Dynamically Managing Hardware I/O Configuration Using VM

Rick Barlow
Nationwide Insurance
E-mail: Richard.Barlow@nationwide.com

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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
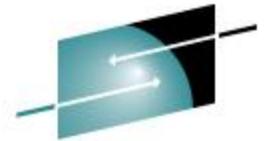
Dynamic I/O Configuration

- 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**
  - z/OS HCD must also meet z/OS requirements

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

- VM commands permit *all* changes allowed by hardware
  - HCD imposes restrictions
    - Safeguards in HCD to help avoid mistakes
    - Prevents 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 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
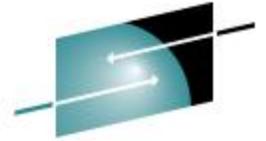
Differences

- ## 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
      - Printers
    - Console information
  - Shared devices not identified

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

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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
  - IODF*nn*
    - 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 IODF*nn* to cause HCD management of only hardware I/O configuration

```
►►─IODF──┬─IODF──nn─┬─────────────────────────────────────────►◄
         └─*────────┘ └─osconfig─┬──────────────┬─┬────────────┬─┘
                                 └─SYSTEM_CONSole─┘ └─SYSTEM_3270─┘
```

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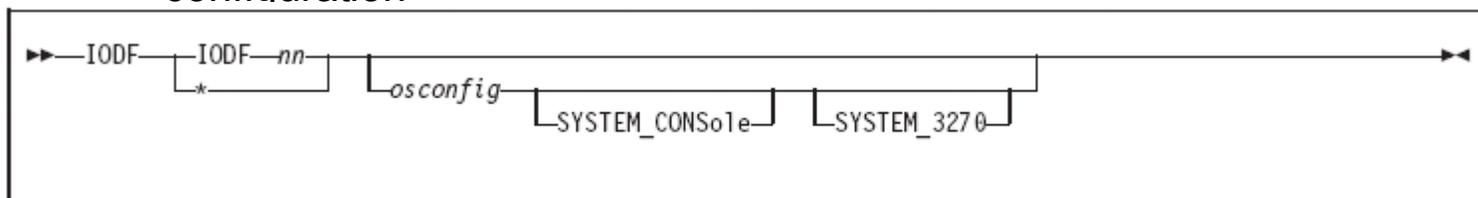
SYSTEM CONFIG
HCD

- 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
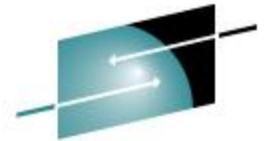
SYSTEM CONFIG extract
CP Commands

```
/***************************************************************/
/*                      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"
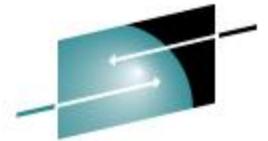
Enabling Dynamic I/O on Hardware
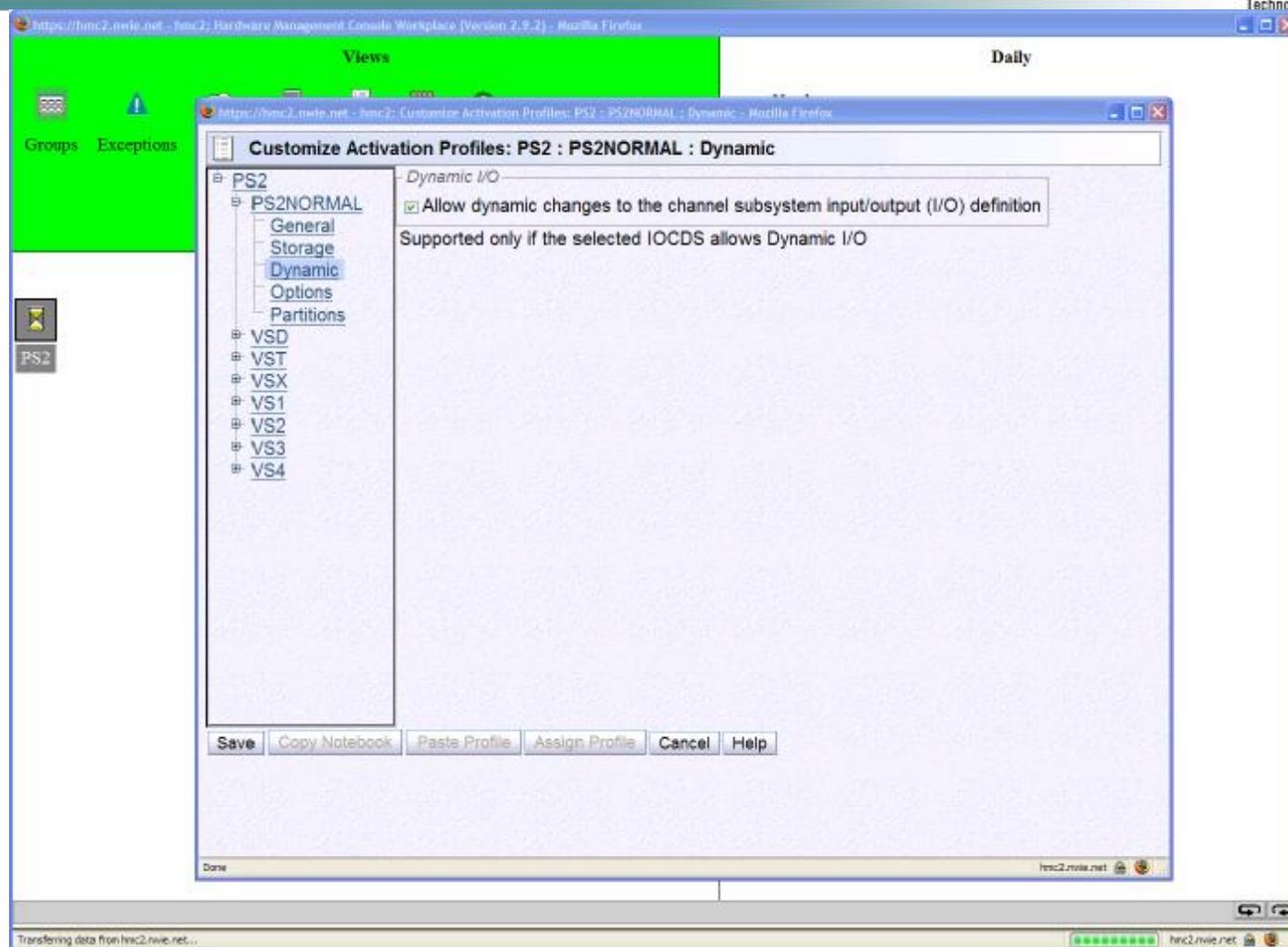

Note: This is a screen shot of the 2094 HMC panel.

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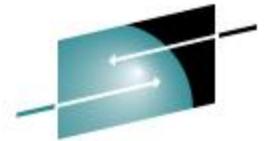
Enabling Dynamic I/O on Hardware
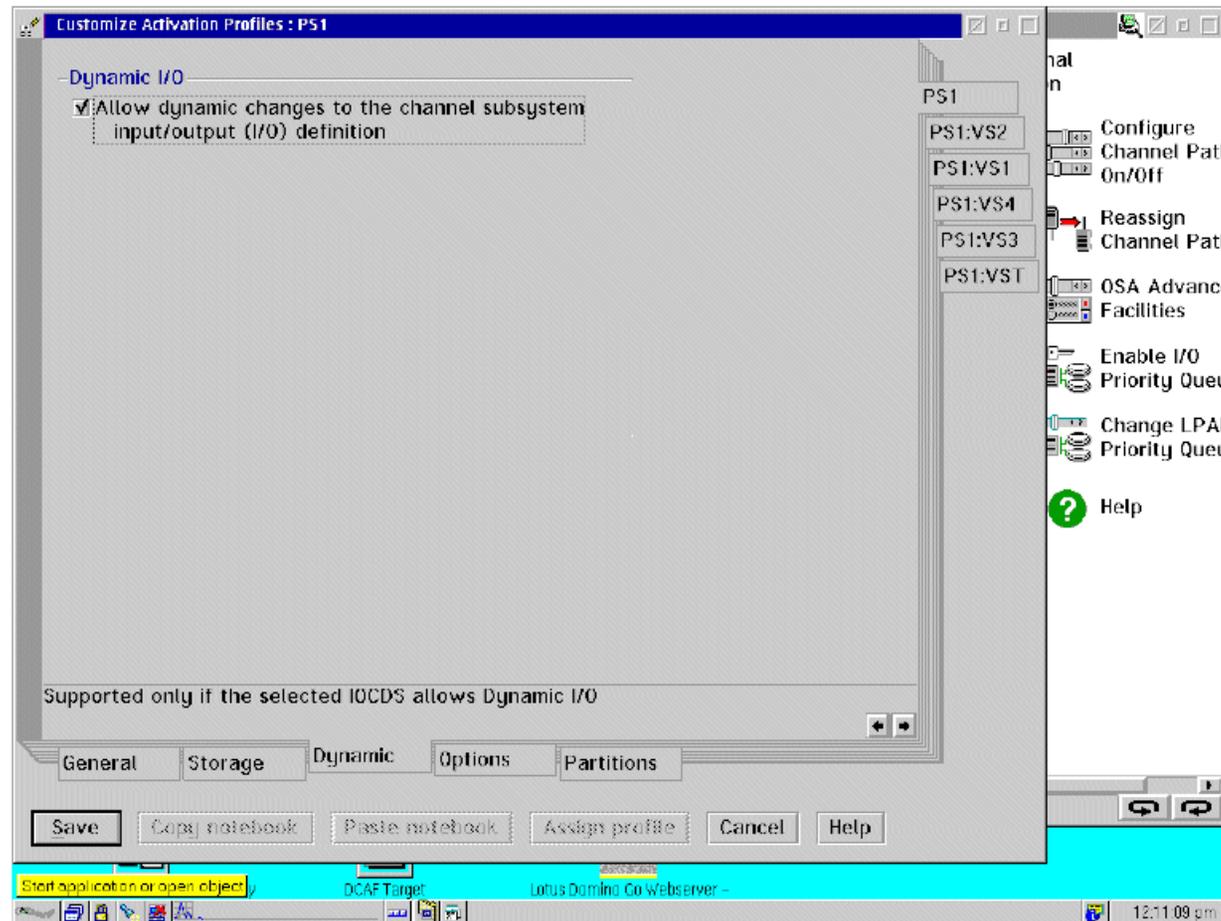
Note: This is a screen shot of the 2084 HMC panel.

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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"

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Authorizing Dynamic I/O on Hardware; Allow One LPAR to Control I/O for Entire CEC

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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)

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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.
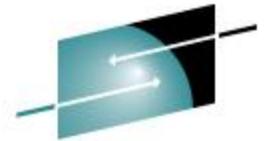
HCD File Relationship

- Work IODF

- HCD

- Production IODF

- HCD

- IOCDS
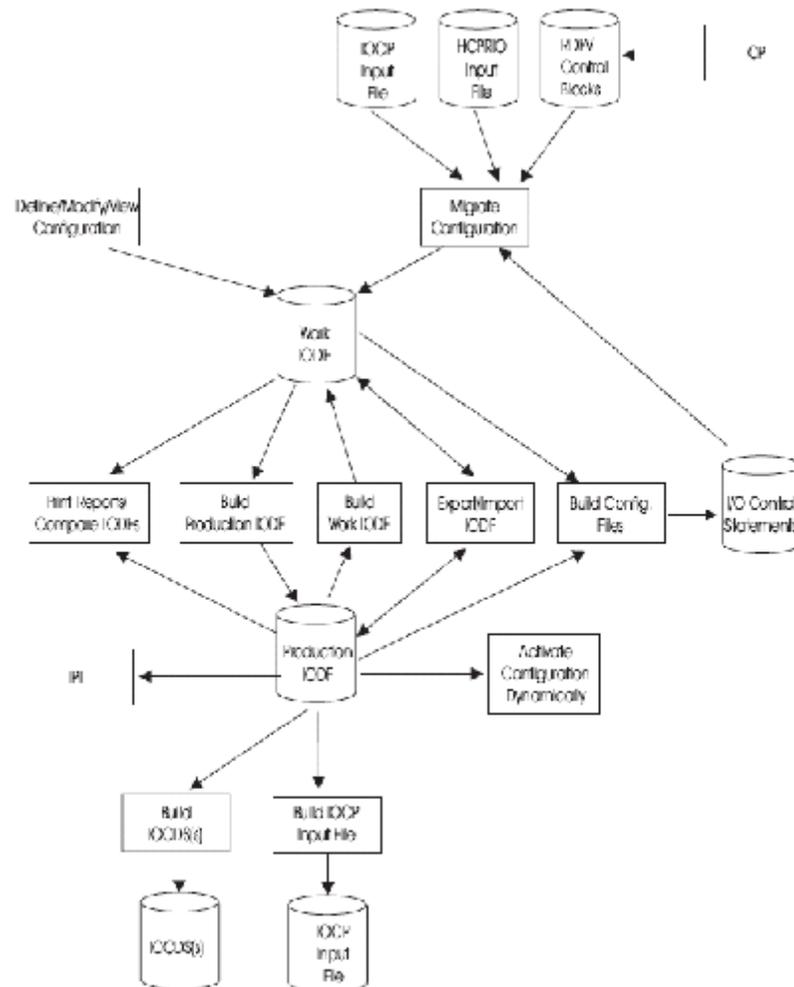
Figure 6. Relationship of Files Used by HCD

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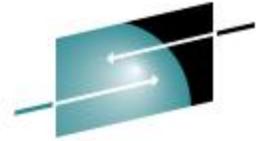
HCD Challenges

- 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.
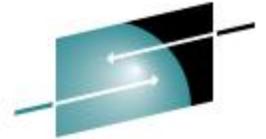
Hardware Token

- ## 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-TOKEN11/03/0509:46:34    ....08/18/0523:32:53
  ```

  Query TOKEN [TARget]
  ```
  HCPCCO6816E Dynamic I/O changes are not allowed on this system
  The target channel subsystem configuration token is:

  VM-TOKEN11/03/0509:46:34    ....08/18/0523:32:53PSYS    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...............06-02-1714:07:59PSYS    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
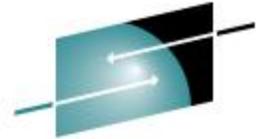
IOCP Statements

- 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={(name|0[,REC])|
                                   (access list)|
                                   ((access list)[,(candidate list)][,REC])}]
                            [PARTITION={(name|0[,REC])|
                                        (access list)|
                                        ((access list)[,(candidate list)][,REC])}]
                            [NOTPART={(access list)|
                                      ((access list)[,(candidate list)])}]
                            [SHARED]
                            [CPATH=(chpid number[,chpid number]...)]
                            [OS=value]
                            [IOCLUSTER=name]
```
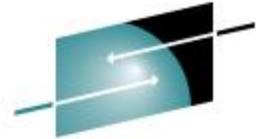
IOCP Statements

- CNTLUNIT Statement

```
[symbol]          CNTLUNIT          CUNUMBR=number
                                    PATH=(chpid[,chpid]...)
                                    [LINK=(link address[,link address]...)]
                                    [CUADD=address]
                                    [PROTOCL={D|S|S4}]
                                    SHARED={Y|N}
                                    UNIT=type
                                    UNITADD=((address[,number]),...)
```
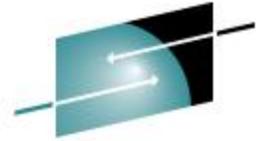
IOCP Statements

- IODEVICE Statement

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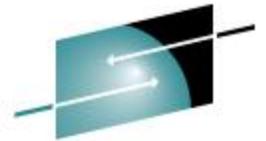
IOCP Statement Relationship

```
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
```
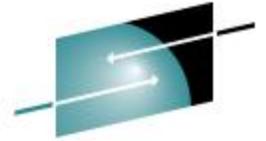
Conclusions

- 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 à use HCD and HCM
  - Lack of examples
  - Limited customer exploitation
  - Complex processes
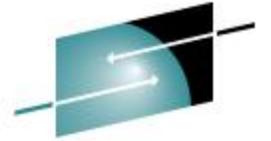
Questions?

VM Dynamic Examples
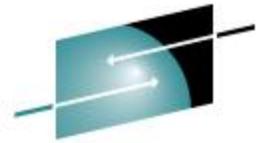
References

- **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
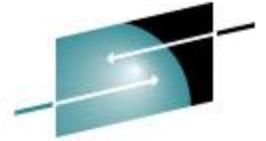
Bibliography

- System z9 Business Class and Enterprise Class and ERserver® 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

Rick Barlow

Systems Engineering Consultant

Phone: (614) 249-5213

Internet: Richard.Barlow@nationwide.com
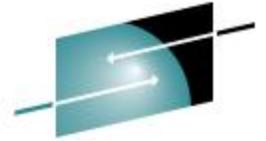
CP Commands

- 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
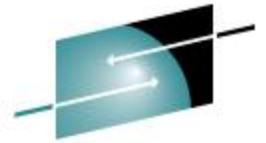
CP Commands

- 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
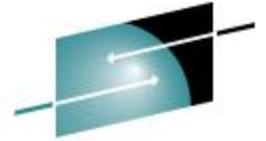
CP Commands

- 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.
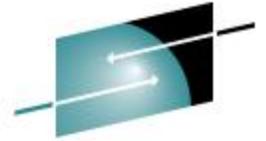
CP Commands

- ## 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