z/VM System Configuration
Let's Talk About all the Choices

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Agenda

- Basic rules on configuring CP
- SYSTEM CONFIG rules and overall guidelines
- System identifiers
- Devices statement
- Features statement
- Commands and Privilege classes
- Operators
- Syntax checking
- IPL Parameters

z/VM System Configuration

- There are 2 primary files that configure CP
  - SYSTEM CONFIG
    - An IPL parm (discussed later) can read a file with a different name
  - LOGO CONFIG
    - This file is read automatically if there is no Logo_Config statement
  - These files reside on a PARM disk

- These CONFIG files are only read when you IPL the system
  - Dynamic system changes are made via CP commands
  - Logo configuration changes using the CP REFRESH command

- The User Directory configures virtual machines
  - It is read often by the system and can be dynamically updated

What are the defaults?

- Some defaults are in the old assembler configuration files (do you remember these?)
  - HCPSYS, HCPRIO, HCPBOX
  - They still exist and can still be customized, but it is not recommended
  - Any changes require the High Level Assembler and for you to rebuild CP
- Can you IPL CP without a SYSTEM CONFIG file?
  - No. CP requires:
    - CP_Owned statement to define the residence volume
    - System_Residence statement to define warm start and checkpoint areas
    - Operator_Consoles statement to find a console (or an IPL override)
- For defaults on each setting – you must read the documentation!
  - I'll cover several of the statements and defaults

Configuration file rules

- General rules
  - Fixed or variable length file
  - Rexx style comments (start with “/*”, end with “*/”, can span lines)
  - Rexx style continuation (comma at the end of the line)
  - Blank lines are ignored – they do not affect continuation
  - Case does not matter. Lines are uppercased except what is quoted
    - Feel free to make your configuration file readable. Please!

- Order of statements and duplicates
  - Order, for most statements, does not matter
    - The System Identifier is referenced in other statements, so usually this is early in the file.
  - Duplicates - for most statements, the last one wins. Some are combined.
    - But, there are statements that can only appear once, such as the SSI statement

Using multiple files

- The Imbed statement can imbed another file that is on the same disk
  - **Imbed *fn ft***
    - Where *fn* or *ft* can be “=” to use the file name or type of the source file
  - Special *fn* or *ft* of “-SYSTEM-” is replaced with the system identifier

- Imbedded files can also contain Imbed statements
  - No limit(!) but you can’t create a circular imbed.

- This can help you create common configurations for your multiple LPARs
  - Some people make extensive use of this

Setting the system identifier

- It can be set by CPU model and serial number, or LPAR name

```
System_Identifier 2965 02BC957 ZVM01
System_Identifier LPAR VM01 ZVM01
```

- Wildcard characters are allowed

```
System_Identifier LPAR VM* ZVM01
```

- A default can be specified if no statement matches

```
System_Identifier_Default ZVMV6R40
```

- These do the same thing using wildcards

```
System_Identifier * * ZVMV6R40
System_Identifier LPAR * ZVMV6R40
```

- You can also set it to match the LPAR name

```
System_Identifier LPAR ZVM* &LPARNAME
System_Identifier LPAR * &LPARNAME
```

- If multiple statements match, the last one sets the identifier.

SSI requirements

- SSI systems share a common CONFIG file for all members
  - Not a technical requirement, but recommended by IBM
- The correct system identifier must be set for each member
  - Using System_Identifier_Default is not recommended
- SSI systems also require:
  - SSI statement to declare the PDR volume and slot number of each member
    - Only 1 SSI statement is allowed and all member's SSI statements must match!
  - ISLINK statements to define ISLinks (CTC) to all other members
  - A statement to enable the SSI feature
- Because SSI systems use the System_Identifier in several places, associating the correct one with the LPAR is very important.

Qualified records

- Lines and blocks of lines can be qualified by system name
  - These must follow System_Identifier statements, of course!
  - You are familiar with these if you have an SSI cluster
- Multiple qualifiers are allowed on a single statement; wildcards are allowed.
    - Wildcard rules are like CMS: “%” for single character, “*” for multiple
      - Example: `LINUXVM1: LINUXVM2: LINUXVM3:  Multithreading Enable`
      - Or: `LINUXVM*:  Multithreading Enable`
- Several systems can be Equated to a new name
      - `Equate LINUXSYS  LINUXVM1 LINUXVM2 LINUXVM3 TESTSYS%`
      - `LINUXSYS:  VMlan Limit Transient 0`

Qualifying blocks of statements

- Begin and End qualify groups of statements
  - System Qualifier required on Begin, optional on End
  - No nesting, and no qualifiers allowed on statements in the block
  - If an error with Begin and End is found during IPL, hard wait code 1689!
    - Make sure you have syntax checked your file.
  - End is required in the same file as the Begin

- Example

```
LINUXVM1:  Begin
 CP_Owned  Slot 1  M01RES
End
```

Creative uses of the System Identifier

- You are allowed to redefine the System Identifier throughout your file

- I've used this to set up systems that may run on many LPARs
  - Note: This example is non-SSI. SSI may add a bit more complexity.
  - First, I set the identifier based on the LPAR name.
    - `System_Identifer LPAR * &LPARNAME`
      - Or more specific: `System_Identifier LPAR ZVM01 ZVM01`
  - Qualify statements based on the various LPAR environments
    - Operator consoles, MAC prefix, machine features like Multithreading
  - Then set the "real" system name
    - `System_Identifier LPAR ZVM01 BRUCETST`

The sample config, from installation

- The SYSTEM CONFIG from a fresh install gets you started
  - It doesn't have examples of everything you may need
    - I hope this presentation will tell you more
    - z/VM 6.4 has added more default and example statements!
  - It includes statements that just re-state the default.
    - For example, the Priv_Classes statement

```
Priv_Classes   ,
  Operator      A ,
  IOCP_Read     CE ,
  IOCP_Write    C ,
  HW_Service    F ,
  User_Default G
```

    - All of these are the default

Sample config, continued

- You may think some statements just show the defaults, but they may not
  - System_Userids statement in the sample

```
System_Userids   ,
  Operator  OPERATOR  ,
  Account   DISKACNT  ,
  Dump      OPERATNS  ,
  Erep      EREP
```

  - The actual defaults

```
System_Userids   ,
  Operator  OPERATOR  Disconnect,
  Account   OPERACCT  ,
  Dump      OPERATNS  ,
  Erep      OPEREREP  ,
  Startup   AUTOLOG1  ,
  Symptom   OPERSYMP
```

  - I don’t know why the default user ids don’t match conventional use

Devices statement

- The sample statement shows the defaults
  - CP accepts and senses all devices. It initializes all devices it can identify
    - Devices that cannot be sensed need an RDEV statement also
    - Note: This assumes there is no IODF statement in the config file
- Devices statement can be specified more than once
  - Basically, multiple Devices statements are merged together
  - If the same parameter is specified again for the same device, last one wins
- References to “Online” and “Initialized” mean the same thing
  - `Online_at_IPL` and `Initialized_at_IPL` are synonyms
  - Also `Offline_at_IPL` and `Notinitialized_at_IPL`

Devices statement, continued

- "New" parameter **Sensed_but_Offline**
  - Better than "Offline_at_IPL" because this does not sense a non-initialized device
    - A query shows "DASD 1000 OFFLINE" instead of "DEV 1000 OFFLINE"
    - You also see it when you issue QUERY DASD OFFLINE

- The parameter **NotAccepted** means no real device block is built
  - Harder to dynamically bring the device online later on

- Specifying DASD as "Shared" is required if the devices are shared
  - SSI clusters set this automatically for shared disks in the cluster
  - It must be set for some other uses, such as a shared RACF database
  - The RDEV statement can also set this mode; also CP SET SHARED

Devices statement, continued

- Other parameters which are used less often
  - **Assign_at_IPL**
    - Automatically assign a tape drive
  - **Dynamic_I/O**
    - (Default) allow dynamic I/O changes, must also be allowed via the Features statement
  - **SCmeasured**
    - (Default) collect subchannel measurement data
  - **Throttled**
    - Limit the rate of I/O to the devices

- The converse of all these is also valid with NOT or NO
  - NOassign_at_IPL, NOTdynamic_I/O, NOTscmeasured, NOTthrottled

Other I/O device statements

- **System_Alias *rdev-rdev***
  - Automatically attaches HyperPAV alias devices to the system
    - This must be done to use alias devices for guests and paging!
  - You should have **`System_Alias 0000-FFFF`**
    - Addresses that are not alias devices are ignored
  - The **CU** statement and CP SET CU command allow you to define a share (entitlement) for CP's usage of alias devices for minidisks and paging (6.4)
    - You can make sure alias devices are available for paging or minidisks when there is high demand for these devices.

The Features statement

- A lot of parameters on this statement
  - *Automatic IPL*
  - *Disconnect time*
  - *Maximum users*
  - *Showing Passwords*
  - *Retrieve settings*
  - *Virtual disk*
  - And, of course, *Enable* or *Disable* of CP features
- The sample from the install (6.4) shows default values with a few overrides
  - A lot more of the most often used keywords are now in the sample for a new install.
    - It shows the system defaults. Having the keywords makes them easy to update.
  - Such as: **Disconnect_Timeout 15**
    - This is the default minutes before automatic logoff after a forced disconnect
    - Change this to specify "**Disconnect_Timeout Off**" by overtyping the '15' with 'Off'
  - These sample settings are different from the default:
    - Retrieve 20 commands with a user maximum setting of 255. The default is 7 for each.
    - Vdisk user limit is set to 140000 blocks, the default is none (zero.)

The Features statement, continued

- Enable and Disable of features
  - There are 22 items that can be enabled (most are disabled by default)
    - The 2 that are enabled by default are:
      - ***New_Devices_Initialized_When_Added*** and ***IPL_Messages***
    - New releases and other enhancements have added to the list.
  - The 6.4 install sample lists "New_Devices…" enabled and 5 others disabled.
    - It is easy to just move a line from the Disabled list to the Enabled list.
  - Some you would never enable unless you are developing code.
    - Such as **CPchecking**, **XRC_Test**, **Cross_System_Timeouts**
  - Enabling others is a very good idea and you'll certainly need one or more.
    - Usability of the system, security, or are required for the system environment.

Features Statement – what to enable?

- My suggestions to list under Enable:
  - **Auto_Warm_IPL** - You can always override with IPL parm PROMPT
  - **Clear_Tdisk** - Your security policy probably requires it
  - **STP_Timezone** - If you have z/OS, it is probably enabled in the LPAR
  - **Validate_Shutdown** - Prevent accidental system shutdowns!
  - **Paging_Alias** & **Paging_HPF** - Enable new enhanced DASD paging (6.4)
- Optional
  - **PCI** - If you are using PCI features, it is required
  - **Set_Devices** - Dynamically change the Devices list
  - **Set_Dynamic_IO** - If you may have to enable dynamic I/O

Features statement

- Others to know about
  - **Logmsg_From_File** - Show a system logon message
  - **Prompt_After_Restart** - Sometimes enabled for a short time
  - **Prompt_After_Shutdown_RelPL**
  - **Set_Privclass** - Useful for testing, auditors may not like it!
  - **STP_Timestamping** - Required if you must timestamp I/Os
    - **XRC_Optional** goes along with this
  - **Throttle_All** - I doubt you'd want to enable this one!

Other Features statement keywords

- Automatic IPL statements
  - **Auto_IPL**
  - **Auto_IPL_After_Restart**
  - **Auto_IPL_After_Shutdown_ReIPL**
    - These all accept as parameters the usual IPL prompt keywords
      - WARM, FORCE, COLD, CLEAN
        - » Optionally NOENABLE, DRAIN, NOAUTOLOG, NODIRECT
    - These can be useful for test systems
    - I set up second level systems with "**Auto_IPL Force**" so they come up unattended
- **Passwords_on_Cmds**
  - Are you allowed to include the password on CP commands? They may be visible in logs if you are allowed.
    - Separate settings for LOGON, (X)AUTOLOG, and LINK commands. Defaults are NO.
  - 6.4 does not include this keyword in the sample Features statement, so the default is used.
    - **Note!** Previous releases included the keyword in the sample and changed the setting to YES.

Features Statement

- VDisk limits
  - The default system limit is calculated based on your storage size
  - The default user limit is zero
  - Both can be changed dynamically with the SET VDISK command
  - “Infinite” is a valid setting, meaning there is no limit
- Maxusers
  - Can be from 1 to 99999
  - Dynamic changes via the SET MAXUSERS command
  - Users with OPTION IGNMAXU can always log on

The SET statement

- This is where you set the time allowed to shut down guests
  - **`Set Shutdowntime 30`**
  - **`Set Signal Shutdowntime 0`**
  - Both values can be set or changed later with CP commands

  – These statements showing the default values are included in the sample config file in 6.4.
- The Shutdowntime is the time reserved for CP to complete its shut down
  - The 30 second default should be plenty except for very large systems
  - If WITHIN is specified on the SHUTDOWN command:
    - The system time is subtracted from the WITHIN time to give the guest shutdown time
    - The same is true for a hardware deactivation, which is 300 seconds
- The **Signal Shutdowntime** is the default time allowed for guests (ignored if WITHIN specified)
  - The total **system shutdown** time is the sum of both intervals (system and signal time)
- The SET statement can also set CP environment variables during system IPL (new in 6.4)
  - **`Set Variable System variable_name string`**
  - The value can be retrieved with CP QUERY VARIABLE and changed with CP SET VARIABLE

Other enabling and setup statements

- **Crypto APVirtual AP *a* Domain *d***
  - This is a somewhat new statement, to reserve shared crypto domains
  - It is recommended if you are using Crypto with Linux
    - Without this statement, crypto statements in the user directory determine the usage
    - CP will assign shared domains in the order specified. Multiple statements are allowed.
    - CP only uses 1 crypto type for sharing (accelerator or co-processor)
    - A range of AP numbers and Domain numbers are allowed

- **Enforce_by_Volid** *ON* or *OFF*
  - Requires you to specify the volume id (label) for Attach or Dedicate
    - If your DASD pool is available to many systems, this may avoid mistakes!

Other setup

- **Multithreading** *Enable* or *Disable*
  - Required to use multithreading on IFLs on z13 and z13s. Disabled by default
  - You can enable it (at IPL time) with any number of threads (1, 2, or Max)
  - On 6.4, you can dynamically change the number of threads if SMT is enabled
    - Suggested statement: **`Multithreading Enable Type IFL 1`**
- **SRM** statement
  - Lets you set some SET SRM values at IPL time
    - Such as CPU Polarization mode to Horizontal or
    - DSPWDMethod (Dispatcher Work Distribution Method) to Rebalance or
    - ExcessUse (how you want to use unentitled capacity)
  - Normally, the defaults are what you want (and to enable you to use multithreading)
    - But – if you're one of those "special systems" that need a different setting..

Privilege classes of CP commands

- What are they?
  - CP commands have 1 or more privilege classes assigned to them by IBM
  - This is the IBMCLASS. IBM defines classes A-G and reserves class H
  - The system supports 32 privilege classes. A-Z and 0-6
  - CP commands may also be class “Any”; available to all users, like LOGOFF
  - G is the general “unprivileged” user class. Other classes are privileged
- You can freely modify the class(es) assigned to a command
    - or to a subcommand of a QUERY or SET command
  - Create new classes for users or servers with only the commands and diagnoses needed for the task
    - Usually known as “least privilege” – Give no more privilege than needed

Modifying CP Commands

- **Modify Command *command* IBMclass *x* Privclasses *classes***
- This allows you to modify the privilege classes of a command
  - You specify the command and the IBM assigned privilege class
  - You may completely change the classes or just add to the IBM assigned ones
  - If there is a duplicate statement, only the first one is used

- Other command modifications
  - Create an alias to an existing CP command
    - **Define Alias *alias* For *command* Abbrevlength *nn***
  - Disable a CP command
    - **Disable Command *command***
  - These commands also work with Query and Set subcommands

Storage statement

- CP calculates many allocations based on the LPAR memory size
- The **Storage** statement lets you override those calculations
  - Some options you may need when using PCIe functions:
    - IOAT – a storage subpool. See the documentation on what to specify
    - LOCKING – Issue messages when size of lock requests exceed usage percentages
  - SCMBK – Subchannel measurement blocks
    - More space available for adding new I/O devices
  - EDEVICE – emulated FBA devices on FCP channels
    - Sets the reserved memory pool for expected EDEVs that will be added
  - AGELIST – List size and **Earlywrites** and **Keepslot** Yes (the default) or No
  - Others sizes you can specify:
    - CP trace area and Reserved pages maximum

Real Devices

- This is the **RDEVICE** statement, and **CU** statement for DASD
- The CU statement allows you to restrict PAV by control unit
  - The default is to enable the highest (best) level of support

- Rdevice allows you to specify these things for devices
  - Define devices that are not sensed
  - Additional characteristics such as shared DASD, minidisk cache, or spooling
  - For unsupported devices, the device class (DASD, printer, tape, etc.)
  - EQID (equivalency ID) is required for some devices in an SSI cluster
    - OSA ports, Hipersockets, FCP channels, and channel to channel devices
    - It is required so that guest relocations can occur for guests using these devices
    - EQID is allowed on all Rdevice statements, but these are the ones that need it

Speaking of real device numbers..

- Did you know you can now specify them for system disks?
  - **CP_Owned Slot *nnn volid* RDEV *rdev***
    - The RDEV operand is optional
  - **User_Volume_RDEV *volid* RDEV *rdev***
    - This is a new statement, used instead of the other User_Volume statements
    - Each statement only defines 1 volume, no wildcards
    - Maybe a good use for an imbedded file.

- This avoids any “duplicate volser” problems at IPL!
  - If you share DASD with many systems, be sure to think about this
  - If users (meaning Linux admins) have the ability to write labels, you really want to use this.

Operators and Operator consoles

- CP requires a console to log on the OPERATOR at IPL time
  - Otherwise it loads a disabled wait PSW with code x‘1010’
- The **Operator_Consoles** statement specifies a list of addresses of locally attached 3270 displays to choose from
  - The HMC 3270 function is specified as “System_3270”
  - The HMC operating system messages panel is “System_Console”
  - The device addresses are OSA-ICC defined devices
  - CP searches for a working device in the order specified
- The IPL parameter “CONS=” overrides this statement
- Tip:
  - Placing “System_Console” at the end of the list ensures your system will always be able to IPL.

Emergency message consoles

- The statement is **Emergency_Message_Consoles**
- This is where CP will send shutdown, abend, and dump messages
- Same syntax as **Operator_Consoles** except “System_3270” not allowed
- Not required – the default is the Operator_Consoles list
  - But only the consoles that are operational at IPL time
  - An address on the IPL parm CONS= is added to the list
  - The “System_Console” is always included
- Limits: 100 devices can be specified.
  - Note that you can have up to 500 Operator_Consoles.

Who is the System Operator?

- The "**`System_Userids Operator`** *user*" is the system operator at IPL
  - Even if that user does not exist in the directory!
  - This is the first user logged on to the system
- What if that user logs off?
  - A user id on the **Alternate_Operators** statement is made the system operator
    - If the user is logged on and has the required privilege class
    - Otherwise, the system has no system operator (QUERY SYSOPER)
  - The system operator will be designated when one of these occur:
    - The default OPERATOR logs on
    - Any user with the required operator privilege class logs on (like MAINT640 or MAINT)
    - The SET SYSOPER command successfully sets a new operator

The Journaling statement

- Lock out logon or CP LINK after invalid attempts
  - Attempts are also written as accounting records
  - Messages about attempts can be sent to the Operator or another user
- Only really useful if you don't have an ESM, such as RACF
  - ESM controls logon attempts and automatic disable of logon
  - No link passwords when using an ESM, so no need to lock out link
- Facility is off by default.
  - CP commands to enable and disable are also off by default

New features in z/VM 6.4

- APAR VM65925 enhances VSWITCH authorization
  - New features are enabled with Directory Network Authorization (DNA)
    - Enabled in SYSTEM CONFIG
      - VMLAN DNA ENABLE
      - It is enabled by default when this APAR is installed.
    - By CP command
      - SET VMLAN DNA ENABLE
  - The APAR should be available in August

Syntax check

- The CPSYNTAX utility checks the syntax of your file
  - Always run it after an update! It is found on MAINT 193.
  - Incorrect statements, bad syntax, unknown keywords
  - It does not check every statement for duplicate operands or interactions with other statements
  - It is a good check, but no guarantee it will find all problems an IPL would find
- If you use qualified statements and multiple identifiers:
  - Run it for each LPAR and/or CPU specification you have
  - The options are:
    - **CPUID *model serial***
    - **LPAR *lparname***
    - **SYSTEM *sysname***
  - Wildcards and multiple options are allowed

Configuration Statement Errors During IPL?

- Some can cause a hard wait. Hopefully you ran a syntax check!
  - Invalid statements are ignored.
    - If that is your only “Features” statement, well…
- **Tolerate_Config_Errors** *Yes* or *No*
    - First one must be “No”; the default is “Yes”
    - This can be specified multiple times turning it on and off
  - Marks sections of the file where errors are not tolerated.
  - If errors are found in these sections:
    - All errors are collected and shown on the Operator console
    - The Operator is prompted to do one of the following:
      - Stop the IPL
      - Continue with a normal IPL
      - Continue but don’t autolog any users (NOAUTOLOG)

IPL Parameters for CP

- These are specified in the IPLPARMS area of the stand alone loader
  - They can also be set with SET IPLPARMS for a SHUTDOWN REIPL
- The valid parameters are documented in *z/VM System Operation*
  - CONS=*addr* or CON=*addr*
    - Override the Operator_Consoles statement and use this console address
  - FN=*filename* and FT=*filetype*
    - The system configuration file. Default is SYSTEM CONFIG
  - PDNUM=*n*, PDOFF=*offset*, PDVOL=*raddr*
    - Where to find the parm disk for SYSTEM CONFIG. Which parm disk or cylinder location
  - PROMPT
    - Prompt for startup, even if Auto_Warm_IPL or Auto_IPL is specified
    - Only valid on the stand alone loader screen. Can be changed on the Features statement
  - IPLVAR=*text*
    - Sets the value of the CP.IPLPARMS.IPLVAR environment variable. Length can be 1-233 characters, A-Z, 0-9, "_" and ".", no embedded blanks, and lower case folded to upper. (New in 6.4)

CP IPL parameters, continued

- Diagnostic parameters
  - NOEXITS, NOHCD
    - Don’t load any exits for this IPL, or ignore the IODF statement
  - CLEARPDR
    - CP will clear the PDR before using. Emergency use only and if no SSI members are active!
  - REPAIR
    - Used very carefully if no members of your SSI cluster will start.
      - It bypasses many SSI management functions, so no other members must be active!
    - Forces start-up parameters NOAUTOLOG and DISABLE (even non-SSI)
- STORE= parameter
  - Specifies the amount of memory CP will use, up to the LPAR amount
    - The SET STORAGE can be used to dynamically increase memory
    - Not needed for dynamic increases; usually just for testing
- PAGING63 to force 6.3 level of paging I/O on 6.4. Only use to migrate or resolve a problem.

Specifying IPL parameters

- Using the stand alone loader, enter a 3270 console addr as loadparm
  - Change or specify the parameters in the IPL PARAMETERS area
- Or, use these special loadparms:
  - **CONS*xxxx*** creates iplparm CONS=*xxxx*. HMC 3270 is device “SYSG”
  - **FN*xxxxxx*** creates iplparm FN=*xxxxxx*
  - **I*rrrrr*** or **I*rrrrr.p*** overrides the load device (*rrrrr*) or device and parm extent (*p*)
    - The first letter is I for IPL device.

- FN*xxxxxx* allows you to use conditional IPL parameters. An example:
  - Loadparm of `FNSITE2`, IPL parms: `FN:SITE1(PDVOL=1111)FN:SITE2(PDVOL=2222)`
  - IPL parms passed to CP: PDVOL=2222 FN=SITE2

What did you learn?

- There are probably more statements and parameters than you knew about!
  - Hopefully you now know more and will make use of some of them

- I didn't cover several statements
  - Many are ones you're used to working with
  - Many are covered elsewhere, such as vswitch statements
  - Some are for special situations, like loading new code and exits
  - Please give me feedback if there are ones I should have covered

The End

Thank you for listening!

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