

z/VM Startup and Shutdown Best Practices

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Topics

- Describe best practices for starting and shutting down your z/VM system
 - Things to check before IPL
 - Starting (IPLing) your system
 - After IPL
 - Validating system resources
 - Starting servers and guests
 - Shutting down
 - Guests
 - z/VM system

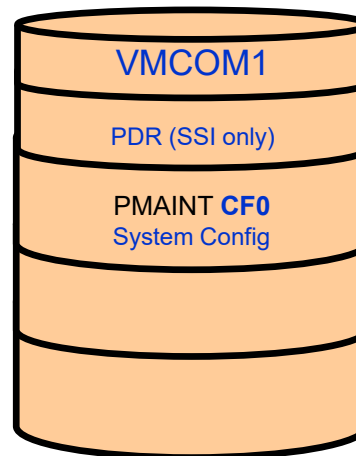
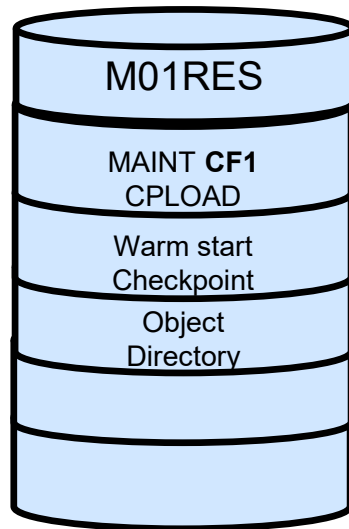
IBM Solutions to Help Manage and Protect Your z/VM System(s)

- Security and User Management
 - RACF Security Server for z/VM
 - Directory Maintenance Facility for z/VM (DirMaint)
- Automation and operational monitoring
 - Operations Manager for z/VM
 - Programmable Operator Facility (PROP)
- Performance monitoring
 - OMEGAMON XE for z/VM and Linux
 - Performance Toolkit for z/VM
- Backup and recovery
 - Backup and Restore Manager for z/VM
 - Tape Manager for z/VM
 - Spectrum Protect (aka Tivoli Storage Manager)

Before Starting Your System

Verify Required Disks

- *IPL volume*
 - Where the loader program (SAPL) is
- *"RES" volume*
 - Contains minidisk (CF1 parm disk) where the CP MODULE is
 - Warmstart and checkpoint areas (CP-formatted)
 - Object directory
- *Default IPL/RES volume:*
- *CF0 Parm disk*
 - Where the system configuration file is
- *Default CF0 Parm disk:*



- *Other system and CP-Owned volumes*
 - Page
 - Spool
 - Guest and user data

Verify I/O Configuration

- Helpful tool: **IBM I/O Exerciser for IBM Z (ESAIO)**
 - ESAIO MODULE on MAINT CF1 parm disk
- Helps identify cabling or definition errors
 - Validates all paths to every device that the LPAR has access to
- Can be run standalone in LPAR (with SAPL) or on a running z/VM system
- See *z/VM System Operation* (chapter 3) for details

```

System Check Out Tool
- NUMBER OF I/O DEVICE SUBCHANNELS: 0119C6 (HEX) - HIGHEST SCH#: 034BDD
- NUMBER OF *RESERVED* SUBCHANNELS: 017158 (HEX) - HIGHEST SCH#: 03FFFE
- NUMBER OF TYPE-1 CFG SUBCHANNELS: 000001 (HEX) - HIGHEST SCH#: 01FF00
- NUMBER OF TYPE-2 MSG SUBCHANNELS: 0000C4 (HEX) - HIGHEST SCH#: 014552
- NUMBER OF TYPE-3 ADM SUBCHANNELS: 000000 (HEX) - HIGHEST SCH#: 000000
- EXTENDED TEST (CABLING & DASD READ_VOLID) STARTED... 16:14:25
* CHP=90 DEV= 0510 ERROR ON CMD=E4 CTRL=4407 STAT=0000 (PATH INOP) 16:14:26
* CHP=95 DEV= 0510 ERROR ON CMD=E4 CTRL=4407 STAT=0000 (PATH INOP) 16:14:26
* CHP=90 DEV= 0511 ERROR ON CMD=E4 CTRL=4407 STAT=0000 (PATH INOP) 16:14:26
* CHP=95 DEV= 0511 ERROR ON CMD=E4 CTRL=4407 STAT=0000 (PATH INOP) 16:14:26
* CHP=90 DEV= 0512 ERROR ON CMD=E4 CTRL=4407 STAT=0000 (PATH INOP) 16:14:26
* CHP=95 DEV= 0512 ERROR ON CMD=E4 CTRL=4407 STAT=0000 (PATH INOP) 16:14:26
* CHP=90 DEV= 0513 ERROR ON CMD=E4 CTRL=4407 STAT=0000 (PATH INOP) 16:14:27
* CHP=95 DEV= 0513 ERROR ON CMD=E4 CTRL=4407 STAT=0000 (PATH INOP) 16:14:27
* CHP=B8 DEV= 1500 ERROR ON CMD=E4 CTRL=4407 STAT=0000 (PATH INOP) 16:14:36
* CHP=85 DEV= 1500 ERROR ON CMD=E4 CTRL=4407 STAT=0000 (PATH INOP) 16:14:36
* CHP=B8 DEV= 1501 ERROR ON CMD=E4 CTRL=4407 STAT=0000 (PATH INOP) 16:14:36
* CHP=85 DEV= 1501 ERROR ON CMD=E4 CTRL=4407 STAT=0000 (PATH INOP) 16:14:36
* CHP=B8 DEV= 1502 ERROR ON CMD=E4 CTRL=4407 STAT=0000 (PATH INOP) 16:14:36
* CHP=85 DEV= 1502 ERROR ON CMD=E4 CTRL=4407 STAT=0000 (PATH INOP) 16:14:36
* CHP=B8 DEV= 1510 ERROR ON CMD=E4 CTRL=4407 STAT=0000 (PATH INOP) 16:14:36
- SELECTING DEVICE= 1510. PLEASE WAIT... 16:14:36
# SCREEN FULL... PRESS ENTER, OR TYPE (DEL) FOR AUTO WRAP MODE ==>

```

Define IPL Environment and Parameters

- Do you want to set the CP system environment variable (**CP.IPLPARMS.IPLVAR**)?
 - For example:
 - *Production vs. Test vs. DR*
 - *"Normal" startup vs. System Maintenance/Service*
 - Can be used by automation to determine actions based on system environment/use

- Do you need to display the **SAPL** menu to verify or change default characteristics for this IPL?
 - IPL Parameters
 - Which system configuration file to use
 - Which parm disk to use
 - Which CP module to load
 - System/operator's console
 - Value of the CP system environment variable (CP.IPLPARMS.IPLVAR)
 - etc.

Single System Image (SSI) Activation

- Do you plan to add a new member to your SSI cluster?
 1. Update the I/O configuration to add CTC pairs to the new and existing LPARs.
 2. Update system config file with **ACTIVATE ISLINK** statements for the new member.
 - existing members -> new member
 - new member -> existing members
 3. Activate and IPL the new member.
 4. Issue **ACTIVATE ISLINK** commands on the existing members to connect to the new member

- Do you need to reinitialize the PDR?
 - All members must be down

Specify Location of System/Operator Console

- Operating System Messages Panel of HMC
 - LOADPARAM **CONSSYSC**
 - **CONS=SYSC** IPL parameter
 - **SYSTEM_CONSOLE** on OPERATOR_CONSOLES config statement

- Integrated 3270 Console
 - LOADPARAM **CONSSYSG**
 - **CONS=SYSG** IPL parameter
 - **SYSTEM_3270** on OPERATOR_CONSOLES config statement

- Device specified by address on OPERATOR_CONSOLES statement

- Selected system console becomes the primary system operator when OPERATOR virtual machine is logged on during IPL

Designate Ownership of CP-owned Volumes?

- Ownership information may be specified for CP-owned volumes
 - Prevents a system from writing CP data on a volume owned by another system

- Ownership definition is mandatory in an SSI cluster, optional otherwise

- Specified with **OWNER** operand of CPFMTXA
 - Owing system name
 - Name of the SSI cluster if system is an SSI member
 - **NOSSI** if not an SSI member

```
q cpowned
Slot  Vol-ID  Rdev  Type  Status  SSIOwner  SysOwner
  1  -----  ----  ----  Reserved  -----  -----
  2  JFEFE0  EFE0  Own   Online and attached  -----  -----
  .
  8  J1E000  E000  Own   Online and attached  JFSSIA  JFSSIA1
  .
 12  J2E000  E002  Share Online and attached  JFSSIA  JFSSIA2
  .
 16  J3E000  E003  Share Online and attached  JFSSIA  JFSSIA3
  .
 20  J4E000  E004  Share Online and attached  JFSSIA  JFSSIA4
```

Specify Real Device Addresses for CP-owned Volumes?

- An optional RDEV address may be specified on **CP_OWNED** statements

```
CP_Owned Slot      8  J1E000      RDEV E000
```

- Ensures that the correct volume is attached when there might be multiple DASD defined with the same void
 - Eliminates the need to set these devices OFFLINE_AT_IPL and attach them later.

Network Definitions

- Define Inter-VSwitch Links (IVLs) in system configuration file
 - Must be defined before any global VSwitches

 - Verify that it is operational and its Uplink port is ready before defining global VSwitches

- Define other VSwitches dynamically after IPL

- Can use automation to define and verify

Where to put Automation?

- Locations:
 - AUTOLOG1 profile
 - AUTOLOG2 profile
 - Server virtual machine's profile
 - User Directory through COMMAND statements
 - Operations Manager for z/VM

- Think about prerequisites

- Thoroughly document

System Config File Considerations

- Whenever the system config file is changed, keep several previous versions on the same disk as backup
 - Easier recovery if changes cause a problem
 - Use a naming convention such as -1SYSTEM, -2SYSTEM, etc.

- Run **CPSYNTAX** after every config file change to prevent errors during IPL

- System Config file controls for errors
 - TOLERATE_CONFIG_ERRORS YES (or NO)
 - If NO and there are errors, Operator is prompted to:
 - Stop IPL
 - Continue IPL normally
 - Continue IPL, but do not autolog any virtual machines

Starting Your z/VM System

Stand Alone Program Loader (SAPL)

- "What you really IPL"
- **Loads and starts z/VM**
 - Can also load and start standalone utilities
- Default SAPL is created during z/VM installation
 - Can rebuild and customize using SALIPL utility
- Menu can optionally be displayed when IPLing z/VM
 - Specify/change IPL attributes and IPL parameters
- To display the SAPL menu during IPL
 - Specify a load parameter with the address of a 3270 console
 - Load parameter **SYSG** will cause SAPL to be displayed on integrated 3270 console
- See *z/VM System Operations* (Chapter 2) for more information

Loading and Starting z/VM with SAPL

```
STAND ALONE PROGRAM LOADER: z/VM VERSION 6 RELEASE 4.0
```

```
DEVICE NUMBER: 018B MINIDISK OFFSET: 35 EXTENT: -
```

```
MODULE NAME: CPLOAD LOAD ORIGIN: 2000
```

```
-----IPL PARAMETERS-----
```

```
cons=0080 iplvar=PRODUCTION fn=MYPROD
```

```
-----COMMENTS-----
```

```
-----
```

```
9= FILELIST 10= LOAD 11= TOGGLE EXTENT/OFFSET
```

Migrating z/VM from z13 or earlier to an IBM z15 or z14/etc.

- The Stand Alone Program Loader (SAPL) must be rewritten with the z/VM 6.4 or newer SALIPL utility
 - Otherwise you will not be able to IPL
 - Look for current release number in upper right corner of SAPL
- Upgrade Installation does not rewrite SAPL
 - Must be done manually
- See red alert <http://www.vm.ibm.com/service/redalert/index.html#SAPLZ14>

```
STAND ALONE PROGRAM LOADER: z/VM VERSION 6 RELEASE 4.0  
DEVICE NUMBER: 018B MINIDISK OFFSET: 35 EXTENT: -  
MODULE NAME: CPLOAD LOAD ORIGIN: 2000
```

- Other stand alone utilities also need to be updated in order to IPL on z14 or later
 - Standalone Dump, DDR, etc.

How Do You IPL?

- Monitoring/responding to messages and prompts
- Automated/not monitored

- Type of IPL
 - Can automate type of IPL on the FEATURES statement in system configuration file ...
 - **AUTO_WARM_IPL** (preferred) or **AUTO_FORCE_IPL**
 - **AUTO_IPL type**

- ... or reply to prompt

```
Start ((Warm|Force|COLD|CLEAN) (DRain) (DIsable) (NODIRect)
      (NOAUTOlog)) or (SHUTDOWN)
```

- Can also disable autolog or terminate IPL (shutdown) in case of errors

IPL Issues

- Watch for errors during IPL
 - Errors in IPL parameter processing
 - Errors in configuration file processing
 - CP-owned volumes that are offline
 - Could result in loss of data (spool files, saved systems, and saved segments)
 - Warmstart or checkpoint errors
 - Might prompt to change to FORCE start
 - Could also result in loss of data

- Decide whether to
 - Stop IPL to fix any errors
 - Continue/complete IPL and attempt to fix them dynamically

- Some errors will result in a wait state

After IPL: Validation, Servers, and Guests

Information About Current IPL

- What caused the system to IPL?
 - System ("normal") IPL
 - SHUTDOWN REIPL
 - Restart from abend or PSW RESTART

- QUERY CPLOAD provides information about the most recent IPL

```
Module CPLOAD was loaded from minidisk on volume IPLDSK at cylinder 0.  
Parm disk on volume IPLDSK, cylinders 0 through 79.  
Last start was a system IPL.
```

ESM and Service Machines

- Make sure ESM is started before any other service machines
 - Change AUTOLOG1 userid's PROFILE EXEC to autolog **only** RACFVM
 - Move everything else in AUTOLOG1's PROFILE to AUTOLOG2
 - RACF will autolog AUTOLOG2 after it is initialized

- AUTOLOG2: start service machines for system operation and monitoring, including:
 1. Operations Manager, PROP
 - Start these first so they can monitor other service machines (consoles, etc.)
 - Use to verify service machines and manage dependencies among them
 2. DirMaint
 3. MONITOR service, Performance Toolkit, OMEGAMON XE
 4. VSwitch Controllers (DTCVSW1, DTCVSW2, DTCVSW3, DTCVSW4)
 5. z/VM TCP/IP
 6. etc.

Networks and Connections

- Create a "networking script" to set up network definitions and verification in AUTOLOG2
 1. If you have an IVL, verify that it is operational and its Uplink port is ready
`SET VSWITCH IVL IVLPORT PING ALL`
 2. Define additional VSwitches and verify that they are operational
e.g. `DEFINE VSWITCH name GLOBAL ETHERNET GROUP group`
- Virtual networks must be operational before starting the guests that use them
 - Recommend automation to defer guest startup
 - Or add polling logic to AUTOLOG2 that delays dependent guests until Global VSwitch is up.

System Resources

- Use QUERY commands to verify:
 - Available processors
 - Real memory amount and configuration
 - Page and spool volumes and available space
 - Dedicated devices for virtual networks are defined and online

- Make sure data is being collected in event of a system failure
 - Console files for Operator and key service virtual machines
 - Retrieve and save regularly to avoid filling spool
 - CP dumps are enabled
 - Make sure enough dump space is allocated on spool volumes

- *Use automation to verify and monitor the above*
 - Define usage thresholds and limits that result in notifications and/or automated actions

Starting Guests

- Start database servers before application servers that are dependent on the database
 - Validate that servers are ready

- "Pace" guest startups to minimize contention for system resources
 - Depends on workloads and guest requirements
 - CPU
 - Memory
 - Network connections and communication

- Verify each group of guests have completed startup before starting next group

- Pacing and verification can be intelligent or simple
 - Automation/verification with system management tools
 - Groups in CMS names file
 - CP SLEEP

Verifying and Changing Guest Resources

- **CP FOR** command can be used to issue commands on a virtual server or guest
- Helpful for querying and/or dynamically changing guest resources
- Response is sent to **CP FOR** issuer

```
cp for lxs00001 cmd cp q v nic
LXS00001 : Adapter 0100.P00 Type: QDIO      Name: UNASSIGNED  Devices: 3
LXS00001 :   MAC: 02-2E-40-00-04-BA      LAN: * None
LXS00001 : HCPFOR069I Command Complete.  CP return code = 0000.
```

Choosing Startup Actions

Why Did We IPL?

- "Normal"
 - Start system servers, applications, networks, etc.
 - Start regular guest workload

- System maintenance
 - Update system resources, configuration, etc.
 - Possibly start system servers and applications
 - Do not start regular guest workload

- Apply service
 - CP (requires system IPL)
 - Other components
 - Do not start system servers and regular guest workload

Choose Startup Actions Based on Reason for IPL

- Define CP environment variables to indicate:
 - Normal IPL and system startup
 - IPL to apply service or do other maintenance
 - Do not start services or regular workload

- Use these environment variables
 - **CP.IPLPARMS.IPLVAR**
 - (CP variable defined as an IPL parameter)
 - **CURRENT.IPLVAR**
 - Define and initialize in system config file
 - `SET VARIABLE SYSTEM CURRENT.IPLVAR INITIAL`

 - Can be changed to allow additional or different actions

Choose Startup Actions Based on Reason for IPL – Example (1 of 3)

- Assumes ESM (RACF) will always be started
- Possible values for **CP.IPLPARMS.IPLVAR**
 - *null* - normal IPL
 - 'NORMAL' – normal IPL
 - 'NOWORKLOAD' – service/maintenance IPL
- In AUTOLOG2's PROFILE EXEC:
 - If **CURRENT.IPLVAR** has its initial value, change it according to **CP.IPLPARMS.IPLVAR**

```

/*****
/* If CURRENT.IPLVAR contains its initial setting from          */
/* system config, set it based on CP.IPLPARMS.IPLVAR           */
/*****

Parse value diag(8,'QUERY VARIABLE SYSTEM NAME CURRENT.IPLVAR') ,
                with curr_iplvar '15'x

If curr_iplvar = "INITIAL" Then Do
  Parse value diag(8,'QUERY VARIABLE SYSTEM NAME CP.IPLPARMS.IPLVAR') ,
                with iplvar '15'x
  If iplvar <> '' Then
    'CP SET VARIABLE SYSTEM CURRENT.IPLVAR' iplvar
  Else
    'CP SET VARIABLE SYSTEM CURRENT.IPLVAR NORMAL'
End

```


Choose Startup Actions Based on Reason for IPL – Example (2 of 3)

- In AUTOLOG2's PROFILE EXEC (continued):

- Check updated **CURRENT.IPLVAR** to determine which actions to take

```

/*****/
/* Determine actions from new value of CURRENT.IPLVAR */
/*****/

Parse value diag(8,'QUERY VARIABLE SYSTEM NAME CURRENT.IPLVAR') ,
                with curr_iplvar '15'x

```

- If "**NOWORKLOAD**"

1. Exit without starting servers or guests

```

/*****/
/* If IPL'd for maintenance, exit without starting workload */
/*****/

If curr_iplvar = 'NOWORKLOAD' Then Do
    Say 'IPLed for service, no servers or workload started'
    Exit
End

```

2. Do maintenance
3. Update **CURRENT.IPLVAR** setting
`SET VARIABLE SYSTEM CURRENT.IPLVAR NORMAL`
4. Restart PROFILE EXEC

Choose Startup Actions Based on Reason for IPL – Example (3 of 3)

- In AUTOLOG2's PROFILE EXEC (continued):
 - If "**NORMAL**", start servers, applications, and guest workload

```
/******  
/* If normal IPL, start regular workload */  
/******  
If curr_iplvar = 'NORMAL' Then  
    Say 'All is well - starting normal workload'  
  
/***** Start servers, applications, and guest workload *****/
```

Choose Startup Actions Based on Available CP Function

- **CP.FUNCTION.xxx** system environment variables introduced in z/VM 7.2 (with VM66439/UM35761)
 - A variable will be defined for every new function that is part of the CP nucleus
 - Starting with z/VM 7.2 New Function APARs
 - Variables can be checked to determine
 - Startup actions based on specific functions
 - Application actions during normal operation

- **QUERY VARIABLE** command

- Determine which CP functions are available

```
pipe CP QUERY VARIABLE | strfind /SYSTEM CP.FUNCTION./ | console
SYSTEM CP.FUNCTION.DASD.HYPERPAV_1_END 1
SYSTEM CP.FUNCTION.QUERY.DEVICES 1
```

```
query variable
```

```
SYSTEM CP.FUNCTION.DASD.HYPERPAV_1_END 1
SYSTEM CP.FUNCTION.QUERY.DEVICES 1
```

- Check for a specific CP function (null string returned for an undefined variable)

```
query variable system cp.function.query.devices
1
```

- Full list of variable names, values, and descriptions at <https://www.vm.ibm.com/newfunction/varlist.html>

Shutting Down

Shutting Down Guest(s)

- Define order of guest shutdowns
 - Application servers before database servers
 - Shut down monitoring service machines last
 - Can be used to automate guest shutdowns

- Orderly shutdown of guests
 - Maintain data integrity
 - Avoid dirty file system on Linux guests

Shutting Down Guest(s)

- Guests that are enabled to receive a shutdown signal will receive a "termination" signal when
 - System is shutting down
 - **FORCE** command is issued to log the guest off
 - **SIGNAL SHUTDOWN** command is sent to the guest

- Guests that receive signals will have a designated amount of time to shutdown
 - SHUTDOWNTIME interval for the system
 - Interval or time of day designated when the signal is sent

- SHUTTRAP tool in VM Download Library
 - Detect a SHUTDOWN signal from CP and optionally execute a CMS command when such a signal is received.

Shutting Down Your z/VM System

- Define the amount of time reserved for shutdown
 - For signaled guests
 - For CP

- System configuration file

```
Set ,  
Signal ShutdownTime 500,  
ShutdownTime 30 /* amount of time reserved for z/VM shutdown
```

- **SET SIGNAL** and **SET SHUTDOWNTIME** commands
- **ShutdownTime** is used when CP SHUTDOWN command is issued or the LPAR is deactivated

Summary

- "Best practices" will help startup and shutdown of your z/VM systems and workload go smoothly

- Specific steps will be different for every system
 - Company policies
 - System capacity and workloads

- Using documented steps and procedures makes it easier when
 - Applying service or upgrading your system
 - Transferring processes to someone else

- Using tools to monitor and automate startup and shutdown processes is recommended
 - Detect completion of one process and start the next
 - Problem detection and notification or remedy