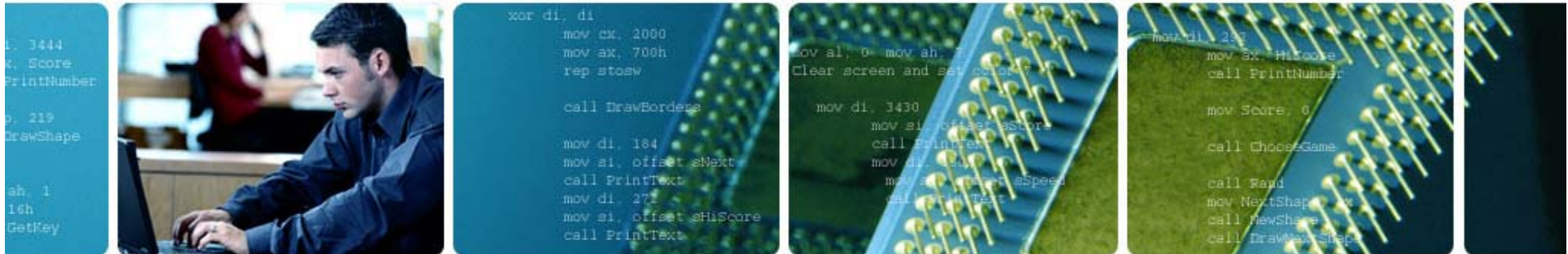




Introduction to the new mainframe

Chapter 10 Topics in z/OS system programming



Objectives

In this chapter you will learn to:

- Discuss the responsibilities of a z/OS system programmer
- Explain system libraries, their use, and methods for managing their content
- Configure consoles
- IPL a system

Key terms

- HCD
- IODF
- SYSRES
- SMP/E
- LNKLST
- IPL
- WTOR
- PARMLIB
- PROCLIB
- system
- symbols
- PSA
- LPA
- nucleus
- LOADPARM
- SQA

■ Considerations for a new application

- **New batch applications to scheduler**
- **New JCL procedures to procedure library**
- **Document operational procedures**
- **Security privileges**
- **Add load libraries to system**
- **Automation**
- **Reload system (if required)**

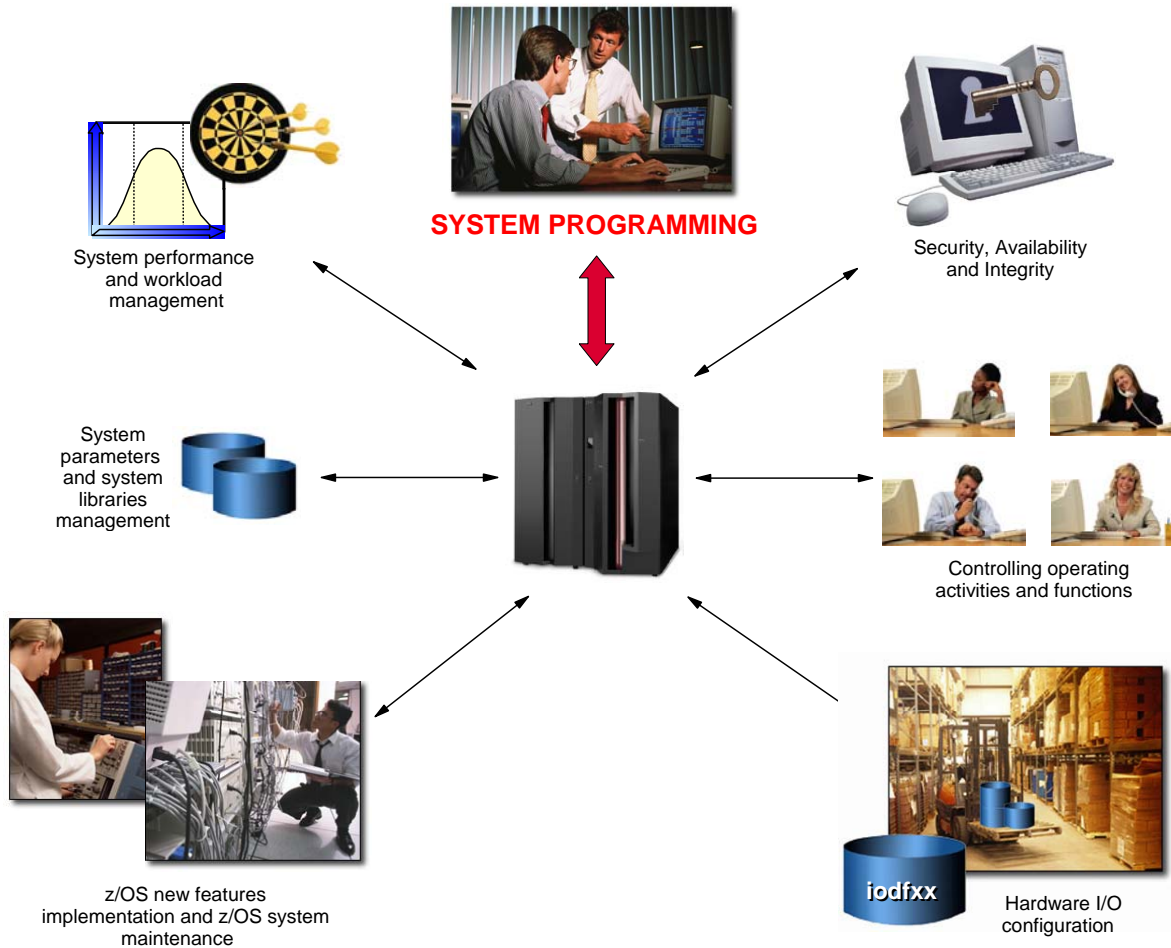
■ What is systems programming?

A systems programmer installs, customizes and maintains the operating system

To do this they need knowledge of

- **Hardware**
 - Storage
 - Processor
- **Software**
 - System libraries and data sets
- **Current customization**

System programming overview



z/OS operational system administration is:

- **Software installation and maintenance**
- **Customize parameters**
- **System libraries for software**
- **System data sets**
- **z/OS system address spaces and subsystems**
- **Real and virtual storage**

z/OS Workload Manager

- **Workload manager (WLM) is an address space which manages the tasks running on the system**
- **Uses an installation-defined policy to determine relative priority of competing workloads**
- **WLM can also be used to manage hardware resources**

■ System performance

- **System tuning is constant and iterative**
- **Only a real problem when resources are constrained**
- **WLM is one component**
- **Can only manage what is set up**
- **Initial set up of initiators and other resources plays a great part**

Job flow

- **Job entry subsystem (JES) controls job flow**
- **Receives jobs into system**
- **Initiates the job**
- **Controls initial output processing**

I/O device management

- **Input/output 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**
- **Sometimes major changes require an IPL of software or POR of hardware**

■ Security

- **Protection of data against unauthorized disclosure, transfer, modification or destruction**
- **Systems programmer installs and maintains the security system**

■ Integrity

- **Designed, implemented and maintained to protect against unauthorized access**
- **Unauthorized software must not be able to access authorized states**
- **Unauthorized software must not be able to bypass system security such as RACF**

■ Availability

- **System availability is designed to be very high**
- **Many systems require 24 hour 7 day operation**

Change control

I/T organizations achieve their goals through disciplined change management processes and policy enforcement

These goals include:

- **High service availability**
- **Increased security**
- **Audit readiness**
- **Cost savings**

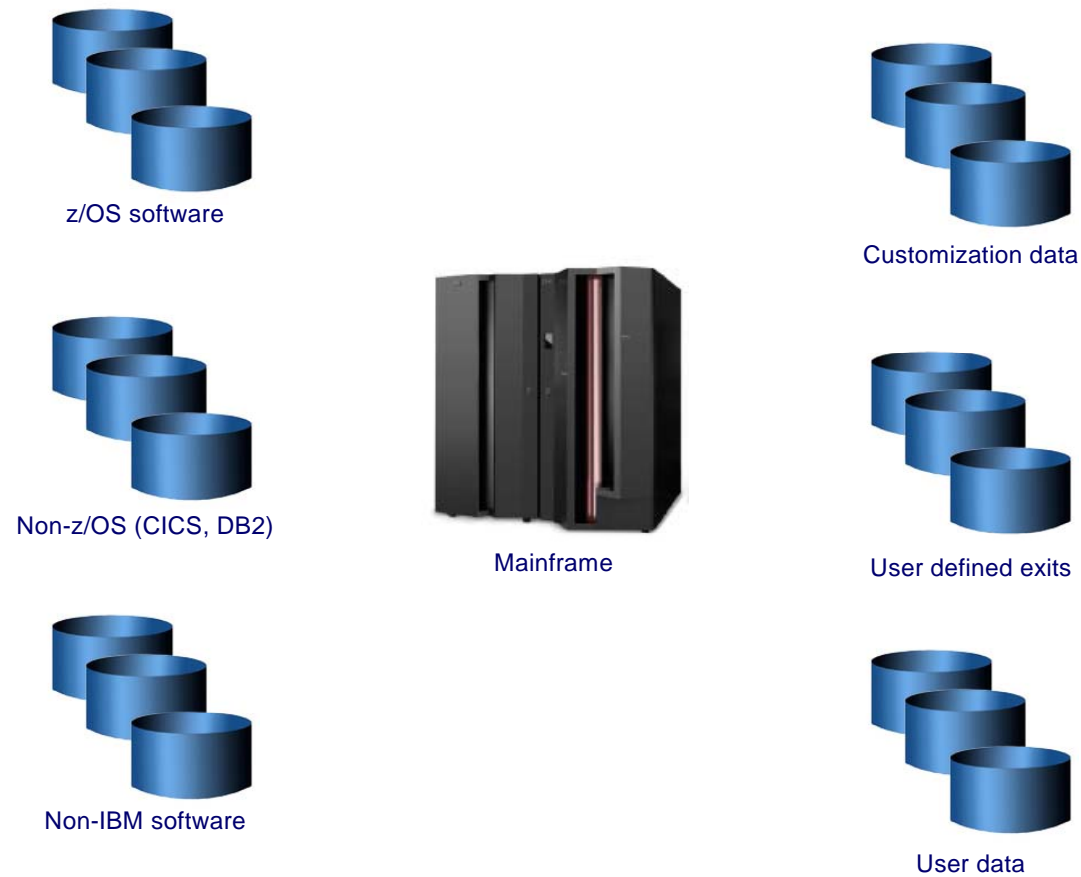
z/OS operation

- **This is the day to day management of the operating environment both software and hardware**
- **Operator interaction is message and command based**
- **Automated processing of the messages and commands is available and operators now manage by exception**

■ z/OS Production Control

- **Build batch schedules**
- **Promote programs to production**
- **Investigate batch failures**

z/OS system libraries



■ Types of data

- **z/OS software on SYSRES volumes**
- **Non-z/OS software e.g. CICS**
- **Non-IBM software**
- **Customization data – parmlib, IODF**
- **User exits**
- **User data – often the largest pool of volumes**

■ z/OS system libraries

These are the most important system libraries

- **SYS1.LINKLIB** prime system software library
- **SYS1.LPALIB** system subroutines
- **SYS1.NUCLEUS** basic supervisor modules
- **SYS1.PROCLIB** system procedure JCL
- **SYS1.PARMLIB** control parameters

SYS1.LINKLIB

- **SYS1.LINKLIB is the main software library**
- **LNKLST concatenation is a group of system and user-defined libraries which form part of the system search order for load modules**
- **Not all on one volume**

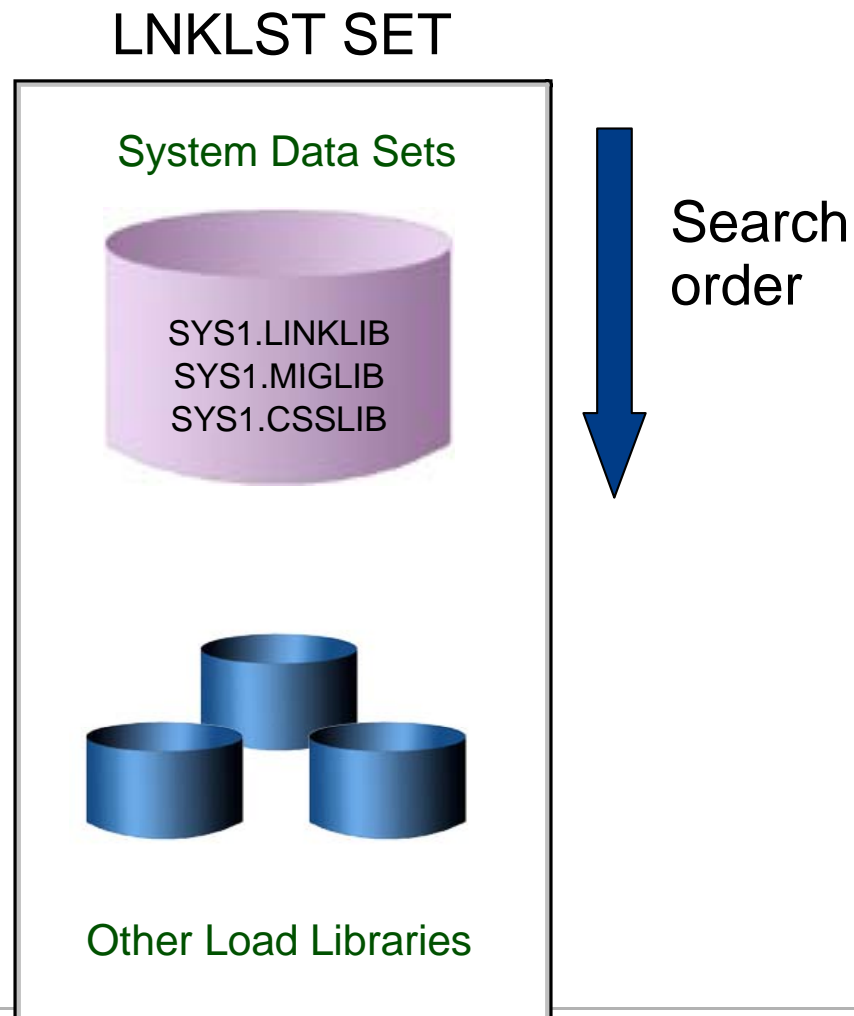
■ System search order for programs

- **Programs (load modules) must be in central storage and therefore in the virtual storage of the address space before they can run**
- **System 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)**
 - Dynamic LPA modules
 - Fixed LPA
 - Modified LPA
 - Pageable LPA
- **Linklist**

Overview of LNKLST



Using PROGxx to define LNKLST

- A LNKLST set is an ordered list of datasets for processing as the LNKLST concatenation
- The PROGxx member may be used to define other lists as well as the linklist
- The linklist must be:
 - Defined
 - Have libraries added
 - Activated

Example linklist definition:

```
LNKLST DEFINE NAME(LNKSYSA) COPYFROM(CURRENT)
LNKLST ADD NAME(LNKSYSA)
        DSNAME(SYS1.PROD.LOADLIB)
LNKLST ADD NAME(LNKSYSA)
        DSNAME(SYS1.TEST.LOADLIB)
LNKLST ACTIVATE NAME(LNKSYSA)
```

■ LLA and VLF

- **Library LookAside** is an address space which maintains a copy of the directories of selected libraries to improve performance
- By default, LLA always caches the linklist directories
- **Virtual Lookaside Facility** is another address space which caches the most popular modules which reduces fetch time
- VLF can also cache other data objects such as RACF tables to improve response

Libraries and members at IPL time

An number of libraries must be present for the system to load at IPL time

- **SYS1.PARMLIB** contains the required definitions
- **SYSn.IPLPARM** searched for **LOADxx**
- **SYS1.LPALIB**
- **SYS1.PROCLIB**
- **SYS1.NUCLEUS**

LOADxx

LOADPARM defines the address of the IODF and the suffix of the LOADxx member

At IPL the system searches for LOADxx in:

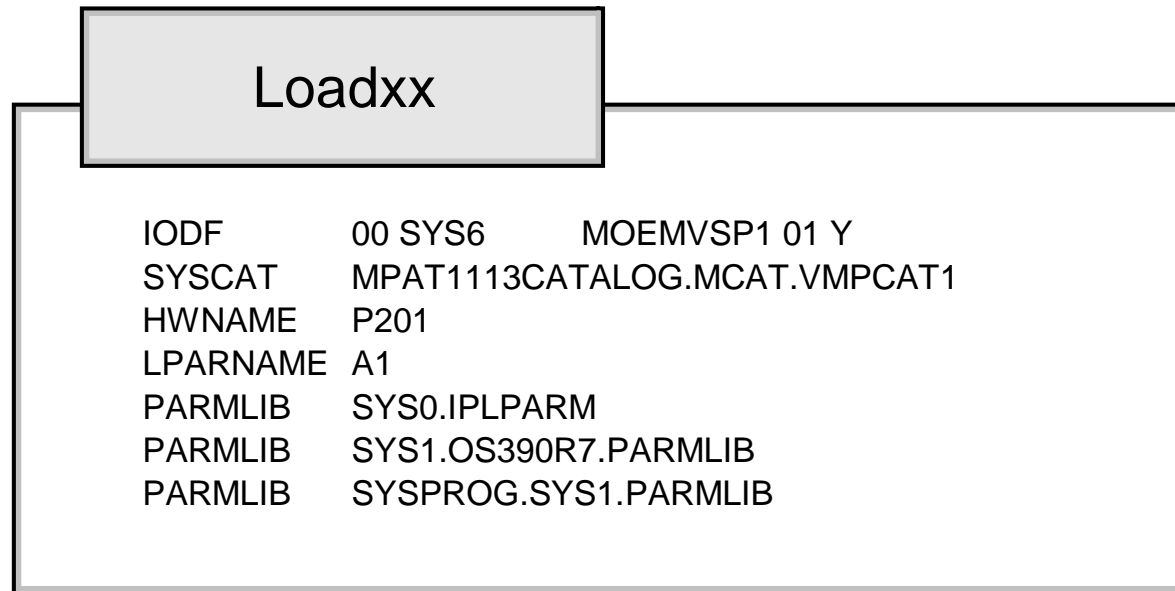
- **SYS0.IPLPARM – SYS9.IPLPARM on IODF volume**
- **SYS1.PARMLIB on the IODF volume**
- **SYS1.PARMLIB on the IPL volume**

LOADxx

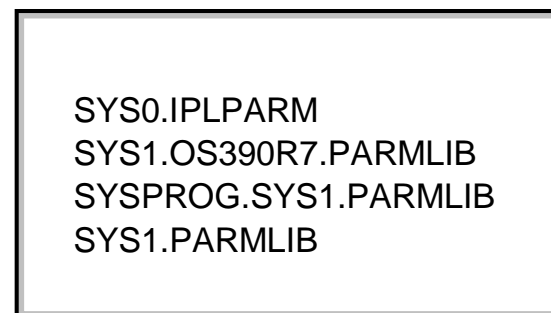
The LOADxx member specifies:

- The IODF data set name
- The master catalog name and volume
- The parmlib concatenation
- The IEASYSxx member to use

Defining a logical parmlib



Parmlib concatenation



IEASYSxx

- **This is the main parameter member for z/OS**
- **IEASYS00 is used by default**
- **If essential parameters are not specified then the operator will be prompted**
- **Normally all parameters are specified to avoid inconsistent operator response**

Parmlib commands

- The parmlib concatenation can be displayed using `D PARMLIB`
- The parameters used at IPL can be displayed using `D IPLINFO`
- The parmlib concatenation can be modified dynamically using `SETLOAD xx, PARMLIB`

Commands to DISPLAY PARMLIB

D PARMLIB

```
IEE251I 17.12.07 PARMLIB DISPLAY 377
PARMLIB DATA SETS SPECIFIED
AT IPL
ENTRY  FLAGS  VOLUME  DATA SET
  1      S    TOTSY1  SYS1.SYSPROG.PARMLIB
  2      D    TOTSY1  SYS1.PARMLIB
  3      S    Z04CAT  CPAC.PARMLIB
  4      S    Z04RE1  SYS1.IBM.PARMLIB
```

D IPLINFO

```
IEE254I 17.15.29 IPLINFO DISPLAY 379
SYSTEM IPLED AT 09.28.14 ON 07/23/2004
RELEASE z/OS 01.04.00    LICENSE = z/OS
USED LOADR2 IN SYS0.IPLPARM ON 3800
ARCHLVL = 2    MTLSHARE = N
IEASYM LIST = XX
IEASYS LIST = (R3,04) (OP)
IODF DEVICE 3800
IPL DEVICE 8038 VOLUME Z04RE1
```

SYS1.LPALIB

- **The Link Pack Area (LPA) is built at IPL time from the modules defined in the LPALSTxx member of parmlib.**
- **SYS1.LPALIB is always the first library used unless overridden by a SYSLIB statement**
- **Modules are loaded into common storage at IPL time and so are available to all address spaces**

SYS1.LPALIB

- **Fixed LPA comprises those modules defined in IEAFIXxx that are fixed in central storage**
- **Pageable LPA comprises most other modules whose pages are eligible to be stolen**
- **Modified LPA has modules which are temporary replacements for PLPA modules and is searched first.**

Example of LPALST member

```
File Edit Edit_Settings Menu Utilities Compilers Test Help
-----
EDIT          SYS1.PARMLIB(LPALST5B) - 01.01          Columns
00001 00072
Command ==>_____ Scroll ==> CSR
***** Top of Data *****
000001 SYS2.LPALIB,
000002 SYS1.LPALIB,
000003 SYS1.SERBLPA,
000004 SDF2.V1R4M0.SDGILPA,
000005 SYS1.SIATLPA,
000006 ING.SINGMOD3,
000007 NETVIEW.SCNMLPA1,
000008 REXX.V1R3M0.SEAGLPA,
000009 ISF.SISFLPA,
000010 EOY.SEOYLPA,
000011 SYS1.SBDTLPA,
000012 CEE.SCEELPA,
***** Bottom of Data *****
```

IEAFIX member

```
File Edit Edit_Settings Menu Utilities Compilers Test Help
-----
EDIT          SYS1.PARMLIB(IEAFIX01) - 01.01                      Columns
00001 00072
Command ==>_____ Scroll ==> CSR
***** ***** Top of Data *****
000001 INCLUDE LIBRARY(SYS1.LPALIB)
000002          MODULES (IEAVAR00,          /* 7K RCT INIT/TERM */
000003          IEAVAR06,          /* RCT INIT/TERM ALIAS */
000004          IGC001G,          /* 456 RESTORE(SVC17) */
000005          ICHRFC00,          /* RACF IMS/CICS */
000006          ICHRFR00)          /* RACF IMS/CICS */
000007 INCLUDE LIBRARY(SYS1.SVCLIB) MODULES(IGC09302)
***** ***** Bottom of Data *****
```

SYS1.PROCLIB

- **When the system is first IPL'd either the MSTJCL00 load module or MSTJCLxx in SYS1.PARMLIB is used to provide the JCL for the master scheduler**
- **This JCL at a minimum points to SYS1.PROCLIB to provide the JCL procedures for the required tasks to run the system**

Sample master JCL

```
//MSTJCL05 JOB MSGLEVEL=(1,1),TIME=1440
//EXEC PGM=IEEMB860
//STCINRDR DD SYSOUT=(A,INTRDR)
//TSOINRDR DD SYSOUT=(A,INTRDR)
//IEFPDSI DD DSN=SYS1.PROCLIB,DISP=SHR
//IEFPARM DD DSN=SYS1.PARMLIB,DISP=SHR
//SYSUADS DD DSN=SYS1.UADS,DISP=SHR
//SYSLBC DD DSN=SYS1.BROADCAST,DISP=SHR
```


■ A job's procedure library

- The JES cataloged procedure in **SYS1.PARMLIB** contains lists of procedure libraries to be searched for JCL procedures
- **JCLLIB** may also be used to specify a private library to be searched first

Procedure library

```
//PROC00 DD DSN=SYS1.PROCLIB,DISP=SHR
// DD DSN=SYS3.PROD.PROCLIB,DISP=SHR
//PROC01 DD DSN=SYS1.PROC2,DISP=SHR
...
//PROCnn DD DSN=SYS1.LASTPROC,DISP=SHR
...
```

```
//MYJOB JOB
//MYLIBS JCLLIB
ORDER=(MY.PROCLIB.JCL,SECOND.PROCLIB.JCL)
//S1 EXEC PROC=MYPROC1
...
```

■ 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

```
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 ' )
```

■ Use of system symbols

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

Summary

The role of the system programmer is to install, customize and maintain the operating system and must be aware of:

- **z/OS operational system administration**
- **Workload management**
- **System performance**
- **Job flow**
- **I/O device management**
- **Security/integrity/availability**
- **z/OS Operation**
- **Change management**