Dynamically Managing Hardware
I/O Configuration Using VM

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Topics

• Benefits of Dynamic Configuration
• Elements of Dynamic I/O Configuration
• Dynamically Changing your I/O Configuration
  • HCD
  • Native VM commands
Dynamic I/O Configuration

- Modify the hardware I/O definitions (IOCDs) without an outage
  - Native VM CP commands
    - New with VM/ESA Version 2 Release 1.0 – GA October 1995
    - Commands based on hardware requirements
    - Add, change, delete CHPID, CNTLUNIT, IODEVICE
    - Modify the software view of I/O definitions
      - Reset I/O control blocks
        - Devices that do not support Sense commands
        - Clear control blocks of devices with errors
  - VM HCD and HCM
    - New with z/VM Version 4 Release 4.0 – GA August 2003
    - Manage I/O definitions for all LPARs on a processor
Comparisons Between Native VM Commands and HCD

- VM dynamic tightly linked to hardware requirements - only
  - HCD requires additional information
    - IODF information
    - Help prevent mistakes
  - z/OS HCD has additional restrictions for other subsystems - JES

- VM uses simple line commands
  - VM HCD uses HCM
  - z/OS HCD uses either:
    - ISPF panels (and multiple entries and confirmations)
    - HCM
    - Same HCM works for either

- VM commands permit all changes allowed by hardware
  - HCD imposes restrictions
    - Safeguards in HCD to help avoid mistakes but complicate some valid changes
Decision

- Choose how and where to manage I/O configuration
  - z/VM
    - VM Configuration - CP commands and IOCP
      - Knowledgeable users
      - Easier and Faster
    - z/VM HCD and HCM
      - New users of z/VM
      - More controlled
    - Considerations
      - Cannot mix HCD / HCM with native CP commands
      - For the duration of an IPL
      - One-time switch from HCD / HCM to native CP commands is possible
      - Return to HCD / HCM requires POR
  - z/OS is easier if the machine has z/OS LPARs or guests
    - z/VM can use the IODF generated by z/OS HCD
    - z/OS cannot use the IODF generated by z/VM HCD
Differences

• VM Configuration
  • Each machine has a unique IOCP source
  • Special devices coded in SYSTEM CONFIG
    • Older devices that don’t response to sense command
    • Devices that require additional configuration
      • e.g. Printers
      • Console information
  • Shared devices not identified
  • Special handling such as offline at IPL

• HCD and HCM
  • All machines in a single view
  • Common IODF has software view for all
  • Shared devices identified
  • Additional information
    • Switch information
Advantages of HCD

• Single point of control
  • Hardware and software definitions both maintained with HCD; activated with data stored in IODF

• Automatic lock-step approach
  • After successfully performing dynamic changes in the running system, the changes are applied to the prospective IOCDS, written to the Support Element to be available for the next POR

• Automatic backout and recovery capability
  • If an error is encountered anywhere in the process, all changes are backed out.

• Check consistency between hardware and software definitions
  • Guaranteed via unique tokens
Elements of Dynamic I/O Configuration

- SYSTEM CONFIG
  - CMS file on the PARM disk
  - Enable Dynamic I/O
  - Specify IODF if using HCD to manage hardware and software
- If not using HCD
  - I/O device definitions (software view of I/O)
  - Additional system-wide options
SYSTEM CONFIG

HCD

• IODF statement
  • IODFnn
    • Name of the IODF file to be used
    • Filetype must be PRODIODF
    • Must reside on PARM disk
  • osconfig
    Optional specification of VM I/O configuration in the IODF
  • SYSTEM_CONSole
    • Specifies that the Operating System Messages panel on the Hardware Management Console can serve as a system operator console.
    • Can only be used if osconfig specified
  • SYSTEM_3270
    • Specifies that the integrated 3270 console on the Hardware Management Console can serve as a system operator console.
    • Can only be used if osconfig specified
  • Specify only IODFnn to cause HCD management of only hardware I/O configuration
SYSTEM CONFIG
HCD

- Statements always ignored when IODF specified
  - Subsequent IODF statements (i.e. only the first IODF statement remains valid)
  - FEATURES DISABLE/ENABLE DYNAMIC_IO
  - FEATURES DISABLE/ENABLE SET_DYNAMIC_IO

- Statements ignored when an IODF statement with osconfig is specified
  - RDEVICE
  - DEVICES ACCEPTED/NOTACCEPTED
  - DEVICES DYNAMIC_I/O/NOTDYNAMIC_I/O
  - DEVICES OFFLINE_AT_IPL/ONLINE_AT_IPL
  - DEVICES SENSED/NOTSENSED
  - DEVICES SHARED/NOTSHARED
  - HOT_IO_RATE
  - OPERATOR_CONSOLES
  - EMERGENCY_MESSAGE_CONSOLES
  - FEATURES DISABLE/ENABLE SET_DEVICES
SYSTEM CONFIG
CP Commands

• Features section
  • Enable and Disable sections
    What functions can and cannot be used

• Recommended for Enable
  • Authorize users system-wide to use certain functions
    • SET_DYNamic_i/o, SET_DYNamic_io
      Allow turning Dynamic I/O on and off
    • SET_DEVices
      Allow changing the software view
  • Tell CP whether, and how, to activate certain system functions
    • NEW_DEVices_initialized_when_added
      How to handle hardware MCH interrupts

• Recommended for Disable
  • Disable Hardware I/O Changes
    • DYNamic_i/o, DYNamic_io
      Allow dynamic changes
    • Dynamic changes can be enabled with CP SET DYN ON when changes will be done
/***********************************************************/
/* Features Statement */
/***********************************************************/

Features,
Enable, /* Enable the following features */
SET_DEVices, /* Allow changing of devices bitmaps */
SET_DYNamic, /* Allow use of Set Dynamic On/Off Cmd */
NEW_DEVices_Initialized_When_added, /* Online at IO MCH */

...

Disable, /* Disable the following features */
DYNamic_I/O, /* Disable hdw i/o changes */
SYSTEM CONFIG
CP Commands

- I/O device definitions (software view of I/O)
  - Only necessary for devices which do not respond to sense ID
  - Alter default characteristics for specific devices
    - Printers
  - How to handle specific devices at initialization
  - Which devices to bring online at IPL time
  - How to handle hardware I/O interrupts

- Ignored if IODF is in use
SYSTEM CONFIG extract
CP Commands

/***************************************************************************/
/*    Special RDEV statements – things that cannot be sensed          */
/***************************************************************************/

Rdevice 0020-002D Type TELE2_ADAPTER
Rdevice 002E Type BSC_ADAPTER
Rdevice 002F-0030 Type TELE2_ADAPTER
Rdevice 0031-0038 Type BSC_ADAPTER
Rdevice 0039 Type TELE2_ADAPTER
Rdevice 003A-003F Type BSC_ADAPTER
Rdevice 06F0-06FF Type 3420 Model 8 Dual_Density Yes
Rdevice 0D0C Type IMPact_Printer Afp No

VMTEST: VMSOUTH: Rdevice 0700-076F Type Tape
VMTEST: VMSOUTH: Rdevice 0B00-0B40 Type Tape
VMTEST: VMSOUTH: Rdevice 10A0-10AF Type 3270_display
VMTEST: VMSOUTH: Rdevice 0EA0-0EBF Type Tape
VMTEST: VMSOUTH: Rdevice 0EA0-0EBF Type Tape
VMTEST: VMSOUTH: Rdevice 0C40-0C5F Type CTCA
SYSTEM CONFIG extract
CP Commands

VMB: VMTEST: Devices ,
  INITialized_at_ipl 0000-FFFF,
  NOTINITialized_at_ipl,
    A0C0-A0FF A1C0-A1FF A2C0-A2FF A3C0-A3FF, /* PAV */
    9000-9FFF,  /* RDC3 DS8100 */
    5000-5FFF,  /* FlashCopy targets */
  Online_at_IPL 0000-FFFF,
  Offline_at_IPL 0020-0030 0033-0035 0037-003F, /* EP devices */
    0D07 0D0B-0D0E 0D90-0D97, /* printers */
    0881 0891 0883, /* LMU - EDC-N */
    0892 0893, /* LMU - RESS */
    A0C0-A0FF A1C0-A1FF A2C0-A2FF A3C0-A3FF, /* PAV */
    9000-97FF 9801-9FFF, /* RDC3 DS8100 */
    5000-5FFF, /* RDC3 DS8100 FC targets */
  Sensed 0000-FFFF,
  NotSensed,
    A0C0-A0FF A1C0-A1FF A2C0-A2FF A3C0-A3FF, /* PAV */
    9000-97FF 9801-9FFF, /* RDC3 DS8100 */
    5000-5FFF, /* RDC3 DS8100 FC targets */
  NOTACCEPTED,
    A0C0-A0FF A1C0-A1FF A2C0-A2FF A3C0-A3FF, /* PAV */
    9000-97FF 9801-9FFF, /* RDC3 DS8100 */
    5000-5FFF /* RDC3 DS8100 FC targets */
Elements of Dynamic I/O Configuration

- Facilities for Enabling dynamic I/O configuration
  - Hardware
  - Software
- IOCP/IOCDS file
- Hardware and Software Functions and Commands
  - HCD and HCM
  - z/VM CP commands
    - Add/Modify/Delete Definitions
      - Channel Paths, Control Units, I/O Devices
    - Select or Change active IOCDS
Enabling Dynamic I/O on Hardware

- Supported on IBM processors since 9021 with VM/ESA Version 2 Release 1 (circa 1994)
- All models with a Hardware Management Console (HMC)
  - Customize Activation Profiles
  - Select your Processor profile
  - View the “Dynamic” 'tab'
  - Check the box for "Allow dynamic changes to the channel subsystem input/output (I/O) definition"
Enabling Dynamic I/O on Hardware

Note: This is a screen shot of the 2094 HMC panel.

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Enabling Dynamic I/O on Hardware

Note: This is a screen shot of the 2084 HMC panel.
Enabling Dynamic I/O on Hardware

- Allow **One** LPAR to Control I/O for Entire CEC
  - Choose which LPAR will “own” the configuration and make all changes from that LPAR
    - Hardware and software I/O configurations are synchronized using configuration tokens
    - VM LPARs can share tokens; z/OS and VM LPARs cannot

- All models with a Hardware Management Console (HMC)
  - Customize Activation Profiles
  - Select your LPAR profile
  - View the “Security” 'tab'
  - Check the box for "Input/output (I/O) configuration control"
Authorizing Dynamic I/O on Hardware; Allow One LPAR to Control I/O for Entire CEC
Enabling Dynamic I/O in Software

- **SYSTEM CONFIG – HCD**
  - IODF IODF xx [OSCONFIG SYSTEM_CONSole SYSTEM_3270]
    - Specify IODF information to z/VM CP

- **SYSTEM CONFIG – CP Commands**
  - Features, Enable,
    - DYNamic I/O, Allow hardware I/O changes
    - SET_DYNamic_io, Allow use of SET DYNamic ON/OFF command
    - SET_DEVices, Allow privileged users to reset CP’s view of real devices
    - NEW_DEVices_initialized_when_added
      - CP will create a real device control block (RDEV) when it receives an I/O machine check (IOMCK)
One Time Hardware Enablement

- Shutdown VM and all other systems on the processor
- POR (IML / Activate) the processor
  - Must be done once to activate an IOCDS with a VM TOKEN
  - Stand-Alone IOCP on all processors later than 9672 CMOS processors can write an IOCDS using a source file modified by the VM IOCP EXEC.
HCD File Relationship

- Work IODF
- HCD
- Production IODF
- HCD
- IOCDS

Figure 6: Relationship of Files Used by HCD

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HCD Challenges

• How to copy / import IODF from z/OS
  • Use z/OS HCD to EXPORT IODF and send to VM
    • IODF will be in the correct format to import to VM HCD

• How to successfully import IOCP source
  cbdsmigr iodf03 workiodf f machine1 iocp a i machine1 9672-x77 lpar
  • Requires significant modifications to IOCP source to provide information required by HCD
  • Tags not fully documented
IOCP / IOCDS Preparation

- **IOCP command syntax**

  IOCP iocpname ( DYN IxP WRTxx LPAR DESC1 SYS1 DESC2 IODF00
  
  - DYN indicates that the IOCDS will be written with a TOKEN that will be used after POR to prevent other LPARs from modifying the I/O configuration
  - IXP is used to cause IOCP to write an IOCDS for an non-EMIF processor
  - IZP is used to cause IOCP to write an IOCDS for an EMIF-capable processor
  - IYP is used to cause IOCP to write an IOCDS for a z900 or z800 processor
  - ICP is used to cause IOCP to write an IOCDS for a z990, z890 or z9 processor
  - LPAR indicates that the IOCP contains multiple LPARs
    - Omit for z9 and later or older machine running in basic mode
  - Include DESC1 and DESC2 if z/OS LPARs or guests will also be active
Safe Dynamic I/O

• Does not apply to HCD / HCM because HCD handles

• Dynamic I/O changes must be implemented in a careful process or you will not be able to activate a new IOCDS and all dynamic changes will be lost at a future machine POR.

• The designers call this a LOCKSTEP process.
  • Plug-and-Play mode available for the adventurous

• I recommend using an EXEC for all commands so that return codes can be checked and no further commands are executed.
Safe Dynamic I/O

- Update the IOCP source statements with proposed changes
- Run **IOCP EXEC** with NOWRT option to check syntax
  - Do not load or activate
- Issue CP commands to dynamically make changes
  - **NOTE**: If any command fails, keep track of what was completed. Either reverse the completed commands or fix the failed commands. Write either the old or a new IOCP to a new IOCDS and activate it.
- If commands complete successfully, run **IOCP EXEC** again with write option to create an IOCDS
- Issue **CP SET IOCDS_active** command to activate the new IOCDS
  - This will change the hardware pointer so that the new IOCDS is selected at a future POR.
Hardware Token

• z/VM Token

Query TOKEN CURrent
HCPCCO6816E Dynamic I/O changes are not allowed on this system
The current channel subsystem configuration token is:
VM-TOKEN 11/03/05 09:46:34 ....08/18/05 23:32:53

Query TOKEN [TARget]
HCPCCO6816E Dynamic I/O changes are not allowed on this system
The target channel subsystem configuration token is:
VM-TOKEN 11/03/05 09:46:34 ....08/18/05 23:32:53 PSYS IODF03

• z/OS Token

Query TOKEN [TARget]
HCPCCO6816E Dynamic I/O changes are not allowed on this system
The target channel subsystem configuration token is:
P4 ........d.................06-02-17 14:07:59 PSYS IODF05
Verify Dynamic is Enabled

- Verify that Dynamic I/O changes are allowed
  
  `Query DYN`
  
  Dynamic I/O changes are not allowed on this system

- Why?
  - Features Disable DYNamic_I/O is in my SYSTEM CONFIG
  - Enable it:
    `CP SET DYNamic ON`
    System is now enabled for dynamic I/O changes

- Verify that Dynamic I/O changes are allowed
  
  `Query DYN`
  
  Dynamic I/O changes are allowed on this system
IOCP Statements

- CHPID Statement

```
[symbol] CHPID
PATH=(chpid number[,chpid number]...)
TYPE={BL | BY | CBY | CVC | CNC | CTC | CFP | CFR | CFS | CBP | CBR | CBS | ICP | OSA | OSD | OSE | FCV | FC | FCP | IQD}
[SWITCH=number]
[PART= {{name0[,REC]|access list}l
    (access list)l
    ((access list)[,(candidate list)][,REC])}
[PARTITION= {{name0[,REC}]l
    (access list)l
    ((access list)[,(candidate list)][,REC])}
[NOTPART= {(access list)l
    ((access list)[,(candidate list)])}
[SHARED]
[CPATH=(chpid number[,chpid number]...)]
[OS=value]
[IOMULTER=name]
```
IOCP Statements

- CNTLUNIT Statement

```
[symbol]  CNTLUNIT  CUNUMBR=number
PATH=(chpid[,chpid]...)
[LINK=(link address[,link address]...)]
[CUADD=address]
[PROTOCOL=DIS|S4]
SHARED={YIN}
UNIT=type
UNITADD=((address[,number]...),...)
```
IOCP Statements

• IODEVICE Statement

```plaintext
[symbol]  IODEVICE
            ADDRESS=(address[,number])
            CUNUMBR=(number[,number]...)
            [MODEL=model]
            [{PART | PARTITION | NOTPART}=(name[,name]...)]
            [PATH=chpid]
            [TIMEOUT={YIN}]
            UNIT=device
            [UNITADD=address]
            [STADET={YIN}]
```
IOCP Statement Relationship

CHPID00  CHPID PATH=(00),TYPE=CNC
DASDCU01  CNTLUNIT CUNUMBR=0001,PATH=(00),UNIT=3390
DASD0001  IODEVICE ADDRESS=(1000,256),CUNUMBR=(0001),STADET=Y,UNIT=3390
Conclusions

• When z/OS is present, let z/OS maintain IOCDS and let z/VM sense hardware changes
• IOCP and Native VM commands simpler for experienced user
  • No safeguards
• New to z/VM † use HCD and HCM
  • Lack of examples
  • Limited customer exploitation
  • Complex processes
Questions?

VM Dynamic Examples
References

- HELP DYNIO
  - Change specific device handling after initialization
  - Change the definition of an existing CHPID
  - Change the definition of an existing control unit
  - Change the definition of one or more existing real devices
  - Change the IOCDS file used during the next POR
  - Define a new channel path identifier
  - Define a new control unit
  - Define one or more new real devices
  - Delete an existing channel path identifier
  - Delete an existing control unit
  - Delete one or more existing real devices
  - Enable or disable the ability to dynamically change the processor's I/O configuration
  - Turn configuration mode on or off
Bibliography

- Library bibliography HELP LIBRARY
- Pointer to VM publications from http://www.vm.ibm.com/library
- z/VM I/O Configuration V5R3 SC24-6100-02
- z/VM CP Messages and Codes V5R3 GC24-6119-04
- z/VM CP Planning and Administration V5R3 SC24-6083-04
- z/VM CP Commands and Utilities Reference V5R3 SC24-6081-04
Bibliography

- System z Input/Output Configuration Program User's Guide for ICP IOCP SB10-7037-07
- System z9 Business Class and Enterprise Class and eServer® zSeries 890 and 990 Input/Output Configuration Program User’s Guide for ICP IOCP SB10-7037-05 (Level 05a, September 2006)
- Hardware Management Console Operations Guide
  - You will need to get the correct manual for your CPU model and SEC.
Contact Information

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CP Commands

- **CP Query**
  - DYNamic_i/o or DYNamic_io [STATus]
    - Determine whether the dynamic changes are currently allowed
  - DYNamic_i/o or DYNamic_io STORage
    - Display how much storage is available for dynamic changes

- **CHPIDS**
  - Display the machines 256 possible channel paths and their physical status

- **CHPID yy**
  - Display the status of all devices defined on a specified channel path

- **PATHS [TO] rdev rdev1-rdev2**
  - Display all paths to a device or range of devices and the path status

- **TOKEN**
  - Display the Current or Target configuration token
CP Commands

- **CP SET**
  - DYNamic_i/o or DYNamic_io ON | OFF
    - Enable or disable CP's ability to make dynamic changes
  - CONFIGmode ON | OFF [RESET]
    - Place the processor in configuration mode
    - This can be done before doing a group of dynamic changes. However, individual command return codes cannot be captured.
    - The RESET option tells CP to enter or exit configuration mode even if there is a mismatch between the software and hardware view of the I/O configuration.
  - NEW_DEVices INITialize_when_added ON | OFF
    - Tells CP whether to initialize devices when I/O MCH is received.
  - IOCDS_active An | Bn
    - Change the IOCDS that the processor will use during the next POR
  - TOKEN
    - Update the configuration token description fields
CP Commands

- **CP VARY**
  - Online | OFFline CHPID nn [FORCE]
    - Enable or disable hardware paths to devices
  - ONline | OFFline PATH yy [TO|FROM] rdev|rdev1-rdev2|ALL
    - Enable or disable a logical path to devices
  - ONline|OFFline rdev|rdev1-rdev2
    - Enable or disable the device
  - ONline|OFFline SUBchannel rdev|rdev1-rdev2
    - Enable or disable one or more subchannels
    - This is required before deleting a device.
CP Commands

• CP DEFINE or CP DELETE
  • CHPID|PATH
    • Add/delete a channel path identifier (CHPID) to/from the configuration
  • CU|CNTLUNIT
    • Add/delete a control unit to/from the configuration
  • DEVICE|IODEVICE
    • Add/delete a device to/from the configuration

• CP MODIFY
  • CHPID|CU|DEVICE
    • Change some characteristic of an existing CHPID, CU or DEVICE