IBM z/OS HCD & HCM

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Migrating devices between subchannel sets

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Starting with z/OS V1R7, you can define Parallel Access Volume (PAV) alias devices (device types 3380A, 3390A) of the 2105, 2107 and 1750 DASD control units to subchannel set 1. The purpose of this topic is to demonstrate a pragmatic solution how to organize PAV base and alias devices in two different subchannel sets. "Numbering schemes" on page 2 introduces a few approaches on how to organize the device numbers and unit addresses of the devices. "Using HCD to move alias devices into a different subchannel set with closing the gaps in the device number range" on page 6 then shows how to use HCD to move PAV alias devices from SS0 to SS1, with applying one of discussed numbering schemes to fill the numbering gaps.

Note: Knowledge on PAV and HyperPAV technology and information on how to select an appropriate ratio between base and alias devices is not covered in this section. Also, the described consolidation of device ranges does not consider any involved migration of data. For this purpose, various tools are available, for example DFSMSDSS, TDMF or LDMF.

Furthermore, knowledge about the following topics and issues is helpful to facilitate both a practical and strategic implementation:

- Availability of free device ranges within the existing 64K channel subsystem limit
- DASD capacity planning detail for a period of 5 years or longer
- Logical Subsystem alignment of existing and future disk subsystems
- Disk subsystem support of new technology (for example, HyperPAV)
- Performance profile of disk subsystems
- DASD replication requirements.

Device number alignment

There is no required correspondence between device numbers in the two subchannel sets. For example, we might have device number 8000 in subchannel set 0 (SS0) and device number 8000 in subchannel set 1 (SS1), but these are completely separate devices.

Typically, base devices (for example, device type 3390B) are defined from the start of the unit address range (unit address 00 forwards), as alias devices are defined from the last device in the range backwards. If the available unit address range is completely filled, this will be unit address FF backwards. Unit addresses of base and alias devices on a single control unit must be unique. These cannot be duplicated across subchannel sets.

Also, base devices and their related alias devices must be defined on the same control unit.

Numbering schemes

You can think of several numbering schemes each of which is suitable for specific circumstances. So the approach you will finally select, strongly depends on your environment and requirements. Also, different implementations of PAV devices may have restrictions on the alignment of alias addresses within the range. Check this with your disk vendor prior to selecting a numbering scheme.

This document introduces the following numbering schemes:

- "Compacting or rolling reuse of addresses"
- "Pairing addresses" on page 3
- "Filling the device number ranges" on page 4

Compacting or rolling reuse of addresses

You can use SS0 and SS1 to have PAV base and aliases in different subchannel sets, but with the same or correlated device numbers. For example, you may use two aliases for one base device (then you know for example, that an alias device with a number of 1080 or greater can only be correlated with a base device with a number of 1080 or greater).

This section presents three examples with different ratios between base and alias devices, for example, a ratio of 1:2 means that two alias devices are related to one base device.

Example with ratio 1:2

Control unit	Devices / SSID	Device addresses / UAs
1000	64 3390Bs in SS0	1000-103F / 00 - 3F
	128 3390As in SS1	1000-107F / 40 - BF
1080	64 3390Bs in SS0	1080-10BF / 00 - 3F
	128 3390As in SS1	1080-10FF / 40 - BF
1100	64 3390Bs in SS0	1100-113F / 00 - 3F
	128 3390As in SS1	1100-117F / 40 - BF

With this approach and the 1:2 ratio, you have a remaining range of 64 unit addresses from C0 - FF on each control unit and you have gaps in the device numbering in SS0 between 1040 and 107F, 10C0 and 10FF and so on. You use up the complete capacity of SS1 for defining alias devices, which results in 256 x 64 available UAs spread over 256 control units and also results in the same amount of available device numbers in SS0, which you can use for non-PAV devices or non-DASD devices.

As an alternative, you can use up the complete unit address range on a control unit, if you select a ratio of 1:1 or 1:3. Especially the 1:1 ratio would yield a direct correspondence between base and alias device numbers with the unit addresses of the bases in the first half of the range (00-7F) and the unit addresses of the aliases in the second half (80-FF).

Example with ratio 1:1

Control unit	Devices / SSID	Device addresses / UAs
1000	128 3390Bs in SS0	1000-107F / 00 - 7F
	128 3390As in SS1	1000-107F / 80 - FF
1080	128 3390Bs in SS0	1080-10FF / 00 - 7F
	128 3390As in SS1	1080-10FF / 80 - FF
1100	128 3390Bs in SS0	1100-117F / 00 - 7F
	128 3390As in SS1	1100-117F / 80 - FF

Example with ratio 1:3

Control unit	Devices / SSID	Device addresses / UAs
1000	64 3390Bs in SS0	1000-103F / 00 - 3F
	192 3390As in SS1	1000-10BF / 40 - FF
1040	64 3390Bs in SS0	1040-107F / 00 - 3F
	192 3390As in SS1	10C0-117F / 40 - FF
1080	64 3390Bs in SS0	1080-10BF / 00 - 3F
	192 3390As in SS1	1180-113F / 40 - FF

So with this approach and the 1:1 ratio, you achieve a complete and consecutive exploitation of the available device number ranges in SS0 and SS1. With the 1:3 ratio, exploitation of device numbers is consecutive, too, in both subchannel sets, but when SS0 is one-third full, SS1 is already used up.

Pairing addresses

Again, we will examine the method of pairing addresses described in this section considering different ratios between base and alias devices.

The first half of a control unit's range of unit addresses (128 devices) is allocated to the initial base range. Opposite to the method described in "Compacting or rolling reuse of addresses" on page 2, we then reuse the second half of this device range for the next consecutive assignment of devices within SS1, thus getting a different correspondence between bases and aliases. This scheme only works when not more than 128 alias devices are defined for a range of base devices. Devices are aligned to unit addresses with this scheme.

Example 1 with ratio 1:1

Range	Control unit	Device addresses / UAs (128 base devices in SS0)	Device addresses / UAs (128 alias devices in SS1)
8000-80FF	8000	8000-807F / 00-7F	8080-80FF / 80-FF
	8080	8080-80FF / 00-7F	8000-807F / 80-FF
8100-81FF	8100	8100-817F / 00-7F	8180-81FF / 80-FF
	8180	8180-81FF / 00-7F	8100-817F / 80-FF

We then can have the following correspondence between base and alias devices, for example, on control units 8000 and 8080:

```
CU 8000:
base devices (SS0) 8000-807F are related to alias devices (SS1) 8080-80FF

and vice versa on CU 8080:
base devices (SS0) 8080-80FF are related to alias devices (SS1) 8000-807F
```

As in "Compacting or rolling reuse of addresses" on page 2, with this approach and the 1:1 ratio, you achieve a complete and consecutive exploitation of the available device number ranges in SS0 and SS1.

Example 2 with ratio 1:2

Range	Control unit	Device addresses / UAs (64 base devices in SS0)	Device addresses / UAs (128 alias devices in SS1)
8000-80FF	8000	8000-803F / 00-3F	8080-80FF / 80-FF
	8080	8080-80BF / 00-3F	8000-807F / 80-FF
8100-81FF	8100	8100-813F / 00-3F	8180-81FF / 80-FF
	8180	8180-81BF / 00-3F	8100-817F / 80-FF

Achieved consecutive device numbering with this approach (ratio 1:2):
```
SS0:                           SS1:
---------------                -----------------

8000-803F ... 8080-80BF        8000-81FF
8100-813F ... 8180-81BF
```

If we now look at an example with ratio 1:4, we see that we still achieve full ranges for the alias devices in SS1, however, the gaps in SS0 for the base devices are growing, compared to ratio 1:2.

Note: A ratio of 1:3 (32 bases/96 aliases) would also yield gaps in SS1 (in addition to the gaps in SS0).

Example 3 with ratio 1:4

Range	Control unit	Device addresses / UAs (32 base devices in SS0)	Device addresses / UAs (128 alias devices in SS1)
8000-80FF	8000	8000-801F / 00-1F	8080-80FF / 80-FF
	8080	8080-809F / 00-1F	8000-807F / 80-FF
8100-81FF	8100	8100-811F / 00-1F	8180-81FF / 80-FF
	8180	8180-819F / 00-1F	8100-817F / 80-FF

Achieved consecutive device numbering with this approach (ratio 1:4):
```
SS0:                           SS1:
---------------                ----------------

8000-801F ... 8080-809F        8000-81FF
8100-811F ... 8180-819F
```

Filling the device number ranges

This scheme preserves the ranges in SS0 and aligns devices to unit addresses. It is driven by the desired base to alias ratio that was calculated in advance (potentially via the PAV analysis tool).

Basic principles used here:

1. Establish base to alias ratio first. Align to boundaries of 16 devices.
2. Stick to this alignment for all device ranges.
3. All ranges are filled with 256 devices (00-FF).
4. Use up all device ranges.
5. Define alias devices to SS1.
6. Reuse device numbers used in SS1 as base device numbers in SS0.
7. Reuse device numbers allocated in SS0 in SS1.

> **Example: 192 bases, 64 aliases (ratio 3:1)**
>
> - There are 256 available ranges for 256 devices each (256 x 256 = 65536 or FFFF(hex) devices).
> - The 64 alias devices in SS1 free up 256 x 64 = 16384 devices in SS0.
> - 16384 / 192 = 85 additional ranges for defining base devices in SS0.

Using this example, you can create a worksheet used to reflect the available ranges.

Table 1. Worksheet showing available ranges

Range	Control unit	192 base devices used in SS0	Free range for 64 base devices in SS0	64 alias devices used in SS1	Free range for 192 alias devices in SS1
1000-10FF	1000	1000-10BF (UA 00-BF)	10C0-10FF	10C0-10FF (UA C0-FF)	1000-10BF
1100-11FF	1100	1100-11BF	11C0-11FF	11C0-11FF	1100-11BF
1200-12FF	1200	1200-12BF	12C0-12FF	12C0-12FF	1200-12BF

Table 1 shows the available device numbers in SS0. Remember, there is no correspondence between the device number and the unit address. So, in a single new control unit, you can define the "spare" device numbers accordingly:

> **Example: new CNTLUNIT 2000**
>
> *Available device numbers in SS0:*
>
> ```
> 64 devices: 10C0-10FF (UA 00-3F)
> 64 devices: 11C0-11FF (UA 40-7F)
> 64 devices: 12C0-12FF (UA 80-BF)
> -------------------------------
> ===> a total of 192 free devices numbers, however discontinuous
> ```
>
> *Available device numbers in SS1:*
>
> ```
> 64 devices to be defined on CNTLUNIT 2000: 1000-103F (UA C0-FF)
> ```

This makes up a range of 4 * 64 = 256 unused device numbers, distributed over subchannel sets SS0 and SS1 as shown in the worksheet above. Further 192-64=128 device numbers are available in SS1 to be defined on a different control unit.

Using HCD to move alias devices into a different subchannel set with closing the gaps in the device number range

In this section, we want to apply the approach from "Filling the device number ranges" on page 4. The optimal circumstances would be, if at the end there would be a relationship between device numbers of base and aliases in the subchannel sets and if the freed device numbers in subchannel set 0 can be reused without disturbing existing numbering schemes.

Supposed you have the following configuration, where all devices are defined to subchannel set 0 related to all channel subsystems of a processor:

- 192 base devices 2000 to 20BF of type 3390B are connected to control unit 2000 (type 2107), having the unit addresses 00 through BF.
- 64 alias devices 20C0 to 20FF of type 3390A are connected to the same CU 2000, having the unit addresses C0 through FF.

```
   Goto  Show/Hide  Filter  Backup  Query  Help
 ------------------------------------------------------------------------------
                              I/O Device List      Row 1 of 6 More:        >
 Command ===> _____  Scroll ===> CSR

 Select one or more devices, then press Enter. To add, use F11.

 Configuration ID . . : PRODZ19      z/OS 1.9 operating system

   ----------Device--------- --#---    --------Control Unit Numbers + --------
 / Number   Type +        SS CSS OS D L 1--- 2--- 3--- 4--- 5--- 6--- 7--- 8---
   2000,192 3390B          2   1  Y N 2000 ____ ____ ____ ____ ____ ____ ____
 m 20C0,64  3390A        0  2   1  # # 2000 ____ ____ ____ ____ ____ ____ ____
 ***************************** Bottom of data ******************************

 F1=Help      F2=Split    F3=Exit     F4=Prompt    F5=Reset     F7=Backward
 F8=Forward   F9=Swap    F10=Actions F11=Add      F12=Cancel   F13=Instruct
 F20=Right    F22=Command
```

Figure 1. Original device configuration - I/O Device List launched from the related OS configuration

Starting from the configuration depicted in Figure 1, you want to achieve the following goals:

- You want to move the 64 3390A alias devices from subchannel set 0 to subchannel set 1 in order to gain space for defining new devices.
- Supposed you have implemented the numbering scheme from "Filling the device number ranges" on page 4 so that you have gaps of device numbers in SS0 which you want to fill by redefining the device numbers for the 192 3390B devices.

As you cannot directly change device numbers in the HCD dialog without deleting and recreating the devices, which might be awkward and error-prone, you need to perform the following steps:

1. Create a work IODF from the production IODF which you want to change.
2. Navigate to the required 3390A device group on the *I/O Device List* (see Figure 1). You can us a filter for all alias devices of type 3390A. Then use action *Subchannel Set ID group change* from the context menu (or action code m).

HCD displays panel *Specify Subchannel Set ID* as shown in Figure 2 where you set the Subchannel Set ID to **1**.

```
┌─────────────── Specify Subchannel Set ID ───────────────┐
│                                                          │
│                                                          │
│  Specify the ID of the subchannel set into which devices are │
│  placed, then press Enter.                               │
│                                                          │
│  Subchannel Set ID    1  +                               │
│                                                          │
│   F1=Help    F2=Split   F3=Exit    F4=Prompt  F5=Reset   F9=Swap │
│  F12=Cancel                                              │
│                                                          │
└──────────────────────────────────────────────────────────┘
```

Figure 2. Specify Subchannel Set ID

3. Pressing Enter leads you to panel *Eligible Channel Subsystems* (Figure 3). Select all channel subsystems where you want to change the subchannel set ID.

```
┌──────────── Eligible Channel Subsystems ─────────────┐
│ CBDPUTPC                                 Row 1 of 2   │
│ Command ===> _____  Scroll ===> CSR       │
│                                                      │
│ Select all channel subsystems for which the          │
│ subchannel set ID has to be changed for all          │
│ selected devices that have a connection to them.     │
│                                                      │
│                                                      │
│ / Proc.CSSID  Description                            │
│ / PROCS1.0    CSS 0 of PROCS1                         │
│ / PROCS1.1    CSS 1 of PROCS1                         │
│ **************** Bottom of data ******************    │
│                                                      │
└──────────────────────────────────────────────────────┘
```

Figure 3. Eligible Channel Subsystems

Select both channel subsystems with **/** .

4. HCD now displays panel *Eligible Operating System Configurations* (see Figure 4) where you select the operating system(s) for which you want to change the subchannel set ID for all selected devices that are connected to it.

```
┌──────────── Eligible Operating System Configurations ─────────────┐
│ CBDPUTOC                                             Row 1 of 1    │
│ Command ===> _____  Scroll ===> CSR     │
│                                                                   │
│ Select all operating system configurations for which the subchannel │
│ set ID has to be changed for all selected devices that have a      │
│ connection to them.                                               │
│                                                                   │
│                                                                   │
│ / Config.ID    Type            Description                        │
│ / PRODZ19      MVS             z/OS 1.9 operating system          │
│ ************************* Bottom of data *************************  │
│                                                                   │
└───────────────────────────────────────────────────────────────────┘
```

Figure 4. Eligible Operating System Configurations

As a result, the alias devices 20C0 to 20FF remain attached to the same control unit 2000 having the unit addresses C0 through FF, but are moved to SS1.
What remains to be done, is to change the device numbers of devices 2000 - 20FF

to the gaps listed in the scenario from "Filling the device number ranges" on page 4 without deleting and recreating these devices.

5. Make a mapping list of old versus new device numbers. In more complicated scenarios, where a large number of devices attached to different CUs are involved, you also may need to map old CU numbers to new ones. The use of a self-written EXEC could reduce the effort for this step.

6. Using the current work IODF, select HCD dialog option 2.10 (*Activate or process configuration data ---> Build I/O configuration statements*) to write:

   a. a processor configuration deck for every processor having CU 2000 and the devices 20C0 - 20FF attached which you want to rename (specify **1** as the configuration type as shown in Figure 5).

   b. an OS configuration deck for every operating system having these devices attached (specify **2** as the configuration type).
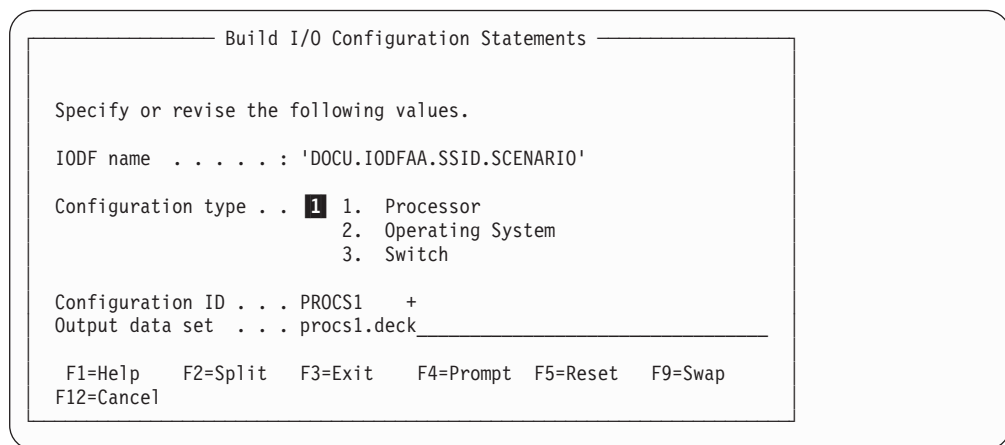
```
┌─────────────────── Build I/O Configuration Statements ───────────────────┐
│                                                                          │
│                                                                          │
│   Specify or revise the following values.                                │
│                                                                          │
│   IODF name  . . . . . : 'DOCU.IODFAA.SSID.SCENARIO'                      │
│                                                                          │
│   Configuration type . . ▊1▊ 1.  Processor                               │
│                               2.  Operating System                       │
│                               3.  Switch                                 │
│                                                                          │
│   Configuration ID . . . PROCS1    +                                     │
│   Output data set  . . . procs1.deck_____      │
│                                                                          │
│    F1=Help    F2=Split   F3=Exit    F4=Prompt  F5=Reset   F9=Swap        │
│   F12=Cancel                                                             │
└──────────────────────────────────────────────────────────────────────────┘
```

Figure 5. Build I/O Configuration Statements

7. Edit every processor configuration deck created under step 6a and

   a. replace device numbers of alias and base devices in the appropriate IODEVICE statements:

   In our scenario, change from:

   ```
    IODEVICE ADDRESS=(2000,192),UNITADD=00,CUNUMBR=(2000),        *
         STADET=Y,UNIT=3390B
    IODEVICE ADDRESS=(20C0,64),UNITADD=C0,CUNUMBR=(2000),STADET=Y,*
         SCHSET=1,UNIT=3390A
   ```

   to:

   ```
    IODEVICE ADDRESS=(10C0,64),UNITADD=00,CUNUMBR=(2000),         *
         STADET=Y,UNIT=3390B
    IODEVICE ADDRESS=(11C0,64),UNITADD=40,CUNUMBR=(2000),         *
         STADET=Y,UNIT=3390B
    IODEVICE ADDRESS=(12C0,64),UNITADD=80,CUNUMBR=(2000),         *
         STADET=Y,UNIT=3390B
    IODEVICE ADDRESS=(1000,64),UNITADD=C0,CUNUMBR=(2000),         *
         STADET=Y,SCHSET=1,UNIT=3390A
   ```

   b. if applicable for more complicated scenarios, replace CU numbers in the appropriate CNTLUNIT and IODEVICE statements. Alternatively, you can change CU numbers before step 6 using the *Change Control Unit Definition* dialog.

> **Note:** For more complex scenarios, especially if the IODFs are well structured, it may be helpful to write an EXEC that could automatically perform this step and step 8.

8. Edit every OS configuration deck created under step 6b on page 8 and
   a. replace device addresses of alias and base devices in the appropriate IODEVICE statements. The changes are similar to the ones in step 7a on page 8.
   b. if required, replace CU numbers of alias and base devices in the appropriate IODEVICE statements (see also step 7b on page 8 for an alternative)
   c. if required, replace device addresses of base devices in the appropriate EDT statements
9. Delete all base/alias devices in the device number range, which is going to be moved, from the work IODF.
10. If required, delete all CUs in the CU number range, which is going to be moved, from the work IODF
11. Use HCD dialog option 5.1 (*Migrate configuration data ---> Migrate IOCP/OS data*) to
   a. migrate all updated processor configuration decks into the work IODF (Migrate option = Incremental (2))
   b. migrate all updated OS configuration decks into work the IODF (Migrate option = Incremental (2))

```
                    ┌─── Migrate IOCP / MVSCP / HCPRIO Data ──────────┐


      Specify or revise the following values.

      Processor ID . . . . . . . . . . . . PROCS1    +   CSS ID . . . . . . _  +
      OS configuration ID  . . . . . . . . PRODZ19   +

      Combined IOCP/MVSCP input data set . 'DOCU.PROCS1.DECK'
      IOCP only input data set . . . . . . _____
      MVSCP only or HCPRIO input data set  _____
              Associated with processor _____   +
                              partition _____   +
      Processing mode  . . . . . . . . . . 2   1.  Validate
                                               2.  Save

      Migrate options  . . . . . . . . . . 2  1.  Complete
                                              2.  Incremental
                                              3.  PCHIDs
      MACLIB used  . . . . . . . . 'SYS1.MACLIB'
      Volume serial number . . . _____   + (if not cataloged)

       F1=Help     F2=Split    F3=Exit    F4=Prompt   F9=Swap    F12=Cancel
```

Figure 6. Migrate IOCP / MVSCP / HCPRIO Data

12. Review the new I/O Device List to check if everything looks as expected. In the I/O device list started from the related OS configuration (Figure 7 on page 10) you can see that the 64 3390A devices are defined to subchannel set 1. Now you have freed the previously occupied device number range 2000 - 20FF, which is now available to be used on a new control unit.

```
  Goto  Show/Hide  Filter  Backup  Query  Help
 ------------------------------------------------------------------------------
                              I/O Device List       Row 1 of 4 More:       >
 Command ===> _____ Scroll ===> CSR

 Select one or more devices, then press Enter. To add, use F11.

 Configuration ID . . : PRODZ19      z/OS 1.9 operating system

    ----------Device---------- --#---      --------Control Unit Numbers + --------
 / Number    Type +        SS CSS OS D L 1--- 2--- 3--- 4--- 5--- 6--- 7--- 8---
 _ 1000,64   3390A         1  2   1  # # 2000 ____ ____ ____ ____ ____ ____ ____
 _ 10C0,64   3390B            2   1  _ _ 2000 ____ ____ ____ ____ ____ ____ ____
 _ 11C0,64   3390B            2   1  _ _ 2000 ____ ____ ____ ____ ____ ____ ____
 _ 12C0,64   3390B            2   1  _ _ 2000 ____ ____ ____ ____ ____ ____ ____
 ***************************** Bottom of data ******************************

  F1=Help      F2=Split    F3=Exit     F4=Prompt    F5=Reset     F7=Backward
  F8=Forward   F9=Swap    F10=Actions F11=Add      F12=Cancel   F13=Instruct
 F20=Right    F22=Command
```

Figure 7. New I/O Device List after migration