COMP 3400 Mainframe Administration[1]

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[1] These slides are based in part on materials provided by IBM's Academic Initiative.

Today

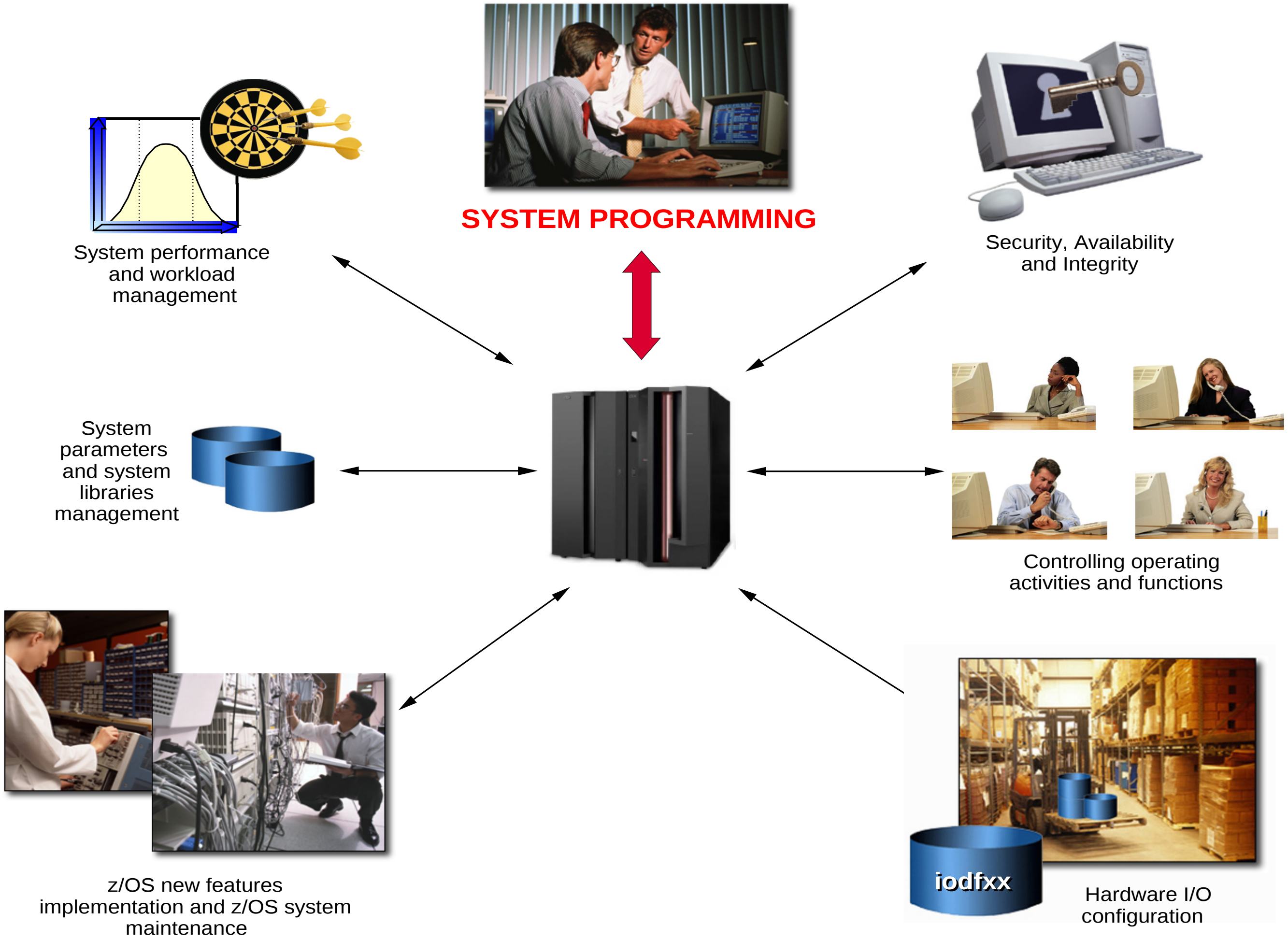
Responsibilities of a z/OS system programmer:

- Use and management of system libraries
- Configuration of consoles
- IPLing a system

What is a Systems Programming?

- A systems programmer installs, customizes and maintains the operating system
- He needs to know:
  - Hardware (Storage, processors)
  - Software (System libraries and data sets)
  - Current customization

System Programming



SYSTEM PROGRAMMING

System performance and workload management

Security, Availability and Integrity

System parameters and system libraries management

Controlling operating activities and functions

z/OS new features implementation and z/OS system maintenance

Hardware I/O configuration

z/OS Administration Tasks

- Software installation and maintenance
- Maintain system libraries for software
- Manage system data sets
- Manage z/OS system address spaces and subsystems
- Manage real and virtual storage
- Monitor and improve system performance

⇒ Customize parameters

Considerations for a New Application

- New batch jobs for the scheduler
- New JCL procedures for the procedure library
- New load libraries
- Documentation of operational procedures
- Security privileges
- Reload system (if required)
- Automation

z/OS day-to-day operation

- Operator interaction is message and command based
- Batch schedules take care of repeated processes
- Automated processing of messages and commands is available

⇒ Operators manage by exception

⇒ Important task is investigation of batch failures

Change Control

Disciplined change management processes and policy enforcement helps with:

- Availability
- Security
- Audit readiness
- Cost savings

⇒ Change control is part of the job of a system programmer.

Considerations for Changes

- Benefits from the change
- What happens if the change is not done
- Resources required to implement the change
- Relative importance compared to other change requests
- Interdependencies between change requests

I/O device management

- I/O device configuration must be defined to both hardware and software
- HCD is used to build an I/O definition file
- This definition can be activated to both software and hardware dynamically
- Major changes require an IPL of software or POR of hardware

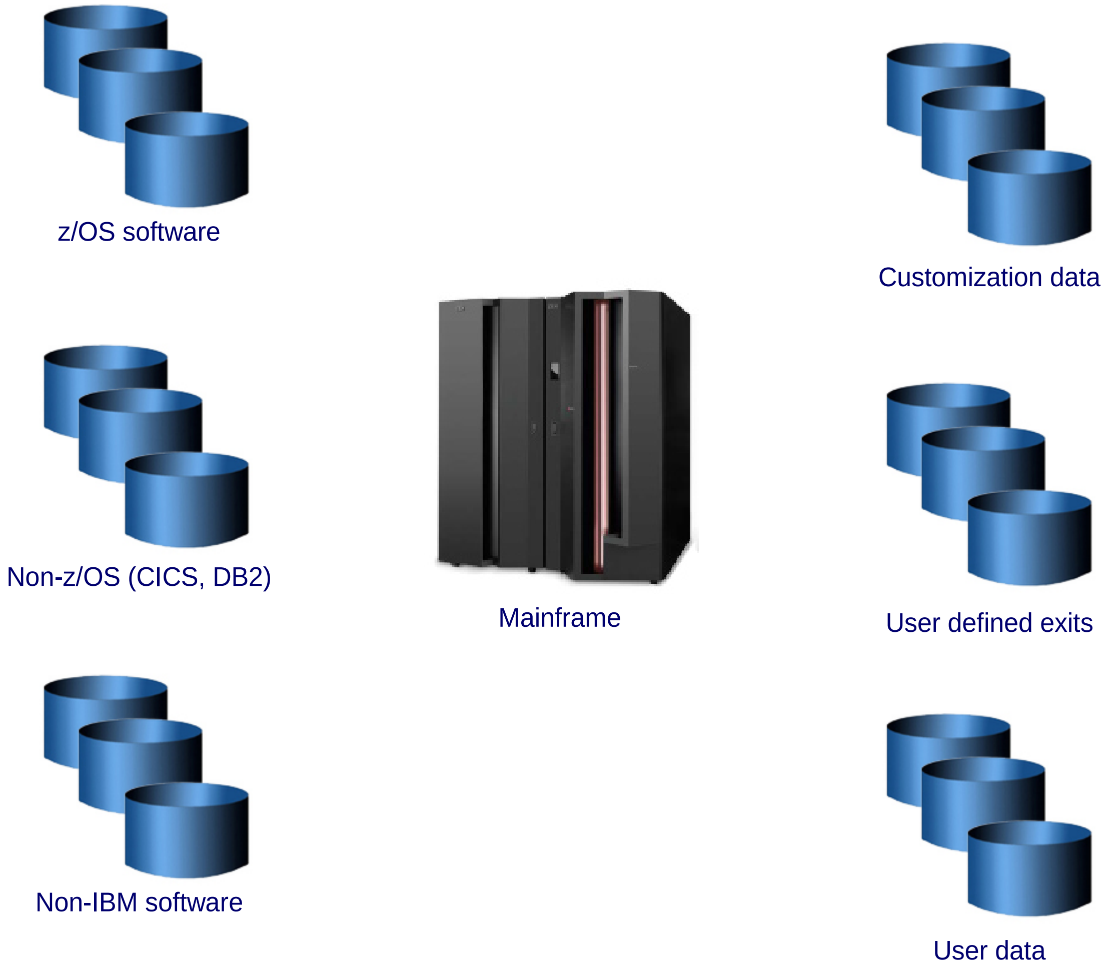
System performance

- System tuning is an iterative, ongoing process

- Initial set up of initiators and other resources plays a great part

⇒ WLM is one component to understand, monitor and configure

Types of Data



z/OS software

Non-z/OS (CICS, DB2)

Non-IBM software

Mainframe

Customization data

User defined exits

User data

Important z/OS System Libraries

Important libraries start with `SYS1.`:

LINKLIB prime system software library

LPALIB system subroutines in LPA (more later)

NUCLEUS basic supervisor modules

PROCLIB system JCL procedures

PARMLIB control parameters (`/etc`)

SVCLIB supervisor call routines

PROCLIB concatenation $\neq$ SYS1.PROCLIB

- `SYS1.PROCLIB` is only one library in the overall `PROCLIB` concatenation
- The same applies to `(SYS1.)PARMLIB` and other concatenations
- Which data sets are part of the `PROCLIB` or `PARMLIB` concatenation is determined by the installation-specific z/OS configuration

Example: Linklist concatenation on Marist

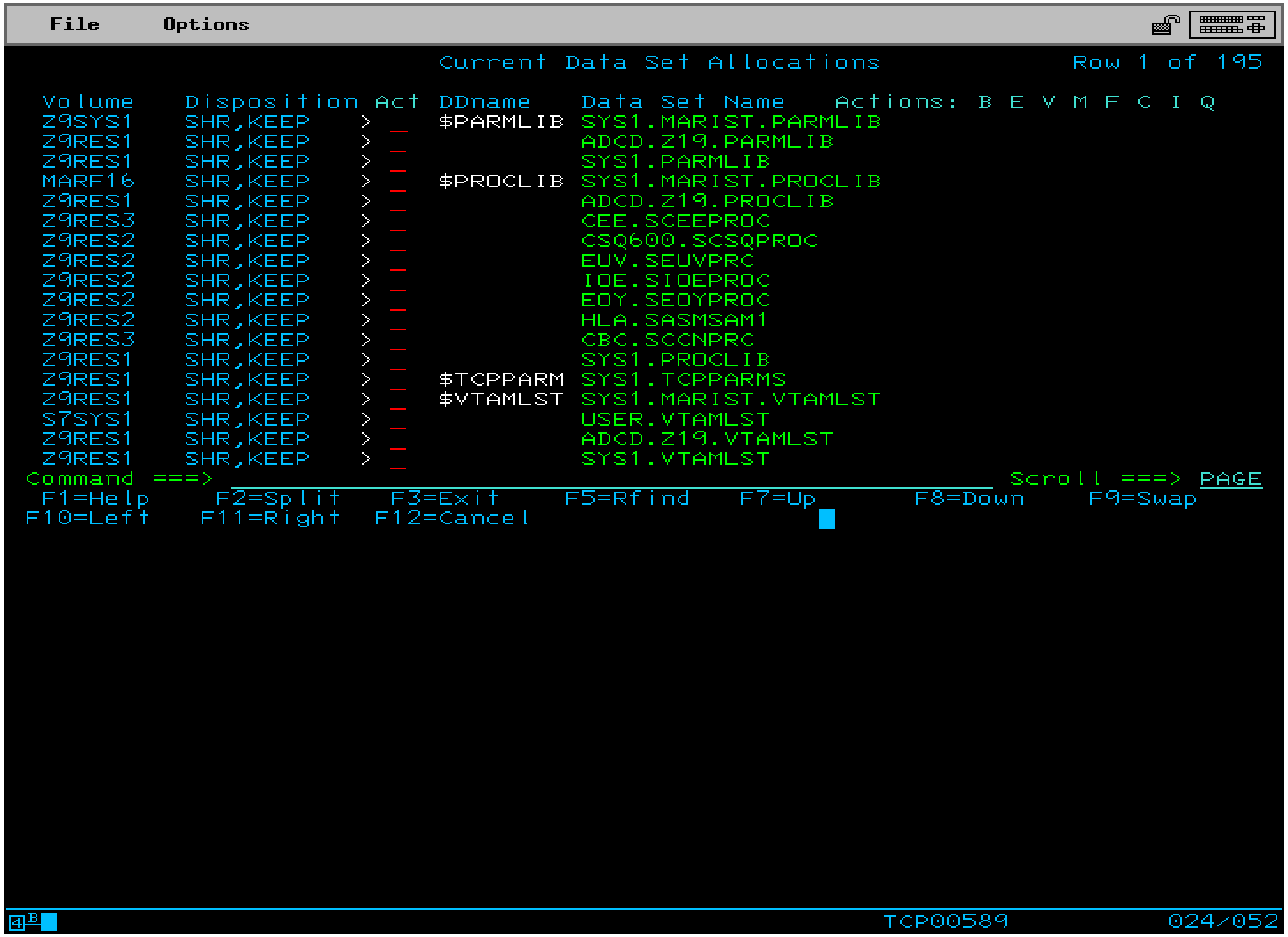
IEASYS99 specifies “PROG=8W”, which means that the link list is defined dynamically in the PROG8W member:

```
APF FORMAT(DYNAMIC)
APF ADD
    DSNAME(SYS1.SHASLNKE)  VOLUME(&SYSR1)
APF ADD
    DSNAME(SYS1.SIEAMIGE)  VOLUME(&SYSR1)
LNKLST DEFINE NAME(LNKLST00)
LNKLST ADD NAME(LNKLST00) DSN(SYS1.MARIST.LINKLIB) VOLUME(Z9DIS2)
LNKLST ADD NAME(LNKLST00) DSN(SYS1.SHASLNKE)       VOLUME(&SYSR1)
LNKLST ADD NAME(LNKLST00) DSN(SYS1.SIEAMIGE)       VOLUME(&SYSR1)
LNKLST ACTIVATE NAME(LNKLST00)
```

Inspecting System Libraries

- If you want to find a member of the PARMLIB or PROCLIB concatenations, you can use the `SYSLIB` command on Marist
- The command builds lists of all members in the concatenation
- The individual members are listed under Data Set Name
- Use the “S”elect action to search

SYSLIB



```
                          Current Data Set Allocations            Row 1 of 195

 Volume    Disposition Act DDname   Data Set Name   Actions: B E V M F C I Q
 Z9SYS1    SHR,KEEP   > _  $PARMLIB SYS1.MARIST.PARMLIB
 Z9RES1    SHR,KEEP   > _           ADCD.Z19.PARMLIB
 Z9RES1    SHR,KEEP   > _           SYS1.PARMLIB
 MARF16    SHR,KEEP   > _  $PROCLIB SYS1.MARIST.PROCLIB
 Z9RES1    SHR,KEEP   > _           ADCD.Z19.PROCLIB
 Z9RES3    SHR,KEEP   > _           CEE.SCEEPROC
 Z9RES2    SHR,KEEP   > _           CSQ600.SCSQPROC
 Z9RES2    SHR,KEEP   > _           EUV.SEUVPRC
 Z9RES2    SHR,KEEP   > _           IOE.SIOEPROC
 Z9RES2    SHR,KEEP   > _           EOY.SEOYPROC
 Z9RES2    SHR,KEEP   > _           HLA.SASMSAM1
 Z9RES3    SHR,KEEP   > _           CBC.SCCNPRC
 Z9RES1    SHR,KEEP   > _           SYS1.PROCLIB
 Z9RES1    SHR,KEEP   > _  $TCPPARM SYS1.TCPPARMS
 Z9RES1    SHR,KEEP   > _  $VTAMLST SYS1.MARIST.VTAMLST
 S7SYS1    SHR,KEEP   > _           USER.VTAMLST
 Z9RES1    SHR,KEEP   > _           ADCD.Z19.VTAMLST
 Z9RES1    SHR,KEEP   > _           SYS1.VTAMLST
Command ===>                                                  Scroll ===> PAGE
 F1=Help    F2=Split   F3=Exit    F5=Rfind   F7=Up      F8=Down    F9=Swap
F10=Left   F11=Right  F12=Cancel

                                                     TCP00589         024/052
```

Concatenations

- PARMLIB concatenation is searched for z/OS system configuration parameters.
- The job procedure library (or PROCLIB concatenation) is searched for JCL PROCs.[2]
- LPALST and LINKLIB concatenations are searched when a program is requested

[2] A modern alternative is the use of `JCLLIB`.

Loading Programs

- Programs ("load modules") must be in central storage and therefore in the virtual storage of the address space before they can run
- z/OS has a defined search order for a newly requested program

Search Order for Programs

- STEPLIB (if present)
- JOBLIB (if present and no STEPLIB)
- Link Pack Area (LPA) concatenation:[3]
  - Dynamic LPA modules
  - Fixed LPA
  - Modified LPA
  - Pageable LPA
- Linklist concatenation

[3] See `SYS1.MARIST.PARMLIB(LPALST8W)`

Defining the Link Pack Area

- LPA is build at IPL time from modules defined in LPALSTxx member of PARMLIB
- SYS1.LPALIB is always the first library used (unless overridden by a SYSLIB statement)
- LPA modules are loaded into common storage at IPL time and available to all address spaces

Example LPALSTxx file

```
SYS2.LPALIB,
SYS1.LPALIB,
SYS1.SERBLPA,
SDF2.V1R4M0.SDGILPA,
SYS1.SIATLPA,
IGN.INGMOD3,
NETVIEW.SCNMPA1,
REXX.V1R3M0.SEGALPA,
```

LPA Types

- Fixed LPA are those modules defined in IEAFIXxx (fixed in central storage)

- Pagable LPA are most other modules (pages eligible to be stolen)

- Modified LPA has modules that are temporary replacements for PLPA modules (used for testing updates for a particular IPL)

Example IEAFIXxx file

```
INCLUDE LIBRARY(SYS1.LPALIB)
MODULES(IEAVAR00,
IEAVAR06,
IGC001G,
ICHRFC00,
ICHRFR00)
INCLUDE LIBARY (SYS1.SVCLIB)
MODULES(IGC09302)
```

System Symbols

- System symbols allow the use of a shared PARMLIB by two or more systems
- Each symbol has a name which can be used in various places and then substituted at IPL time
- Major uses are indirect cataloging and substituting system specific datasets such as the page data sets

System Symbols

- Static System Symbols are defined at IPL and remain fixed for the life of an IPL
- Dynamic System Symbols can change at any point

Defining System Symbols

System symbols are defined in a IEASYSMxx PARMLIB member:

```
SYSDEF  HWNAME(SCZP801)
LPARNAME(A08)
SYSNAME(SC04)
SYSPARM(R3,04)
SYMDEF(&CPCNAME='P801')
SYMDEF(&DFHSMHST='ON')
SYMDEF(&SYSR2='ZXYSY2')
SYMDEF(&SYSR3='&SYSR1(1:5).3')
```

Using System Symbols

To use a system symbol, use “&SYMNAME.” where the substitution is needed:

```
PAGE=(PAGE.&SYSNAME..&PLPADSN1.,
      PAGE.&SYSNAME..&COMMDSN1.,
      PAGE.&SYSNAME..LOCAL1,
      PAGE.&SYSNAME..LOCAL2,L)
```

IPLing z/OS

- IPL = Initial Program Load = “booting”
- Specify address of the IPL volume and the IODF volume
- Bootstrap code on IPL volume is loaded into storage (at address 0) and control is passed to it
- Bootstrap reads the IPLTEXT program IEAIPL00 which is given control

IEAIPL00

- Clears central storage areas (to zeros), defines storage areas for master scheduler
- Locates SYS1.NUCLEUS, loads modules to construct environment of control blocks and subsystems
- Finally, the Nucleus Initialization Program (NIP) is loaded

Nucleus Initialization Program

NIP sets up:

- System Queue Area (SQA)
- PLPA, FLPA, MLPA
- Common Service Area (CSA)
- Starts the master scheduler

The System Queue Area (SQA)

- Storage that is common to all running tasks
- Contains tables and queues with system meta data
- Contents are highly dependent on configuration

Master Scheduler (ASID $= 1$)

- Starts other required address spaces
- Initializes subsystems, including JES
- Once JES is ready, jobs can be started
- VTAM and TSO started after JES

⇒ System available to do work!

Virtual Input/Output (VIO)

- Method of using memory to store small temporary data sets for rapid access
- These are backed up to disk (unlike a RAM disk on a PC)
- Size is restricted

Configured on Marist in `SYS1.MARIST.PARMLIB(IEASYS99)` to be `SYS1.STGINDEX`.

IPL Types

- Cold start: PLPA is reloaded and VIO is cleared (required when contents of LPA have changed)
- Quick start: PLPA is not reloaded, but VIO is cleared (no changes to LPA made, but VIO needs to be refreshed)
- Warm start: PLPA and VIO are retained from before the IPL, jobs can restart using journalled VIO data

Libraries required at IPL time

These must be present for the system to IPL:

- SYS1.PARMLIB
- SYS1.IPLPARM – with LOADxx member!
- SYS1.LPALIB
- SYS1.PROCLIB
- SYS1.NUCLEUS

Specifying IPL Information

- Operator specifies IODF file's device address, selects LOADxx member and controls how the system will prompt during IPL

- If IEASYSxx is not specified in LOADxx, then the operator will be prompted to specify system parameters!

LOADxx

The LOADxx member specifies:

- The IODF data set name
- The master catalog name and volume
- The parmlib concatenation
- The IEASYSxx member (of SYS1.PARMLIB) to use ($xx = 00$ is default)
- The IEASYMxx member (of SYS1.PARMLIB) to use ($xx = 00$ is default)

Locating LOADxx

LOADPARM defines the address of the IODF and the suffix of the LOADxx member. The system searches for LOADxx in:

- SYS1.IPLPARM on IODF volume
- SYS1.PARMLIB on IODF volume
- SYS1.PARMLIB on the IPL volume

Example LOADxx file

```
IODF  00 SYS6 MOEMVSP1 01 Y
SYSCAT   MPAT1113CATALOG.MCAT.VMPCAT1
HWNAME  P201
LPARNAME A1
PARMLIB  SYS0.IPLPARM
PARMLIB  SYS1.OS390R7.PARMLIB
PARMLIB  SYSPROG.SYS1.PARMLIB
```

Search order for Control Paramters

Using the LOADxx file from the previous slide:

1. SYS0.IPLPARM
2. SYS1.OS390R7.PARMLIB
3. SYSPROG.SYS1.PARMLIB
4. **SYS1.PARMLIB** – implicitly last!

LOADxx can specify up to 16 PDS names.

IPL at Marist

- Master configuration for the IPL is in `SYS1.IPLPARM(LOAD99)`
- This specifies the `PARMLIB` concatenation and other major parameters
- If IEASYSxx is not specified in LOADxx, then the operator will be prompted to specify system parameters!

SDSF /D IPLINFO

```
RESPONSE=S0W1
 IEE254I  17.42.47 IPLINFO DISPLAY 283
  SYSTEM IPLED AT 10.09.45 ON 11/09/2008
  RELEASE z/OS 01.08.00    LICENSE = z/OS
  USED LOADW1 IN SYS1.IPLPARM ON 0CE3
  ARCHLVL = 2   MTLSHARE = N
  IEASYM LIST = (W1,SV,VN)
  IEASYS LIST = 18 (OP)
  IODF DEVICE 0CE3
  IPL DEVICE 1000 VOLUME VIMVSB
```

SDSF /D PARMLIB

```
RESPONSE=S0W1
 IEE251I 17.44.27 PARMLIB DISPLAY 291
  PARMLIB DATA SETS SPECIFIED
  AT IPL
  ENTRY  FLAGS  VOLUME  DATA SET
    1      S    VPMVSD  VENDOR.PARMLIB
    2      S    VTMVSG  SVTSC.PARMLIB
    3      S    VTLVL0  LVL0.PARMLIB
    4      D    VIMVSB  SYS1.PARMLIB
```

IPL Errors

- If a required PARMLIB member has an error (or is missing), the operator will be prompted
- If the parameter cannot be corrected, then the default can be accepted
- If a default does not exist, then the parameter maybe cancelled or the IPL abandoned

Shutting down the System

- Production systems are only shutdown when necessary (change, work on power lines)
- Many changes can be done dynamically without IPL
- Tasks needs to be shut down in the correct order (installation specific)
- Most installations have an automation package for shutdown

Questions

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