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z/OS V1R13

JES2: Extending and migrating JES2 spool

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Overview – Extend SPOOL data set

- Problem Statement / Need Addressed
  - Customers have the capability to dynamically resize their volumes, but JES2 cannot expand its single extent SPOOL data set.

- Solution
  - Enhance JES2 to expand a single SPOOL extent into free space contiguous to the extent.

- Benefit / Value
  - The JES2 support allows customers to exploit the increased z/OS addressable disk storage of dynamically resized volumes within the SPOOL data set.

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Overview – Extend SPOOL data set

- Operator requests the extend via command
  - Can ask for maximum available size or specific, larger size
  - DFSMS services used to extend the data set into adjacent free space
  - JES2 updates SPOOL volume size information based on new extent size
  - Extend can occur without impacting running jobs

- Extension of the data set is limited by:
  - SPOOL volume must be STATUS=ACTIVE with no commands or migration active
    or pending against it, and using relative addressing
  - Singe JES2 SPOOL extent per volume restriction still applies
  - Available free space contiguous to the JES2 SPOOL extent
  - JES2 data set maximum sizes based on available support
  - All members of the MAS must be at JES2 z/OS V1R13
    - Down level members can later join the MAS and use the extended data set

If large data set support is not active (LARGEDS=ALLOWED or ALWAYS on SPOOLDEF) the data set extension is limited to a maximum of 65,535 tracks

●If large data set support is active the data set extension is limited to a maximum of 1,048,575 tracks

●If the SPOOL volume is an Extended Address Volume (EAV) then the data set may extend into Extended Addressing Space (EAS) storage on the EAV volume if:

    ●The data set is currently EAS eligible (EATTR=OPT)

        ●Correct DSCB format

    ●JES2 is configured to utilize EAS storage (CYL_MANAGED=ALLOWED on SPOOLDEF)

    ●If both the above are true the maximum is that determined by LARGEDS support

    ●If either of the two is false, the maximum is the smaller of 65,520 cylinders and the maximum determined by LARGEDS support

Usage and invocation – Extend SPOOL data set

- $TSPL command to extend, using SPACE= parameter
  - SPACE=MAX to obtain the largest possible data set
  - SPACE=(CYL,xx) or SPACE=(TRK,xx) for new, larger size
    - Size is total expanded size

- New message $HASP740 indicates Extend is successful

- Use $DSPL to display the results of the extend
  - $DSPL,TGNUM to display the number of track groups in the data set after the extend
  - $DSPL,UNITDATA to display the track range (TRKRANGE) of the data set after the extend

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- $TSPL(SPOOL5),SPACE=MAX

  - Extends the SPOOL volume volser SPOOL5 data set to the maximum size allowed

  - Maximum allowed is influenced by

    - Largest contiguous free space next to the current JES2 SPOOL extent

    - Configuration values like LARGEDS and CYL_MANAGED

    - If CYL_MANAGED=ALLOWED an extent can be extended into EAS storage. Otherwise it has to stay in track-managed storage

- $TSPL(SPOOL6),SPACE=(CYL,200)

  - Extends the SPOOL volume volser SPOOL6 data set to 200 cylinders if that much contiguous space is available.

- Cannot extend a SPOOL volume data set for a volume that is part of an active migration, an extend, or does not use relative addressing.

- Extending a SPOOL volume's data set can cause the track group map to become full

Overview – SPOOL migration

- Problem Statement / Need Addressed :
  - Currently no quick and easy way to remove a SPOOL volume from a configuration without impacting active systems or subsystems.

- Solution :
  - Have JES2 support a SPOOL migration command.

- Benefit / Value :
  - Automates the migration process.
  - Existing active SPOOL pointers (MTTRs and MQTRs) are unaffected.
  - SPOOL volume consolidation
  - JES2 services will make the migration transparent

- NOTE :
  - If you have applications that directly access SPOOL, **you will break!** See the *Migration & Coexistence Considerations* section!

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Overview – SPOOL migration – Key terms and definitions

- *Migrator* :
  - The member that coordinates the migration.

- *Migration Phase* :
  - The current 'step' of the migration process.

- *Source Volume* :
  - The SPOOL volume to be migrated.

- *Target Volume* :
  - The SPOOL volume to receive the migrated data.

- *MERGE Migration* :
  - Copy a *Source Volume* to free space on an existing *Target Volume*.

- *MOVE Migration* :
 - Copy an inactive *Source Volume* to a new *Target Volume*.

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Overview – SPOOL migration – Key terms and definitions

- *Mapped Volume:*
  - When a *Merge Migration* completes, the *Source Volume* becomes *Mapped.*
  - *Remains Mapped* until all jobs and SYSOUT that have space on the *Source Volume* have been purged.
  - When *Mapped*, the source dataset can be removed and the <u>physical device can be removed</u>.

- *Mapped Target:*
  - A volume with at least one volume *Merged* onto it.

- *Reserved* :
  - New SPOOL attribute.
  - Indicates if the spool volume is selectable but not allocatable.
  - Used to Reserve a new volume for future *Merge Migration(s)*.
  - Reserved volumes have no entries in the BLOB.

.NOTE: Never reserve ALL of your SPOOL volumes!

Overview – SPOOL migration – Merge migration (1 of 2)

- MERGE Migration :
    - Copies an existing *Source Volume* to free space on a *Target Volume* :
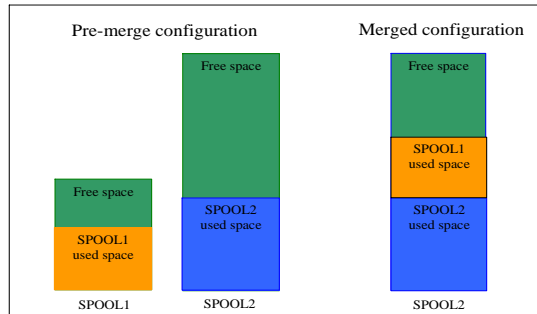
- Upon completion, the *Source Volume* becomes a *Mapped Volume.*
    - Remains *MAPPED* until all jobs and SYSOUT that have space on the *Source Volume* are purged. It then goes away (no longer exists).

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Overview – SPOOL migration – Merge migration (2 of 2)

- Restrictions:
  - The *Target Volume* must be *Active* (can be *Reserved*).
  - The *Records Per Track* of the *Target Volume* cannot be less than the *Source Volume.*
  - The *Target Volume* cannot be stunted.
  - The *Target Volume* must use relative addressing.
  - The *Target Volume* cannot be actively extending.

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Overview – SPOOL migration – MOVE migration

- MOVE Migration :
  - Copies a single <u>Inactive (halted)</u> *Source Volume* to a <u>new</u> *Target Volume*.
  - Upon completion, the *Target Volume* inherits the $DAS structure of the *Source Volume*.

- Restrictions :
  - The *Source Volume* must be Inactive.
  - Cannot move an Absolute Volume (instead, do a merge).
  - Need SPACE= parameter.
  - The *Target Volume* will inherit the *Source Volume* Tracks per Track Group value.

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Overview – SPOOL migration – General restrictions

- Additional Restrictions :
  – The *Source Volume* cannot be a *Mapped Target.*
  – The *Source Volume* cannot be actively migrating or extending.
  – The *Source Volume* cannot be stunted.
  – Must be at z11 checkpoint mode.
  – All members must be at release V1R13.

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Overview – SPOOL migration – Migration states and phases

- A *Source Volume* moves through various states during migration :
  - MERGE Migration :
    - ACTIVE → DRAINING → MIGRATING → MAPPED → gone
  - MOVE Migration :
    - INACTIVE (required) → MIGRATING → ACTIVE (new volume)

- A migration moves through various *Migration Phases* during migration :
  - PENDING, INITIALIZING, SETUP, COPY, CATCHUP, CANCEL, BACKOUT, CLEANUP.
  - The Phase is associated with the *Source Volume*.
  - SYSLOG status messages are output by the *Migrator* to track each phase step.
    - Most message go to SYSLOG only (DEBUG option to display)

- See speaker notes for additional details.

NEW SPOOL VOLUME STATES :

MIGRATING :

The SPOOL volume is a source of an active migration.

MAPPED :

The SPOOL volume has been migrated and the corresponding data set is eligible for deletion. The volume will remain MAPPED until all jobs and SYSOUT that have space on the volume have been purged.

MIGRATION PHASES :

PENDING :

Awaiting start of migration.

INITIALIZING :

General migration configuration work is being done, such as creating subtasks, data structures, and XCF mailboxes.

SETUP :

Setup for a migration is being done. All MAS members participate in this process.

COPY :

The dataset on the source spool volume has been migrated to the target spool volume. Runtime changes are coordinated and tracked by the migrator.

CATCHUP :

Tracks that were changed by runtime operations during the COPY phase are being recopied.

CLEANUP :

General cleanup is being done at the end of the migration.

CANCEL :

Migrator subtask cleanup is being done because an operator cancelled the active migration or the migration process encountered an error.

BACKOUT :

Updates are being backed out because an operator cancelled the active migration or the migration process encountered an error.

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Overview – SPOOL migration – cancelling a migration

- An active Migration can be cancelled via $MSPL(*source*),CANCEL.
  - However, Migration cannot be cancelled during the CATCHUP phase or any CLEANUP phase.
  - Upon completion of a cancel, the Source Volume will remain in *draining* state.

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Usage and invocation – SPOOL migration - $D SPOOL, MIGDATA

- Use $D SPOOL..,MIGDATA to determine if enough space exists on a *Target Volume* to accommodate planned *Source Volume(s) :*

    – Display the largest contiguous free area on each SPOOL volume.

```
$D SPOOL,MIGDATA
$HASP893 VOLUME (SPOL3)
$HASP893 VOLUME (SPOL3) MIGDATA=(SPACE_USED=40000,LARGEST_FREE=10000)
$HASP893 VOLUME (SPOL5)
$HASP893 VOLUME (SPOL5) MIGDATA=(SPACE_USED=20000,LARGEST_FREE=10000)
```
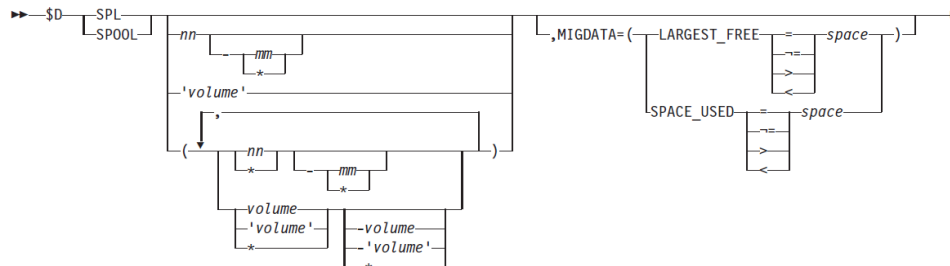
    – Display all volumes having contiguous free space greater than 3000 cylinders :

```
$D SPOOL,MIGDATA=LARGEST_FREE>3000,MIGDATA
$HASP893 VOLUME (SPOL2)
$HASP893 VOLUME (SPOL2) MIGDATA=(LARGEST_FREE=4000)
$HASP893 VOLUME (SPOL3)
$HASP893 VOLUME (SPOL3) MIGDATA=(LARGEST_FREE=7000)
```

Note: Track groups in the BLOB are considered to be used (not free)

.$D SPOOL..., MIGDATA SYNTAX:

.IMPORTANT KEYWORDS :

.MIGDATA=([LARGEST_FREE | SPACE_USED]) :

.On a per spool volume basis, displays the largest contiguous free space or the highest used location. The unit of measurement is tracks.

Usage and invocation – SPOOL migration - $T SPOOL (1 of 2)

- If needed, Use $T SPOOL to extend an existing *Target Volume* to accommodate planned *Source Volume(s) :*

  – Extend a *SPOOL Volume* to the largest size available :

```
$TSPOOL(SPOL2),SPACE=MAX
$HASP893 VOLUME(SPOL2)
$HASP423 SPOL2 EXTENSION IS BEING FORMATTED
$HASP646 54.4986 PERCENT SPOOL UTILIZATION
```

  – Extend a *SPOOL Volume* to 1000 cylinders :

```
$TSPOOL(SPOL2),SPACE=(CYL,1000)
$HASP893 VOLUME(SPOL2)
$HASP423 SPOL2 EXTENSION IS BEING FORMATTED
$HASP646 54.4986 PERCENT SPOOL UTILIZATION
```
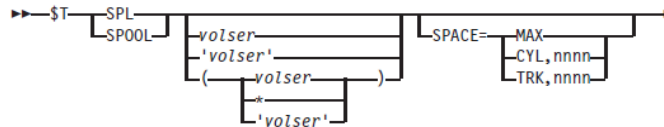
- Allows concurrent SPOOL activity.

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- $T SPOOL SYNTAX:

- NOTES:

- To satisfy the request, adequate free extent space must exist adjacent to the spool volume being extended.

- Otherwise, the extend will do the 'best it can'. That is, extend up to the end of the adjacent extent space.

Usage and invocation – SPOOL migration - $T SPOOL (2 of 2)

- The extended volume may become *Stunted* if JES2 Track Group Map (TGM) space isn't available.
  - Stunted volumes cannot be the *Source Volume* or *Target Volume* of a migration!
  - Use $D SPOOLDEF,TGSPACE to expand the TGM size.
    - A checkpoint reconfiguration may be necessary if there is not enough free space in the checkpoint.
    - Use $DCKPTSPACE to see how much free space is available.

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Usage and invocation – SPOOL migration - $M SPOOL - MERGE

- Use $M SPOOL to merge *Source Volume(s)* to an <u>existing</u> *Target Volume*:

```
$MSPL(SPOL2,SPOL3),TARGET=J2SPL1
$HASP893 VOLUME(J2SPL1) STATUS=ACTIVE,PERCENT=2
$HASP893 VOLUME(SPOL2) STATUS=ACTIVE,COMMAND=(MIGRATE)
$HASP808 SPOL2 IS BEING MOVED TO J2SPL1 - MIGRATION PHASE 1
$HASP808 SPOL2 IS BEING MOVED TO J2SPL1 - MIGRATION PHASE 2
$HASP808 SPOL2 MIGRATION TO J2SPL1 COMPLETE
$HASP630 VOLUME (J2SPL1) STATUS=ACTIVE 10 PERCENT UTILIZATION
$HASP893 VOLUME(SPOL2) STATUS=MIGRATED PERCENT=42
$HASP893 VOLUME(SPOL3) STATUS=ACTIVE,COMMAND=(MIGRATE)
$HASP808 SPOL3 IS BEING MOVED TO J2SPL1 - MIGRATION PHASE 1
$HASP808 SPOL3 IS BEING MOVED TO J2SPL1 - MIGRATION PHASE 2
$HASP808 SPOL3 MIGRATION TO J2SPL1 COMPLETE
$HASP630 VOLUME (J2SPL1) STATUS=ACTIVE 19 PERCENT UTILIZATION
$HASP893 VOLUME(SPOL3) STATUS=MIGRATED PERCENT=17
```

- RESERVED can be specified to reserve the *Target Volume* for further *Merges*.

- Allows concurrent SPOOL activity.

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●$M SPOOL MERGE SYNTAX:

```
►►──$MSPL(volser,)─,──TARGET=──volser──────────────────────────►◄
                                      └─,RESERVED─┘
```

●IMPORTANT KEYWORDS :

●RESERVED :

●Leaves the target spool volume RESERVED once the migration is complete, which prohibits new allocations. The RESERVED parameter is similar to the DRAINING state, but without the associated DAS on the work queue. The RESERVED parameter is only valid when migrating to a new spool volume.

Usage and invocation – SPOOL migration - $M SPOOL - MOVE

- Use $M SPOOL to move an <u>inactive</u> *Source Volume* to a <u>new</u> *Target Volume*:

$MSPL(SPOL2,SPOL3),TARGET=J2SPL1,SPACE=MAX,RESERVED

$HASP423 J2SPL1 IS BEING FORMATTED

$HASP630 VOLUME(J2SPL1) STATUS=RESERVED 0 PERCENT UTILIZATION

$HASP893 VOLUME(SPOL2) STATUS=ACTIVE,COMMAND=(MIGRATE)

$HASP808 SPOL2 IS BEING MOVED TO J2SPL1 - MIGRATION PHASE 1

$HASP808 SPOL2 IS BEING MOVED TO J2SPL1 - MIGRATION PHASE 2

$HASP808 SPOL2 MIGRATION TO J2SPL1 COMPLETE

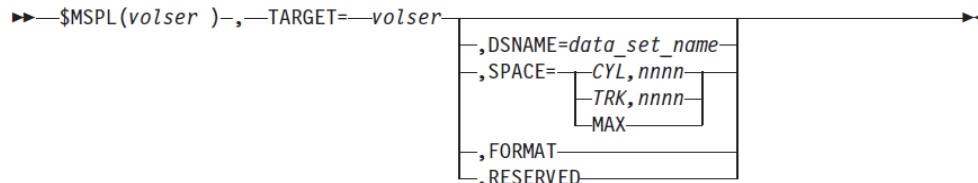$HASP630 VOLUME (J2SPL1) STATUS=RESERVED 40 PERCENT UTILIZATION

- RESERVED can be specified to reserve the *Target Volume* for further *Merges.*

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- $M SPOOL MOVE SYNTAX:

```
►►──$MSPL(volser )─,──TARGET=──volser──────────────────────────────────►◄
                              ├─,DSNAME=data_set_name─┤
                              ├─,SPACE=──┬─CYL,nnnn─┬─┤
                              │          ├─TRK,nnnn─┤ │
                              │          └─MAX──────┘ │
                              ├─,FORMAT───────────────┤
                              └─,RESERVED─────────────┘
```

- IMPORTANT KEYWORDS ::

  - DSNAME=data_set_name:

  - Specifies a JES2 spool data set data_set_name of 1–44 characters. The DSNAME parameter can only be specified when migrating to a new spool volume. If the DSNAME parameter is not specified, the default data set name is used, which is set using the SPOOLDEF command. If the specified data set name does not exist and the SPACE parameter is also specified, JES2 creates the specified data set on the target spool volume.

- FORMAT :

  - Formats the target spool volume unconditionally before the migration starts. The FORMAT parameter is only valid when migrating to a new spool volume.

- RESERVED :

  - Leaves the target spool volume RESERVED once the migration is complete, which prohibits new allocations. The RESERVED parameter is similar to the DRAINING state, but without the associated DAS on the work queue. The RESERVED parameter is only valid when migrating to a new spool volume.

- SPACE= (CYL,nnnn | TRK,nnnn | MAX)

  - Specifies the space allocation when moving spool volumes to a new volume. The migration requirements dictate the minimum space that is permitted. One of the following operands must be specified:

    - CYL,nnnn - Allocates a spool data set with nnnn number of cylinders.

    - TRK,nnnn - Allocates a spool data set with nnnn number of tracks.

    - MAX   - Allocates the largest spool data set permitted.

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Usage and invocation – SPOOL migration - $M SPOOL - CANCEL

- Use $M SPOOL...CANCEL cancel an active migration :

`$MSPL(SPOL2), CANCEL`

- Note that migration cannot be cancelled during the CATCHUP phase or any CLEANUP phase.

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.$M SPOOL CANCEL SYNTAX:

```
►►──$MSPL(volser,)──,CANCEL─────────────────►◄
```

.IMPORTANT KEYWORDS ::

.CANCEL

.Cancels the spool migration. Migration cannot be cancelled during later portions of the CATCHUP phase or any CLEANUP phases.

.NOTES:

.Migration cannot be cancelled during later portions of the CATCHUP phase or any CLEANUP phase.

.Upon completion of a cancel, the Source Volume will remain in *draining* state.

Usage and invocation – SPOOL migration - $D SPOOL monitoring

- Use $D SPOOL to monitor a migration and check results :
  - MANY ways to view and filter. Here are a few examples :

- Display all spool volumes that are currently migrating:

```
$D SPOOL(SPOL1,SPOL2,SPOL7,SPOL8),STATUS=MIGRATING
$HASP893 VOLUME(SPOL7) STATUS=MIGRATING-MOVE,TARGET=SPOL2
$HASP893 VOLUME(SPOL8) STATUS=MIGRATING-MOVE,TARGET=SPOL2
$HASP646 75.0000 PERCENT SPOOL UTILIZATION
```

- Display all spool volumes that have a Target (are *Mapped*) :

```
$D SPOOL, TARGET^=' ',TARGET
$HASP893 VOLUME(SPOL4) TARGET=SPOL11
$HASP646 80.0000 PERCENT SPOOL UTILIZATION
```

- Display all spool volumes that are reserved :

```
$DSPL,RESERVED=YES
$HASP893 VOLUME(SPOL2) STATUS=RESERVED,PERCENT=20
$HASP893 VOLUME(SPOL3) STATUS=RESERVED,PERCENT=40
$HASP646 30.0000 PERCENT SPOOL UTILIZATION
```

- See speaker notes for full list of new keywords.

- NEW AND CHANGED $D SPOOL KEYWORDS:

  - TARGET = '*target*'

  - Display or filter on volumes that have a target (are MAPPED).

  - MAPTARGET = YES | NO

  - Display or filter on volumes that are (YES) or are not (NO) the target of a MAPPED volume (that is, volumes that are or are not a target volume).

  - MIGDATA=([LARGEST_FREE | SPACE_USED])

  - Display or filter, on a per volume basis, displays the largest contiguous free space or the highest used location. The unit of measurement is tracks.

- MIGRATOR

  - Displays the name of the JES2 MAS member that is performing the migration of a MIGRATING spool volume.

- MPERCENT

  - Display or filter on the percentage of the migration that has completed.

  - PHASE

  - Display or filter migrating volume(s) by current migration phase (PENDING, INITIALIZING, SETUP | COPY | CATCHUP | CANCEL | BACKOUT | CLEANUP).

- RESERVED = YES | NO

  - Display or filter on reserved volumes. YES indicates the spool volume is reserved. NO indicates the spool volume is not reserved.

- STATUS = MIGRATING

  - Display or filter on volumes that are MIGRATING. That is, the spool volume is a source of an active migration. The associated target volume is also displayed.

- STATUS = MAPPED

  - Display or filter on volumes that are MAPPED. That is, The spool volume has been migrated and the corresponding data set is eligible for deletion.

Overview – SPOOL data set name (DSNAME)

- Problem Statement / Need Addressed
  - JES2 uses the same SPOOL data set name for all SPOOL volumes

- Solution
  - Enhance JES2 to allow specification of the SPOOL data set name to be used for a volume

- Benefit / Value
  - Allows unique naming of SPOOL data sets

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Usage and invocation – SPOOL data set name (DSNAME)

- SPOOL data set name can be specified on:
  - Start SPOOL command for a new volume: $SSPL(*x*),DSName=
  - New SPOOL Initialization statement: SPOOL(*x*) DSName=

- SPOOLDEF DSNAME= is the default name used

- SPOOLDEF DSNMASK= limits possible data set names
  - DSNMASK= can contain generics
  - Supplied SPOOL data set names must match the mask
  - If not specified, DSNAME= must match SPOOLDEF DSNAME=

- Use of a non-standard DSNAME= requires z11 checkpoint mode
  - Cannot activate to z2 mode if non-standard DSNAME used

Overview – SPOOL volume prefix

- Problem Statement / Need Addressed
  – Current JES2 SPOOL Volume prefix is too restrictive

- Solution
  – Enhance JES2 SPOOL prefix to support generics

- Benefit / Value
  – More flexibility in identifying SPOOL volumes that can be used in the MAS

Usage and invocation – SPOOL volume prefix

- SPOOLDEF VOLUME=
  - Allows generics
  - Can still provide specific 4 or 5 character prefix
  - "*" allows any volume to be used for SPOOL

- New SPOOL Initialization statement
  - Lists SPOOL volumes to be used at cold start
  - SPOOL prefix using generics skips scanning UCBs at cold start.
    - Could start with no SPOOL volumes without SPOOL Init statement

- If SPOOL prefix contains generics, down level members cannot start
  - Can set SPOOL volume prefix to non-generic value to allow down level members to start
  - SPOOL volumes started on a z/OS V1R13 member will be useable by down level members (must have COMPAT APAR OA31806 applied)

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Migration and coexistence considerations (1 of 3)

- A down level member will not be allowed to join the MAS and a HASP720 message will be issued in the following situations:
  - A SPOOL migration is active or pending
  - An Extend SPOOL is active or pending
  - A SPOOL volume has STATUS=MAPPED
  - A SPOOL prefix has been defined using generics

- To request an Extend SPOOL data set or SPOOL Migration, all members of the MAS must be at JES2 z/OS 1.13

- To request a SPOOL Migration the MAS must be running in z11 checkpoint mode

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Migration and coexistence considerations (2 of 3)

- From JES2 z/OS 1.9 or 1.10
  - Can all member warm to z/OS 1.13
  - No coexistence support
  - Fall back implications
    - Some new data structures created by z/OS 1.13 JES2 may result in problems in z/OS 1.10 and prior
    - Prior to z/OS 1.10 may not be able to use SPOOL volumes with non-standard data set names

- From JES2 z/OS 1.11 or z/OS 1.12
  - COMPAT APAR OA31806 is needed on a z/OS 1.11, or z/OS 1.12 member to coexist in a MAS with z/OS 1.13
  - APAR also highly recommended for fall back as well
    - Some new data structures created by z/OS 1.13 JES2 may result in problems if OA31806 is not installed.

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Migration and coexistence considerations (3 of 3)

Applications that directly access SPOOL data without using published
SSI interfaces will encounter severe problems accessing data
for migrating/migrated volumes.

- If you do I/O to SPOOL directly you will break
    - I/Os need to be serialized to the data migrator
    - Need to notify data migrator of intent to do I/O
    - Need to know which device (source or target) to direct I/O to

Session summary

- SPOOL Migration allows customers to alter their current SPOOL configuration, including discontinuing use of a volume, in an environment where they have long running applications, without interrupting their system.

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Appendix - References

- Publications
    - z/OS V1R13.0 JES Application Programming – SA23-2240-03
    - z/OS V1R13.0 JES2 Commands – SA22-7526-12
    - z/OS V1R13.0 JES2 Initialization and Tuning Guide – SA22-7532-11
    - z/OS V1R13.0 JES2 Initialization and Tuning Reference – SA22-7533-11
    - z/OS V1R13.0 JES2 Installation Exits – SA22-7534-13
    - z/OS V1R13.0 JES2 Macros – SA22-7536-11
    - z/OS V1R13.0 JES2 Messages – SA22-7537-11
    - z/OS V1R13.0 MVS Using the Subsystem Interface - SA22-7642-11