z/OS MVS
System Initialization Logic
Initial Program Load (IPL)

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Abstract

- This presentation will describe the general processing which is involved in initializing a z/OS system, from the IPL process until the system is ready to start either JES2 or JES3.

- The major steps described are:
  - The hardware process of loading z/OS
  - The loading and initialization of the nucleus
  - The initialization of general system resources
  - Master Scheduler Initialization

- In addition, this presentation will provide you with information on how to create an IPL statistics report:
  - From an SVC dump using IPCS
  - Using the IPLSTATX and IPLSTATZ utilities provided on the z/OS USS tools and toys website

Special Notices

- This documentation contains some parts of the presentation “Pulling a System up by its Bootstraps” by Greg Dyck (IBM), SHARE session 2854, March 2000

- IBM may change the implementation of internal processing at any time with no prior notice.
z/OS Initialization Overview

- Processed in different phases
- Each phase builds on the next
- Within each phase, steps build on each other
**UCW and UCB Generation**

Activate using a Reset Profile (POR)

SE
Selected IOCDS
UCW Images (subchannels)

IOCP Program Writes IOCDS

Central Storage

HSA
UCWs (1 per Device)

Main Storage
UCBs (1 per Device)

Dynamic Changes

HCD DYNAMIC
Allows adding, deleting or modifying the Hardware Definitions (CHPIDs, CU, Devices) UCBs and EDTs (requires a Production IODF to activate)

UCBs built during IPL/NIP IODF pointed to by the LOADPARMs and LOADxx

HCD
Production IODF contains the LPAR Names, Channel Info Control Unit, I/O Device Info for both UCWs and UCBs, EDT and NIP consoles

HCD
Work IODF used to define Configuration and to make Changes

Main Storage

Activated using a Reset Profile (POR)
Dataset Considerations – the big Picture

Load Operation

Load Address

Load Parameters

ddddd

xx

i

n

SYSRES Volume

R1 = IPL Record
R2 = Bootstrap
R4 = IPL text
SYS1.NUCLEUS
IEANUC0n

SYS1.PARMLIB

Member IEASYS
Modified by the Member
IEASYSxx
IEASYMxx
contains Symbolics
The Operator can override
many Settings by using
prompting in the LOAD
Parameter IMSI Field

Master Catalog

IOSF Volume

SYSn.IPLPARM or
SYS1.PARMLIB
LOADxx

SYSPARM xx
IEASYM xx
SYSPLEX Name
SYSCAT
IODF

IODF Dataset
UCB’s and EDT’s

IMSI Field
Load Parameters

<table>
<thead>
<tr>
<th>IODF dddd</th>
<th>LOADxx xx</th>
<th>IMSI i</th>
<th>NUCx n</th>
</tr>
</thead>
</table>

- **DDDXXINN Load Parameter Values**
  - **DDDD:** Device number of the volume containing the IODF dataset  
    (Default is SYSRES)
  - **XX:** ID of the LOADxx member to be used (the default is LOAD00)
  - **I:** Initial Message Suppression Indicator (IMSI)  
    The default suppresses most informational messages and does not prompt for system parameters; will use the LOADxx values
  - **N:** Nucleus ID to be used (default is 1: IEANUC01)
## IMSI Character

<table>
<thead>
<tr>
<th>IMSI Character</th>
<th>Display informational Messages</th>
<th>Prompt for Master Catalog Response</th>
<th>Prompt for System Parameter Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Period (.) or blank</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>A</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>C</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>D</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>M</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>P</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>S</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>T</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
</tbody>
</table>
And all begins with a Mouse Click...
Hardware IPL Overview

- **Process is defined by the z/Architecture**
- **Controlled by hardware**
- A single CPU is used for IPL - all other CPUs are placed into a manual (i.e. stopped) state
- A hardware system reset occurs before the process begins
- **IPL records are provided in SYS1.SAMPLIB and written with ICKDSF**
  - **Cyl 0, Trk 0, R1, R2, IEAIPL00**
- **Sample JCL to write IPLTEXT to a SYSRES Volume:**

```verbatim
//INSTTXT EXEC PGM=ICKDSF
//SYSPRINT DD SYSOUT=*  Volser of IPL (SYSRES) Volume
//IPLVOL DD DISP=OLD,UNIT=SYSDA,VOL=SER=vvvvvv
//IPLTEXT DD DSN=SYS1.SAMPLIB(IPLRECS),DISP=SHR,
//          UNIT=SYSDA,VOL=SER=vvvvvv
//          DSN=SYS1.SAMPLIB(IEAIPL00),DISP=SHR,
//          UNIT=SYSDA,VOL=SER=vvvvvv
//SYSIN DD *
  REFORMAT DDNAME(IPLVOL) -
  IPLDD(IPLTEXT,OBJ) -
  NOVERIFY -
  BOOTSTRAP
```

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**Hardware IPL Flow**

1) **CSS**
   - **UCW** for Load Device
   - Hardware turns on enable bit

2) CSS stores IPL CCW into absolute Storage Location 0 and initiates SSCH with CCW Addr = 0
   - DASD will then seek to CYL 0, Head 0 and read Record 1

3) Record 1 will provide CCW’s to read Record 2

4) Record 2 will provide CCW’s to read Record 4

5) IEA IPL00 Location 0 contains initial PSW

After Record 4 has been read the Hardware Portion of IPL is complete
Hardware IPL Summary

- Hardware generates an IPL CCW to read of 24 bytes IPL text into location 0
  - \text{CCW} = 02000000,40000018
  - For DASD, this always reads cylinder 0, track 0, record 1
- Location 8 treated as a command chained CCW
  - Read record 2 into storage, command chain to next CCW
  - Transfer CCW execution to record 2 location
  - Seek and search for IEAIPLOO record
  - Read IEAIPLOO into location 0
- CCW chain completion, PSW is loaded from absolute 0 and execution begun
  - IEAIPLOO location 0 contains initial PSW
• Overview
  • Originally just loaded the Nucleus and set up the Master address space environment
    • Processing has gotten more complex with the XA architecture and Dynamic I/O support
  • Processing is single threaded
  • The IPL vector table (IVT) contains global information during this phase
• IEAIPLOO
  • A mini operating system - non relocatable
  • Builds an initial virtual environment
    • IPL workspace located at X’20000000’ virtual
  • Provides services to
    • Back virtual storage with real frames
    • Do I/O
  • Controls the IPL initialization process
    • Loads IPL Resource Initialization Modules (RIMs) into workspace
    • Gives them control
IPL RIM Processing

1. **Test Block Instruction (clear Storage)**
2. **Read SCPINFO**
   - **Get loadparm**
   - **Set autostore status on**
3. **Locate usable real storage at top of memory**
4. **Get IPL load parameters, and set any defaults**
5. **Search LOADxx, process the information in LOADxx**
   
   IEA371I SYS0.IPLPARM ON DEVICE 5411 SELECTED FOR IPL PARAMETERS  
   IEA246I LOAD  ID 00 SELECTED

6. **Search IODF, process the information in the IODF**
   
   IEA246I NUCLST ID 00 SELECTED
   IEA519I IODF DSN = SYSIOD.IODF24
   IEA520I CONFIGURATION ID = SM15DPRI. IODF DEVICE NUMBER = 5411

   - **Build a table of NIP consoles**
     
     - **max. number of NIP consoles supported by IPL RIM is 64 (HCD supports 128)**
       
       - see APAR OA12877 for additional information

*Store Status

The store-status operation places an architectural-mode identification and the contents of the CPU registers, except for the TOD clock, in assigned storage locations.

For more information, refer to "zArchitecture Principles of Operations", SA22-7832
IPL RIM Processing...

6. **process the information in the IODF (cont.)**
   - **Invoke the device UIMs to**
     - Identify device specific nucleus and LPA modules
     - Calculate required SQA and ESQA
     - Build device control blocks in the workspace
     - Build the Allocation EDT in the workspace

7. **Create a map of the DAT-on nucleus CSECTs**
   
   IEA091I NUCLEUS 1 SELECTED
   IEA093I MODULE IEANUC01 CONTAINS UNRESOLVED WEAK EXTERNAL REFERENCE IFFIOM
   IEA093I MODULE IEANUC01 CONTAINS UNRESOLVED WEAK EXTERNAL REFERENCE IEDQATTN
   IEA093I MODULE IEANUC01 CONTAINS UNRESOLVED WEAK EXTERNAL REFERENCE IECTATEN

   - **Includes modules contained in IEANUC0x and IEANUC2x, and those identified by NMLs, NUCLSTxx, and UIMs**

   - **CSECTs are grouped/positioned by attributes, RMODE and read-only**

8. **Load modules, dynamically resolving external references**
IPL RIM Processing...

9. **Create the initial SQA/ESQA areas**
   - Sum of IBM supplied value, LOADxx INIT SQA, UIM determined value

10. **Create Master’s VSM control blocks and LSQA**

11. **Create Master’s permanent page and segment tables**

12. **Move from the workspace into SQA/ESQA**
   - Device control blocks
   - Allocation EDT
   - IPL Messages
   - LPA device support module list

13. **Validate real storage, build available frame queue**
   - IPL workspace is destroyed

14. **Load Prefix Register**

15. **Switch to nucleus version of the PSA**

*Note:* this is just a brief overview of the IPL RIMs. For a complete list of all IPL RIMs refer to the IPCS IPL statistics report at the end of this presentation.
Virtual Storage Layout

- **Private**
  - High User Region
  - Default shared Memory Addressing
  - Low User Region
  - Reserved
  - Extended LSQA/SWA/229/230
  - Extended User Region
  - Extended CSA
  - Extended FLPA/MLPA/PLPA
  - Extended SQA
  - Extended Nucleus
  - Nucleus
  - SQA
  - FLPA/MLPA/PLPA
  - CSA
  - LSQA/SWA/229/230
  - User Region
  - System Region
  - PSA

- **Shared Area**
  - 16Eb
  - 512Tb
  - 2Tb
  - 4Gb
  - 2Gb

- **Low User Private**
  - 16Mb

- **Extended Private**
  - 16Gb

- **Extended Common**
  - 24K
  - 8K

- **Common**
  - 0

- **Reserved**
  - 2Gb

- **Low User Private**
  - 2Gb

- **Extended Nucleus**
  - 16Mb

- **Extended Shared Area**
  - 16Gb

- **Extended User Region**
  - 16Gb

- **Extended Common**
  - 16Gb

- **Extended Private**
  - 16Gb

- **Private**
  - 16Gb

- **PSA**
  - 0
LOADxx Search Sequence

Search for the LOADxx member specified in the LOADPARM field, digits 5 and 6 (example Load Parm = 012355M)

Is SYSn.IPLPARM on the IODF volume? (n=0-9)
  - Yes
  - No

Is LOADxx in SYSn.IPLPARM?
  - Yes
  - No

LOADxx not found, enter non-restartable disabled
  Wait State WSC=088 RC=00; Re-IPL required

Is SYS1.PARMLIB on the IODF volume?
  - Yes
  - No

Is LOADxx in SYS1.PARMLIB?
  - Yes
  - No

LOADxx not found, enter non-restartable disabled
  Wait State WSC=088 RC=00; Re-IPL required

Is SYS1.PARMLIB on the SYSRES volume?
  - Yes
  - No

LOADxx not found, enter non-restartable disabled
  Wait State WSC=0B1 RC=01; Re-IPL required

LOADxx found, continue IPL/NIP processing
Overview

- Initializes basic system resources
- Processing is multithreaded - normal dispatching of work is done
- Basic system service (SRBs, WAIT, POST, EXCP, ATTACH, etc.) are initially available
- Additional services enabled as NIP RIMs run
- The NIP vector table (NVT) contains global information during this phase

Control routine

- Sets traps for unexpected errors (no RTM support is available yet)
- Verifies the hardware environment
- Creates IPL processor control blocks
- Creates global VSM control blocks
- Creates I/O control block pools
- Creates the initial system trace table
- Opens SYS1.NUCLEUS as the LNKLST
- Loads and invokes NIP RIM routines
In order for MVS to use a device:
- a UCW for the device must exist
- a UCB for the device must exist

During device mapping:
- each matching UCW is enabled
- each matching UCB is connected

During the mapping process, the I/O configuration (UCWs) loaded into the HSA with a POR (or updated via dynamic I/O) is matched with the operating system configuration (UCBs) defined in the IODF.

The UCWs are placed in the disabled state after POR or system reset.

Initial UCB state:
- the UCBs are built with the “not connected“ state bit = 1 (UCB byte 7, bit 2)
- at the completion of this mapping process all devices defined to both the channel subsystem (UCWs) and MVS (UCBs) will be enabled and connected
  - any UCWs without corresponding UCBs will be left disabled
  - any UCBs without corresponding UCWs will be left not connected

Devices in either one of these states cannot be used by the system.
Non-DASD Pathing

- The process of determining path availability is referred to as Pathing

  - during this process MVS will check all paths for devices generated to come up online by attempting to complete an I/O operation down each path defined to a device

  - if at least one path is operational the device will be online

  - Tapes are an exception: pathing is performed to offline tape devices

  *MVS does not report any paths or devices that are found to be not operational during pathing*
DASD Pathing

- A NIP console is required before DASD pathing takes place to allow the operator to respond to out-of-line conditions encountered during the DASD pathing
  - Issue SSCH to multiple devices (test multiple devices in parallel)
  - After each successful I/O another device is tested
  - Redrive another device if an I/O is complete for a device
    - If an I/O fails to complete within 15 seconds, the I/O operation is purged
  - Perform path testing on each path
    - no 1.5 sec. timeout (no IOS120A message during path testing)
    - create PIM (Path Installed Mask), represents CHPID’s defined in IOCDS
    - create LPM (Logical Path Mask), used by UCB to control paths to be used for an I/O operation
  - Get device characteristics - one path
  - Self description - each path (msg IOS291I)
  - VOLSER checking - one path for SDP products (all paths for other DASD)
    - duplicate VOLSER message (IEA213A - not SYSRES, IEA214A SYSRES)
  - at end of pathing wait 15 seconds for any outstanding I/O to complete
    - mark any UCB with outstanding I/O to test later again
    - purge all outstanding requests
## DASD Pathing...

<table>
<thead>
<tr>
<th>1 (P)</th>
<th>2 (D)</th>
<th>3 (S)</th>
<th>4 (V)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Path Testing</td>
<td>UCB Device Characteristics Initialization</td>
<td>SDP</td>
<td>VOLSER</td>
</tr>
<tr>
<td>Each Path</td>
<td>One Path</td>
<td>Each Path</td>
<td>One Path SDP Device</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Each Paths non-SDP device</td>
</tr>
<tr>
<td>CCW: 94 Release</td>
<td>CCWs: E4 Sense Id; 64 RDC; 54 Subsystem; FA RCD</td>
<td>CCWs: E4 Sense Id (one Path) FA RCD (each Path)</td>
<td></td>
</tr>
<tr>
<td>Messages: IGGN504A; IGGN505A; Required Dataset missing; IOS120A moved to MSI</td>
<td>Message: IEC334I (duplicate SSID)</td>
<td>Message: IOS291I (Configuration Mismatch)</td>
<td>Messages: IEA213A; IEA214A (Duplicate VOLSER)</td>
</tr>
</tbody>
</table>

DASD pathing consists of 4 different phases: path testing on each path (P), read device characteristics (D), self-describing product (S) and VOLSER processing (V)

Any error conditions detected during the DASD pathing steps are reported to the NIP console via messages IGGN504A, IGGN505A, IEC334I, IOS291I, IEA213A or IEA214A (*any A or action messages requires operator response*)

- CCW = Channel Command Word
- SDP = Self-describing Product
- RCD = Read Configuration Data
- SSID = Subsystem ID (DASD CUs)
- RDC = Read Device Characteristics
DASD Pathing...

- **Dynamic Pathing Error Messages**

  IOS291 CONFIGURATION DATA COULD NOT BE READ ON PATH (24C0,49) RC=21
  
  • IOS291I messages with a RC of 21, 27 or 29 indicate a possible configuration error and should be investigated

  IEC334I DUPLICATE SUBSYSTEM X`0001`,CCA X`00`, DEVI VE 24C0 NOT BROUGHT ONLINE
  
  • In addition the the IOS291I messages, a misconfiguration problem to a DASD CU may also show up as a duplicate SSID condition

  IEA213A DUPLICATE VOLUME `SPOOL1` FOUND ON DEVICES 2465 AND 28A0
  IEA213A REPLY DEVICE NUMBER WHICH IS TO REMAIN OFFLINE

  IEA214A DUPLICATE SYSRES `S15R21` FOUND ON DEVICE 22C4
  IEA214A VERIFY THAT THE CORRECT DEVICE WAS USED FOR IPL
  IEA214A DUPLICATE DEVICE WILL REMAIN OFFLINE
  IEA214A REPLY `CONT` TO CONTINUE IPL

  • The last step of dynamic pathing is Direct Access Volume Verification (DAVV)

  • DAVV processing reads the volume label of each online DASD device and updates the UCB with the VOLSER

  • If a duplicate VOLSER exists, either message IEA213A or IEA214A will be issued
DASD Pathing...

- Dynamic Pathing Error Messages...

  IGGN505A SPECIFY UNIT FOR SYS1.PRODXY.LINKLIB ON DCSYS2 OR CANCEL

  R 00,1A60
  IEE600I REPLY TO 00 IS;1A60

  • If the busy condition still exists IOS120A will be issued

  *IOS120A DEVICE 1A60 SHARED, REPLY ‘CONT’ OR ‘WAIT’
  IOS600I REPLY TO 00 IS ‘WAIT’
  *IOS124A STILL WAITING FOR RESPONSE FROM DEVICE 1A60, TOTAL WAIT TIME
  IS 46 SECONDS, REPLY ‘CONT’ OR ‘WAIT’

  *IOS120A DEVICE 1A60 SHARED, REPLY ‘CONT’ OR ‘WAIT’
  IOS600I REPLY TO 00 IS ‘WAIT’
  IGGN306I 1A60,UNIT UNACCEPTABLE, 00000004
  IGGN505A SPECIFY UNIT FOR SYS1.PRODXY.LINKLIB ON DCSYS2 OR CANCEL

  • IGGN504A or IGGN505A message issued if required dataset is on a volume that was busy during DASD
    pathing and the dataset is required for the IPL to complete

  • Issue D U,VOL=vvvvv on an active system that shares the DASD device to obtain the device number
    associated with the VOLSER
NIP RIM Processing

1. Create RTM recovery and control blocks
2. Create WTO control blocks and pools
   - WTOs issued now will be logged in SYSLOG
3. Initialize Machine Check handling (MCH)
4. Device mapping (UCWs to UCBs), test availability, and initialize non-DASD devices
5. Select and initialize NIP
   - WTOs will now be displayed on the NIP console
6. Test availability, and initialize DASD devices (DASD Pathing)
   - Operator can be prompted during validation
7. Open the master catalog
8. Create the system symbolics from IEASYMxx
9. Open SVCLIB, PARMLIB, and LOGREC
10. If required, prompt for system parameters (message IEA101A)
11. Merge and analyze the system parameters
NIP RIM Processing...

12. Initialize ASM, opening page and swap datasets
13. Process SQA= parameter
   - On a quickstart (CLPA not specified), PLPA boundaries control SQA/ESQA boundaries
   - On a coldstart, expand initial SQA/ESQA
14. Create user SVC table entries from IEASVCxx
15. Create the PLPA if CLPA specified
   - LPALSTxx datasets
   - UIM specified device support from SYS1.NUCLEUS
16. Create FLPA and MLPA, fix FLPA area and protect both areas as requested
17. Complete type 3 and 4 SVC table entries
18. Process CSA= parameter
19. Initialize system resource manager (SRM)
20. Enable RTM for task termination / SRB purge
   - Limited Function Address spaces can now be created by master scheduler
21. Initialize Cross-memory services, creates PCAUTH address space
NIP RIM Processing...

22. Initialize RSM Dataspaces services, creates RASP
23. Initialize System Trace services, creates TRACE
24. Initialize Timing services, sets TOD if needed
25. Initialize SVC dump services, creates DUMPSRV address space
26. Initialize XCF/XES services, creates XCFAS address space
27. Initialize GRS services, creates GRS address space
28. Initialize SMS and PDSE services, creates SMXC and SYSBMAS address spaces
29. Open LNKLST -- drops SYS1.NUCLEUS
30. Initialize Console services, creates CONSOLE address space
   • Full function console is still unavailable
31. Initialize WLM services, creates WLM address space
32. Initialize data management
33. Initialize Concurrent-copy, creates ANTMAIN and ANTAS000 address spaces
34. Initialize UNIX System Services, creates OMVS address space
NIP RIM Processing...

35. **Close master catalog**

36. **Initialize Catalog services, creates CATALOG address space**
   - Limited function, for use until MSI completes

37. **Exit NIP processing**
   - Create the IPL parameter area (IPA)
   - Free control blocks no longer needed by NIP
   - Reset traps for unexpected errors, enables full RTM recovery/retry
   - LINK to Master Scheduler processing

Note: this is just a brief overview of the NIP RIMs. For a complete list of all NIP RIMs refer to the IPCS IPL statistics report at the end of this presentation.
Master Scheduler Initialization (MSI) Overview

- Completes initialization of system functions
- Coordinates final completion with primary subsystem (JES2/JES3)

Basic Processing

- Initialize Master Trace processing
- Enable full function Console processing
  - All MCS consoles are now available
- Initialize Sysplex-wide ENF services, creates IEFSCHAS address space
- Initialize MSTR subsystem
- Initialize Common JES services, creates JESXCF address space
- Initialize Allocation services, creates ALLOCAS address space
- Attach Initiator to start Master JCL
MSI Processing Details

1. Initialize MIH services
2. Complete ASM initialization
3. Initialize IOS dynamic pathing, create IOSAS
4. Initialize Master’s security environment
5. Initialize Console attributes, DEL=RD etc.
6. Initialize APPC services
7. Initialize TSO services
8. Initialize LOGREC Logstream recording
9. Enable ENF services
10. Initialize System Logger services, creates IXGLOG address space
11. Vary all available CPs online
   - we are now multiprocessing
12. Initialize SMF services, creates SMF address space
MSI Processing Details...

13. Issue commands in IEACMD00 and COMMNDxx parmlib members
   - only commands processed by CONSOLE will execute now

14. Initialize RTM services
   - LOGREC recording
   - Address space termination
   - SVC dump processing

15. Initialize System security processing

16. Build defined subsystems
   - Invoke initialization routine
   - Issue START for primary JES subsystem, if requested

17. Hold primary JES STC and TSO processing

18. Indicate MSI is complete

19. Initialize Master command processing
   - Any pending commands that execute in Master will now be executed
   - Start commands are executed by Master
MSI Processing Details...

Full function address spaces can be created - JES and other tasks started under MSTR will now start

20. Issue command processing available message

21. Allow pending address space creates (not done by Master) to complete
   - Create full function CATALOG
   - Original CATALOG terminates
   - Address spaces may switchover from limited to full function

22. Wait for JES to indicate primary services are available
   - Release primary JES STC and TSO processing
   - Start the System Log Syslog/OPERLOG

All IPL processing is now complete

The next and final step is to bring up and initialize the job entry subsystem (JES2 or JES3)
IPCS Display IPL Statistic

VERBX BLSAIPST

*** IPL Statistics ***

IEAIPL10  00:00:00.000  ISNIRIM - Read SCPINFO
IEAIPL20  00:00:00.000  Test Block storage to 2G
IEAIPL11  00:00:00.008  Fast FIND service
IEAIPL31  00:00:00.001  LOAD service
IEAIPL30  00:00:00.001  IPLWTO service
IEAIPL46  00:00:00.110  Read SCHIBs into IPL workspace
IEAIPL49  00:00:00.000  Process Load and Default parameters
IEAIPL50  00:00:08.747  IPL parmlib - process LOADxx and NUCLSTxx
IEAIPL51  00:00:00.000  System architecture
IEAIPL43  00:00:00.012  Find and Open IODF data set
IEAIPL60  00:00:00.000  Read NCRs from IODF
IEAIPL70  00:00:00.097  UIM environment - load CBD and IOS services
IEAIPL71  00:00:00.064  Build DFT for each device
IEAIPL08  00:00:00.004  Read EDT information from IODF
IEAIPL40  00:00:00.043  Read MLTs from nucleus
IEAIPL42  00:00:00.05  Read NMLs from nucleus (IEANynnn modules)
IEAIPL41  00:00:00.627  Read PDS directory entries and CESD records
IEAIPL05  00:00:00.000  Build and sort NUCMAP
IEAIPL02  00:02.130  Load nucleus modules
IEAIPL04  00:00:00.005  Allocate PFT and SQA/ESQA
IEAIPL14  00:00:00.000  Build LSQA/ELSQA for Master
IEAIPL09  00:00:00.40  IAXMI - PFT, master RAB, etc.
IEAIPL07  00:00:00.005  Update AMODE for nucleus resident SVCs
IEAIPL03  00:00:00.29  Build UCBs, ULUT, etc.
IEAIPL18  00:00:00.015  Copy and relocate EDT to ESQA
IEAIPL99  00:00:00.194  Page frame table and cleanup

Total IPL Time:  00:00:12.147

To determine the time required for an IPL in your installation, use IPCS VERBX BLSAIPST to display IPL statistics information.

Note: the IPL statistic shown on this and the following slides is from a z/OS 1.10 (HBB7750) system.
IPCS Display IPL Statistics...

*** NIP Statistics ***

IEAVNIP0 00:00:00.034 NIP Base
IEAVNIPM 00:00:00.109 Invoke NIP RIMs
IEAVNPE6 00:00:00.065 Service Processor Interface
IEAVNPFF 00:00:00.044 Loadwait/Rerstart
IEAVNPA6 00:00:00.011 RTM - RTCT and recording buffer
IEAVNPC6 00:00:00.011 WTO
IEAVNPC3 00:00:00.011 Issue messages from IPL message queue
IEAVNP24 00:00:00.032 SMS Open/Mount
IEAVNP06 00:00:00.013 Machine Check
IEAVNP27 00:00:00.016 Reconfiguration
IEAVNPA2 00:01:30.319 IOS - Non-DASD UCBs
IEAVNPCA 00:00:00.219 NIP Console
IEAVNPB2 00:00:03.136 IOS - DASD UCBs
IEAVNP11 00:00:00.043 Locate and Open master catalog
IEAVNPC7 00:00:00.030 Open SYS1.SVCLIB
IEAVNPOP 00:00:00.156 Open PARMLIB
IEAVNPIL 00:00:00.091 Process IEALSTxx
IEAVNPC4 00:00:00.044 Prompt for System Parameters
IEAVNP03 00:00:00.005 Merge and analyze system parameters
IEAVNPCF 00:00:04.098 Process system name and system variables
IEAVNP76 00:00:00.057 Open LOGREC
IEAVNPE8 00:00:00.033 RSM - Process REAL=
IEAVNP23 00:00:00.050 Build GRS blocks in SQA
IEAVNP04 00:00:00.097 ASM - Open page and swap data sets
IEAVNPA8 00:00:00.012 VSM - Expand SQA
IEAVNP14 00:00:00.206 ASM part 2 - Build SQA control blocks
IEAVNPGD 00:00:00.009 Move console data to ESQA
IEAVNP25 00:00:00.618 Process SVC=
IEAVNP05 00:00:13.072 LPA, APF
IEAVNP44 00:00:00.003 ASA Reuse stuff
IEAVNPB1 00:00:00.001 Process CSCBLOC=
IPCS Display IPL Statistic...

IEAVNPE2  00:00:00.004  RACF SAF
IEAVNPB8  00:00:00.021  Create CSA
IEAVNP47  00:00:00.003  ENF
IEAVNPD6  00:00:00.002  RTM - SDUMP, ABDUMP, ESTAE
IEAVNP09  00:00:00.003  Build ASVT
IEAVNPD8  00:00:09.865  RSM - Frame queues, VRREGN= and RSU=
IEAVNP10  00:00:07.029  SRM - OPT=, IPS=, etc.
IEAVNPD1  00:00:00.022  ABDUMP
IEAVNPD2  00:00:00.025  SDUMP
IEAVNPCX  00:00:00.002  Context services, registration services
IEAVNPX1  00:00:00.002  NIP cleanup
IEAVNPF5  00:00:00.061  PCAUTH
IEAVNPF8  00:00:00.017  RASP
IEAVNP1F  00:00:00.138  SRM - I/O measurement blocks
IEAVNPC2  00:00:00.038  IOS - Move CDT to SQA
IEAVNP51  00:00:00.033  TRACE
IEAVNP20  00:00:00.231  Process CLOCK=
IEAVNP21  00:00:00.202  TOD clock
IEAVNP57  00:00:00.014  SDUMP
IEAVNPF9  00:00:15.811  XCF
IEAVNP33  00:00:13.329  GRS
IEAVNPED  00:00:00.021  PROD
IEAVNP26  00:00:01.757  SMS
IEAVNP85  00:00:04.480  LNKLST
IEAVNPD5  00:00:00.378  Load pageable device support modules
IEAVNP88  00:00:00.238  Allocation move EDT II
IEAVNPAL  00:00:38.746  CONSOLE
IEAVNPD0  00:00:00.592  WLM
IEAVNP16  00:00:03.508  EXCP appendages
IEAVNP13  00:00:00.030  Prepare NIP/MSI interface
IEAVNP17  00:00:00.003  GTF Monitor Call interface
IEAVNP36  00:00:00.005  VSM defined monitor call enablement
IEAVNP18  00:00:05.463  PARMLIB Scan Routine interface
IPCS Display IPL Statistic...

IEAVNPF2  00:00:00.130  Process IOS=
IEAVNP15  00:00:00.424  Process VATLST
IEAVNPRR  00:00:00.002  RRS
IEAVNP0E  00:00:00.468  USS
IEAVNPSC  00:00:00.002
IEAVNPLE  00:00:07.342  System LE RIM
IEAVNPUN  00:00:00.142  Unicode
IEAVNPXL  00:00:00.014
IEAVNP1B  00:00:00.085  Close catalog
IEAVNIPX  00:00:00.001  Nip final cleanup

Total NIP Time:  00:03:43.361
IPCS Display IPL Statistic...

*** IEEVIPL Statistics ***
- IETRACE 00:00:00.004 Master trace
- ISNSMI 00:00:00.776 SPI
- UCMPECBM 00:00:01.163 CONSOLE address space
- ENFPC005 00:00:00.000 CONSOLE ready ENF
- IEFSCHIN 00:00:00.174 IEFSCHAS address space
- IEFJINT 00:00:00.003 Subsystem interface
- IEFSJLOD 00:00:00.023 JESCT
- IAEGINIT 00:00:00.051 JESXCF address space
- IAEPFSI 00:00:00.006 FSI trace
- IEFQBIN 00:00:00.020 SWA manager
- IEFAB410 00:00:00.108 ALLOCAS address space

IEEVIPL 00:00:02.332 Uncaptured time: 00:00:00.000

*** IEEMB860 Statistics ***
- ILRTMRLG 00:00:00.204 ASM
- IECVIOSI 00:00:42.407 IOS dynamic pathing
- ATBINSYS 00:00:00.010 APPC
- IJEFEKSR 00:00:00.160 TSO
- IXGBLF00 00:00:00.025 Logger
- COMMNDXX 00:00:00.133 COMMANDxx processing
- SMFWAIT 00:00:02.534 SMF
- SECPROD 00:00:04.873 Security server
- IEFJSIN2 00:00:28.051 SSN= subsystem
- IEFHB412 00:00:00.020 ALLOCAS - UCB scan
- CSRINIT 00:00:00.006 Windowing services
- FINSHMSI 00:00:00.000 Wait for attached CMDs

IEEMB860 00:01:18.585 Uncaptured time: 00:00:00.156

Total Time: 00:05:16.426

Tip: in the IPCS dialog, to display the last IPL statistic using in-storage source rather than an SVC dump, proceed as follows:

1. Select IPCS option 6 (commands)
2. Issue DROPD MAIN
3. (delete data from a previous IPCS session using in-storage as source)
4. Issue VERBX BLSAIPST MAIN
How to automatically create an IPL Statistics Report

- Wouldn’t it be nice to automatically create a regular IPL statistics report with the durations of each RIM (Resource Initialization Module) during an IPL of a z/OS system?

- On the UNIX System Services Tools and Toys web site, 2 utilities are provided which can be used to create such a report

- On this web site, link IPLSTATS provides a ZIP-file, iplstats.zip, which contains these 2 utilities and a readme file:
  - IPLSTATX.OBJ
  - IPLSTATZ.OBJ
  - README

- IPLSTATX.OBJ writes the IPL statistics report to a SYSOUT dataset pointed to by the OUTPUT DD-statement

- IPLSTATZ.OBJ writes the IPL statistics report to SYSLOG/OPERLOG using WTO messages
How to automatically create an IPL Statistics Report

- Sample report created with the IPLSTATZ utility:

```
IPLST000I z/OS             01.11.00 CH01PROD 281700017E16    25 CPs
IPLST001I IPL started at:  2011/03/26 19:31:41.810
IPLST100I **** IPL Statistics ****
IPLST101I IEAIPL99         0.131    Page frame table and cleanup
IPLST102I                   0.131    TOTAL IPL TIME (seconds)
IPLST002I NIP started at:  2011/03/26 19:32:03.588
IPLST200I **** NIP Statistics ****
IPLST201I IEAVNIP0        0.031    NIP Base
IPLST201I IEAVNIPM        0.090    Invoke NIP RIMs
IPLST201I IEAVNPE6        0.077    Service Processor Interface
IPLST201I IEAVNPFF        0.031    Loadwait/Restart
IPLST201I IEAVNPAA6       0.007    RTM - RTCT and recording buffer
IPLST201I IEAVNPC6        0.014    WTO
IPLST201I IEAVNPC3        0.007    Issue messages from IPL message queue (IEA371I)
IPLST201I IEAVNP24        0.040    SMS Open/Mount
IPLST201I IEAVNP06        0.009    Machine Check
IPLST201I IEAVNP27        0.013    Reconfiguration
IPLST201I IEAVNPAA2       52.271   IOS - Non-DASD UCBs
IPLST201I IEAVNPCA        0.007    NIP Console
IPLST201I IEAVNPB2        1.794    IOS - DASD UCBs
IPLST201I IEAVNP11        0.457    Locate and Open master catalog
```

IPL Statistics Reporting
How to automatically create an IPL Statistics Report

- Sample report created with the IPLSTATZ utility (cont.):

<table>
<thead>
<tr>
<th>Task Description</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open SYS1.SVCLIB</td>
<td>0.049</td>
</tr>
<tr>
<td>Open PARMLIB</td>
<td>0.145</td>
</tr>
<tr>
<td>Process IEALSTxx</td>
<td>0.802</td>
</tr>
<tr>
<td>Prompt for System Parameters</td>
<td>0.156</td>
</tr>
<tr>
<td>Merge and analyze system parameters</td>
<td>0.029</td>
</tr>
<tr>
<td>Process system name and system variables</td>
<td>33.371</td>
</tr>
<tr>
<td>Open LOGREC</td>
<td>0.160</td>
</tr>
<tr>
<td>RSM - Process REAL=</td>
<td>0.014</td>
</tr>
<tr>
<td>Build GRS blocks in SQA</td>
<td>0.045</td>
</tr>
<tr>
<td>ASM - Open page and swap data sets</td>
<td>0.058</td>
</tr>
<tr>
<td>VSM - Expand SQA</td>
<td>0.008</td>
</tr>
<tr>
<td>ASM part 2 - Build SQA control blocks</td>
<td>1.138</td>
</tr>
<tr>
<td>Move console data to ESQA</td>
<td>0.003</td>
</tr>
<tr>
<td>Process SVC=</td>
<td>5.454</td>
</tr>
<tr>
<td>LPA, APF</td>
<td>21.837</td>
</tr>
<tr>
<td>ASA Reuse stuff</td>
<td>0.013</td>
</tr>
<tr>
<td>Process CSCBLOC=</td>
<td>0.002</td>
</tr>
<tr>
<td>RACF SAF</td>
<td>0.004</td>
</tr>
<tr>
<td>Create CSA</td>
<td>0.020</td>
</tr>
<tr>
<td>ENF</td>
<td>0.007</td>
</tr>
<tr>
<td>RTM - SDUMP, ABDUMP, ESTAE</td>
<td>0.002</td>
</tr>
</tbody>
</table>
**How to automatically create an IPL Statistics Report**

- **Sample report created with the IPLSTATZ utility (cont.):**

<table>
<thead>
<tr>
<th>Module</th>
<th>Time</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IEAVNP09</td>
<td>0.003</td>
<td>Build ASVT</td>
</tr>
<tr>
<td>IEAVNPD8</td>
<td>3.656</td>
<td>RSM - Frame queues, VRREGN= and RSU=</td>
</tr>
<tr>
<td>IEAVNP10</td>
<td>33.031</td>
<td>SRM - OPT=, IPS=, etc.</td>
</tr>
<tr>
<td>IEAVNPD1</td>
<td>0.032</td>
<td>ABDUMP</td>
</tr>
<tr>
<td>IEAVNPD2</td>
<td>0.019</td>
<td>SDUMP</td>
</tr>
<tr>
<td>IEAVNPCX</td>
<td>0.002</td>
<td>Context services, registration services</td>
</tr>
<tr>
<td>IEAVNPX1</td>
<td>0.002</td>
<td>NIP cleanup</td>
</tr>
<tr>
<td>IEAVNPF5</td>
<td>0.051</td>
<td>PCAUTH</td>
</tr>
<tr>
<td>IEAVNPF8</td>
<td>0.032</td>
<td>RASP</td>
</tr>
<tr>
<td>IEAVNP1F</td>
<td>0.076</td>
<td>SRM - I/O measurement blocks</td>
</tr>
<tr>
<td>IEAVNPC2</td>
<td>0.017</td>
<td>IOS - Move CDT to SQA</td>
</tr>
<tr>
<td>IEAVNP51</td>
<td>0.038</td>
<td>TRACE</td>
</tr>
<tr>
<td>IEAVNP20</td>
<td>2.198</td>
<td>Process CLOCK=</td>
</tr>
<tr>
<td>IEAVNP21</td>
<td>0.484</td>
<td>TOD clock</td>
</tr>
<tr>
<td>IEAVNP57</td>
<td>0.014</td>
<td>SDUMP</td>
</tr>
<tr>
<td>IEAVNPF9</td>
<td>31.598</td>
<td>XCF</td>
</tr>
<tr>
<td>IEAVNP33</td>
<td>12.009</td>
<td>GRS</td>
</tr>
<tr>
<td>IEAVNPED</td>
<td>0.027</td>
<td>PROD</td>
</tr>
<tr>
<td>IEAVNP26</td>
<td>7.928</td>
<td>SMS</td>
</tr>
<tr>
<td>IEAVNPES</td>
<td>4.943</td>
<td>LNKLST</td>
</tr>
<tr>
<td>IEAVNPD5</td>
<td>0.470</td>
<td>Load pageable device support modules</td>
</tr>
</tbody>
</table>
How to automatically create an IPL Statistics Report

- **Sample report created with the IPLSTATZ utility (cont.):**

<table>
<thead>
<tr>
<th>Command</th>
<th>Time</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IEAVNP09</td>
<td>0.003</td>
<td>Build ASVT</td>
</tr>
<tr>
<td>IEAVNP88</td>
<td>0.160</td>
<td>Allocation move EDT II</td>
</tr>
<tr>
<td>IEAVNPA1</td>
<td>274.898</td>
<td>CONSOLE</td>
</tr>
<tr>
<td>IEAVNPDC</td>
<td>0.524</td>
<td>WLM</td>
</tr>
<tr>
<td>IEAVNP16</td>
<td>3.646</td>
<td>EXCP appendages</td>
</tr>
<tr>
<td>IEAVNP13</td>
<td>0.078</td>
<td>Prepare NIP/MSI interface</td>
</tr>
<tr>
<td>IEAVNP17</td>
<td>0.003</td>
<td>GTF Monitor Call interface</td>
</tr>
<tr>
<td>IEAVNPG8</td>
<td>0.005</td>
<td>VSM defined monitor call enablement</td>
</tr>
<tr>
<td>IEAVNP18</td>
<td>69.774</td>
<td>PARMLIB Scan Routine interface</td>
</tr>
<tr>
<td>IEAVNPF2</td>
<td>0.091</td>
<td>Process IOS=</td>
</tr>
<tr>
<td>IEAVNP15</td>
<td>0.815</td>
<td>Process VATLST</td>
</tr>
<tr>
<td>IEAVNPRR</td>
<td>0.002</td>
<td>RRS</td>
</tr>
<tr>
<td>IEAVNPOE</td>
<td>0.405</td>
<td>USS</td>
</tr>
<tr>
<td>IEAVNPSC</td>
<td>0.007</td>
<td>Metal C RTL</td>
</tr>
<tr>
<td>IEAVNPLE</td>
<td>59.583</td>
<td>System LE RIM</td>
</tr>
<tr>
<td>IEAVNPNUN</td>
<td>0.320</td>
<td>Unicode</td>
</tr>
<tr>
<td>IEAVNPXL</td>
<td>0.053</td>
<td>zXML Parser</td>
</tr>
<tr>
<td>IEAVNPCI</td>
<td>0.002</td>
<td>IQP</td>
</tr>
<tr>
<td>IEAVNPDD</td>
<td>0.002</td>
<td>DDM</td>
</tr>
<tr>
<td>IEAVNP1B</td>
<td>0.102</td>
<td>Close catalog</td>
</tr>
<tr>
<td>IEAVNIPX</td>
<td>0.001</td>
<td>NIP final cleanup</td>
</tr>
</tbody>
</table>

**574.339** TOTAL NIP TIME (seconds)
How to automatically create an IPL Statistics Report

- Sample report created with the IPLSTATZ utility (cont.):

  **** IEEVIPL Statistics ****
  IEETRACE    0.002   Master trace
  ISNMSI      0.768   SPI
  UCMPECBM    0.548   CONSOLE address space
  ENFPC005    0.000   CONSOLE ready ENF
  IEFSCCHIN   0.208   IEFSCHAS address space
  IEFJSINT    0.002   Subsystem interface
  IEFJSJLOD   0.021   JESCT
  IAZINIT     0.035   JESXCF address space
  IAZFSII     0.006   FSI trace
  IEFQBINT    0.024   SWA manager
  IEFAB4I0    0.113   ALLOCAS address space
  **IEEVIPL** 1.727   TOTAL TIME. Uncaptured time: 0.000
How to automatically create an IPL Statistics Report

- Sample report created with the IPLSTATZ utility (cont.):

```
IPLST003I MSI started at:  2011/03/26  7:36:50.088
IPLST400I **** IEEMB860 Statistics ****
IPLST401I ILRTMRLG      0.180   ASM
IPLST401I IECVIOSI     35.865   IOS dynamic pathing
IPLST401I ATBINSYS      0.017   APPC
IPLST401I IKJEFXSR      0.153   TSO
IPLST401I IXGBLF00      0.016   Logger
IPLST401I HWIAMIN1      0.021   BCPii
IPLST401I COMMNDXX      0.142   COMMANDxx processing
IPLST401I SMFWAIT      2.656   SMF
IPLST401I SECPROD      3.914   Security server
IPLST401I IEFJSIN2     14.911   SSN= subsystem
IPLST401I IEFHB4I2      0.009   ALLOCAS - UCB scan
IPLST401I CSRINIT      0.004   Windowing (DIV) services
IPLST401I FINSHMSI      0.000   Wait for attached CMDs
IPLST004I MSI ended at:  2011/03/26  7:37:48.109
IPLST004I MSI ended at:  2011/03/26  7:37:48.109
IPLST402I IEEMB860     58.021   TOTAL TIME. Uncaptured time:      0.133
IPLST009I IPL completed (TCP/IP up) at:  2011/03/26  7:44:08.813
IPLST999I 634.217   TOTAL TIME (seconds) IPL+NIP+VIPL+MB860
IPLST999I 1028.468   ELAPSE TIME (seconds) to TCP/IP up
```
How to automatically create an IPL Statistics Report

**Implementation:**

1. Download iplstats.zip from the USS Tools and Toys web site to your workstation:
   - [http://www-03.ibm.com/systems/z/os/zos/features/unix/bpxa1ty2.html](http://www-03.ibm.com/systems/z/os/zos/features/unix/bpxa1ty2.html)

2. Unzip iplstats.zip

3. Binary transfer IPLSTATZ.OBJ to a PDS or PDSE library with RECFM=FB and LRECL=80

4. Link-edit (bind) IPLSTATZ into a (LNKLST) load library

5. Create a started task procedure named IPLSTATZ and store it in a procedure library, e.g. SYS1.PROCLIB:

   ```
   //IPLSTATZ PROC
   //******************************************************************************
   // * REF: SYS1.PROCLIB(IPLSTATZ). *
   // * DOC: CREATE AN IPL STATISTICS REPORT AND WRITE IT TO *
   // *      SYSLOG/OPERLOG USING WTO MESSAGES. *
   //******************************************************************************
   //IEFPROC EXEC PGM=IPLSTATZ,REGION=0M,TIME=NOLIMIT
   ```

   - Note: add `//STEPLIB DD DSN=...` if IPLSTATZ has not been placed into a LNKLST library

6. Add the following statement to the COMMND00 parmlib member:

   ```
   COM='S IPLSTATZ'
   ```
Where to read more

- z/Architecture Principles of Operations”, SA22-7832
- ABCs of z/OS System Programming Volume 1, SG24-6981
- z/OS Planned Outage Avoidance Checklist, SG24-7328
- System z Mean Time to Recovery Best Practices, SG24-7816
### Terms and Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASM</td>
<td>Auxiliary Storage Manager</td>
</tr>
<tr>
<td>ENF</td>
<td>Event Notification Facility</td>
</tr>
<tr>
<td>IOCP</td>
<td>I/O Configuration Program</td>
</tr>
<tr>
<td>IOS</td>
<td>Input/Output Supervisor</td>
</tr>
<tr>
<td>IRIM</td>
<td>IPL Resource Initialization Module</td>
</tr>
<tr>
<td>MCH</td>
<td>Machine Check Handler</td>
</tr>
<tr>
<td>MIH</td>
<td>Missing Interrupt Handler</td>
</tr>
<tr>
<td>NIP</td>
<td>Nucleus Initialization Phase</td>
</tr>
<tr>
<td>RIM</td>
<td>Resource Initialization Module</td>
</tr>
<tr>
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The End...