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The Future of PDSE: The Version 2 Format

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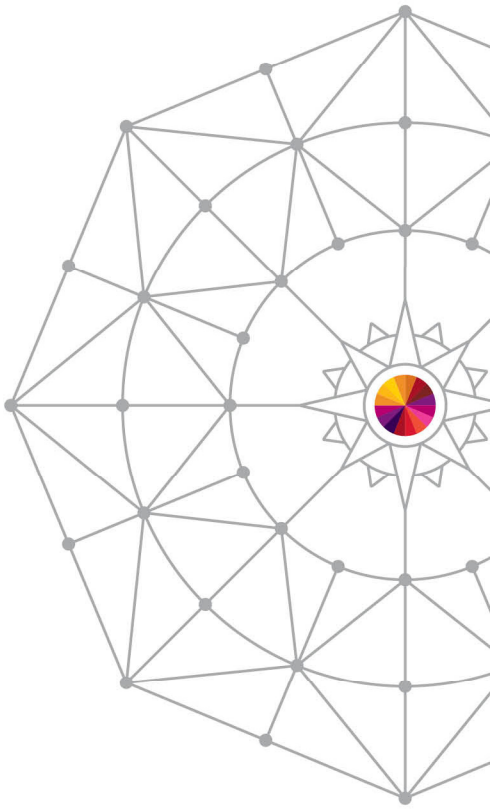
IBM Corporation

Session: **15083**

SHARE in Anaheim

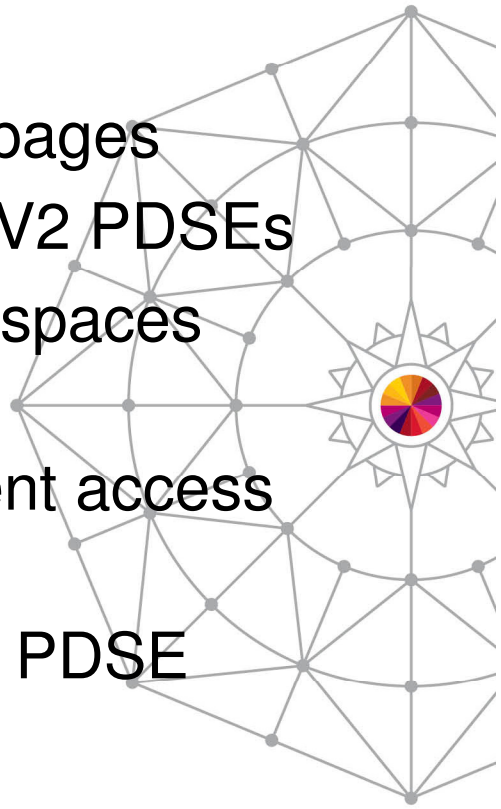
Agenda

- The PDSE Version 2 Rationale
- Version 2 Architecture Changes
- Performance Improvements
- New Feature: PDSE Member Generations
  - What is it?
  - Generations Structure
  - Working with Generations
- Version 2 Usage and Considerations



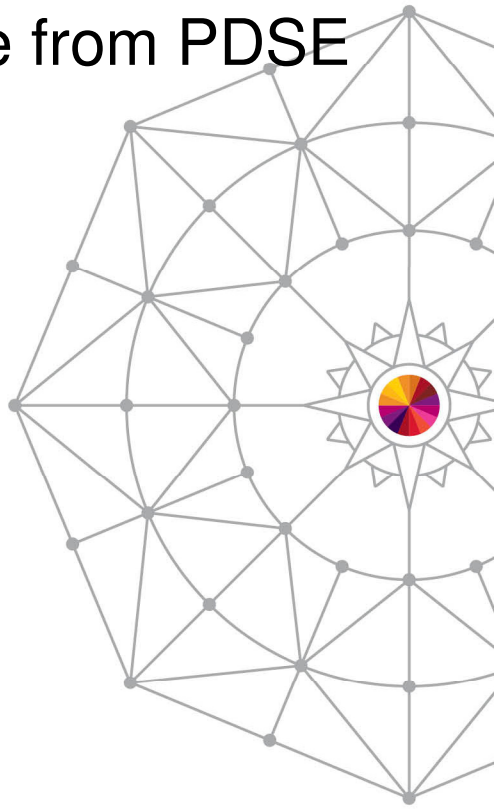
What is a PDSE?

- PDSE: Partitioned DataSet Extended
- A PDSE is a collection of directory and data pages
- At V2R1 there are 2 dataset formats V1 and V2 PDSEs
- PDSE server consists of one or two address spaces (SMSPDSE and SMSPDSE1)
- The SMSPDSE(1) address spaces serve client access requests for PDSE datasets
- Under the hood SMSPDSE(1) also manages PDSE serialization and buffering



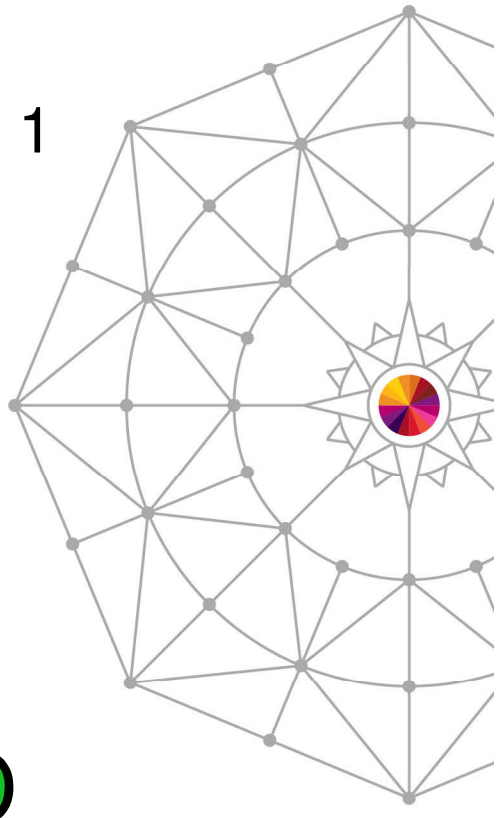
PDSE User Needs

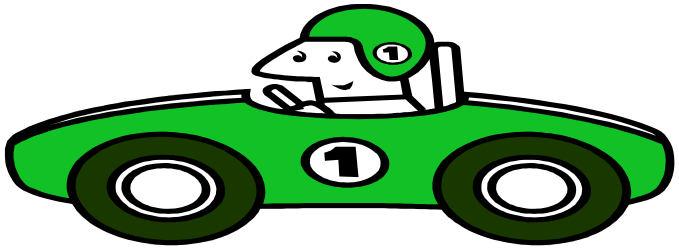
- Users want to be able to better reclaim space from PDSE datasets that is allocated but unused
- Users want to reduce PDSE I/O usage
- Users want to reduce PDSE CPU usage



PDSE Version 2 Format: Rationale

- **Streamlining** of the PDSE format
- Enables multiple improvements over Version 1
  - Enhanced Partial Release
  - Consolidation of directory pages
  - Enhanced read performance
  - Reduced virtual storage utilization



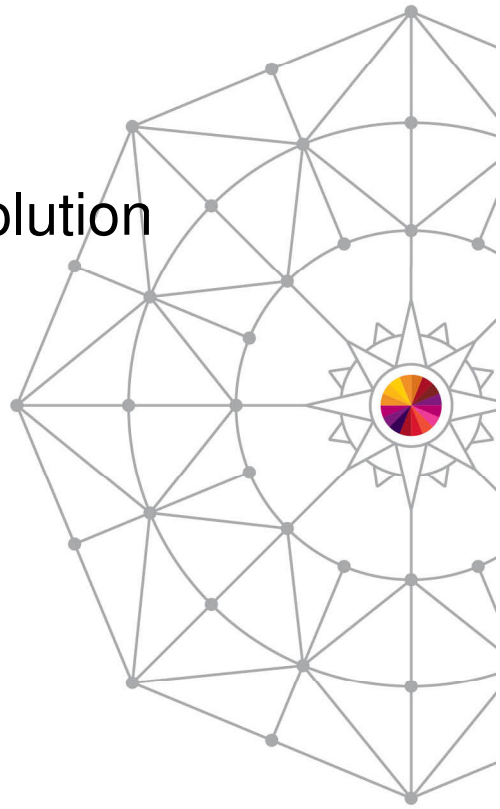


The more things change…
the more they stay the same

- Like Version 1, Version 2 datasets:
  - Still are homogenous collections of 4K pages
  - Still have multiple indexes
  - Are serialized identically
  - Retain the same sharing capabilities and restrictions
  - Leverage the same V2R1 IMF/BMF restructure enhancements

Streamlining the PDSE Format

- Removal of unnecessary index structures
  - Removed VDF AD mapping
  - Removes a layer of complexity from page resolution
  - Allows for faster index searches
  - Allows for finer control of partial release



Streamlining the PDSE Format

- Set commonly referenced dataset statistics as easily referenced values
  - Page, Member, and Total Member Count values are now stored in the AD root
  - No longer dynamically calculated
  - Speeds up queries

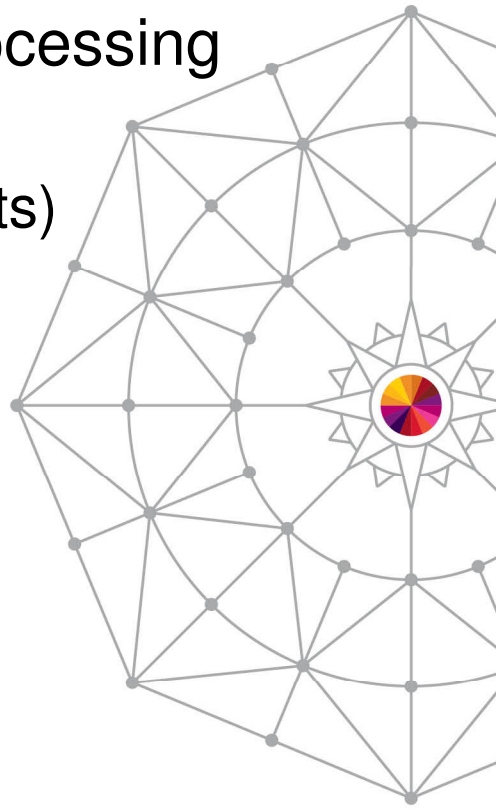
Streamlining the PDSE Format

- Variable Record PDSE efficiency enhancements
  - Removed the static RRI
  - RRI now built dynamically
  - Drastically reduces storage and CPU needs

- The Tradeoff
  - An OPEN followed by a ‘blind’ Point to the end of a member will be slower
    - If this is your primary use for a PDSE then consider using a V1 data set

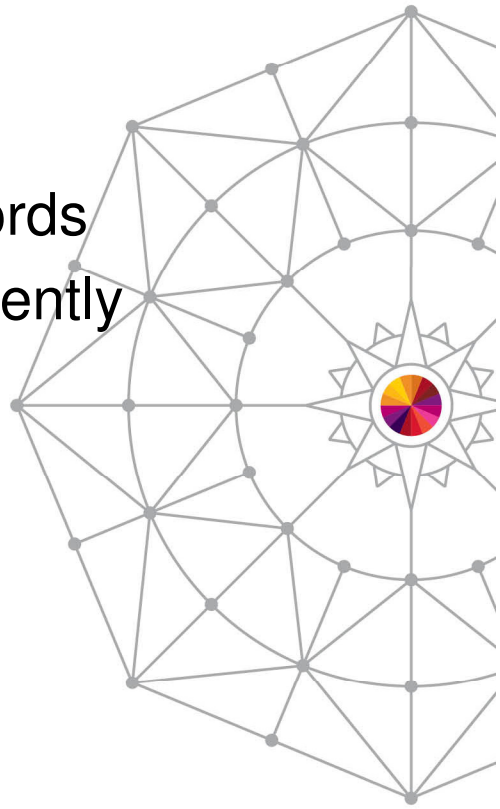
Performance Benefits

- Enhancements will benefit the majority of processing based on:
  - Directory consolidation (especially VB data sets)
  - Improved space management
  - Reduced path length for almost all index operations



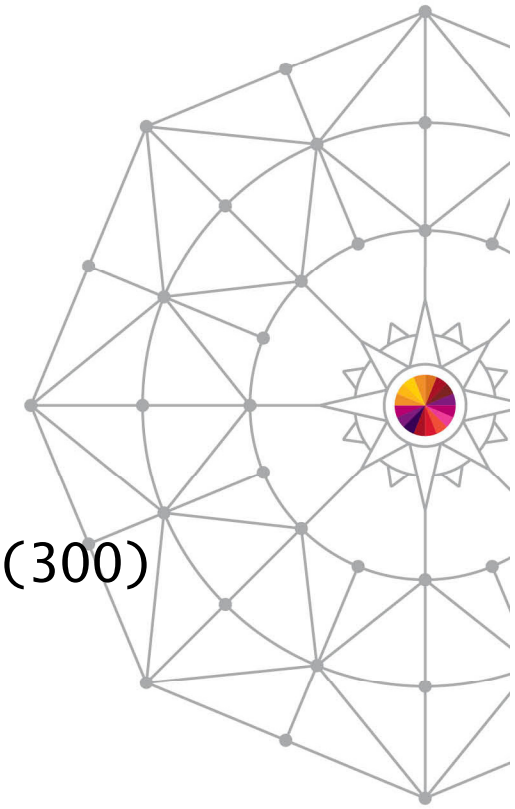
Performance Benefits

- Real world improvements:
  - First OPEN of large PDSEs
  - Creation of large members using variable records
  - Variable records use storage much more efficiently
  - Variable records are much faster in the vast majority of use cases
  - Reduced I/O usage
  - Reduced CPU usage



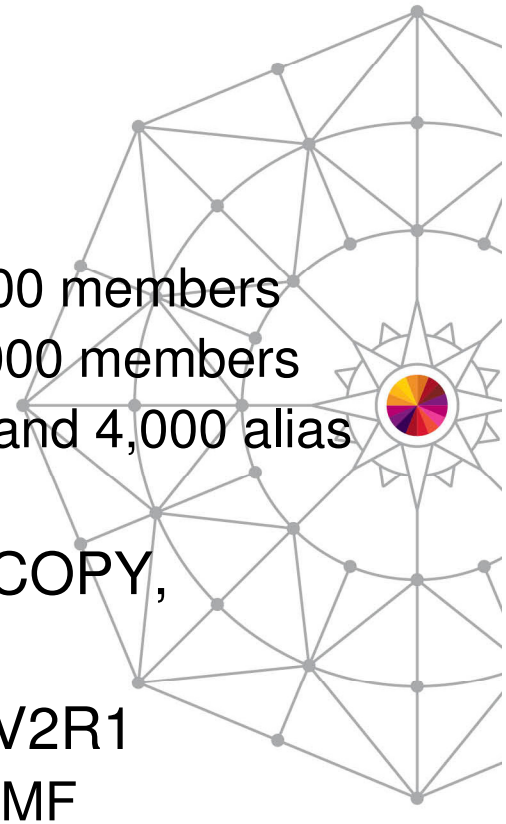
Performance Results

- Testing Configuration
  - 2 LPARs at V2R1, 7 processors each
  - SMS Parameters:
    - PDSESHARING(EXTENDED)
    - PDSE_RESTARTABLE_AS(YES)
    - PDSE_BUFFER_BEYOND_CLOSE(YES) AND PDSE1_BUFFER_BEYOND_CLOSE(YES)
    - PDSE_BMFTIME(300) AND PDSE1_BMFTIME(300)



Performance Results

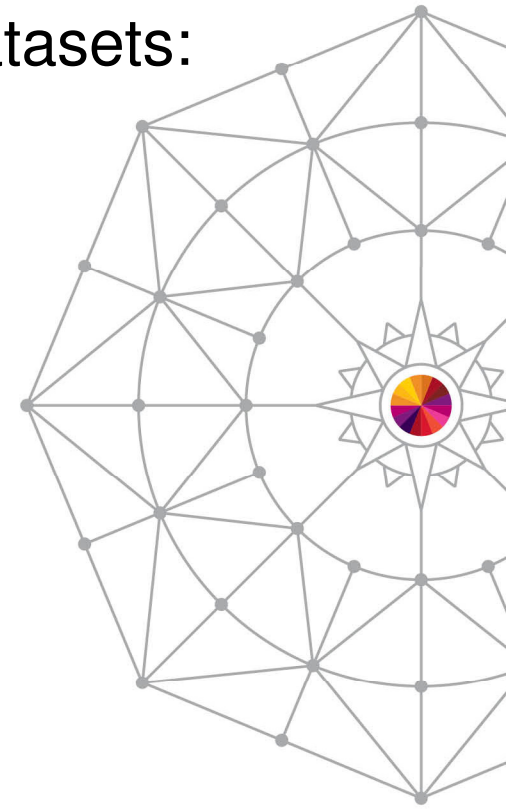
- Testing Workload
  - 400 users split evenly between the LPARs
  - 30 large PDSE datasets
    - 10 with RECFM=FB, LRECL 256 and over 13,000 members
    - 10 with RECFM=VB, LRECL=133 and over 13,000 members
    - 10 with RECFM=U and about 15,000 members and 4,000 alias entries
  - TSO workload includes READ, UPDATE, IEBCOPY, CREATE, and DELETE of members
  - Comparing PDSE V1 and V2 performance at V2R1
    - Meaning both dataset types are using the IMF/BMF improvements



NOTE: Performance improvements are based on internal IBM laboratory tests. Your results will vary.

Performance Results

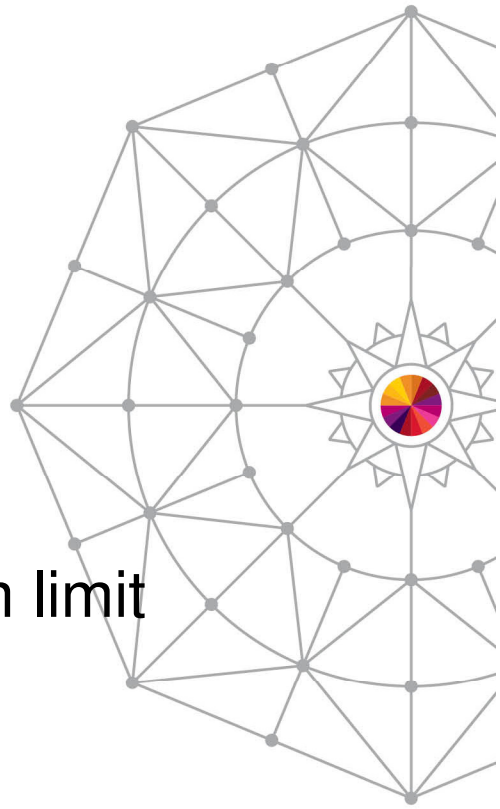
- Improvements between V1 and V2 PDSE datasets:
  - 11-18% Reduction in storage used
  - 9% Reduction in CPU used by SMSPDSE1
  - 2% Reduction in CPU used by TSO users
- Improvements in index heavy operations
  - Browse dataset to member list - 7% faster
  - Member delete to member list – 20% faster



NOTE: Performance improvements are based on internal IBM laboratory tests. Your results will vary.

New Feature:
PDSE Member Generations

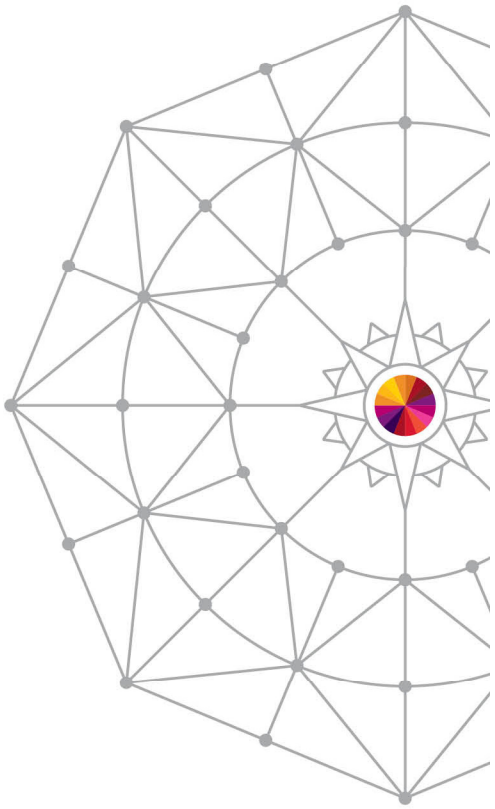
- Implemented via APAR OA42358
- Exclusive to the V2 PDSE Format
- PDSE Datasets can now retain multiple generations of members
- Applies to BOTH Data Members and Program Objects
- Retains generations up to the dataset/system limit



New Feature:
PDSE Member Generations

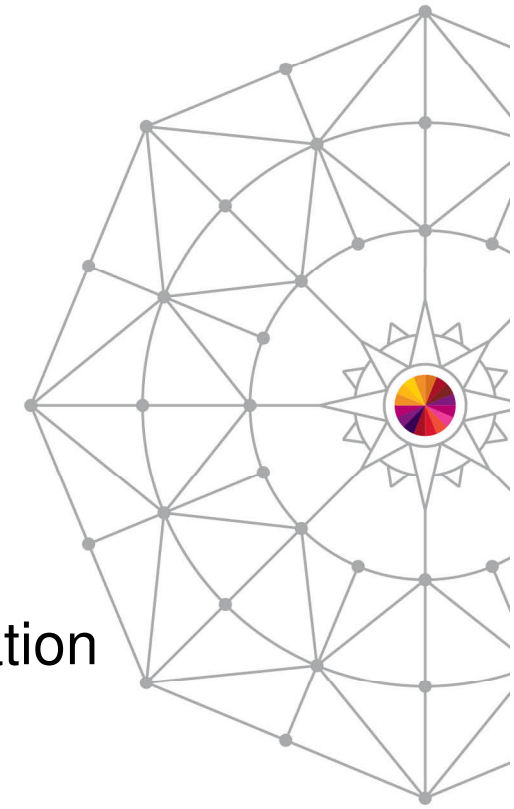
Terminology

- Generation (GEN)
  - A prior copy of a member
- Primary Generation
  - The current member
  - Absolute and Relative 0
- Generation Numbering
  - Absolute: GEN(n), GEN(n-1), GEN(n-2)….
  - Relative: GEN(-1), GEN(-2),….,GEN(-n)
    - n being the nth generation created



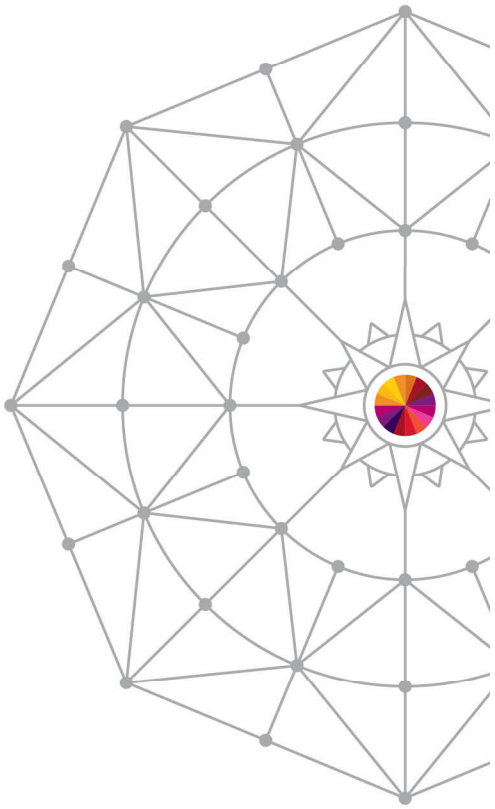
PDSE Member Generations

- FIFO (First In, First Out) structure
  - Mostly….
- Generations are uniquely numbered
  - They can be referenced either by their **Absolute** or **Relative** generation
  - Current member is always 0, both relative and absolute
  - Greatest number indicates the newest generation



PDSE Member Generations

- FIFO (First In, First Out) structure
  - Oldest generation is permanently deleted if it's over the generation limit
  - Old generations generally behave just like primary members
  - Aliases are retained for previous generations*

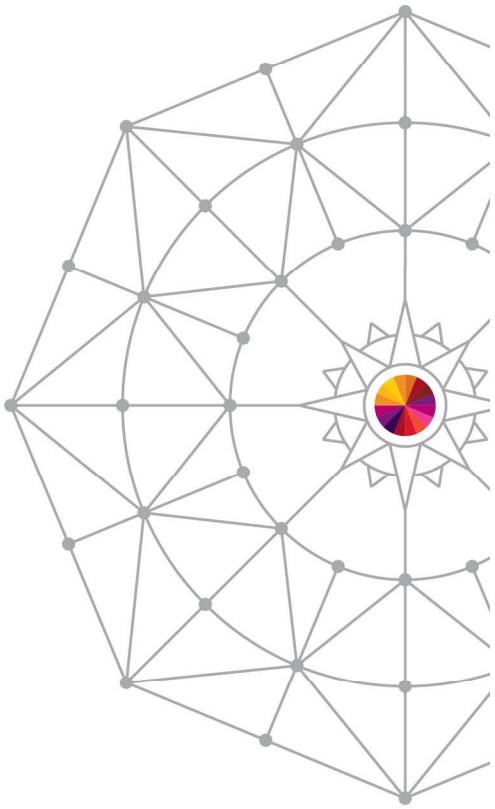


* When STOW RECOVERG is used

PDSE Member Generations

Usage Considerations

- Allow extra space for each generation
- Each generation retains the entire member
- MAXGENS_LIMIT in IGDSMSxx is the System limit
- MAXGENS_LIMIT can be set dynamically
- MAXGENS_LIMIT is set at 2 billion



PDSE Member Generations: Working with Generations

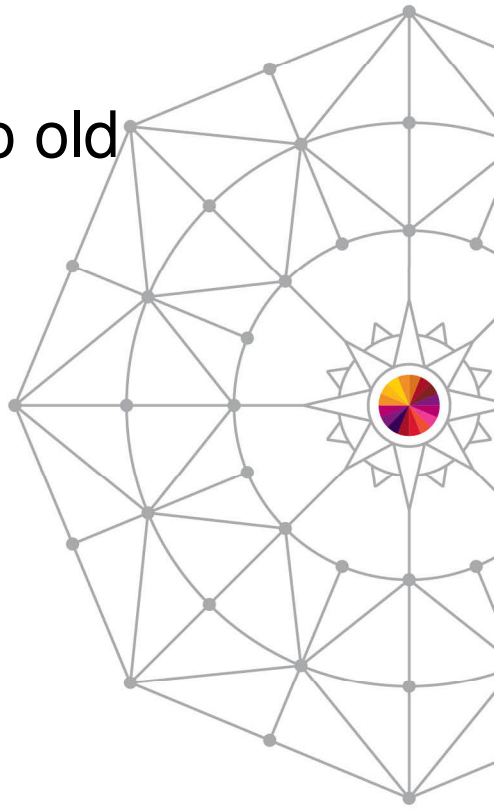
Creating a Generation

- 2 requirements
  - (LIBRARY,2)
  - MAXGENS > 0
- New generations are automatically created on replace or delete of a member
- Update in place will not create a new generation
- Generation creation is atomic

PDSE Member Generations: Working with Generations

Reading Old Generations

- FIND macro will allow programs to connect to old generations
- Conventional READ and CHECK macros still apply
- Old generations cannot be accessed via JCL or dynamic allocation



PDSE Member Generations: Working with Generations

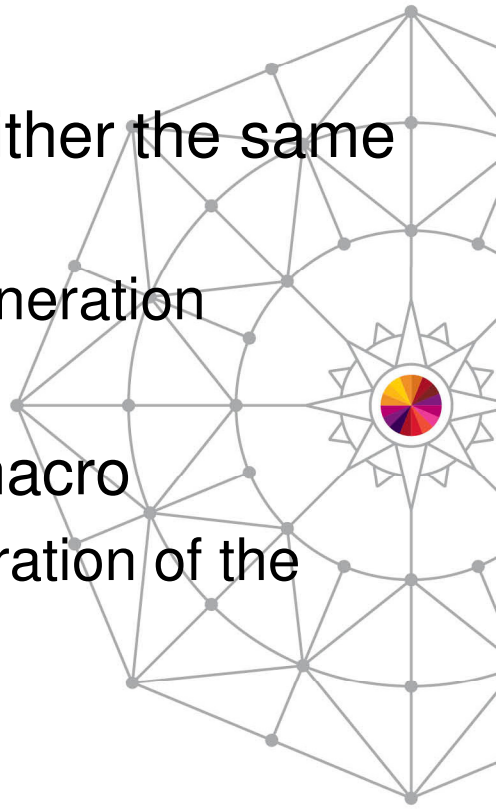
Deleting Old Generations

- Each generation must be deleted separately
- Deleted generations can be replaced by using STOW RG
- ISPF member delete will delete all generations

PDSE Member Generations: Working with Generations

Recovering Old Generations

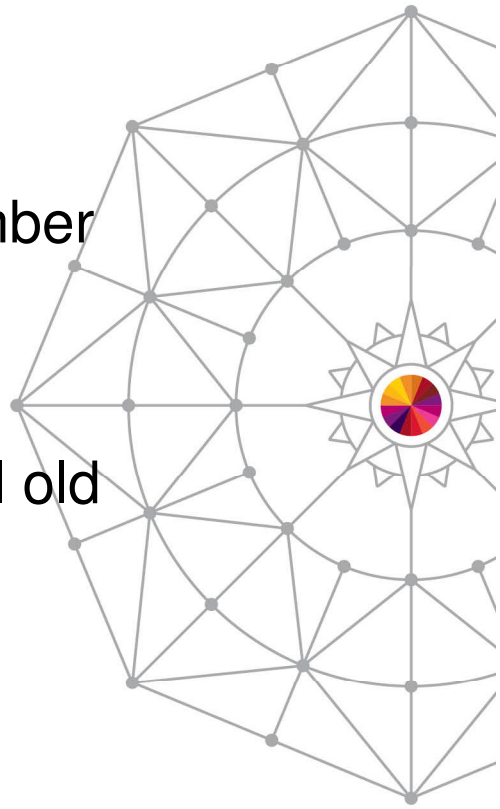
- Read an old generation and then write it to either the same or a different member name
  - The old generation will become the current generation
  - Note: This method will not restore aliases
- Use the RECOVERG option for the STOW macro
  - The old generation becomes the current generation of the member of the same name
  - Note: Aliases ARE recovered by this method



PDSE Member Generations: Working with Generations

Backup Considerations

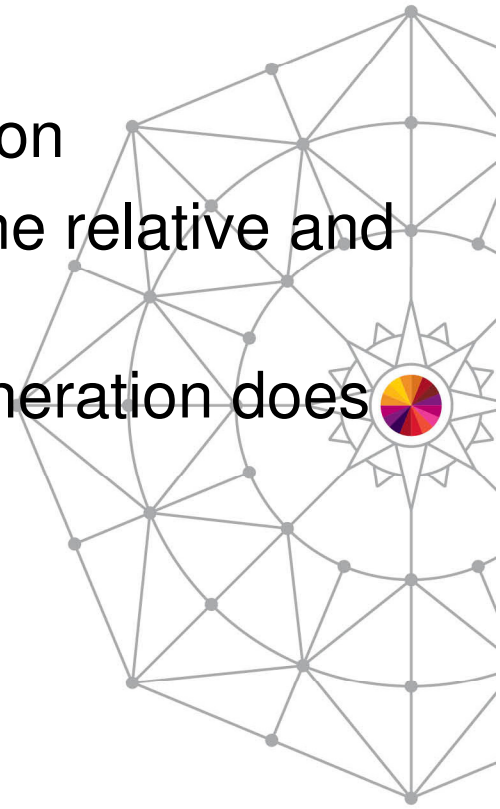
- IEBCOPY and IDCAMS REPRO
  - Only copy the current generation of each member
  - All old generations are lost
- DFSMSdss
  - Physical or Logical dump and restore retain all old generations
  - This includes HSM backup



PDSE Member Generations: DESERV Macros

FUNC=GET_G (AKA Get Generation)

- Returns information for the selected generation
- Returns the same information as GET plus the relative and absolute generation numbers
- A dummy entry is returned if the selected generation does not exist
- Does not support CONNECT



PDSE Member Generations: DESERV Macros

FUNC=GET_G

,AREA=(buffer_area, buffer_area_size)

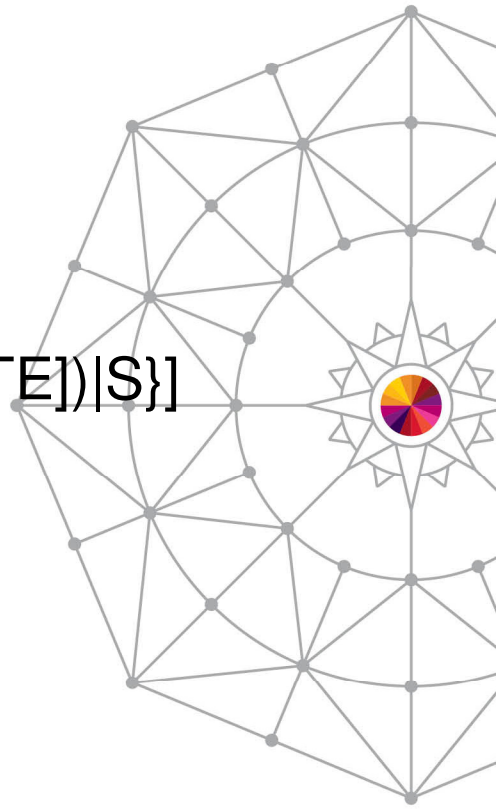
,DCB=data_control_block

,NAME_LIST=(generationname,1)

[,MF={(E,parmlist_name[,NOCHECK|COMPLETE])|S}]

[,RETCODE=return_code]

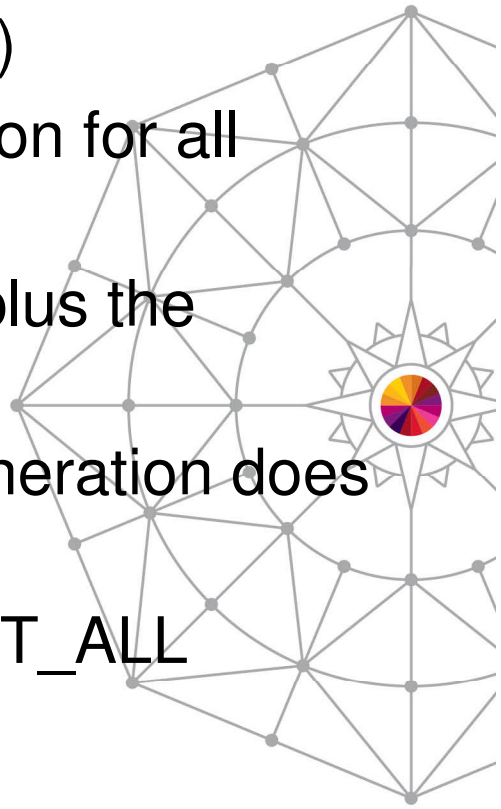
[,RSNCODE=reason_code]



PDSE Member Generations: DESERV Macros

FUNC=GET_ALL_G (AKA Get All Generations)

- Returns information for the selected generation for all members
- Returns the same information as GET_ALL plus the relative and absolute generation numbers
- A dummy entry is returned if the selected generation does not exist for a member
- Does not support all the same options as GET_ALL



PDSE Member Generations: DESERV Macros

FUNC=GET_ALL_G

,AREA=(buffer_area, buffer_area_size)

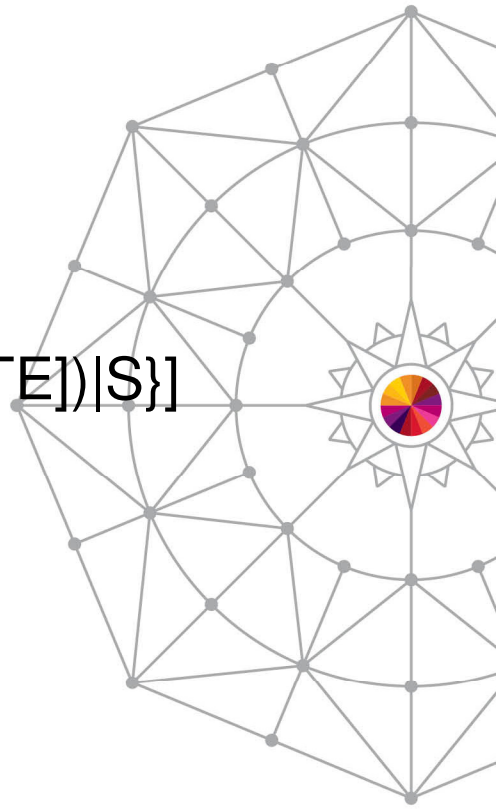
,DCB=data_control_block

,NAME_LIST=(generationname,1)

[,MF={(E,parmlist_name[,NOCHECK|COMPLETE])|S}]

[,RETCODE=return_code]

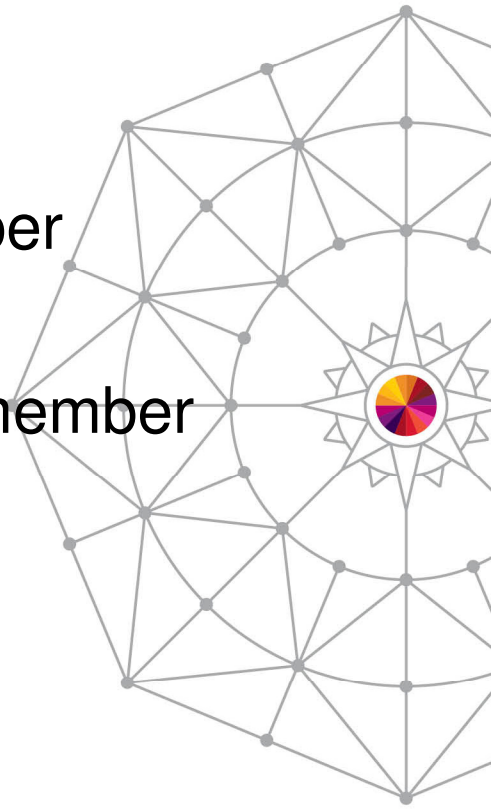
[,RSNCODE=reason_code]



PDSE Member Generations: STOW Macro

DG (Delete Generation)

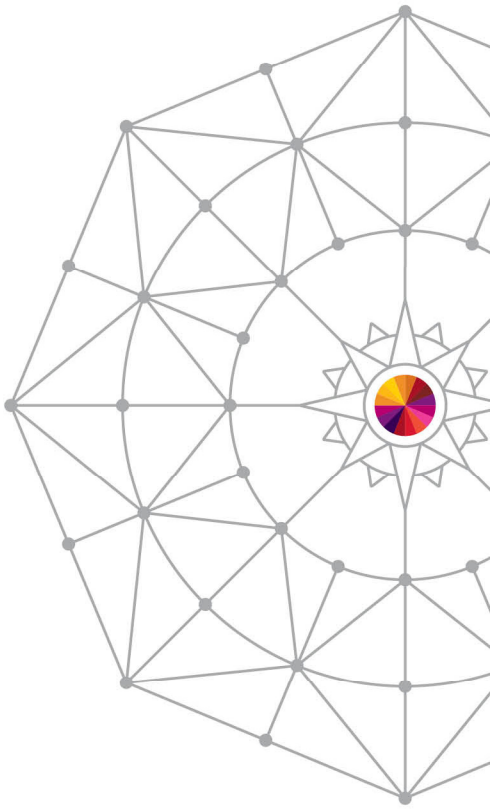
- Deletes an existing generation
- Takes a member name and generation number
- Leaves a gap in the generation list
- If issued with a generation of 0, deletes the member without creating a generation



PDSE Member Generations: STOW Macro

RG (Replace Generation)

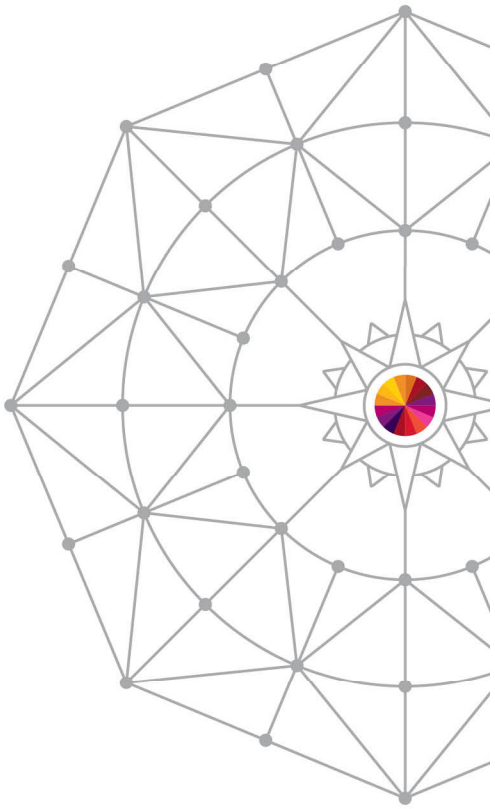
- Replaces an existing generation
- Adds a generation if replacing a gap in the generation list



PDSE Member Generations: STOW Macro

RECOVERG (Recover Generation)

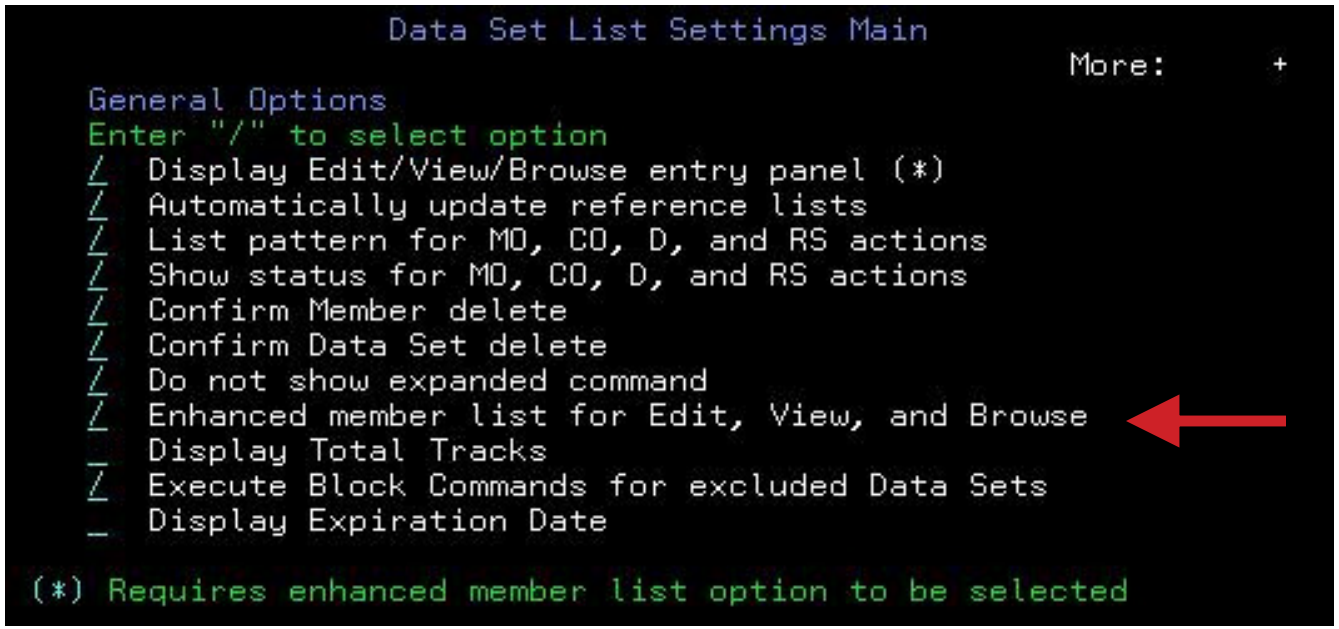
- Recovers an existing generation
- Removes the selected generation from the generation list and makes it the primary member
- Creates a new generation in the replace process from the former primary member



PDSE Member Generations: ISPF Support

Panels

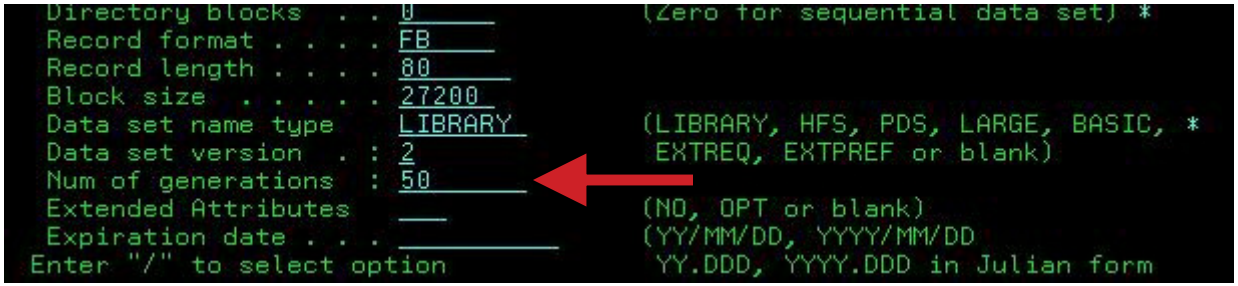
- ISPF now has generations support
- Enhanced member list option must be selected

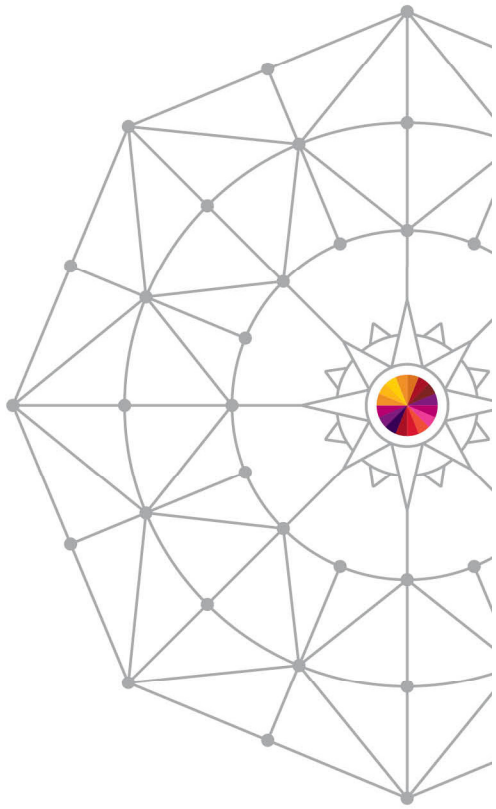


PDSE Member Generations: ISPF Support

Allocation

- Allocates like any other PDSE
- MAXGENS must be >0
- Be sure you're using version 2!

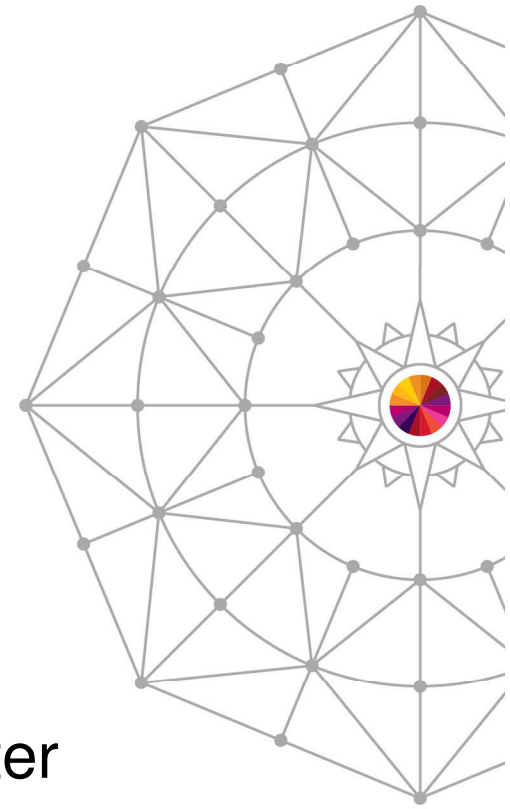




PDSE Member Generations: ISPF Support

Restrictions

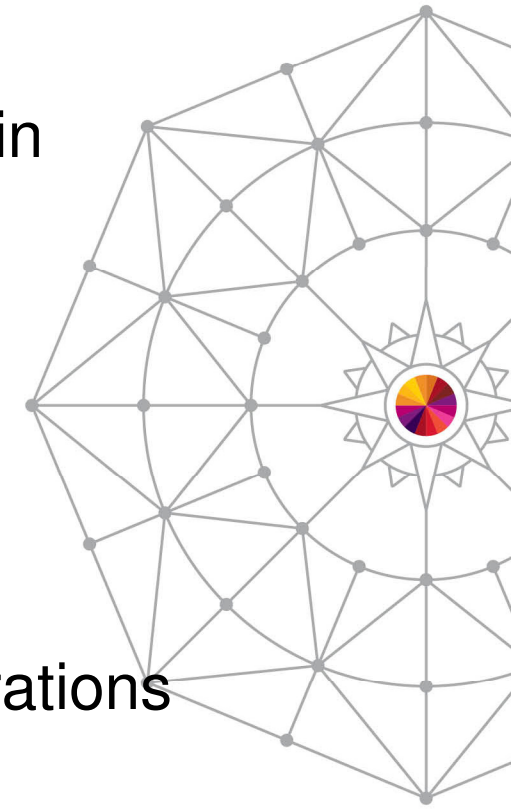
- ENQUEUEing on one generation applies to all generations of that member
  - This is not a PDSE serialization restriction
  - The native API's allow for editing of multiple generations of the same member
- ISPF Options 1 and 2 do not support a GEN parameter
- ISPF 3.1 and 3.4 do support a GEN parameter



PDSE Member Generations: ISPF Support

Editing

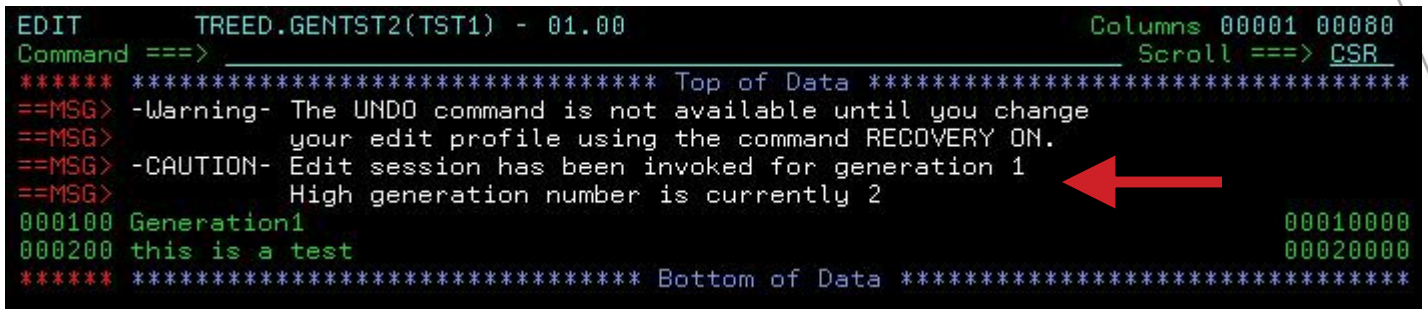
- Editing the current member (GEN 0) results in a new generation being created
- Editing prior generations does NOT result in a new member
- Supports referencing generations by either absolute or relative generation number
- Deleting a member in ISPF deletes all generations
  - This is an ISPF implementation feature
  - TSO DELETE pdse(member) deletes only the primary



PDSE Member Generations: ISPF Support

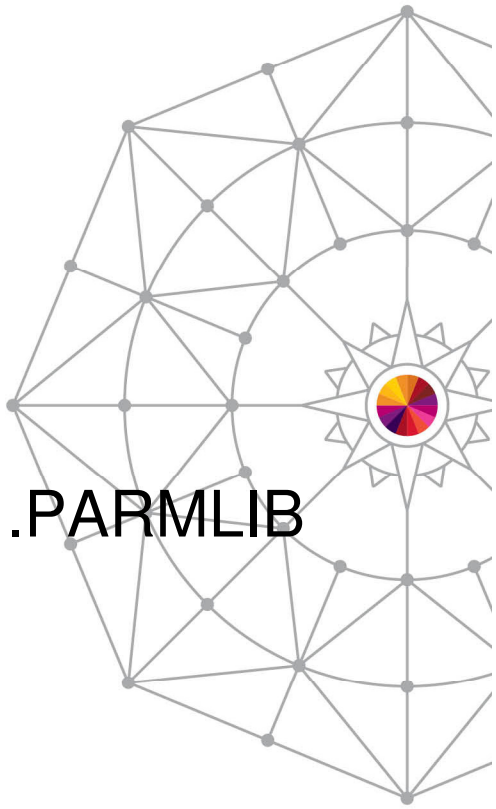
Editing Cont'd

- Generation creation behavior can be forced
  - SAVE NEWGEN – Creates a new generation
  - SAVE NOGEN – Does not create a new generation
- Edit will tell you which absolute generation you are working with



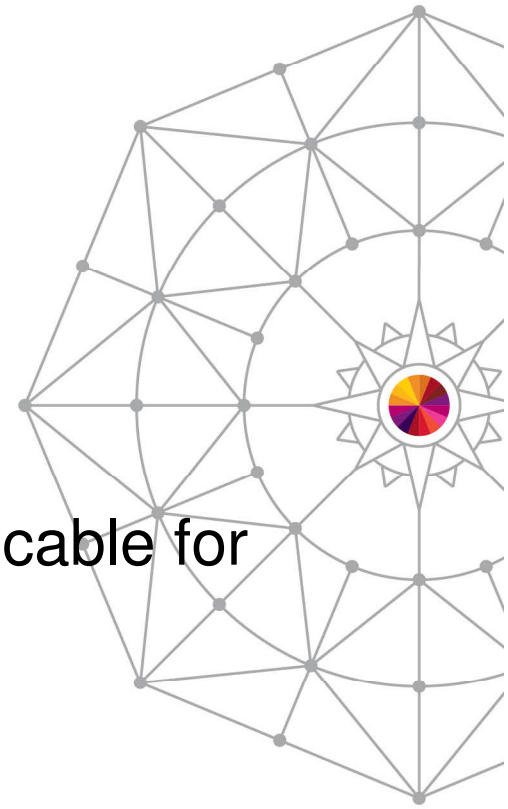
How to create Version 2 PDSEs

- New option for DSNTYPE keyword
  - DSNTYPE=(LIBRARY,{1,2})
    - 1– Version 1 PDSE (Default)
    - 2 – Version 2 PDSE
    - Supported for JCL, TSO Allocate
- New options for IGDSMSxx member in SYS1.PARMLIB
  - DSNTYPE=({LIBRARY|PDS|HFS},{1,2})
  - MAXGENS_LIMIT (1 – 2bn)
- Precedence:
  - DSNTYPE on JCL takes precedence over PARMLIB



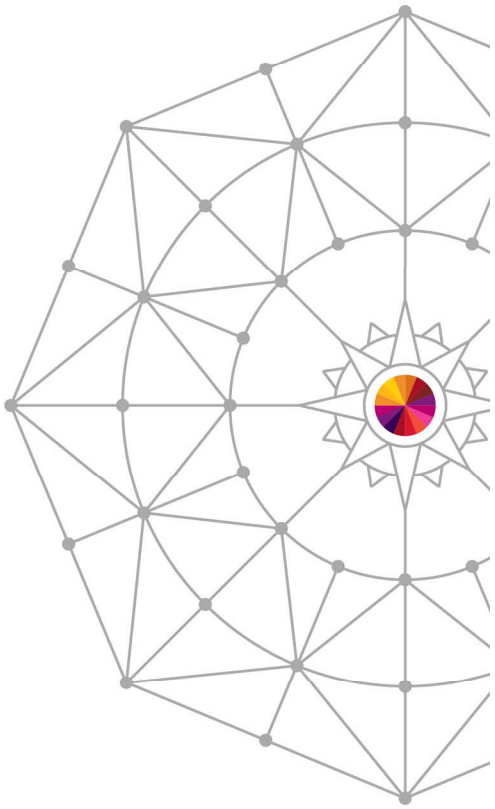
Usage Expectations

- Long Term
  - It is expected that PDSE users will specify DSNTYPE=(LIBRARY,2) in their IGDSMSxx parmlib member
  - It is expected that V2 data sets will eventually supplant V1 data sets
- The following usage considerations are applicable for mixed PDSE V1 and V2 environments



How to differentiate PDSE versions

- ISMF
  - Dataset List: Version added to data under column ‘DATA SET NAME TYPE’
- ISITMGD
  - New field added: ISMDSNVER
- SMF Type 14/15
  - New field added: SMF14DSVER



How to differentiate PDSE versions: ISMF

- Dataset List Example

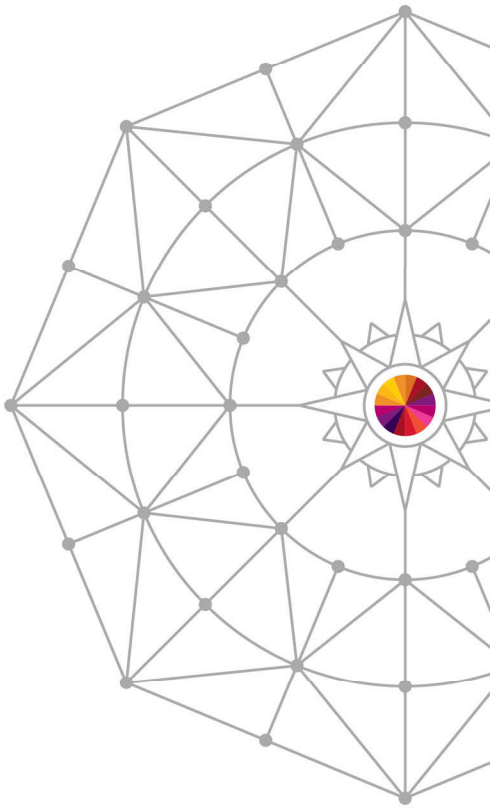
```
------------------------------------------------------------------------------
DGTLGP13                          DATA SET LIST
Command ===>                                                Scroll ===> CSR
                                                      Entries 22-38 of 38
Enter Line Operators below:                           Data Columns 30-33 of 42
      **FILTERED LIST**                                **ENTRIES HIDDEN**
     LINE                                    DATA SET   NUM OF    ENTRY      REBLK
     OPERATOR          DATA SET NAME         NAME TYPE  STRIPES   TYPE        IND
    ---(1)----  ------------(2)------------ --(30)---  -(31)--  --(32)--  (33)-
                SYS1.LINKLIB                OTHERS          --  NONVSAM    NO
                SYS1.LINKLIB.PDSE0          LIBRARY,1       --  NONVSAM    NO
                SYS1.LPALIB                 OTHERS          --  NONVSAM    NO
                SYS1.LINKLIB.PDSE2          LIBRARY,2       --  NONVSAM    NO
```

- Version displayed with data set type

How to differentiate PDSE versions cont.

- Note:
  - Neither IEHLIST LISTVTOC nor LISTPDS can be used to identify Version 2 PDSE data sets
  - No VTOC bit is set for Version 2 data sets

- PDSE data set versions are internally self describing



Coexistence

- Coexistence APARs:
  - OA39530
  - OA40844
  - OA41790

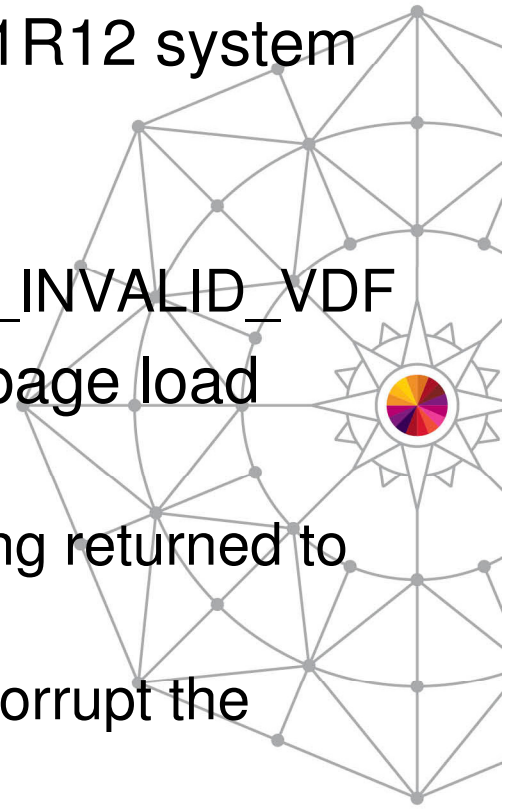
- Down-level systems (z/OS V1R12 and V1R13)
  - Coexistence APARs allow for access to PDSE Version 2 datasets
  - PDSE Version 2 data sets **cannot** be created below V2R1

Diagnostics

- Existing diagnostics updated to support PDSE Version 2 data sets
  - IEBPDSE
  - IGWFPMAN
  - IGWPIT
- Coexistence APARs are required for compatibility

Unsupported Releases

- Attempting to open a V2 data set on a pre-V1R12 system will result in a 0F4 ABEND
  - ABEND 0F4 RC=24 RSN=01045AF1
  - Reason Code 01045AF1 translates to: JCDM_INVALID_VDF
- PDSE Connect Processing will fail on initial page load checks
  - Prevents invalid data set information from being returned to the client
  - Prevents any processing that could break or corrupt the Version 2 PDSE from occurring



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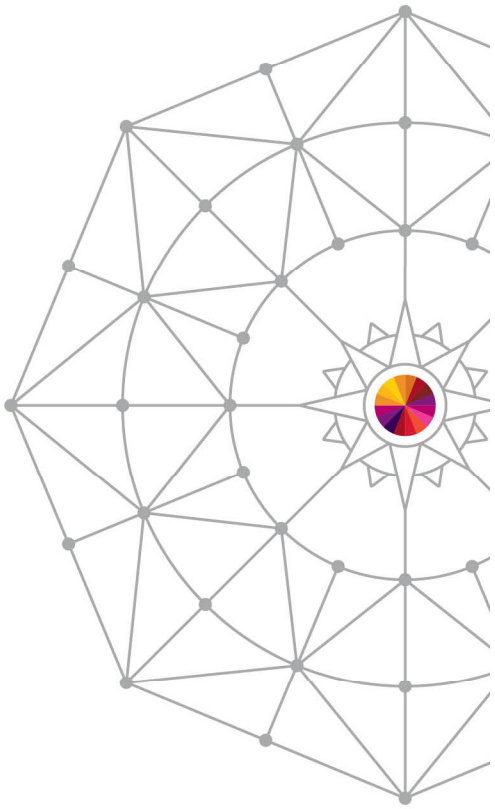

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