supervisor 4-306
- packaging of SRM 3-3.2 (VS2.03.807)
- page data sets (ASM) (VS2.03.807)
 - description of 1-46.1 (VS2.03.807)
 - dynamic addition of 5-344 (VS2.03.807)
 - error matrix 7-491 (VS2.03.807)
 - overflow processing 5-152 (VS2.03.807)
- page expansion (ASM) (VS2.03.807)
 - introduction 1-44 (VS2.03.807)
 - introduction to MOs 5-344 (VS2.03.807)
 - overview diagram 5-345 (VS2.03.807)
- page faults
 - error in 5-82
 - global locks end 5-22
 - satisfying 5-22
 - validity checking 5-22
- page, finding 5-78
- page fix (see also PGFIX)
 - freeing a fixed page 5-38
 - "long fix" processing 5-24, 5-38
 - processing 5-34
- page frame (see also GFA)
 - allocation 5-24, 5-34
 - assigning real 5-42
 - freeing 5-52, 5-40
 - interruption 5-22
 - paging out 5-40
 - reclamation 5-24
 - replacement 5-64, 3-47
 - status, determining 5-8
 - stealing 5-6
 - validating 5-64
- page free request (see PGFREE)
- page I/O completion processing 5-28
- page I/O error processing 4-324
- page I/O initiation 5-52
- page I/O initiation error 5-59
- page I/O post 5-28
- page load (see PGLOAD)
- page release processing 5-14
- page seconds 5-73 (VS2.03.807)
- page services interface 5-32
- page services interface error 5-32
- page stealing 3-46-3-47
- page table building/creation
 - in obtaining a new memory 5-102, 2-250
 - in V=R region allocation 5-8
- page table, freeing 5-12
- PAGEADD command (ASM) (VS2.03.807)
 - description of 1-42 (VS2.03.807)
 - processing of 5-344 (VS2.03.807)
 - program organization overview 6-14 (VS2.03.807)
- page-in completion 5-28
- paging I/O (VS2.03.807) 5-119
- paging measurements for MF/1
 - initialization 3-97
- paging termination services 5-62
- page-out completion 5-28
- page validation 5-65
- PARMAD parameter in SETFRR 7-479
- parameter value analysis in interpreter 3-248
- parse (see IKJPARSE)
- parse of MF/1 syntax 3-86
- parse/scan interface
 - flowchart 6-34
 - function 2-450, 2-454, 2-456
 - module description 6-336
- PART (page activity reference table) (VS2.03.807)
 - description of 1-44 (VS2.03.807)
 - in page processing 5-119 (VS2.03.807)
 - overview diagram 1-46 (VS2.03.807)
 - relating to a virtual address 7-479 (VS2.03.807)

- PARTE (page activity reference table entry) (VS2.03.807)
 - in page processing 5-152 (VS2.03.807)
- passed data set information scan
 - flowchart 6-60
 - function 3-334
 - module description 6-313
- PAT (page allocation table) (VS2.03.807)
 - description of 1-44 (VS2.03.807)
 - overview diagram 1-46 (VS2.03.807)
- path, device (see device path)
- PCB (page control block)
 - in freeing a V=R region 5-12
 - in FREEMAIN release processing 5-16
 - in general frame allocation 5-24
 - in page I/O initiation 5-52
 - in page I/O post 5-28
 - in page release processing 5-14
 - in page termination services 5-62
 - in PCB management 5-74
 - in PGFIX/PGLOAD root exit 5-36
 - in PGOUT 5-40
 - in program interruption extension 5-22
 - in real storage reconfiguration 5-70
 - in swap-in processor routine 5-42
 - in swap-in root exit 5-44
 - in swap-out processor routine 5-46
 - in swap-out root exit 5-50
 - in V=R region allocation 5-10
 - in VIO services 5-56
 - I/O complete 5-46
 - I/O not-complete 5-46
- PCB free queue (VS2.03.807)
 - in swap-out completion routine 5-50 (VS2.03.807)
 - in swap-post process routine 5-45.0 (VS2.03.807)
- PCB manager 5-74
- PCB/AIA (VS2.03.807)
 - in delete address space routine 5-60 (VS2.03.807)
 - in LSQA swap I/O initiator routine 5-52-5-53 (VS2.03.807)
 - in swap-out completion routine 5-50 (VS2.03.807)
- PCBVBN 5-40 (VS2.03.807)
- PCCA (physical communications configuration area)
 - in asynchronous timer recovery 4-38
 - in displaying a matrix of real storage 2-290
 - in emergency signal second level interrupt handler 4-128
 - in external call second level interrupt handler 4-126
 - in interval measurement gathering routine for CPU 3-118
 - in memory switching 4-84
 - in MF/1 channel initialization 3-101
 - in MF/1 channel sampling module 3-140
 - in quiesce processing 2-410
 - in restore processing 2-414
 - in setting a specific TOD clock 4-26
 - in setting clock comparator 4-20
 - in signal service routines 4-120
 - in synchronous timer recovery 4-36
 - in TOD clock synchronization 4-32
 - in TOD clock status test 4-34
 - in TQE dequeue 4-14
 - in TQE enqueue 4-12
 - in TQE processing 4-22
 - in varying a channel online 2-376
 - in varying a CPU offline 2-374
 - in varying a CPU online 2-372
- PCCAT (physical communications configuration area vector table)
 - in TOD clock status test 4-34
 - in TQE dequeue 4-14
- PCCAVT (see also PCCAT)
 - in memory switching 4-84
- PCCB (private catalog control block)
 - in JFCB housekeeping control 3-314
 - in JLOCATE 3-336
 - in step initiation 3-204
- PCCB routine
 - flowchart 6-49, 6-56, 6-60
 - function 3-336-3-337, 3-314-3-315
 - module description 6-306
- PCCW (program channel command workarea) (VS2.03.807)
 - in completion processing 5-153 (VS2.03.807)
 - in page processing 5-152 (VS2.03.807)
- PDI (passed data set information)
 - in DD function control 3-322
 - in JLOCATE 3-334
 - in job unallocation 3-410
 - searching 3-334
- PDI read and chain
 - flowchart 6-59-6-60
 - function 3-334-3-335
 - module description 6-306
- percolation
 - in recovering a task 4-390-4-391
- performance group descriptor (see WPGD) (VS2.03.807)
- performance group period change
 - by workload manager 3-70, 3-72
- performance group reset module
 - flowchart 6-15
 - function 2-330
 - module description 6-294
- performance objective
 - use by workload manager 3-71
- periodic track display
 - stopping 2-342
- permanently resident volumes
 - allocating request for 3-294
- PFK (see program function key)
- PFT (page fix table)
 - displaying definition of 2-294
 - in varying the status of real storage 2-384
- PFTE (page fix table entry)
 - in deleting an address space 5-60
 - in displaying a matrix of system status 2-290
 - in freeing a V=R region 5-12
 - in FREEMAIN release processing 5-16
 - in general frame allocation 5-24
 - in initializing an address space 5-58
 - in LSQA/SQA allocation 5-6
 - in page frame replacement 5-64
 - in page I/O completion processing 5-30
 - in page release processing 5-14
 - in page termination services 5-62
 - in PFTE enqueue/dequeue 5-72
 - in PGFIX/PGLOAD 5-36, 5-34
 - in PGFREE 5-38
 - in PGOUT 5-40
 - in swap-out 5-46
 - in translating real to virtual 5-80
 - in VIO services 5-54
 - in V=R region allocation 5-8
 - putting on LSQA frame queue 5-58
- PFTE (enqueue dequeue routine) 5-72
- PGFIX
 - completion 5-36
 - interfaces 5-32
 - processing 5-34
- PGFREE
 - interfaces 5-32
 - processing 5-38
- PGLOAD
 - completion 5-36

- interfaces 5-32
- processing 5-34
- PGOUT**
 - module description 6-274
 - processing 5-40
- PGTBITS 5-40 (VS2.03.807)**
- PGTE (page table entry)**
 - calculating addresses in 5-78
 - in creating a segment 5-18
 - in destroying a segment 5-20
 - in finding a page 5-78
 - in FREEMAIN release processing 5-16
 - in general frame allocation 5-24
 - in LSQA/SQA allocation 5-6
 - in page frame replacement 5-64
 - in page I/O post 5-28
 - in page invalidation 5-76
 - in page release processing 5-14
 - in PGFIX/PGLOAD processing 5-34
 - in PGOUT 5-40
 - in program interruption extension 5-22
 - in real storage reconfiguration 5-68
 - in swap-in root exit 5-44
 - in VIO services 5-54
 - in invalidating real and virtual pages 5-14, 5-76
 - initializing 5-18
- phase I overview 6-201
- phase II overview 6-202
- phase III overview 6-202
- phase I 6-201
- phase II 6-202
- phase III 6-203
- PICA (program interruption communication area)**
 - in program check interrupt handler 4-110
 - in SPIE routine 4-250
 - in SYNCH routine 4-290
- PIE (program interruption element)**
 - in program check interrupt handler 4-104
 - in SPIE routine 4-250
 - in SYNCH routine 4-290
- PIRL (purged I/O restore list)**
 - in quiesce processing 2-410
 - in restore processing 2-414
- PKF commands, processing from a graphic console** 2-186-2-187
- PLPA (pageable link pack area) (VS2.03.807)**
 - description of 1-46.1(VS2.03.807)
 - error matrix 7-491(VS2.03.807)
 - overflow processing 5-152(VS2.03.807)
- PLPASAVE diagram** 5-186
- pool (see quick cell)
- POST**
 - error handling 4-229-4-233
 - interface with EVENTS 4-196
 - (see also EVENTS processing)
 - processing 4-222
 - SRB processing for cross-memory post 4-226-4-229
- post exit processing (VS2.03.805)**
 - function 4-222, 4-225, 4-233 (VS2.03.805)
 - introduction 37 (VS2.03.805)
 - module description 6-278 (VS2.03.805)
- posting communications task** 2-148
- posting SMF**
 - error exit 3-460
- posting region requests**
 - error termination 5-100
- post-TMP exit, LOGON** 2-466
- PPT (program properties table)**
 - in step initiation 3-200
 - scan
 - flowchart 6-39
 - function 3-200-3-201
 - module description 6-330
- PQE (partition queue element)**
 - in freeing a virtual region 5-101
 - in VSM address space creation 5-103
- PRB (program request block)**
 - in LINK routine 4-280
 - in RCT initialization/termination 2-406
 - in restore processing 2-410
 - in STAX service routine 2-416
 - in XCTL routine 4-300
- preferred area, meaning of** 5-25
- preferred area steal (in RSM)** 5-84
- prepare for a write diagram** 5-430
- pre-prompt exit interface, LOGON** 2-460
- pre-TMP exit, LOGON** 2-464
- primary job entry subsystem initialization** 3-176
- priority (see CHAP)** 4-214
- "privileged" property (as indicated in program properties table)** 3-200-3-201
- PRLIST** 3-294
- PROC statement** 3-233
- procedure, cataloged, processing** 3-232
- procedure, in-stream, processing** 3-232
- process job condition codes**
 - flowchart 6-77
 - function 3-406, 3-414
 - module description 6-320
- process request diagram** 5-430
- process TP requests**
 - flowchart 6-52
 - function 3-286-3-287
 - module description 6-311
- processing system log** 2-306
- processing TIME requests** 4-6
- processors, command (see command processing)**
- PROCLG diagram** 5-171
- PROCSTEP (procedure step)** 3-226
- program check interruption handler** 4-104
- program fetch processing**
 - interaction with LINK macro 4-288
 - interface to BLDL 4-288
 - processing 4-308
 - use 4-306
- program function key (PFK)**
 - displaying definition of 2-295
- program interrupt extension** 5-22
- program management overview** 1-37
- Program Organization Section** 6-1
- program properties table**
 - function 3-200-3-201
 - module description 6-329
- programmed timer**
 - in establishing timer intervals using STIMER 4-8
- programmer, writing to (see WTP)**
- prolog**
 - attention exit 2-421
 - exit 4-258
- prompting exit (see pre-prompt exit, LOGON)**
- protect key, message**
 - use in DOM device support processing 2-167
- PSA (prefixed save area)**
 - in dispatcher 4-54
 - in dispatching local SRBs 4-74
 - in dispatching local supervisor routines 4-76
 - in emergency signal second level interrupt handler 4-128
 - in external call first level interrupt handler 4-98
 - in external call second level interrupt handler 4-126
 - in I/O interrupt handler 4-94
 - in memory switching 4-84

- in MF/1 channel sampling module 3-140
- in MF/1 second CPU test channel sampling module 3-142
- in program check interruption handler 4-104
- in quiesce processing 2-410
- in RCT ESTAE processing 2-426
- in RCT initialization/termination 2-406
- in restore processing 2-414
- in restart interrupt handler 4-116
- in routing to FRRs 4-354
- in RTMI initialization 4-344
- in SETLOCK 4-148
- in SLIH processing 4-352
- in stage 3 exit effector 4-134
- in supervisor interruption handler 4-86
- in task dispatching 4-80
- in validity check processing 4-162
- in varying a CPU online 2-372
- in wait task dispatching 4-82
- PSAANEW 4-84
- PSAAOLD (VS2.03.807)
 - in memory switch 4-84 (VS2.03.807)
 - in resume processing 4-192.5 (VS2.03.807)
 - in suspend processing 4-192 (VS2.03.807)
- PSATOLD 4-192-4-192.0 (VS2.03.807)
- PSCB (protected step control block)
 - in dynamic allocation control 3-414
 - in LOGOFF 2-452
 - in LOGON
 - in post-TMP exit 2-466
 - in pre-prompt exit interface 2-460
 - in pre-TMP exit 2-464
 - initialization 2-442
 - monitor 2-450
 - validation 2-454
 - in WTP (write to programmer) processing 2-52
- pseudo access method in subsystem initiation control
 - flowchart 6-38
 - function 3-182, 3-184
 - module description 6-326
- direct read and write
 - flowchart 6-38
 - function 3-182-3-183
 - module description 6-326
- sequential read and write
 - flowchart 6-38
 - function 3-184-3-185
 - module description 6-327, 6-328
- PSLIST (public storage list)
 - in nonspecific volume allocation control 3-308
- PSW (program status word)
 - external call old 4-98, 4-126
 - in dispatching the wait task 4-82
 - in global SRB dispatcher 4-72
 - in I/O interrupt handler 4-94
 - in MODESET routine 4-268
 - in rescheduling locally locked tasks or SRBs 4-372
 - in SLIH processing 4-352
 - in SPIE routine 4-250
 - in SYNCH routine 4-290
 - in validity check processing 4-162
 - wait 4-82
- public volume allocation requests
 - in allocating nonspecific volume requests 3-308
 - in demand allocation 3-356
 - processing in fixed device control 3-294
- purge, attention exit 2-424
- PURGE command (MSS)
 - flowchart 6-14
- PURGE SVC routine
 - flowchart 6-25
 - function 2-410-2-413
- PURGEDQ processing 4-144
- purging SRB
 - in purging timer queue elements 4-16
- purging timer queue elements 4-16
- PUTASPCT diagram 5-338
- PUTONE diagram 5-318
- putting commands on system log 2-242
- PVT (page vector table)
 - in interval measurement gathering routine for paging 3-122
 - in main storage occupancy analysis 3-52
 - in PFTE enqueue/dequeue 5-72
 - in quiesce processing 2-410
 - in resource monitor MPL adjustment processing (IRARMRM2) 3-67.0 (VS2.03.807)
 - in RSM functional recovery routine 5-82
 - in storage management (IRARMSTM) 3-46 (VS2.03.807)
 - in swap-in 5-42
 - in swap-in control 3-40
- QCB (queue control block)
 - in ENQ/DEQ/RESERVE routine 4-242
- QDB (queue descriptor block)
 - in dynamic allocation 3-414
 - in dynamic unallocation 3-416
 - in LOGON initialization 2-442
 - in SVC 99 control 3-412
- QEDIT processor
 - flowchart 6-9
 - function 2-240, 2-232
 - module description 6-299
- QEL (queue element)
 - in ENQ/DEQ/RESERVE routine 4-242
- QMNGRIO macro interface handler
 - flowchart 6-45
 - function 3-264
 - module description 6-329
- QMPA (queue management parameter area)
 - in converter
 - initialization 3-225
 - processing in-stream and cataloged procedures 3-232
 - in converter/interpreter interface 3-178
 - in job deletion 3-210-3-211
 - in job initiation 3-196
 - in restart interface processing 3-510
 - in step deletion 3-210-3-211
 - in SWA create interface 3-216
 - in SWA manager locate mode 3-266
 - in SWA manager control block overview 7-290
 - in SWA manager move mode 3-264
 - in writing blocks to the job journal 3-520
- QREG0 unconditional message to operator 2-114
- QSCEFL SYSEVENT code (18)
 - processing in SRM SYSEVENT code processor 3-15
- QSCECMP SYSEVENT code (13)
 - in SRM CPU load balancing swap analysis 3-67
 - in SRM CPU management 3-63
 - in SRM SYSEVENT code processor 3-14
 - in SRM workload manager 3-71
- QSCEST SYSEVENT code (12)
 - in SRM I/O management (IRARMIOM) 3-54-3-55
 - in SRM SYSEVENT code processor 3-14
- QTIP subroutine 2-259
- QUEIOE diagram 5-382
- QUEIT diagram 5-176
- QUESWAP diagram 5-374

queue manager processing
 in SWA manager move mode 3-264
 queue verification 4-170
 quick cell
 allocating 5-110
 boundary alignment of pool 5-112
 building pools 5-108
 deleting pool 5-114
 formatting pool 5-108
 freeing pool space 5-114, 5-112
 returning to pool 5-112
 quiesce processing
 in quiesce routine 2-410
 in SRM swap-out control 3-42
 system 2-320
 QUIESCE command processing
 flowchart 6-14
 function 2-320
 module description 6-296

 RACF security accessor environment
 deleting 3-193, 3-197, 3-210-3-211 (VS2.03.807)
 deleting 3-193, 3-197, 3-210-3-211 (VS2.03.804)
 initializing 3-216-3-217 (VS2.03.804)
 writing JCTX into SWA 3-256-3-257 (VS2.03.804)
 RACF security accessor control blocks (VS2.03.813)
 creating 2-456 (VS2.03.813)
 deleting 2-446, 2-452, 2-462 (VS2.03.813)
 RACINIT processing 3-211 (VS2.03.807)
 RACINIT macro (VS2.03.813)
 creating RACF control blocks 2-456 (VS2.03.813)
 deleting RACF control blocks 2-446, 2-452, 2-462
 (VS2.03.813)
 range of device addresses, varying 2-364
 RB (request block) (see also VM&V request block)
 dynamic 4-259 (VS2.03.807)
 in ATTACH routine 4-198
 in attention exit scheduler 2-418
 in exit prolog 4-258
 in exit routine (IEAVOR) 4-256
 in external call first level interrupt processing 4-98
 in identify routine 4-296
 in I/O interrupt handler 4-94
 in MODESET routine 4-268
 in POST processing 4-222
 in program check interruption handler 4-104
 in quiesce processing 2-410
 in recovering a task 4-388
 in resume processing 4-192.5-4-192.8 (VS2.03.807)
 in routing to searching routines 4-284
 in RTM rescheduling 4-366
 in SETLOCK 4-148
 in SPIE routine 4-250
 in status routine 4-260
 in supervisor interruption handler 4-86
 in suspend processing 4-192-4-192.0 (VS2.03.807)
 in SYNCH routine 4-290
 in system directed task termination 4-370
 in TCTL processing 4-192.1-4-192.2 (VS2.03.807)
 in TESTAUTH routine 4-270
 in WAIT processing 4-220
 in XCTL routine 4-300
 RCA (RSM recovery communications area)
 in initializing an address space 5-58
 in initiating page I/O 5-52
 in page I/O post 5-28
 in page termination services 5-62
 in RSM functional recovery routine 5-82
 in swap-in 5-42
 RCT (routing control table) (see also region control task)

 in display command preprocessing 2-274-2-275
 in resource monitor MPL adjustment processing
 (IRARMRM2) 3-67.0 (VS2.03.807)
 in resource monitor periodic monitoring (IRARMRM1)
 3-66 (VS2.03.807)
 in routing messages to consoles 2-318
 in track command preprocessing 2-274-2-275
 RCTD (region control task data area)
 in attention exit prolog and epilog 2-420
 in attention exit purge 2-424
 in attention exit scheduler 2-418
 in quiesce processing 2-410
 in RCT common processing 2-408
 in RCT ESTAE processing 2-426
 in RCT initialization/termination 2-406
 in restore processing 2-414
 in STAX service routine 2-416
 RDCM (resident display control module)
 in CONTROL command processing 2-264
 in DISPLAY command preprocessing 2-278
 in displaying program function key definitions 2-294
 in displaying system status 2-282
 in TRACK command preprocessing 2-278
 in tracking system status 2-282
 read
 in pseudo access method 3-182
 read channel program
 use in processing typed commands from a graphic
 console 2-184-2-185
 READ macro instruction
 in SWA manager move mode 3-264-3-265
 read operation
 use in processing typed commands from a graphic
 console 2-184
 reading on ASM dump 7-481
 READ/LOCATE commands 3-266
 real address, translating to virtual 5-80
 real frame (see page frame)
 real frame replacement 5-64
 real page shortage in SRM 3-52-3-53
 real storage
 reconfiguration 5-68
 varying status of 2-384
 real storage manager
 ABEND reason codes 7-474
 calls to ASM 1-4 (VS2.03.807)
 functional recovery routine 5-82
 PGFIX function 5-34, 5-36
 preferred area steal 5-84
 relationship to auxiliary storage manager (overview)
 1-41
 real-time queue (VS2.03.807)
 in SETDIE routine 4-11.0-4-11.1 (VS2.03.807)
 real timer interval requests 3-508
 real TQE (timer queue element)
 in timer error recovery 4-24
 in TQE dequeue processing 4-14
 in TQE enqueue processing 4-12
 RECHAIN diagram 5-458, 1-24-2-282
 reconfiguration commands
 logical reconfiguration (overview) 1-28
 RECONNECT parameter 2-455, 2-457
 recording, error (see error recording)
 recording, log 2-308
 recording task, asynchronous 4-468
 recovery (ASM) (VS2.03.807)
 introduction 1-43 (VS2.03.807)
 introduction to MOs 5-250 (VS2.03.807)
 overview diagram 5-256 (VS2.03.807)
 recovery allocation (IEFAB485) (see also allocation)
 conditions that cause execution of 3-289

- interface with operator
 - flowchart 6-69
 - function 3-374, 3-364
 - module description 6-316
- messages, module description of 6-310
- online devices
 - flowchart 6-70
 - function 3-377
- processing
 - flowchart 6-48, 6-65-6-66, 6-52
 - function 3-358
 - module description 6-316
- type requests that need recovery or retry 3-305
- recovery, error (see error recovery ESTAI)
- recovery, FRR (see functional recovery routine)
- recovery function table 7-485
- recovery reply options processor
 - flowchart 6-69
 - function 3-374, 3-376
 - module description 6-317
- recovery routine (see also functional recovery routine)
 - for MF/1 3-83
- recovery routines 7-487
- recovery/termination manager 7-476
- recovery/termination manager 1 7-476
- recovery/termination manager 2 7-477
- recovery/termination (R/TM) 4-319
 - abnormal EOT (ABEND) 4-330
 - CANCEL command processing 4-332
 - cleanup processing 4-372
 - dump processing 4-335-4-336
 - hardware error processing 4-326
 - normal termination processing 4-328-4-329
 - overview 4-319
 - page I/O error processing 4-324-4-325
 - processing for started task control 2-435
 - restart interrupt handling 4-116
 - retry 4-331
 - task recovery processing 4-388
 - terminating of an address space 4-333-4-334
 - types of recovery routines (overview) 1-37
- recursion processing of errors
 - in RCT 2-426-2-427
 - in SUPER FRR 4-172
- reducing information displays 2-343
- region allocation
 - insufficient space for 5-99, 5-9
 - V=R 5-8
 - XMPOST errors during 5-99
- region control blocks
 - creating 5-102-5-103
 - dequeueing 5-104-5-105
 - releasing 5-12-5-13, 5-101
- region control task
 - common processing 2-408
 - error recovery 2-426
 - ESTAE processing 2-426
 - FRR work area, use of (see FRRWA)
 - initialization 2-406
 - invocation 2-408
 - posting by swap-in root exit 5-44
 - purge 2-410
 - quiesce 2-410
 - quiesce back out (restore) 2-414
 - relationship to START/LOGON/MOUNT 6-13, 6-14, 6-16
 - restarting subtasks 2-414
 - SRM notification 2-410
 - termination 2-406
- REGION parameter 3-201
- region requests
 - checking V=R requests after freeing a region 5-100-5-101
 - V=R 5-98
 - V=V 5-98
 - XMPOST error during 5-99
 - region size, system default 5-99
 - region validation 5-10-5-11
 - register usage table 7-375
 - RELEASE command, checking 2-388
 - release data set
 - flowchart 6-50, 6-75
 - function 3-396-3-397
 - module description 6-305
 - RELEASE LG (RELLG)
 - functional description 5-222 (VS2.03.807)
 - initial processing 5-203 (VS2.03.807)
 - MO diagram 5-136
 - recovery for 5-252 (VS2.03.807)
 - release LPID (RELLP)
 - MO diagram 7-483
 - release processing in FREEMAIN routine 5-16
 - RELEASE TP command, checking 2-388
 - RELLG diagram 5-136
 - RELLP diagram 5-138
 - remote pendable signal routine 4-123
 - REMOVA diagram 5-192
 - remove in-use attribute routine (IEFDB480)
 - functions 3-424
 - remove in-use control routine
 - flowchart 6-83
 - function 3-424
 - module description 6-324
 - remove in-use processor
 - flowchart 6-83
 - function 3-416, 3-426
 - module description 6-324
 - REPLY command
 - processing 2-324
 - reply processors, stages 1 and 2
 - module description 6-285
 - report generators, MF/1, calling
 - in data control 3-109
 - in report generation control 3-146-3-147
 - REQSERVC sysevent code, processing 3-19
 - REQSV DAT SYSEVENT code (49) (VS2.03.807)
 - processing in SRM SYSEVENT code processor 3-22.5 (VS2.03.807)
 - request router, common 3-172
 - request subsystem services function codes 3-161
 - requests
 - operator action 2-292
 - operator console 2-4
 - operator information 2-324
 - requests, allocation
 - not satisfied
 - processing in common allocation clean-up (IEFAB490) 3-378
 - retry criteria 3-379
 - satisfied
 - processing in common allocation clean-up 3-378
 - multi-unit tape data sets, processing 3-380
 - volume mount & verify interface 3-380
 - requests, region (see region requests)
 - requests, timer interval
 - in establishing timer intervals using STIMER 4-8
 - rescheduling
 - locally locked task or SRB 4-372
 - of R/TM in master scheduler address space 4-368
 - reserved volume allocation requests
 - processing in fixed device control (IEFAB430) 3-294
 - RESET command

flowchart 6-15
 interface to SRM 2-331
 processing 2-330
RESETPG SYSEVENT code (31)
 processing in SRM SYSEVENT code processor 3-17
 use by workload manager 3-71
 resetting time (in IEE0603D) 2-338
 resources available
 in ENQ/RESERVE routine 4-242-4-243
 resource factor coefficient, use of (RFC)
 in SRM CPU management 3-65
 in SRM I/O management 3-55
 resource word, building in IEEMPS03 2-321
 resource manager
 for address space purge 4-411
 for task purge 4-403
 resource monitor MPL adjustment (VS2.03.807)
 processing (IRARMRM2) 3-67.0, 3-67.3 (VS2.03.807)
 resource monitor periodic monitoring (IRARMRM1)
 3-66, 3-67.3 (VS2.03.807)
 resources manager (see system resources manager)
 resources unavailable
 in ENQ/RESERVE routine 4-242
 restart (see also checkpoint/restart, DSS)
 automatic step 3-500
 interface routine
 flowchart 6-90
 function 3-510-3-511
 module description 6-334
 interrupt handler processing 4-116
 SRBs in RCT ESTAE processing 2-426
 subtasks
 in attention prolog/epilog 2-422
 system
 processing 3-496
 via interruption 2-392, 4-116
 restart interrupt handler 4-116
 restart preparation routine
 flowchart 6-90
 function 3-516
 module description 6-329
 restart word, building 2-320
 restarting (see restart)
 restore SVC routine processing (see also region control task)
 flowchart 6-27
 function 2-414-2-415
 resume processing (IEAVETCL) (VS2.03.807)
 function 4-51, 5-192.5 (VS2.03.807)
 module description 6-267 (VS2.03.807)
 return code table 7-353
 returning virtual region space to available space (in FREEPART) 5-100
 retry
 overview 3-273
 processing in common allocation clean-up 3-379
 processing in recovering a task 4-388, 4-390
 R/TM processing for 4-331
REVERSER diagram 5-172
 rewinding requests, processing in volume mount and verify 3-390
 RF code in lockword in restart interrupt handler 4-116-4-117
RLCT
 in I/O load balancing swap analysis 3-56
 in I/O management (SRM) 3-54
RLGB (re-logon buffer)
 in LOGOFF 2-452
 in LOGON
 initialization 2-442
 monitor 2-448
 post-TMP exit 2-466
 pre-TMP exit 2-464
RLGSG01 diagram 5-304
RLGSG02 diagram 5-308
RLGSG03 diagram 5-310
RLGSG04 diagram 5-354
RLGSG05 diagram 5-356
RLPSG01 diagram 5-224
RMCA
 in CPU load balancing swap analysis 3-66
 in CPU management (SRM) 3-62
 in I/O load balancing swap analysis 3-56
 in I/O management (SRM) 3-54
 in partial analysis 3-36
 in workload management 3-72
RMCT (system resources manager control table)
 in algorithm request 3-30
 in CPU load balancing swap analysis 3-66
 in deferred action processing 3-28
 in full analysis 3-34
 in I/O load balancing swap analysis 3-56
 in I/O management (SRM) 3-54
 in main storage occupancy analysis 3-52
 in partial analysis 3-36
 in periodic entry point scheduling 3-32
 in select user for swap-in (IRARMCPPI) 3-43.0 (VS2.03.807)
 in select user for swap-out (IRARMCPO) 3-43.2 (VS2.03.807)
 in SRM control 3-23
 in SRM interface 3-5
 in SRM service routine (IRARMSRV) 3-9.8 (VS2.03.807)
 in storage management (IRARMSTM) 3-46 (VS2.03.807)
 in swap analysis (IRARMCAP) 3-36 (VS2.03.807)
 in swap-in control 3-40
 in swappable user evaluation (IRARMWM2) 3-70 (VS2.03.807)
 in timer action analysis 3-26
 in user ready processing (IRARMHIT) 3-73.2 (VS2.03.807)
 in workload management 3-69
RMEP
 in periodic entry point scheduling 3-32
 in storage management (IRARMSTM) 3-46 (VS2.03.807)
 used in processing actions/algorithms 3-23.2, 3-23.3 (VS2.03.807)
RMPL (system resources manager parameter list)
 in page termination services 5-62
 in purging timer queue elements 4-16
RMPT
 in CPU management (SRM) 3-62
 in partial analysis 3-36
 in periodic entry point scheduling 3-32
RMS service routine, branching to from emergency signal SLIH 4-128-4-129
RMWA
 in page termination services 5-62
 roll mode message deletion processing (DIDOCS) 2-198, 2-122
 route requests to active subsystems 3-172
 routing and list operand processor
 flowchart 6-10, 6-11, 6-17
 function 2-262, 2-342
 module description 6-304
 routing codes, changing 2-350
 routing commands 2-242
 routing
 messages to consoles 2-318

to searching routines (see also LINK routine) 4-284
to FRRs 4-354

RPL (request parameter list)
in log writer processing 3-474
in pseudo access method 3-182
in subsystem initiation message writer 3-186
in WTP (write-to-programmer) processing 2-50
in WTP (write-to-programmer) requests 2-48

RPL/ACB interface
in subsystem initiation message writer 3-186
in pseudo access method 3-182

RPSGNL macro instruction, processing in external call
SLIH 4-126

RQE (request queue element)
in stage 2 exit effector 4-132
in stage 3 exit effector 4-134

RRPA
in collect data for MF/1 (IRARMWR3) 3-73.8
(VS2.03.807)
in full analysis 3-34
in user evaluation (IRARMCVL) 3-43.4 (VS2.03.807)

RSM (see real storage manager)
RSM functional recovery routine 5-82
RSM preferred area steal 5-84
RSM V=R region allocation 5-98
RSMCNSTS SYSEVENT code (22)
processing in SRM SYSEVENT code processor 3-16

RSMH
in deleting an address space 5-60
in destroying a segment 5-20
in initializing an address space 5-58

RSTORCMP SYSEVENT code (19)
processing in SRM SYSEVENT code processor 3-15
use by SRM workload manager 3-71

RTB (response/throughput bias) (VS2.03.807)
in user evaluation (IRARMCVL) 3-43.4 (VS2.03.807)

RTCT (recovery termination table)
in changing dump parameters 2-260
in RTM rescheduling 4-366

R/TM (see recovery termination)
R/TM rescheduling in master scheduler's address space
4-368

RTM1 cleanup 4-374
RTM1 entry point processor 4-376, 4-344, 4-342
RTM1 exit processing 4-376
RTM1 initialization 4-344
RTM1 overview 4-342
RTM1 SLIH mode
services performed 4-366, 4-370, 4-352, 4-371, 4-343
system recovery 6-189

RTM1WA (RTM work area)
in clean up 4-374
in processing SLIH requests 4-352
in RTM1 exit processing 4-352

RTM2 initialization 4-382, 4-385
RTM2 mainline controller 4-380-4-381
RTM2 overview 4-378
RTM2WA (RTM work area)
in recovering a task 4-388

R/TM hardware error processor 4-348, 4-342
(see also recovery termination)

RV (recommendation value) (VS2.03.807)
in CPU management (IRARMCPM) 3-63 (VS2.03.807)
in select user for swap-in 3-43.0 (VS2.03.807)
in select user for swap-out 3-43.2 (VS2.03.807)
in swap analysis 3-37 (VS2.03.807)
in user evaluation 3-43.5 (VS2.03.807)

'S' symbol (VS2.03.807)

in save, activate, and release processing 5-222
(VS2.03.807)

S, LONG (MSS command)
flowchart 6-12

S, SNAP (MSS command)
flowchart 6-12

SACB (screen area control block)
in control command processing 2-262
in displaying system status 2-280
in stopping periodic track (status) displays 2-342
in tracking system status 2-280

SART (swap activity reference table) (VS2.03.807)
description of 1-44 (VS2.03.807)
diagram of 1-46 (VS2.03.807)
in swap processing 5-119 (VS2.03.807)

SARWAITQ (SART wait queue) (VS2.03.807)
in swap completion processing 5-120 (VS2.03.807)

SAT (swap allocation table) (VS2.03.807)
description of 1-44 (VS2.03.807)
diagram of 1-46 (VS2.03.807)

SAVEACT diagram 5-150
SAVE diagram 5-140
save LG request (VS2.03.807)
functional description 5-222 (VS2.03.807)
initial processing of 5-203 (VS2.03.807)
recovery for 5-252 (VS2.03.807)

SAVEPUT diagram 5-334
saving messages 2-332

SAVSG04 diagram 5-282
SAVSG06 diagram 5-288
SAVSG08 diagram 5-292
SAVSG10 diagram 5-294
SAVSG11 diagram 5-284
SAVSG061 diagram 5-344
SAVSG062 diagram 5-346
SAVSG063 diagram 5-348

SCA (SPIE control area)
in program check interruption handler 4-104
in SPIE routine 4-250
in SYNCH routine 4-290

scan dictionary
in converting statements to internal text 3-236

SCB (STAE control block)
in ATTACH routine 4-198
in RCT initialization/termination 2-406
in recovering a task 4-388

SCCW (swap channel command workarea) (VS2.03.807)
in completion processing 5-153 (VS2.03.807)
in swap processing 5-119 (VS2.03.807)

SCHEDULE macro instruction (see also PURGEDQ)
overview 1-34
processing (scheduling SRBs) 4-138

scheduler (see job scheduler)
scheduler, attention exit 2-418
scheduling, SRM periodic entry point IRARMCET 3-32

scratch processing, special
flowchart 6-49
module description 6-305

scratch requests 3-358

screen message deletion (DIDOCS) 2-198
screen image buffer (see SIB)

SCT (step control table)
in ABENDED job restart preparation 3-518
in allocation/initiator interface 3-396
in data set descriptor records, processing 3-486
in DD function control 3-322
in DOM device support processing 2-166
in dynamic allocation 3-414
in dynamic information retrieval 3-422
in dynamic unallocation control 3-416
in initiator/allocation interface 3-396

- in interpreter
 - creating and chaining tables 3-252
 - writing tables into SWA 3-256
- in JFCB housekeeping control 3-314
- in job deletion 3-208
- in started task control 2-430
- in step continue processing 3-494
- in step deletion 3-208
- in step initiation 3-200
- in SVC 99 control 3-412
- SCT entry
 - use in DOM device support processing 2-166
- SCVT (secondary communications vector table)
 - in attention exit prolog and epilog 2-420
 - in attention exit scheduler 2-418
 - in cancelling TSO, system initiated 2-256
 - in LOGON initialization 2-442
 - in restore processing 2-414
- SDT (start descriptor table)
 - in started task control 2-430
- SDUMP macro, issuance by DUMP command (IEECB866) 2-298-2-299
- SDUMPS 7-479
- SDWA (system diagnostic work area)
 - in ASCBCHAP processing 4-164
 - in asynchronous timer recovery 4-38
 - in checking a time interval using TTIMER 4-10
 - in communications task (FRR) recovery 2-202
 - in communications task (STAR) recovery 2-212
 - in ENQ/DEQ/RESERVE routine 4-242
 - in establishing timer intervals using STIMER 4-8
 - in freeing an address space 5-104
 - in freeing a virtual region 5-100
 - in getting a virtual region 5-98
 - in identify routine 4-296
 - in LINK routine 4-278
 - in LOGON monitor recovery 2-462
 - in master scheduler wait 2-246
 - in master scheduler wait recovery and retry 2-248
 - in processing TIME requests 4-6
 - in PURGEDQ processing 4-144
 - in quiesce processing 2-410
 - in RCT ESTAE processing 2-426
 - in recovering a task 4-388
 - in restore processing 2-414
 - in routing to FRRs 4-354
 - in RSM functional recovery routine 5-82
 - in RTM1 cleanup 4-374
 - in SCHEDULE processing 4-138
 - in SETLOCK 4-148
 - in SLIH processing 4-352
 - in setting a specific TOD clock use 4-26
 - in super FRR processing 4-172
 - in SVC 34 STAE routine 2-236
 - in timer error recovery 4-24
 - in VSM address space creation 5-102
 - in VSM task termination 5-106
 - in WTP (write-to-programmer) requests 2-48
- searching TCB queue (in task dispatcher) 4-78
- searching the LPA directory (IEAVLK00) 4-286
- searching for volser in UCBs (in job unallocation) 3-411
- SECCHK diagram 5-386
- SECHT
 - in SRM interface 3-5
- second CPU test channel sampling module (IRBMFTCH), function 3-142
- second level interrupt handler (see SLIH)
- security accessor control blocks (VS2.03.813)
 - creating 2-456 (VS2.03.813)
 - deleting 2-446, 2-452, 2-462 (VS2.03.813)
- security accessor environment (RACF) (VS2.03.804)
 - deleting 3-193, 3-197, 3-210 (VS2.03.804)
 - initializing 3-216 (VS2.03.804)
 - writing JCTX into SWA 3-256 (VS2.03.804)
- security accessor environment (RACF) (VS2.03.807)
 - deleting 3-193, 3-197, 3-210 (VS2.03.807)
- security TESTAUTH processing 4-270
- security switch on TOD clock, effect of releasing 4-33
- segment
 - creating, in IEAVCSEG 5-18
 - destroying, in IEAVDSEG 5-20
 - invalidating, in RSM 5-16
- segment table building, in IEAVEMCR 2-250
- SEGRLE diagram 5-226
- select I/O request diagram 5-402
- select user for swap-in (IRARMCP1) 3-43.0 (VS2.03.807)
- select user for swap-in (IRARMCPO) 3-43.2 (VS2.03.807)
- SEND command
 - processing
 - flowchart 6-15
 - function 2-332-2-333, 2-335
 - module description 6-298, 6-335, 6-338
- sequential read
 - in pseudo access method 3-182
- sequential write
 - in pseudo access method 3-182
- serialization
 - in ASM processing 7-486 (VS2.03.807)
 - in common allocation control 3-282
 - in master scheduler wait 2-246-2-247
- service manager in dispatcher and supervision control, general overview 1-34 (see also PURGEDQ)
- service rate
 - explanation of use by SRM workload manager 3-69
- service mode entries, processing in RTM1 initialization 4-346
- service routines (ASM) (VS2.03.807)
 - introduction 1-44 (VS2.03.807)
 - introduction to MOs 5-334 (VS2.03.807)
 - overview diagram 5-335 (VS2.03.807)
- set clock comparator routine 4-20
- SET command
 - immediate routine
 - flowchart 6-16
 - function 2-336
 - module description 6-300
 - SET IPS
 - flowchart 6-16
 - function 2-340, 3-18, 3-71
 - module description 6-294
 - SET local time 2-336
 - SET TOD clock routine
 - function 2-336
 - module description 6-303
- SETDIE routine (VS2.03.807)
 - flowchart 6-113 (VS2.03.807)
 - function 4-11.0 (VS2.03.807)
 - module description 6-277 (VS2.03.807)
- SETDMN SYSEVENT code (37) (VS2.03.807)
 - processing in SRM SYSEVENT code processor 3-20 (VS2.03.807)
- SETFRR macro 7-477
- SETLOCK macro instruction, general overview 1-34
- setting domains 3-20, 2-401.0, 6-36.1 (VS2.03.807)
- setting local time 2-336
- SGTE (segment table entry)
 - in creating a segment 5-18
 - in destroying a segment 5-20
 - in FREEMAIN release processing 5-16
 - in initializing an address space 5-58
 - initializing 5-18

- invalidating 5-20
- swap-in root exit 5-44
- in V=R region allocation 5-8
- shared data set attributes, replacing in job initiation 3-199
- shared subpools
 - exception in freeing when task terminates 5-106
- SIB (screen image buffer)
 - use in displaying single line messages on a graphic console 2-122
 - use in DOM device support processing 2-166
 - use in processing typed commands from graphic console 2-184
- signal processor (see SIGP instruction)
- signal routines (part of interprocessor communication)
 - direct signal routine 4-125
 - remote pendable signal routine 4-123
- signalling other CPUs (signal service routines) 4-120
- SIGP instruction
 - overview 1-34
 - use in signal services routines 4-120
- single line message (see WTO)
- single thread queues, verifying
 - with header 4-170
- SIOT (step I/O table)
 - completing DCB information in 3-329
 - completing DISP information in 3-333
 - copying unit information into 3-331
 - in allocate request to unit 3-302
 - in allocating offline devices 3-366
 - in allocation/initiator interface 3-396
 - in allocation/volume mount and verify (VM & V) interface 3-386
 - in allocation via algorithm 3-348
 - in common allocation cleanup 3-378
 - in common allocation control 3-280
 - in common unallocation 3-432
 - in data set descriptor records processing 3-486
 - in DD function control 3-322
 - in demand allocation 3-355
 - in disposition processing 3-440
 - in dynamic allocation control 3-414
 - in dynamic concatenation 3-418
 - in dynamic information retrieval 3-422
 - in dynamic deconcatenation 3-420
 - in dynamic unallocation control 3-416
 - in fixed device control 3-294
 - in generic allocation control 3-338
 - in initiator/allocation interface 3-396
 - in initiator/unallocation interface 3-402
 - in interpreter 3-252
 - in JFCB housekeeping control 3-314
 - in JLOCATE 3-334
 - in job unallocation 3-410
 - in nonspecific volume allocation control 3-308
 - in recovery allocation 3-358
 - in remove in-use processor 3-424
 - in specific volume allocation 3-298
 - in SVC 99 control 3-412
 - in unallocation/initiator interface 3-402
 - in unit unallocation processing 3-444
 - selecting in non-specific allocation control 3-308
- SIRB (system interrupt control block)
 - errors, reaction to in RCT ESTAE processing 2-426
 - in stage-3 exit effector 4-134
- SLIH (second level interrupt handler)
 - emergency signal 4-128
 - external call 4-126
 - processing for RTM1 4-352
 - RTM1 initialization, done to satisfy a request from a SLIH 4-344
 - timer 4-18
- SLIP (servicability level indication processing) 4-356-4-357
- SLIP processing
 - function 4-360-4-361, 4-356-4-357, 4-362-4-363
- SLOT (scheduler look-up table)
 - in varying devices offline and online 2-360
- SMCA (system management control area)
 - in display command preprocessing 2-272
 - in HALT command processing 2-302
 - in SMF cross-memory post error exit 3-460
 - in STAE exit processing for SMF 3-458
 - in switch command processing 2-302
 - in switching SMF data sets 3-454, 3-456
 - in track command preprocessing 2-272
 - in volume mount and verify (VM & V)/allocation interface 3-386
 - in writing SMF records 3-450
- SMF (System Measurement Facility)
 - cross-memory post error exit routine
 - flowchart 6-88
 - function 3-460
 - module description 6-295
 - in converter
 - initialization 3-224
 - data sets, switching 3-454
 - (see also SMF data set)
 - dynamic dd routine
 - flowchart 6-82, 6-87, 6-89
 - function 3-418
 - module description 6-322
 - exit in step initiation 3-200
 - initialization exit support module
 - flowchart 6-39
 - function 3-200-3-201
 - module description 6-295
 - interface to interpreter 3-256
 - new exits (general overview) 1-34
 - open initialization
 - flowchart 6-88
 - module description 6-295
 - record manager
 - flowchart 6-88
 - function 3-452, 3-450-3-451
 - module description 6-295
 - record writing
 - flowchart 6-88
 - function 3-450-3-451, 3-456, 3-452, 3-454
 - module description 6-295
 - records, writing
 - in MF/1 routine for channels 3-131
 - in MF/1 routine for CPU 3-119
 - in MF/1 routine for devices 3-135
 - in MF/1 routine for paging 3-123
 - in MF/1 routine for workload 3-127-3-129
 - in step initiation 3-200
 - in varying a channel offline 2-379
 - in varying path to a device 2-383
 - in varying real storage status 2-384
- STAE exit message module
 - flowchart 6-88
 - module description 6-295
- STAE exit processing
 - flowchart 6-88
 - function 3-458
 - module description 6-295
- SYSEVENT REQPGDAT (39) issued to obtain paging data 3-20
- TCT "storage-used" field, updating by FREEMAIN 5-97
- TCTIOT construction interface
 - flowchart 6-39
 - function 3-206

- module description 6-319
- VARY record handler
 - flowchart 6-20
 - function 2-352
 - module description 6-301
- writer message module
 - flowchart 6-88
 - module description 6-295
- SMF data set
 - in MFDATA mainline 3-115
 - opening of 3-450
 - opening of alternate 3-454
 - splitting 3-454, 3-453
 - switching 3-454, 3-452, 2-303
- SMF records
 - count of, updating 3-456
 - splitting 3-452
- SNAP dump processing 4-335
- sort rotation diagram 5-434
- space, address (see address space)
- space, region
 - allocating in GETPART 5-98
- SPCT (swap control table)
 - in creating a segment 5-18
 - in deleting an address space 5-60
 - initializing 5-58, 5-18
 - in swap-in 5-42
 - processing 5-46
 - in swap-out 5-50 (VS2.03.807)
 - repacking 5-20
- special protect key 3-200
- specific volume allocation control
 - processing
 - flowchart 6-53, 6-62, 6-64-6-65
 - function 3-298
 - module description 6-311
 - use with fixed device control 3-295
 - use with generic allocation 3-344
- SPIE routine 4-250, 4-254
 - FRR 4-251
- SPL (service priority list)
 - in deleting a virtual memory 2-400
 - in quiesce processing 2-410
- SPQE (subpool queue element)
 - in freeing a virtual region 5-100
 - in FREEMAIN 5-96
 - in GETMAIN 5-94
 - in getting a virtual region 5-98
 - in SVC 34 STAE routine 2-236
 - in VSM task termination 5-106
- SQA
 - allocation 5-6
 - allocation, virtual storage for 5-94
 - GETMAIN for, processing 5-94
 - in MF/1 device initialization 3-46
 - reserve queue, search of to satisfy SQA request 5-7
 - search of the available frame queue 5-6
 - stealing a frame if no preferred area frame is on the available frame queue 5-7
- SQALOW SYSEVENT code (25)
 - processing in SRM SYSEVENT code processor 3-16
 - in SRM storage management 3-50-3-51
- SRB mode 7-483
- SRB mode error 7-483
- SRB (service request block) (see also dispatcher)
 - cancelling in PURGEDQ routine 4-144
 - exit entry in dispatcher from POST 4-226
 - global
 - dispatching 4-74
 - overview 1-34
 - in cancelling TSO, system initiated 2-256
 - in deleting an address space 5-60
 - in dispatcher 4-54
 - in displaying information requests 2-324
 - in global SRB dispatcher 4-72
 - local
 - dispatching 4-74
 - overview 1-34
 - in memory switch 4-84
 - in page I/O initiation 5-60
 - in page I/O post 5-28
 - in PCB management 5-74
 - in PFTE enqueue/dequeue 5-72
 - in PURGEDQ processing 4-144
 - in RCT ESTAE processing 2-426
 - in real storage reconfiguration 5-68
 - in rescheduling locally locked task or SRBs 4-372
 - in rescheduling RTM 4-366
 - in SCHEDULE processing 4-138
 - in stage 2 exit effector 4-132
 - in stage 3 exit effector 4-134
 - in status routine 4-260
 - in swap-in root exit 5-44 (VS2.03.807)
 - in swap-post processor 5-45.0 (VS2.03.807)
 - in timer SLIH (second level interrupt handler) 4-18
 - in TQE processing 4-22
 - in V=R region allocation 5-8
 - purging 4-16
 - removing 4-144
 - rescheduling 4-372
- SRM (see also system resources manager)
 - algorithm processor 3-23, 3-23.2, 3-23.3, 3-24 (VS2.03.807)
 - collect data for MF/1 3-73.8 (VS2.03.807)
 - constants module description 6-338
 - control algorithm 3-23
 - control swapin routine 3-40
 - control swapout routine 3-42
 - CPU load balancing swap analysis 3-66
 - CPU management routines 3-62
 - deferred action processor 3-28
 - FRR 3-9
 - full analysis retry function 3-34
 - individual user evaluation 3-73.0 (VS2.03.807)
 - initialize for MF/1 3-73.6 (VS2.03.807)
 - interface module 3-6
 - I/O load balancing user I/O monitoring 3-58 (VS2.03.807)
 - I/O load balancing swap analysis routine 3-56
 - I/O management routines 3-54
 - main storage occupancy routine 3-52
 - message module (text) 6-339
 - module/entry point cross reference 3-3.2, 3-3.3 (VS2.03.807)
 - nonresident set to new IPS routine 3-32
 - obtain/free SQA storage 3-9.6 (VS2.03.807)
 - partial analysis routine 3-36
 - periodic entry point scheduling routine 3-32
 - processing algorithms and actions 3-23, 3-23.2, 3-23.3 (VS2.03.807)
 - requeue SRM TQE 3-9.8 (VS2.03.807)
 - resource monitor MPL adjustment processing 3-67.0 (VS2.03.807)
 - resource monitor periodic monitoring 3-66 (VS2.03.807)
 - resource use algorithms, overview 3-45
 - RMEP algorithm and action invocation flags 3-23.3 (VS2.03.807)
 - select user for swap-in 3-43.0 (VS2.03.807)
 - select user for swap-out 3-43.2 (VS2.03.807)
 - service routine 3-9.2 (VS2.03.807)
 - storage management routines 3-46

supervisor service request routine 3-48, 3-32, 3-42, 3-40
 swap analysis 3-36 (VS2.03.807)
 swappable user evaluation 3-70 (VS2.03.807)
 sysevent processor 3-11
 sysevent routers and processors 3-12
 timer action analysis 3-26
 user evaluation 3-43.4 (VS2.03.807)
 user ready processing 3-73.2 (VS2.03.807)
 uses ASM and RSM 3-3 (VS2.03.807)
 workload activity recording routine 3-70
 workload management function, overview 3-69
 workload manager algorithm module 3-70
SSCVT (subsystem communications vector table)
 in common request router 3-172
 in subsystem determination 3-174
 in subsystem interface 3-159
SSIB (subsystem identification block)
 in common request router 3-172
 in data set name assignment 3-188
 in job initiation 3-196
 in log initialization 3-466
 in started task control 2-430
 in subsystem determination 3-174
 in subsystem initiation 3-176
 in subsystem interface 3-159
 in switching log data sets 3-472
 in terminating the system log 3-470
SSOB (subsystem options block)
 in command translation 2-242
 in command routing 2-242
 in common request router 3-172
 in converter/interpreter interface 3-178
 in data set name assignment 3-188
 in job initiation 3-196
 in log initialization 3-466
 in multiple line WTO processing 2-72
 in started task control 2-430
 in subsystem determination 3-174
 in subsystem initiation 3-176
 in subsystem interface 3-159
 in subsystem job termination 3-190
 in SVC 35 processing 2-28
 in WTO and WTOR macro instruction processing 2-28
SSRB
 in dispatching local SRBs 4-74
 in program check interruption handler 4-104
 in rescheduling locally locked task or SRBs 4-372
 in SETLOCK processing 4-148
SSVT (subsystem vector table)
 in subsystem interface 3-159
 stack, FRR (see FRR stack)
STACK macro use 2-449
STAE (set task asynchronous exit)
 creating STAE for SVC 34 command processing 2-234
 dump conditions for SVC 34 STAE 2-236
 for SMF 3-458
 for SYNCH and LINK routine 4-280-4-281
 service routine 4-430
 for TTIMER 4-11
STAE environment for SVC 34, creating 2-234
STAE/STAI relationship to recovery/termination 4-331
 stage-1 exit effector 4-130
 stage-2 exit effector 4-132
 stage-2 swap-in PCBs 5-44 (VS2.03.807)
 stage-3 exit effector 4-134
STAR (system task abend recovery)
 for communications task 2-212
START command (see also START/LOGON/MOUNT
 overview)
 flowchart 6-16
 in started task control 2-430
 issued by a JES2/JES3 subsystem when CSCB or an
 address space is unavailable 2-245
 parameters used by MF/1 START command 3-84,
 3-80
START command syntax check routine
 flowchart 6-32
 function 2-432, 2-431
 module description 6-299
 started task control (see also STC serialization) 2-430
 starting a subsystem, checking for 2-435
 starting or stopping the system via interrupt 2-392
 starting monitoring procedures 2-314
START/LOGON/MOUNT overview
 functions, relationship to RCT, and relationship to STC
 1-31
 obtaining a new virtual memory 2-250
STARTDP diagram 5-178
STATE CHECK processing in TESTAUTH 4-270
 statement (see JCL statement)
STATUS action codes 4-266
 status, console (see console status)
 status display, periodic, stopping 2-342
 status routine
 processing 4-260
 status, system
 displaying matrix of 2-290
 status, TOD clock
 messages and return codes 4-31
 testing for synchronization 4-34-4-35
STATUS STOP 4-266
STAX (STAX parameter list)
 in attention exit prolog and epilog 2-420
 in STAX service routine 2-416
STAX service routine
 processing 2-416
 use during LOGON 2-449
STC (started task control)
 ABEND and reason codes 7-464
 attaching by region control task 2-406
 detach by region control task 2-406
 flowchart 6-32, 6-33
 function 2-430, 2-433, 2-436
 module description 6-296, 6-297, 6-298
 overview 1-33
 relationship to JES, LOGON, and START 1-31
 SWA subpool for 3-267
 write JCL routine
 flowchart 6-32
 function 2-436-2-437
 module description 6-294
 stealing page frames 5-64, 3-46, 5-7, 5-25, 5-84
 step allocation processing in initiator/allocation interface
 3-396
 step continue processing (IEFXB601) 3-494
 step delete routine
 flowchart 6-40
 function 3-208
 module description 6-329
 step header record, for job journal, building
 flowchart 6-39, 6-90
 function 3-512, 3-514, 3-202
 module description 6-334
 step initiation 3-200
 step, preparing for allocation 3-396
 step restart
 automatic, job journal processing for 3-500
 reconstructing SWA for 3-216
 step time processing if job step is canceled 3-207
 step unallocation 3-402
STEPCAT requests 3-314
STEPL (STAE exit parameter list)

- in creating STAE environment for command processing 2-234
- in job initiation 3-196
- STIMER processing 4-8, 4-10
- STINDY diagram 5-180
- STCOA (common option area for supervisor state options, see also INCOA, MPCOA, TMCOA)
 - in mainline initialization of MF/1 3-90
- STGST (global supervisor table)
 - in mainline initialization of MF/1 3-90
 - in MF/1 workload initialization 3-98
- STMMV
 - in MFROUTER processor 3-138
 - in MF/1 channel initialization 3-100
 - in MF/1 device initialization 3-104
- STMV (measurement vector table for supervisor state options, see also DTMV, INMV, MFMV, TMMV)
 - in mainline initialization of MF/1 3-90
- STOP command
 - processing
 - flowchart 6-14, 6-16
 - function 2-312
 - module description 6-300
 - MF/1 enabling use of 3-80
 - STOP command for MF/1
 - in data control routine 3-108, 3-106
 - in measurement facility control 3-80
 - STOP processing 3-196-3-197
 - STOP/MODIFY command processing 2-312
 - STOP MONITOR command
 - operand validity according to source of the command 2-315
 - processing 2-314, 2-344
 - stop/restart subroutine
 - flowchart 6-14
 - function 2-392
 - module description 6-297
 - stop track processor
 - flowchart 6-16, 6-17
 - function 2-314, 2-344
 - module description 6-303
 - stopping monitoring procedures 2-314
 - stopping operating system
 - in HALT and SWITCH command processing 2-300
 - via interrupt 2-392
 - stopping periodic track displays 2-342
 - stopping TCAM 2-300-2-301
 - STOPTR and CONTROL command processor
 - flowchart 6-10, 6-17
 - function 2-262, 2-344
 - module description 6-303
 - STOPTR command processing 2-342
 - storage deletion routine
 - flowchart 6-38
 - function 3-176-3-177
 - module description 6-326
 - storage volume allocation requests
 - in fixed device allocation (IEFAB430) 3-295
 - in nonspecific volume allocation control 3-309
 - storage, global
 - freed when task terminates 5-106
 - storage, low, verifying 4-176
 - storage management (see real storage manager, virtual storage management, system resources manager)
 - storage, real allocation of frames 5-25
 - storage, virtual, dumping (DUMP command) 2-298
 - STPRT
 - in MF/1 channel initialization 3-100
 - in MF/1 CPU initialization 3-96
 - in MF/1 device initialization 3-104
 - in MF/1 paging initialization 3-96
 - in MF/1 workload initialization 3-98
 - stream, input (see converter)
 - structure, examining alternatives in MF/1 syntax analyzer 3-86
 - STRVT (resource vector table)
 - in mainline initialization of MF/1 3-90
 - STSCT (supervisor control table)
 - in mainline initialization of MF/1 3-90
 - in MF/1 termination processor 3-110
 - STSGT
 - in channel interval measurement gathering routine 3-130
 - in interval measurement gathering routine for CPU 3-118
 - in interval measurement gathering routine for devices 3-134
 - in interval measurement gathering routine for paging 3-122
 - in interval measurement gathering routine for workload 3-126
 - in MFDATA mainline 3-114
 - in MFROUTER processor 3-138
 - in MF/1 channel initialization 3-100
 - in MF/1 CPU initialization 3-96
 - in MF/1 device initialization 3-104
 - in MF/1 paging initialization 3-96
 - in MF/1 termination processor 3-110
 - STSMA (supervisor measurement table)
 - in channel interval measurement gathering routine 3-130
 - in interval measurement gathering routine for CPU 3-118
 - in interval measurement gathering routine for devices 3-134
 - in interval measurement gathering routine for paging 3-122
 - in mainline initialization of MF/1 3-90
 - in MFDATA mainline 3-114
 - in MF/1 channel initialization 3-100
 - in MF/1 CPU initialization 3-96
 - in MF/1 device initialization 3-104
 - in MF/1 paging initialization 3-96
 - in MF/1 workload initialization 3-98
 - SUBMIT (IKJEFF08) 2-454-2-456 (VS2.03.813)
 - submitting commands in the background 2-454-2-456 (VS2.03.813)
 - subpool numbers, attributes of 5-89
 - subpool number, checking in GETMAIN 5-94
 - subpool storage
 - freeing at task termination 5-106
 - subpool, checking in FREEMAIN 5-96
 - subpools, shared
 - exception from freeing at task termination 5-106-5-107
 - subsystem allocation requests, processing in common allocation control 3-281
 - subsystem determination
 - flowchart 6-38
 - function 3-174
 - module description 6-327
 - subsystem exit routine
 - in DOM (delete operator message) processing 2-148
 - subsystem initiation 3-176
 - in converter/interpreter interface 3-178
 - in data set name assignment 3-188
 - in pseudo access method 3-182
 - message writer
 - flowchart 6-38
 - function 3-186
 - module description 6-328
 - processing
 - flowchart 6-38

- function 3-176
- module description 6-327
- subsystem/initiator SWA interface
 - flowchart 6-41
 - function 3-216
 - module description 6-324
- subsystem interface
 - function codes 3-161
 - introduction 3-159
 - overview 1-33
 - processing
 - flowchart 6-38-6-39, 6-2
 - function 6-87-6-91
 - module description 6-327
 - resource manager
 - function 4-415
 - module description 6-327
- subsystem job termination
 - flowchart 6-38
 - function 3-190
 - module description 6-327
- subsystem, routing request to 3-172
- subtasks, restarting
 - in attention prolog/epilog 2-422
- subtasks, stopping in attention exit scheduling 2-418
- supervisor control
 - authorization checking in TESTAUTH 4-270
 - FRR 4-172
 - overview discussion of 4-41
- supervisor interruption handler
 - determining SVC types 4-86
 - processing 4-86
- supervisor state, putting initiator task into 3-197
- suspend processing (IEAVETCL) (VS2.03.807)
 - function 4-51, 4-192 (VS2.03.807)
 - module description 6-267 (VS2.03.807)
- SVAREA parameter on ATTACH 4-203
- SVC dump, scheduling 4-458
- SVC dump
 - overview 4-336
 - processing 4-452
- SVC dump resources manager 4-411
- SVC dump task, posting of 4-460
- SVC interruptions (see supervisor interruptions handler)
- SVC routing 4-87
- SVC 3 4-328
- SVC 13
 - in system directed task termination 4-371
 - rescheduling 4-373
- SVC 34
 - command translation routine
 - flowchart 6-9
 - function 2-242, 2-232
 - module description 6-302
 - commands in the input stream, processing 3-230
 - common processing/initialization 2-232
 - control block chain manipulator
 - flowchart 6-9
 - function 2-240, 2-232
 - module description 6-299
 - ESTAE environment creation routine
 - flowchart 6-9
 - function 2-234, 2-232
 - module description 6-299
 - ESTAE exit routine
 - flowchart 6-9
 - function 2-236
 - module description 6-302
 - message assembly routine 2-238
 - message handling 2-238
 - STAE environment for 2-236
- use in processing typed commands from a graphic console 2-185
- SVC 35
 - in displaying unit status 2-297
 - in MLWTO processing 2-72
 - in WTO and WTOR macro instruction processing 2-28
 - use in processing typed commands from a graphic console 2-185
- SVC 51
 - in dumping virtual storage (DUMP command) 2-298
- SVC 72
 - attention interrupt processing 2-180
 - console switching 2-369
 - DOM communications task overview 2-153
 - DOM communication task processing 2-165
 - external interrupt processing 2-168
 - I/O complete processing 2-133
- SVC 87
 - DOM communication task processing 2-153
 - DOM macro instruction overview 2-138
 - DOM macro instruction processing 2-141
- SVC 95
 - memory deletion 2-401
- SVC 99 control (IEFDB400) 3-412
 - in JLOCATE 3-337
- SVC 101 2-259
- SVC 109 (see extended SVC routing)
- SVC 110 interface routine
 - flowchart 6-11
 - function 2-294-2-295
 - module description 6-296
- SVC 116 (see extended SVC routing)
- SVC 122 (see extended SVC routing)
- SVCIH (see supervisor interruption handler)
- SVRB (supervisor request block)
 - in ATTACH routine 4-198
 - in BLDL/program fetch interface 4-288
 - in checking a time interval using TTIMER 4-10
 - in DOM macro instruction 2-140
 - in identify routine 4-296
 - in LINK routine 4-278
 - in load routine 4-292
 - in multiple line WTO processing 2-72
 - in STAX service routine 2-416
 - in SVC interruption handler 4-86
 - in SVC 35 processing 2-28
 - in SVC 78 processing 2-140
 - in SYNCH routine 4-290
 - in WTO and WTOR macro instruction processing 2-28
 - in WTP processing 2-50
 - in XCTL routine 4-300
- SVRLGGET diagram 5-328
- SWA (scheduler work area)
 - block length 3-265
 - control blocks built by STC 2-437
 - in automatic checkpoint/restart 3-498
 - in automatic step restart 3-500
 - in converter/interpreter interface 3-180
 - in data set descriptor records processing 3-486
 - in job initiation 3-196
 - in merge cleanup 3-502
 - in SWA manager locate mode 3-266
 - in SWA manager move mode 3-264
 - in system restart processing 3-496
 - interface to in-stream and cataloged procedures 3-233
 - interpreter writing tables into SWA 3-256
 - merging from job journal 3-492
 - STC SWA initialization 2-437
 - virtual address in SWA, updating 3-504
- SWA conversion from JCLS
 - flowchart 6-38

- function 3-177, 3-179
- module description 6-326
- SWA and TIOT initialization for private catalogs
 - flowchart 6-32
 - function 2-436
 - module description 6-296
- SWA create interface
 - flowchart 6-41
 - function 3-216-3-217
 - module description 6-325
- SWA manager
 - function code 3-264
 - interface to in-stream and cataloged procedure processing 3-233
 - interface to interpreter 3-256
 - interface to job step allocation 3-397
 - interface to job unallocation 3-411
 - interface module
 - flowchart 6-45
 - function 3-264
 - module description 6-329
 - locate mode
 - flowchart 6-45
 - function 3-266
 - module description 6-329
 - move mode
 - flowchart 6-45, 6-90
 - function 3-264
 - module description 6-328
 - overview 1-33
 - reason codes 7-468
 - SWA merge processing 3-492, 3-503
- SWA prefix
 - in SWA manager move mode 3-265
 - in SWA manager locate mode 3-267
- SWA reader routine
 - flowchart 6-75-6-77, 6-81
 - function 3-396, 3-412
 - module description 6-308
- SWA reconstruction processing
 - in journal merge error processing 3-509
 - in restart processing 3-511
 - reconstruction module (see SWA create interface)
- SWA storage
 - freed when task terminates 5-106
- SWA subpool
 - alternation 3-267
- SWA virtual address
 - in SWA manager move mode 3-265
 - in SWA manager locate mode 3-267
- swap (VS2.03.807)
 - in SRM exchange swap 3-23.0 (VS2.03.807)
- swap analysis 3-36 (VS2.03.807)
- swap analysis in SRM
 - CPU 3-62
 - in partial analysis routine (IRARMCAP) 3-36
 - I/O load 3-56
- SWAPCHK diagram 5-148
- SWAP command processing
 - flowchart 6-17
 - function 2-311
 - module description 6-335
- "swap package", definition of 3-37
- swap data sets (ASM) (VS2.03.807)
 - description of 1-46.2 (VS2.03.807)
 - dynamic addition of 5-344 (VS2.03.807)
 - error matrix 7-491 (VS2.03.807)
- swap sets 1-46.2 (VS2.03.807)
- swapping I/O 5-119 (VS2.03.807)
- swap-in, address space
 - root exit 5-44
 - in SRM control swap-in (IRARMCSI) 3-40
 - completion error 5-82
 - in SRM I/O management routine (IRARMIOM) 3-54, 3-57
 - storage evaluation for in SRM partial analysis 3-36
- swap-in (VS2.03.807)
 - in SRM express swap-in 3-23.0 (VS2.03.807)
 - in SRM select use for swap-in (IRARMCPI) 3-43.0 (VS2.03.807)
 - in SRM unilateral swap-in 3-23.0, 3-40 (VS2.03.807)
- swap-in processor routine (in RSM) 5-42, 5-44
- swap-in root exit routine (in RSM) 5-44
- swap-in root PCB chained out 5-42-5-43 (VS2.03.807)
- swap-in SRM notification if swap-in fails 5-43
- swap-in, timer dependent, in SRM timer action analysis (IRARMCAT) 3-26
- swap-out, address space
 - in SRM control swap-out 3-42
 - in SRM I/O load balancing swap analysis 3-56
 - in SRM partial analysis 3-36
 - initiating 5-52
 - SRM notification that swap-out is complete 5-51
 - swap-out processor (in RSM) 5-46, 5-50
 - timer dependent, in SRM timer action analysis (IRARMCAT) 3-26
- swap-out completion processor (IEAVSWPC) (VS2.03.807)
 - flowchart 6-133, 6-164 (VS2.03.807)
 - function 5-4, 5-50-5-51.0 (VS2.03.807)
 - module description 6-278 (VS2.03.807)
- swap-out parameter list 5-47-5-49, 5-52-5-53, 5-63 (VS2.03.807)
- swap-out (VS2.03.807)
 - in SRM select use for swap-out (IRARMCPO) 3-43.2 (VS2.03.807)
 - in SRM unilateral swap-out 3-23.0, 3-42 (VS2.03.807)
- swap-post processor (IEAVSWPP) (VS2.03.807)
 - flowchart 6-159 (VS2.03.807)
 - function 5-4, 5-45.0-5-45.1 (VS2.03.807)
 - special recovery check 5-82 (VS2.03.807)
- SWINFL SYSEVENT code (17)
 - processing in SRM SYSEVENT code processor 3-15
- SWITCH command
 - initialization 2-300
 - processing 2-302
 - syntax checker
 - flowchart 6-12, 6-17
 - function 2-300
 - module description 6-300
- SWITCH/HALT message module
 - flowchart 6-12, 6-17, 6-89
 - function 2-304
 - module description 6-304
- switch address spaces, indicating need for in memory switch routine 4-84
- switching consoles (in IEE4303D) 2-368-2-369
 - in external interrupt processing 2-168
- switching SMF data sets 3-454, 3-452, 2-303
- switching system log data sets (IEEMB803) 3-472
- SWOUTCMP SYSEVENT code (15), processing in SRM SYSEVENT code processor 3-15
- SWPINST SYSEVENT code (16) (VS2.03.807)
 - processing in SRM SYSEVENT code processor 3-16 (VS2.03.807)
- symbol usage table for data area usage by modules 7-337
- symbolic parameters, processing in the converter 3-234
- SYNCH macro instruction processing 4-290
- synchronization check in timer SLIH 4-18
- synchronization of TOD clock
 - allowing checks for 4-34
 - setting to match master clock 4-32
- synchronous exit processing (SYNCH routine) 4-290

synchronous timer recovery routine 4-36
 syntax analyzer of MF/1 input (IRBMFANL) 3-86
 syntax checker for allocation
 flowchart 6-82-6-84
 function 3-424, 3-420, 3-422, 3-428, 3-418, 3-416
 module description 6-322
 syntax errors in JCL symbolic parameters, scanning for in
 converter 3-235
 SYQSCCMP SYSEVENT code (36)
 processing in SRM SYSEVENT code processor 3-18
 SYQSCST SYSEVENT code (35)
 processing in SRM SYSEVENT code processor 3-18
 SYSCHK DD statement processing in converter 3-229
 SYSEVENT codes
 MF/1 related 3-98
 processing 3-12-3-22
 in SRM CPU management 3-63
 in SRM CPU swap load balancing analysis 3-67
 in SRM interface 3-5-3-9
 in SRM workload manager 3-71
 tracing 3-6
 SYSEVENT List 3-11 (VS2.03.807)
 SYSOUT data set name
 assigning for subsystem initiation 3-188
 System Activities Measurement Facility (see MF/1)
 system commands
 routing exclusion on a JES3 console 2-277
 system default region size 5-99
 system directed task termination 4-370
 system fix counters (VS2.03.807)
 decrementing 5-13, 5-17, 5-31, 5-39 (VS2.03.807)
 incrementing 5-7, 5-9, 5-25, 5-35 (VS2.03.807)
 system initiated cancellation of a TSO user
 schedule routine
 flowchart 6-10
 function 2-256, 2-254
 module description 6-336
 SRB FRR FREEMAIN routine
 flowchart 6-10
 function 2-257
 SRB routine
 flowchart 6-10
 function 2-256, 2-258
 module description 6-338
 system log
 allocating new 3-472
 changing console status 2-350
 commands LOG and WRITELOG 2-306
 translation and routing 2-242
 data sets, processing of 2-306
 ESTAE processor
 flowchart 6-89
 function 3-476
 module description 6-294
 hardcopy 2-306
 initialization 3-466
 initializing log data set 3-466
 message module
 function 3-472, 3-468
 module description 6-294
 switching 3-472
 terminating 3-470
 abnormally 3-476
 unallocating
 current 3-472
 during termination 3-470
 writer processing 3-474
 writing 3-480, 2-306
 system log data set (see system log)
 system log initialization
 in master scheduler wait 2-246
 writer module
 flowchart 6-89
 function 3-466, 3-470, 3-474, 3-472
 module description 6-294
 system mask, changing with MODESET 4-268
 System Measurement Facility (see SMF)
 system message interface routine
 flowchart 6-49, 6-58, 6-60, 6-71, 6-72, 6-75-6-77
 function 3-380, 3-398, 3-400
 module description 6-308
 system parameter library (see SYS1.PARMLIB)
 system, quiescing 2-320
 system reconfiguration (see reconfiguration commands)
 system recovery manager (resource managers)
 for address space purge 4-411
 for task purge 4-403
 system resources manager (SRM) (see also workload
 manager) 1-31
 action/algorithm scheduling 3-23, 3-23.2, 3-23.3
 (VS2.03.807)
 algorithms
 in periodic entry point scheduling 3-32
 resource use algorithms, introduction to 3-45
 algorithm request routine 3-30
 allocated UCB list, use of 3-310-3-311
 analysis routines
 full 3-34
 partial 3-36
 automatic priority group (APG) management 3-45.1
 (VS2.03.807)
 auxiliary slot shortage prevention 3-45 (VS2.03.807)
 control routine 3-23-3-25
 control swap-in routine 3-40
 control swap-out routine 3-42
 consists of five functional groups (VS2.03.807)
 control function 3-3 (VS2.03.807)
 interface function 3-3 (VS2.03.807)
 resource use algorithm 3-3 (VS2.03.807)
 sysevent processor 3-3 (VS2.03.807)
 workload manager 3-3 (VS2.03.807)
 CPU management 3-62
 CPU load balancing swap analysis 3-66
 deferred action processor 3-28
 domain MPL adjustment routine 3-67.0 (VS2.03.807)
 ENQ/DEQ algorithm 3-9.8 (VS2.03.807)
 error processing 3-9
 flowchart, inter-module 6-36
 functional recovery routine 3-9, 3-7
 functions assumed from VS2 Release 1 1-31
 functions no longer supported from VS2 Release 1 1-31
 how packaged 3-3.2 (VS2.03.807)
 interface, general 3-5
 interface
 with LOGON 2-457
 with region control task for quiesce and restore
 2-410, 2-414
 with SCHEDULE processing 4-140
 with timer 4-22
 to UCB candidates list in offline/allocated device
 allocation 3-371
 interface routine (IRARMINT) 3-6, 3-5
 in non-specific volume allocation control
 3-312-3-313
 with allocation in common allocation cleanup 3-382
 interval notification 4-22
 introduction, general 3-3
 I/O load balancing swap analysis 3-56
 I/O management routine 3-54
 IPS values changing (set IPS command processing)
 2-340

lock, obtaining and releasing in full analysis routine 3-34

locking considerations for SYSEVENTS 3-5

LOGON interface 2-457

main storage occupancy analysis 3-52

new functions of SRM, compared to VS2 Release 1 1-31

overview of SRM 1-31

page replacement 3-45 (VS2.03.807)

pageable real storage shortage prevention 3-45 (VS2.03.807)

periodic entry point scheduling routine 3-32

PSLIST use 3-311

real page shortage prevention 3-45 (VS2.03.807)

region control task interface 2-410, 2-414

resource monitor 3-45.1 (VS2.03.807)

resource use algorithms, introduction to 3-45

SQA shortage prevention 3-45 (VS2.03.807)

SRB analysis processing 3-34

SRB scheduling 3-23 (VS2.03.807)

storage management routine 3-46

swap evaluation 3-37

swap-in control routine 3-40

swap-out completion, notification from RSM 5-50

swap-out control 3-42

SYSEVENT code

- locking considerations 3-5
- MF/1 related (WKLDINIT) 3-99
- processing 3-11-3-22

time-driven queue

- definition of 3-3

timer action analysis 3-26

timer interface 4-22

TQE

- in periodic entry point scheduling 3-33

visual contents for HIPO diagrams 3-4

visual table of contents 3-4 (VS2.03.807)

workload manager

- introduction to 3-69
- routine 3-70

system restart

- processing to cause restart at the next step 3-494
- via interrupt 2-394

system status, displaying matrix of 2-290

system, stopping (see stopping)

system termination conditions 4-319

system trace (see trace, system)

system trace termination (see trace termination)

SYSZEC16, use of 2-413

SYSZVARY (CPU resource) issuing ENQ for 2-291

SYS1.BROADCAST

- in LOGON, checking that data set has been defined 2-442
- in sending/saving/listing messages 2-332-2-335

SYS1.BROADCAST data set access controller

- flowchart 6-15
- module description 6-298

SYS1.IKJUA (major name of user identification resource for ENQ in LOGON scheduler) 2-445

SYS1.LINKLIB, obtaining master JCL from in subsystem initiation 3-176

SYS1.LOGREC

- recording 4-466

SYS1.PARMLIB

- IPS values, changing via SET IPS command 2-340

SYS1.PROCLIB

- not opened successfully in subsystem initiation 3-177

SYS1.STGINDEX data set (ASM) (VS2.03.807)

- description of 1-46.2 (VS2.03.807)

TAIE (terminal attention interrupt element)

- in attention exit prolog and epilog 2-420
- in attention exit purge 2-424

tape allocation requests processing 3-358 (see also volume mount and verify)

tape label read

- flowchart 6-61, 6-80
- function 3-340, 3-418
- module description 6-309

tape unloading (VS2.03.804)

- in unit unallocation 3-445 (VS2.03.804)
- in common unallocation flowchart 6-50 (VS2.03.804)

task

- commands, creating 2-244
- creation (ATTACH) 4-198
- dispatcher

 - asynchronous exit processing 4-79
 - function 4-78
 - overview 1-37

- locally locked, rescheduling 4-372
- purge processing 4-398
- recovery 4-388
- termination

 - abnormal (ABEND) 4-330
 - attention exit purge routine 2-424
 - conditions for 4-320
 - flowchart 6-190-6-191
 - in purging timer queue elements and timer SRBs 4-16
 - normal 4-328
 - system directed 4-370

TQE queue

- placing element on 4-12
- removing elements from 4-14

wait task dispatcher 4-82

task management

- overview 4-193-4-197
- post cross-memory option (overview) 1-37
- task recovery processing 4-388

task mode 7-484

task mode error 7-484

task recovery routines 7-476, 7-478

TAXE (terminal attention exit element)

- checking activity of and dequeuing 2-424
- in attention exit prolog and epilog 2-420
- in attention exit purge 2-424
- in attention exit scheduler 2-418
- in STAX service routine 2-416

TCAM, stopping (HALT command) 2-300

TCAM cleanup

- in address space purge resource managers 4-412-4-413
- in task purge resource managers 4-404-4-405

TCAS (terminal control address space) (VS2.03.813)

- interface with IEE0803D 2-244 (VS2.03.813)
- interface with IKJEFLE and IKJL4T00 2-256 (VS2.03.813)

TCB (task control block)

- dispatcher use of (general) 1-37
- in allocation/initiator interface 3-396
- in ATTACH routine 4-198
- in ABENDED job restart preparation 3-516
- in attention exit prolog and epilog 2-420
- in attention exit scheduler 2-418
- in cancelling TSO, system initiated 2-256
- in CHAP processing 4-214
- in checking a time interval using TTIMER 4-10
- in common unallocation 3-430
- in communications task functional recovery 2-202
- in delete routine 4-294
- in deleting a virtual memory 2-400
- in DETACH routine 4-206

- in dispatcher 4-54
- in dynamic allocation control 3-414
- in exit prolog 4-258
- in exit routine (IEAVOR) 4-256
- in external call first level interrupt handler 4-98
- in EXTRACT routine 4-254
- in freeing an address space 5-104
- in GETMAIN 5-94
- in identify routine 4-296
- in initiator/allocation interface 3-396
- in initiator/unallocation interface 3-402
- in I/O complete processing 2-130
- in I/O interrupt handler 4-94
- in job deletion 3-208
- in LINK routine 4-278
- in load routine 4-292
- in log initialization 3-466
- in LOGON
 - initialization 2-442
 - monitor 2-448
 - pre-prompt exit interface 2-458
 - verification 2-454
- in merging job journal to SWA 3-492
- in MFDATA mainline 3-114
- in MODESET routine 4-268
- in multiple line WTO processing 2-72
- in obtaining a new virtual memory 2-250
- in page termination services 5-62
- in PGFREE 5-38
- in POST processing 4-222
- in program check interruption handler 4-104
- in purging timer queue elements 4-16
- in quiesce processing 2-410
- in RCT initialization/termination 2-406
- in remove in-use attribute 3-424
- in restore processing 2-414
- in resume processing 4-192.5-4-192.8 (VS2.03.807)
- in routing to searching routines 4-284
- in RTM rescheduling 4-366
- in SETLOCK 4-148
- in SPIE routine 4-250
- in stage 3 exit effector 4-134
- in started task control 2-430
- in status routine 4-260
- in STAX service routine 2-416
- in step deletion 3-208
- in step initiation 3-200
- in subsystem interface 3-159
- in supervisor interruption handler 4-86
- in suspend processing 4-192.4-192.0 (VS2.03.807)
- in SVC 35 processing 2-28
- in SVC 99 control 3-412
- in SYNCH routine 4-290
- in system directed task termination 4-370
- in task dispatching 4-78
- in TCTL processing 4-192.1-4-192.4 (VS2.03.807)
- in timer SLIH (second level interrupt handler) 4-18
- in TQE dequeue 4-14
- in TQE enqueue 4-12
- in unallocation/initiator interface 3-402
- in validity check processing 4-162
- in VSM task termination 5-106
- in writing blocks to the job journal 3-520
- in WTO and WTOR macro instruction processing 2-28
- in WTP (write-to-programmer) processing 2-72
- in WTP (write-to-programmer) requests 2-48
- in XCTL routine 4-300

TCT (timing control table)

- FREEMAIN 5-96
- in initiator/allocation interface 3-396

TCTIOT (timing control table I/O table)

- in allocate request to unit 3-302
- in dynamic allocation control 3-414
- in step initiation 3-200

TCTIOT allocation control

- flowchart 6-87
- module description 6-322

TCTIOT FRR routine

- module description 6-322

TCWA (TOD clock work area)

- in setting local time 2-336
- in setting a specific TOD clock use 4-26
- in TOD clock operator communication 4-30
- in TOD clock status test 4-34
- in TOD clock synchronization 4-32

teleprocessing

- allocation of device requests 3-286
- commands
 - modules given control 2-387
 - (for descriptions of TP processing, refer to OS/VS2 TCAM Logic)

terminal control address space (TCAS) (VS2.03.813)

- interface with IEE0803D 2-244 (VS2.03.813)
- interface with IKJEFLE and IKJL4T00 2-256 (VS2.03.813)

terminal, inactive, message routine

- function 2-114
- flowchart 6-3
- module description 6-273

terminal input output coordinator (TIOC)

- use of during LOGON 2-455, 6-13

terminal I/O, checking for in attention exit 2-418

terminal messages, during LOGON (see IKJ... IDs in message list) 7-345

terminal recognizer, calling in MF/1 syntax analyzer 3-86

terminal session (see also LOGON) completion code, saving 2-466

terminating allocation error processing (common allocation cleanup) 3-378

termination, address space 4-426

- purging timer queue elements 4-16

termination, abnormal, log task 3-476

termination, system activities measurement 3-110

termination, system trace

- in master scheduler wait 2-246

termination, task

- abnormal (ABEND) 4-330
- in purging attention exits 2-424
- in purging timer queue elements and timer SRBs 4-16
- normal 4-328
- system directed 4-370

termination, trace

- in master scheduler wait 2-246

terminator (see initiator/terminator)

TERMWAIT SYSEVENT code (2)

- processing in SRM SYSEVNET code processor 3-12
- use by workload manager 3-69

test EXEC dependency codes message text

- module description 6-334

text EXEC statement condition codes

- flowchart 6-75
- function 3-500
- module description 6-320

test if device is ready

- flowchart 6-61
- function 3-340-3-341
- module description 6-306

test volume ENQ

- flowchart 6-52
- module description 6-308

TESTAUTH routine 4-270

text, internal (see converter, internal text)

text keys, in ddname allocation 3-429
 TGETTPUT SYSEVENT code (34)
 processing in SRM SYSEVENT code processor 3-18
 use by workload manager 3-71
 time dependent swap-in processing 3-26
 time driven queue (in SRM), definition of 3-3
 TIME macro instruction processing 4-6, 4-9
 error checking 4-7
 time limit checking, canceling
 in TQE purge routine 4-16-4-17
 time limit, step 3-202
 time
 GMT specified for TIME requests 4-6
 interval unit conversion in TTIMER 4-10-4-11
 local
 obtaining from a valid TOD clock for TIME requests 4-6-4-7
 zone constant, getting in setting local time 2-338
 time wait limit, checking for a job step 4-23
 timer action analysis in SRM 3-26
 timer, checking hardware status 4-39
 timer components
 checking in synchronous timer recovery 4-36-4-37
 error count of component in error in CSD 4-37
 in establishing TQE using STIMER 4-9
 interruption types
 clock-comparator 4-19
 CPU timer 4-19
 synchronous check 4-19
 SLIH, processing of 4-18-4-19
 timer, CPU
 error recovery, asynchronous timer 4-38-4-39
 interrupt type 4-19
 timer error recovery
 asynchronous timer recovery 4-38-4-39
 synchronous timer recovery routine 4-36
 timer FRR 4-24-4-25
 timer ESTAE processing
 TIME service routine 4-7
 timer interval
 changing in DIDOCS message deletion 2-192
 checking 4-22, 2-198
 establishing TQEs using STIMER 4-8
 timer second level interrupt handler (see timer SLIH)
 timer service routines 4-3-4-38
 timer SLIH 4-18-4-19
 timer supervision overview 4-3
 timer unit conversion
 in establishing TQEs using STIMER 4-9
 in processing TIME requests 4-7
 TIMEREXP SYSEVENT code (1)
 processing in SRM SYSEVENT code processor 3-12
 in periodic entry point scheduling 3-32-3-33
 timing control in step initiation 3-202
 timing intervals
 calculating remaining interval in TTIMER 4-10
 cancelling in TTIMER 4-10
 setting (STIMER) 4-18-4-19
 TIOC (terminal input output coordinator)
 use by LOGON 2-455, 6-13
 TIOCRPT (TIOC reference pointer table)
 in cancelling TSO, system initiated 2-256
 TIOT (task input/output table)
 in allocating offline devices 3-366
 in allocation via algorithm 3-348
 in common allocation cleanup 3-378
 in common allocation control 3-280
 in ddname allocation control 3-428
 in demand allocation 3-355
 in dynamic allocation control 3-414
 in dynamic concatenation 3-418
 in dynamic deconcatenation 3-420
 in dynamic unallocation control 3-416
 in dynamic information retrieval 3-422
 in generic allocation control 3-338
 in LOGON initialization 2-442
 in obtaining a new virtual memory 2-250
 in nonspecific volume allocation control 3-308
 in recovery allocation 3-358
 in remove in-use processor 3-426
 in specific volume allocation 3-298
 in started task control 2-430
 in step initiation 3-200
 in WTP (write-to-programmer) processing 2-50
 flowchart 6-49, 6-51-6-54, 6-62, 6-64-6-65, 6-68
 function 3-280-3-281, 3-302-3-303
 module description 6-311
 TIOT manager control routine
 flowchart 6-49-6-53, 6-64, 6-65, 6-68, 6-75, 6-77, 6-81-6-84
 function 3-396, 3-398, 3-418, 3-436
 module description 6-308
 TLB (translation look-side buffer)
 invalidating 5-20
 purging 5-52
 TMCMSG diagram 5-364
 TMCSG06 diagram 5-360
 TMCSG10 diagram 5-362
 TOD (time-of-day) clock
 high-order synchronization, test for 4-35
 in processing TIME requests 4-6
 in set specific clock (SSC) routine 4-26-4-27, 4-29
 in asynchronous timer error recovery routine 4-38-4-39
 manager 4-38, 4-34, 4-32, 4-30
 master value calculation 4-33
 operator communications 4-30-4-31
 security switch 4-32-4-33
 setting local time and date 4-31
 status
 messages 4-31
 return codes 4-31
 test 4-34-4-35
 synchronization routine 4-30, 4-32, 4-34, 4-38
 task-type request to STIMER 4-9
 TPC (timer work area)
 in asynchronous timer recovery routine 4-38
 in processing TIME requests 4-6
 in set clock comparator routine 4-20
 in set specific clock (SSC) routine 4-26, 4-28
 in STIMER service routine 4-8
 in synchronous timer recovery routine 4-36
 in timer FRR 4-24
 in timer SLIH (second level interrupt handler) 4-18
 in TOD clock operator communication routine 4-30
 in TOD clock status test routine 4-34
 in TOD clock synchronization routine 4-32
 in TQE enqueue routine 4-12
 in TQE processing routine 4-22
 in TQE purge routine 4-16
 TPCA (see TPC)
 TPUT issuing routine for DISPLAY or TRACK 2-284-2-285
 TPUT/TGET service routine
 flowchart 6-22, 6-29
 function 2-420-2-421
 TQE (timer queue element)
 dequeuing because of TTIMER CANCEL 4-10-4-11
 in timer FRR 4-24-4-25
 in TQE dequeue routine 4-14-4-15
 enqueueing
 in timer FRR 4-24-4-25

- in TQE enqueue routine 4-12-4-13
- freeing space for in TTIMER service routine 4-10-4-11
- in TTIMER service routine 4-10-4-11
- in establishing TQEs using STIMER 4-9
- in MFROUTER processor 3-139
- in requeue SRM TQE (IRARMI05) 3-9.8 (VS2.03.807)
- in TQE purge routine 4-16-4-17
- in set specific clock (SSC) routine 4-26-4-29
- in set clock comparator routine 4-20-4-21
- in SETDIE processing 4.11.0-4-11.1 (VS2.03.807)
- in SRM periodic entry point scheduling 3-33
- in synchronous timer recovery 4-36-4-37
- in timer SLIH (second level interrupt handler) 4-18-4-19
- midnight field, updating 4-22-4-23
- processing routine 4-22-4-23
- real, queue
 - dequeuing in TQE dequeue routine 4-14-4-15
 - enqueueing in TQE enqueue routine 4-12-4-13
 - verification in timer FRR 4-24-4-25
- task queue
 - dequeuing TQEs from 4-14-4-15
 - enqueueing TQEs on 4-12-4-13
- TQETYPE indicator
 - in TQE dequeue 4-15
 - in TQE enqueue 4-13
- TRACE command initialization 2-300
- TRACE command processing 2-300
- trace, system (see also trace termination)
 - continuing 2-300-2-301
 - processing 4-168
 - terminating 2-300-2-301
- trace termination
 - in master scheduler wait 2-246-2-247
 - processing 2-300-2-301
- TRACK command processing 2-272, 2-280
 - (see also displaying system status)
 - exclusion on a JES3 console 2-277
- TRACK command, stopping 2-342
- track options 2-282-2-283
- tracking system status (see also displaying system status) 2-280
- transfer control-transfer logical (TCTL) (IEAVETCL) (VS2.03.807)
 - flowchart (VS2.03.807)
 - function 4-51, 4-192.1 (VS2.03.807)
 - in stage-3 exit effector 4-135 (VS2.03.807)
 - module description 6-267 (VS2.03.807)
- TRANSFER PAGE
 - MO diagram 5-142
- translating real addresses to virtual 5-80
- translation, command 2-242
- TRPAGE diagram 5-142
- TRPSG02 diagram 5-234
- TRPSG03 diagram 5-236
- TRPSG04 diagram 5-240
- TSB (terminal status block)
 - in attention exit prolog and epilog 2-420
 - in attention exit purge 2-424
 - in attention exit scheduler 2-418
 - in cancelling TSO, system initiated 2-256
 - in dynamic allocation control 3-414
 - in LOGON/LOGOFF verification 2-454
 - in LOGON pre-prompt exit interface 2-458
 - in RCT common processing 2-408
 - in restore processing 2-414
 - in STAX service routine 2-416
- TSO jobs, cancelling 2-254
- TSO LOGON (see LOGON)
- TSO, user system initiated cancellation 2-256-2-257
- TTIMER processing 4-10
- type 1 SVC processing 4-88-4-89 (VS2.03.807)
- type 2,3,4 SVC processing 4-88, 4-90 (VS2.03.807)
- type 6 SVC processing 4-88, 4-92.0 (VS2.03.807)
- typewriter-keyboard console
 - command processing 2-184
- UADS (user attribute data set)
 - LOGOFF use 2-452
 - LOGON use
 - initialization 2-442
 - verification 2-455
- UCB (unit control block)
 - in allocate request to unit 3-302
 - in allocating offline devices 3-366
 - in allocation/initiator interface 3-396
 - in allocation/volume mount and verify (VM&V) interface 3-386
 - in allocation via algorithm 3-348
 - in changing command authorization 2-350
 - in changing console status 2-350
 - in changing message routing 2-350
 - in common allocation cleanup 3-378
 - in common allocation control 3-280
 - in common unallocation 3-430
 - in demand allocation 3-355
 - in device information subroutine 2-396
 - in displaying a matrix of real storage 2-290
 - in displaying operator action requests 2-292
 - in displaying the console station 2-286
 - in displaying unit status 2-296
 - in dynamic allocation control 3-414
 - in dynamic unallocation control 3-416
 - in fixed device control 3-294
 - in generic allocation control 3-338
 - in initiator/allocation interface 3-396
 - in initiator/unallocation interface 3-402
 - in job unallocation 3-410
 - in MF/1 device initialization 3-104
 - in MF/1 device sampling module 3-144
 - in nonspecific volume allocation control 3-308
 - in processing log and WRITELOG commands 2-306
 - in recovery allocation 3-358
 - in specific volume allocation 3-298
 - in unallocation/initiator interface 3-402
 - in unloading I/O devices 2-346
 - in varying a channel offline 2-378
 - in varying a channel online 2-376
 - in varying a CPU offline 2-374
 - in varying a CPU online 2-372
 - in varying devices offline and online 2-360
 - in volume mount and verify (VM&V)/allocation interface 3-386
- UCB candidate list in offline/allocated device allocation building, and interfacing with SRM 3-371
- UCB list in nonspecific volume allocation control building
 - flowchart 6-55, 6-63, 6-68, 6-70, 6-72-6-73
 - function 3-350, 3-310
 - module description 6-312
 - interfacing with SRM 3-312
 - releasing 3-312
- UCB update routine
 - use in allocate request to unit 3-303
- UCM (unit control module)
 - in attention interrupt processing 2-174
 - in changing command authorization 2-350
 - in changing console status 2-350
 - in changing message routing 2-350
 - in closing a console 2-22
 - in communications task overview 3-418

- in communications task recovery (STAR) 2-212
- in console switching 2-368
- in control command processing 2-262
- in delete operator message processing 2-154, 2-152
- in displaying information requests 2-324
- in displaying multiple line messages
 - graphics console 2-128
- in displaying operator action requests 2-292
- in displaying the console station 2-286
- in DOM device support processing 2-166
- in DOM macro instruction 2-140, 2-138
- in external interrupt processing 2-168
- in interrupt processing 2-174, 2-168
- in I/O complete processing 2-130
- in multiple line WTO processing 2-72
- in QREG0 2-114
- in processing log and WRITELOG commands 2-306
- in routing messages to consoles 2-318
- in starting monitoring procedures 2-314
- in stopping monitoring procedures 2-314
- in stopping periodic track (status) displays 2-342
- in SVC 35 processing 2-28
- in SVC 78 processing 2-140, 2-138
- in unconditional message to inactive console processing 2-114
- in unit unallocation processing 3-444
- in unloading I/O devices 2-346
- in vary HARDCPY processing 2-366
- in varying devices offline and online 2-360
- in varying the path to a device 2-380
- in WTO and WTOR communications task processing 2-98, 2-96
- in WTO and WTOR macro instruction processing 2-28
- in WTP (write-to-programmer) processing 2-50
- in WTP (write-to-programmer) requests 2-48
- UCMDECB post 2-148
- UCME (unit control module entry)
 - in attention interrupt processing 2-174
 - in communications task overview 3-418
 - in communications task recovery (STAR) 2-212
 - in console switching 2-368
 - in delete operator message processing 2-154
 - in display command preprocessing 2-272
 - in external interrupt processing 2-168
 - in interrupt processing 2-174, 2-168
 - in I/O complete processing 2-130
 - in opening a console 2-18
 - in processing typed commands from a graphic console 2-184
 - in QREG0 2-114
 - in track command preprocessing 2-272
 - in unconditional message to inactive console processing 2-114
 - in WTO and WTOR communications task processing 2-98
 - in WTP processing 2-50
- UCME scanner for VARY command
 - flowchart 6-20
 - function 2-352, 2-360
 - module description 6-302
- UIC (in referenced internal count) (VS2.03.807)
 - in resource monitor periodic monitoring 3-67.1 (VS2.03.807)
 - in SRM service routine 3-9.3 (VS2.03.807)
 - in storage management (IRARMSTM) 3-46 (VS2.03.807)
- unallocate requests to be rearranged
 - flowchart 6-63, 6-67
 - function 3-360, 3-348, 3-368
 - module description 6-315
- unallocated volunit entries, processing 3-371
- unallocating current system log 3-472
- unallocation (see also allocation/unallocation)
 - control, common
 - flowchart 6-49-6-50
 - function 3-430
 - module description 6-304
 - deserialization (VS2.03.804)
 - IEFAB4EC module description 6-306 (VS2.03.804)
 - IEFAB4E7 module description 6-307 (VS2.03.804)
 - in common allocation cleanup 3-381 (VS2.03.804)
 - in job unallocation 3-411 (VS2.03.804)
 - in initiator/unallocation interface flowchart 6-78 (VS2.03.804)
 - dynamic unallocation control and processor
 - flowchart 6-80, 6-81, 6-47
 - function 3-416, 3-426
 - module description 6-321
 - job status messages for IGFBB410
 - module description 6-320
 - job/step unallocation ESTAE exit, module description 6-305
 - job unallocation
 - flowchart 6-78
 - function 3-410
 - module description 6-321
 - messages
 - module description 6-320
 - step unallocation control
 - flowchart 6-77
 - function 3-404-3-405
 - module description 6-320
- unallocation/initiator interface
 - flowchart 6-77-6-79, 6-47, 6-40
 - function 3-402, 3-404
 - module description 6-320
- unilateral swap-out/swap-in 3-23.0, 3-36 (VS2.03.807)
- unit affinity (see allocating affinity requests)
- unit, allocating request to (see allocating request to units)
- unit allocation
 - in offline/allocated device allocation 3-369
- unit, eligible
 - in specific volume allocation control 3-299
- unit information
 - copying in dd function control 3-323
 - retrieving in dd function control 3-323
 - in JFCB housekeeping 3-316
- unit name conversion
 - flowchart 6-56
 - function 3-316-3-317
 - module description 6-314
- unit parameter in started task control 2-433
- unit status, displaying
 - flowchart 6-11
 - function 2-296
 - module description 6-300, 6-301
- unit, timer conversion
 - in establishing timer intervals using STIMER 4-9
 - in processing TIME requests 4-7
- unit unallocation (IEFAB4A4)
 - direct access device processing 3-446
 - flowchart 6-50
 - in common unallocation 3-434
 - module description 6-305
 - non-direct access device processing 3-446
 - tape processing 3-446
- unit verification
 - module description 6-310
- units code
 - in workload manager 3-71
- UNLOAD comand syntax scanner
 - flowchart 6-18

- function 2-346
- module description 6-294
- unload interface routine
 - flowchart 6-50, 6-53, 6-61, 6-63, 6-65-6-67, 6-73
 - function 2-346, 3-340, 3-358, 3-304, 3-368, 3-410
 - module description 6-317
- unload requests, processing in volume mount and verify 3-390
 - for an MSS volume 3-391
- unloading I/O devices 2-346
- unmounted volumes, processing in demand allocation 3-357
- unset TOD clock, testing for 4-34
- update algorithm tables
 - flowchart 6-54, 6-62, 6-64-6-65
 - function 3-368-3-369
 - module description 6-308
- update DDR count routine
 - flowchart 6-51
 - function 3-282-3-283
 - module description 6-312
- update UCB FRR exit routine
 - module description 6-307
- update UCB routine
 - flowchart 6-53
 - function 3-302
 - module description 6-312
- UPT (user profile table)
 - in LOGOFF 2-452
 - in LOGON
 - initialization 2-442
 - post-TMP exit 2-466
 - pre-prompt exit interface 2-458
 - pre-TMP exit 2-464
 - verification 2-454
 - in WTP (write-to-programmer) processing 2-50
- user, allocating virtual storage for (GETMAIN) 5-94
- user error exit
 - in checking a timer interval using TTIMER 4-11
 - in establishing timer intervals using STIMER 4-9
 - in processing TIMER requests 4-7
- user evaluation (IRARMCVL) 3-43.4 (VS2.03.807)
- user ready processing (IRARMHIT) 3-73.2 (VS2.03.807)
- user-replaceable nonstandard label routine
 - flowchart 6-61
 - module description 6-335
- user, swapping (see swap-in, swap-out)
- USERRDY SYSEVENT code (4)
 - processing in SRM SYSEVENT code processor 3-12
 - use by workload manager 3-71

- V=R completion processing for intercepted frames 5-6
- V=R frame interception 5-11
- V=R region allocation 5-8
- V=R region requests, processing in GETPART 5-98
- V=V region requests, processing in GETPART 5-98
- validate page routine
 - flowchart 6-19
 - function 2-384
 - module description 6-297
- validity checking an address or address range 4-162
- validity checking unallocated device or data set requests that need a specific volume 3-368
- values, IPS (see IPS values)
- VARY command processing
 - CN operand 2-356, 2-358
 - flowchart 6-19
 - CPU/channel processor
 - flowchart 6-19
 - function 2-372, 2-370, 2-374, 2-376, 2-378
 - module description 6-297
- CPU offline 2-374
- CPU online 2-372
- CPU stop routine
 - function 2-374
 - module description 6-299
- CPU wakeup and quiet routines
 - flowchart 6-19
 - function 2-372, 2-374
 - module description 6-299
- HARDCPY operand processor
 - flowchart 6-18
 - function 2-366, 2-348
 - module description 6-302
- HARDCPY processor
 - flowchart 6-18
 - function 2-366
 - module description 6-303, 6-304
- keyword scan routine
 - flowchart 6-18
 - function 2-348
 - module description 6-301
- keyword scanner
 - flowchart 6-20
 - function 2-352
 - module description 6-302
- master console command processor
 - flowchart 6-18
 - function 2-368, 2-348
 - module description 6-302
- ONLINE/OFFLINE/CONSOLE syntax scan routine
 - flowchart 6-18
 - function 2-350, 2-352
 - module description 6-301
- ONLINE/OFFLINE for devices
 - flowchart 6-20
 - function 2-360
 - module description 6-302
- ONLINE/OFFLINE processor
 - flowchart 6-20
 - module description 6-301
- path command processor
 - flowchart 6-19
 - function 2-380
 - module description 6-298
- routing of 2-348
- storage command
 - flowchart 6-19
 - function 2-384
 - module description 6-296
- UCME scanner
 - flowchart 6-20
 - function 2-352, 2-360
 - module description 6-302
- varying
 - channel offline 2-378-2-379
 - channel online 2-376-2-377
 - channel or CPU, overview 2-370-2-371
 - CPU offline 2-374-2-375
 - informing MSS subsystem of U.P. operation 2-374-2-375
 - CPU online 2-372-2-373
 - informing MSS subsystem of M.P. operation 2-372-2-373
 - command authorization 2-350
 - console authority (VARY CN) 2-356, 2-358
 - flowchart 6-19
 - console status 2-350
 - devices online and offline 2-360
 - message routing 2-350
 - path to a device 2-380

- range of device addresses 2-364
 - flowchart 6-18, 6-20
- status of real storage 2-384
- VAT (virtual address table)
 - in automatic step restart 3-500
 - in journal merge error processing 3-508
 - in merge cleanup 3-502
 - in merging job journal to SWA 3-492
 - in restart interface processing 3-510
 - in system restart processing 3-496
 - in updating virtual addresses in SWA 3-504
- VBP (virtual block processor) (VS2.03.807)
 - relationship to ASM 1-4 (VS2.03.807)
- VCB
 - in VIO services 5-54
- verbs, converter identifying on JCL statement 3-226
- verify control routine
 - function 3-394
 - module description 6-318
- VERIFYPG SYSEVENT code (30)
 - processing in SRM SYSEVENT code processor 3-17
- vertical bar
 - use in DOM device support processing 2-167
- VIO allocation requests
 - processing in common allocation control 3-280
- VIO control (ASM) (VS2.03.807)
 - introduction 1-43 (VS2.03.807)
 - introduction to MOs 5-202 (VS2.03.807)
 - overview diagram 5-204 (VS2.03.807)
 - program organization 5-205 (VS2.03.807)
- VIO data sets (VS2.03.807)
 - activating 5-222 (VS2.03.807)
 - ASM processing of 5-202 (VS2.03.807)
 - cleaning up (ILRJTERM) 6-40 (VS2.03.807)
 - creating 5-203 (VS2.03.807)
 - freeing ASM control blocks for 3-210 (VS2.03.807)
 - saving 5-222 (VS2.03.807)
- VIO eligible requests, processing in dd function control 3-328
- VIO group operators (ASM) (VS2.03.807)
 - introduction 1-43 (VS2.03.807)
 - introduction to MOs 5-222 (VS2.03.807)
 - overview diagram 5-224 (VS2.03.807)
 - program organization 6-208 (VS2.03.807)
- VIO services routine 5-54
- virtual address in SWA, updating 3-504
- virtual addresses, translating from real 5-80
- virtual memory (see also memory, START/LOGON/MOUNT overview)
 - deleting 2-400
 - obtaining a new 2-250
- virtual region
 - freeing 5-100
 - getting 5-98-5-99
 - space to available space, returning 5-100
- virtual storage, allocating (GETMAIN processing) 5-94
- virtual storage, dumping (DUMP command) 2-298
- virtual storage management (VSM)
 - address space creation 5-102
 - non-region storage 1-41
 - overview 5-87
- virtual storage unallocation 5-96
- VM&V count tables, contents 3-391
- VM&V request block
 - building in allocate request to unit 3-302
 - in allocation/volume mount and verify (VM&V) interface 3-386
 - in common allocation cleanup 3-378
 - in volume mount and verify (VM&V) 3-390
- VOLSER searching in job unallocation 3-411
- volume allocation control, nonspecific
 - flowchart 6-55, 6-48, 6-52, 6-62-6-65
 - function 3-308
 - module description 6-312
- volume demounting for an MSS volume 3-391
- volume, determining if it is on an eligible unit 3-298
- volume, enqueueing on in nonspecific volume allocation control 3-312
- volume information
 - copying and retrieving in dd function control 3-327
- volume list
 - building
 - in common unallocation control 3-434
 - in disposition processing 3-440
 - obtaining new 3-336
- volume mount and verify (VM&V)
 - conditions under which a volume cannot be used 3-395
 - control
 - function 3-390
 - module description 6-318
 - determining functions to be performed 3-390
- DOMR and cleanup routine
 - flowchart 6-74, 6-71
 - function 3-394, 3-388
 - module description 6-317
- ESTAE and FRR exits, module descriptions of 6-306
- functions 3-390
- interface with allocation
 - flowchart 6-71
 - function 3-386
 - module description 6-318
- interface to common allocation cleanup 3-395
- messages, module description of 6-309
- MSS mount request, handling 3-392
- routines used 3-390
- WTO/WTOR format routine
 - function 3-392
 - module description 6-319
- volume, releasing
 - flowchart 6-50
 - function 3-434, 3-436-3-437
 - module description 6-305
- volume serial number (see VOLSER)
- volume, specific allocation (see specific volume allocation control)
- volume/unit resolution
 - flowchart 6-58
 - function 3-326
 - module description 6-313
- volume validity checker
 - flowchart 6-68, 6-53, 6-54
 - function 3-368, 3-302
 - module description 6-312
- volume, requests for
 - permanently resident or reserved
 - processing in fixed device allocation 3-294
 - specific 3-298
- volume unload control (see IEFAB494 object module)
- volume unload for an MSS volume 3-391
- volumes, verifying 3-394-3-395
- volunit affinity processing
 - flowchart 6-51
 - function 3-282-3-283
 - module description 6-311
- volunit table
 - eligible entries, locating in nonspecific volume allocation control 3-308
 - in allocate request to unit 3-302
 - in allocating offline devices 3-366
 - in allocation/volume mount and verify (VM&V) interface 3-386
 - in allocation via algorithm 3-348

- in common allocation cleanup 3-378
- in common allocation control 3-280
- in demand allocation 3-356
- in fixed device control 3-294
- in generic allocation control 3-338
- in nonspecific volume allocation control 3-308
- in recovery allocation 3-358
- in specific volume allocation 3-298
- in volume mount and verify (VM&V)/allocation interface 3-386
- obtaining space for 3-282-3-283
- VRWAITQ**
 - in freeing a V=R region 5-101
- VRWPQE** (V=R wait/post queue element)
 - in getting a virtual region 5-98
- VSL** (virtual subarea list)
 - in freeing a virtual region 5-12
 - in page services 5-32
 - in PGOUT 5-40
- VSM** (see virtual storage management)
- VSM** address space creation 5-102
- VSPC** (VS2.03.805)
 - introduction (CHANGKEY) 41 (VS2.03.805)
 - post exit processing 37,4-225,4-233 (VS2.03.805)
 - SVC screening 4-86 (VS2.03.805)
- VS2** system overview 1-24
- VTAM** commands (see NET commands)
 - recognizing and exiting to VTAM processor 2-301
- VTAM** cleanup
 - in address space purge resource managers 4-412-4-413
 - in task purge resource managers 4-404-4-405
- VTIOC** (VS2.03.813)
 - initialization 2-442, 4-444 (VS2.03.813)
 - logoff 2-444 (VS2.03.813)
 - logon 2-454 (VS2.03.813)
- VUT** (volume unit table)
 - in job unallocation 3-410
 - in unit unallocation processing 3-444
- V=R** region
 - freeing 5-12
 - getting 5-98-5-99, 5-8
- wait holding resources
 - flowchart 6-73, 6-48, 6-52
 - function 3-280, 3-366
 - module description 6-317
- WAIT** macro instruction processing (see also POST) 4-220
- wait queue (deferred action queue) in SRM 3-28
- wait PSW 4-82
- WAIT** queue for SRM (VS2.03.807)
 - definition 3-23.0 (VS2.03.807)
 - in user ready processing (IRARMHIT) 3-73.2 (VS2.03.807)
- wait state codes, list of 7-345
- wait task, dispatching 4-82
- wait TQE interval requests in STIMER 4-8
- WAMT**
 - in collect data for MF/1 (IRARMWR3) 3-73.8 (VS2.03.807)
 - in initialize for MF/1 (IRARMWR1) 3-73.6 (VS2.03.807)
 - in interval measurements gathering routine for workload 3-126
 - is SYSEVENT processing in SRM SYSEVENT code processor 3-11
- warmstart**
 - in SWA create interface 3-217
 - locating JFCBs and JFCBXs in initiator /unallocation interface 3-403
- WKLD**COLL SYSEVENT code (46)
 - processing in SRM SYSEVENT code processor 3-21
 - use by workload manger 3-71
- WKLD**TERM SYSEVENT code (47)
 - processing in SRM SYSEVENT code processor 3-21
- WLLD**INIT SYSEVENT code (45)
 - processing in SRM SYSEVENT code processor 3-21
 - use by workload manager 3-71
- WMCT** (workload manager control table)
 - in changing IPS values 2-340
- WMPGV** (performance group vector table)
 - in changing IPS values 2-340
- WMST** (workload manager specification table)
 - in changing IPS values 2-340
 - in individual user evaluation (IRARMWM3) 3-73.0 (VS2.03.807)
 - in swappable user evaluation (IRARMWM2) 3-70 (VS2.03.807)
 - in user evaluation (IRARMCVL) 3-43.4 (VS2.03.807)
 - in workload management 3-69
 - initialize for MF/1 (IRARMWR1) 3-73.6 (VS2.03.807)
- work masks (group masks) in device allocation
 - definition 3-272
 - use of 3-339
- workload level, introduction 3-69
- workload manager
 - function 3-69-3-73
- workload measurement in MF/1
 - initialization 3-98
 - interval routine (RBMFDWP) 3-126
- WPGD** (performance group descriptor) (VS2.03.807)
 - in individual user evaluation (IRARMWM3) 3-73.0 (VS2.03.807)
 - in swappable user evaluation (IRARMWM2) 3-70 (VS2.03.807)
 - in user evaluation (IRARMCVL) 3-43.4 (VS2.03.807)
 - in user ready processing (IRARMHIT) 3-73.2 (VS2.03.807)
- WPGDT**
 - in workload mangement 3-69
- WPL**
 - in communications task recovery (STAR) 2-212
 - in multiple line WTO processing 2-72
 - in SVC 35 processing 2-28, 2-26
 - in unconditional message to inactive console processing 2-114
 - in WTO and WTOR macro instruction processing 2-28, 2-26
 - in WTP (write-to-programmer) processing 2-50
 - in WTP (write-to-programmer) requests 2-48
- WQE** (write queue element, see also WWB)
 - in communications task recovery (STAR) 2-212
 - in control command processing 2-262
 - in delete operator message processing 2-154, 2-152
 - in displaying information requests 2-324
 - in displaying operator action requests 2-292
 - in displaying single line messages on a graphic console 2-122
 - in DOM macro instruction 2-140
 - in multiple line WTO processing 2-72
 - in QREG0 2-114
 - in SVC 35 processing 2-28, 2-26
 - in SVC 78 processing 2-140
 - in unconditional message to inactive console processing 2-114
 - in WTO and WTOR communications task processing 2-98, 2-96
 - in WTO and WTOR macro instruction processing 2-28, 2-26
- wrap-around CPU values in MF/1, adjusting for 3-119
- write

- in pseudo access method 3-184
- WRITE/ASSIGN function
 - in SWA manager move mode 3-264-3-265
- WRITE/LOCATE function
 - in SWA manager locate mode 3-267
- WRITE request
 - in SWA manager move mode 3-264-3-265
- WRITELOG command
 - in switching system log data sets 3-473
 - processing 2-306, 2-308
- write-to-log
 - writing data to system log
 - flowchart 6-89
 - function 3-480
 - module description 6-294
 - WTO and WTOR communications task 2-112
- write-to-programmer (see WTP)
- WSAL
 - in quiesce processing 2-410
- WTL (write to log) 3-480
- WTOMSG diagram 5-154
- WTO (write-to-operator) (see also MLWTO)
 - comm task processing 2-98, 2-110
 - deleting from graphic console 2-166
 - display to a graphic console 2-122
 - issuing routine for DISPLAY or TRACK 2-284-2-285
 - overview 2-26
- WTO (write-to-operator) macro instruction
 - in subsystem initiation message writer 3-186
 - overview 2-26
 - processing 2-28
 - use in processing typed commands from a graphic console 2-185
- WTOR (write-to-operator with reply)
 - comm task processing 2-98, 2-110
 - overview 2-48, 2-26
 - processing 2-28
- WTP (write-to-programmer)
 - buffer routine 6-75-6-77
 - module description 6-286
 - flowchart 6-2
 - processing 2-50
 - processing overview 2-48
 - put routine
 - flowchart 6-50, 6-75-6-77
 - module description 6-286
- WWB (write wait block, see also ORE WQE)
 - in communications task recovery (STAR) 2-212
 - in multiple line WTO processing 2-72
 - in SVC 35 processing 2-28
 - in WTO and WTOR macro instruction processing 2-28
- XCTL service routine 4-300
 - FRR 4-304
- XMPOST
 - processing 4-222-4-223
- XPTE (external page table entry)
 - calculating addresses in 5-78
 - calculating the address of 7-479 (VS2.03.807)
 - in creating a segment 5-18
 - in finding a page 5-78
 - in freeing a virtual region 5-12
 - in FREEMAIN release processing 5-16
 - in general frame allocation 5-24
 - in LSQA/SQA allocation 5-6
 - in page processing 5-119 (VS2.03.807)
 - in PGFIX/PGLOAD 5-38
 - in PGOOUT 5-40
 - in swap-in root exit 5-44
 - in VIO services 5-54
- in V=R region allocation 5-8
- initializing 5-18
- XSA (extended save area)
 - in cancelling background jobs 2-254
 - in cancelling foreground jobs 2-254
 - in changing command authorization 2-350
 - in changing console status 2-350
 - in changing dump parameters 2-260
 - in changing message routing 2-350
 - in command processing initialization 2-232
 - in command processing STAE environment 2-234
 - in command routing 2-242
 - in command translation 2-242
 - in console switching 2-368
 - in control command processing 2-262
 - in CSCB creating 2-244
 - in display command preprocessing 2-272
 - in displaying control command operands 2-288
 - in displaying information requests 2-324
 - in displaying program function key definition 2-294
 - in getting a virtual region 5-98
 - in halt command
 - initialization 2-300
 - processing 2-302
 - in holding teleprocessing 2-388
 - in manipulation of command control blocks 4-308
 - in processing LOG and WRITELOG commands 2-306
 - in releasing teleprocessing 2-388
 - in routing of vary commands 2-348
 - in routing message to consoles 2-318
 - in setting local time 2-336
 - in STAE environment creation 2-234
 - in starting monitoring procedures 2-314
 - in stopping monitoring procedures 2-314
 - in stopping periodic track (status) displays 2-342
 - in SVC 34
 - general message assembly 2-238
 - overview 2-232
 - in switch command
 - initialization 2-300
 - processing 2-302
 - in task creating command 2-340
 - in track command preprocessing 2-272
 - in vary HARDCPY processing 2-366
 - in varying devices offline and online 2-360
 - relation to SVRB 2-234
- zone constant, time
 - use in setting local time 2-338
- 1052 printer keyboard
 - device support processor 2-22, 2-18, 2-120, 2-124, 2-182, 2-174
 - in closing a console 2-22
 - in processing commands from a 1052, 2540, or 2740 console 2-182
 - in writing multiple line messages to 1052, 1443, 2740, or 3284/3286 consoles 2-124
 - in writing single line messages to 1052, 1443, 2740, or 3283/3286 consoles 2-120
 - opening as a console 2-18
- 1403 printer
 - in closing a console 2-22
 - in opening a console 2-18
 - in writing multiple line messages to 1052, 1443, 2740, or 3284/3286 consoles 2-124
 - in writing single line messages to 1052, 1443, 2740, or 3283/3286 consoles 2-120
- 1443 device support processor 2-124, 2-120, 2-18, 2-22
- 1443 printer

- in closing a console 2-22
- in opening a console 2-18
- in writing multiple line messages to 1052, 1443, 2740, or 3284/3286 consoles 2-124
- in writing single line messages to 1052, 1443, 2740, or 3283/3286 consoles 2-120
- 2540 device support processor 2-18, 2-22, 2-182
- 2250 device I/O module (DIDOCS) 2-166, 2-122, 2-184, 2-128, 2-198, 2-196, 2-194, 2-192
- 2260 device I/O module (DIDOCS) 2-166, 2-122, 2-22, 2-184, 2-188, 2-198, 2-196, 2-194, 2-192
- 2250 display unit
 - in closing a console 2-22
 - in opening a console 2-18
- 2260 display station
 - in closing a console 2-22
- 2501 card reader
 - in closing a console 2-22
 - in opening a console 2-18
 - in processing commands from a 1052, 2540, or 2740 console 2-182
- 2520 card reader punch
 - in closing a console 2-22
 - in opening a console 2-18
 - in processing commands from a 1052, 2540, or 2740 console 2-182
- 2540 card reader punch
 - in closing a console 2-22
 - in opening a console 2-18
 - in processing commands from a 1052, 2540, or 2740 console 2-182
- 2740 communications terminal
 - in closing a console 2-22
 - in opening a console 2-18
 - in processing commands from a 1052, 2540, or 2740 console 2-182
 - in writing multiple line messages to 1052, 1443, 2740, or 3284/3286 consoles 2-124
- 3066 System Console
 - in closing a console 2-22
 - in opening a console 2-18
- 3210 Console Printer-Keyboard
 - in closing a console 2-22
 - in opening a console 2-18
 - in processing commands from a 1052, 2540, or 2740 console 2-182
 - in writing single line messages to 1052, 1443, 2740, or 3283/3286 consoles 2-120
- 3211 printer
 - in closing a console 2-22
 - in opening a console 2-18
 - in writing multiple line messages to 1052, 1443, 2740, or 3284/3286 consoles 2-124
- in writing single line messages to 1052, 1443, 2740, or 3283/3286 consoles 2-120
- 3213 Console Printer
 - in closing a console 2-22
 - in opening a console 2-18
 - in writing single line message to 1052, 1443, 2740, or 3283/3286 consoles 2-120
 - in writing multiple line messages to 1052, 1443, 2740, or 3284/3286 consoles 2-124
- 3215 Console Printer-Keyboard
 - in closing a console 2-22
 - in opening a console 2-18
 - in processing commands from a 1052, 2540, or 2740 console 2-182
 - in writing multiple line messages to 1052, 1443, 2740, or 3284/3286 consoles 2-124
 - in writing single line messages to 1052, 1443, 2740, or 3283/3286 consoles 2-120
- 3277 device and model 158 system console I/O module (DIDOCS) 2-192, 2-194, 2-188, 2-196, 2-198, 2-184, 2-122, 2-128, 2-166
- 3277 display station
 - in closing a console 2-22
 - in opening a console 2-18
- 3284 printer
 - in closing a console 2-22
 - in opening a console 2-18
 - in writing multiple line messages to 1052, 1443, 2740, or 3284/3286 consoles 2-124
 - in writing single line message to 1052, 1443, 2740, 3283/3286 consoles 2-120
- 3284/3286 console device support processor 2-124, 2-120, 2-22, 2-18, 2-174
- 3286 printer
 - in closing a console 2-22
 - in opening a console 2-18
 - in writing multiple line messages to 1052, 1443, 2740, or 3284/3286 consoles 2-124
 - in writing single line messages to 1052, 1443, 2740, or 3283/3286 consoles 2-120
- 3505 card reader
 - in closing a console 2-22
 - in opening a console 2-18
 - in processing commands from a 1052, 2540, or 2740 console 2-182
- 3525 card punch
 - in closing a console 2-22
 - in opening a console 2-18
- 3800 printing subsystem (VS2.03.810)
 - in interpreter 3-245 (VS2.03.810)
 - related JCL parameters 3-249 (VS2.03.810)
 - (see also JFCBE and JFCBX)

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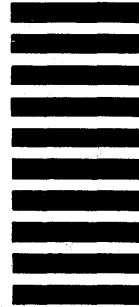
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