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zFS V5 Migration and Performance

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Agenda “zFS V5 Migration and Performance ”

- What are V5 Filesystems
  - Differences between V4 and V5
- V5 Conversion Details
  - Controls
  - Utilities and programs
- V5 Exploitation Strategy
- V5 Performance Preliminary Data
- Backup Information:
  - New Salvager, and Quiesce updates

Terminology/Abbreviations

- **File System = Aggregate**

  Because zFS has removed multi-file system aggregates and clones in z/OS 2.1, the term file system and aggregate can be considered synonymous.

  This presentation uses the term file system where the publications might use the term aggregate and/or file system but they are equivalent now with z/OS 2.1.

- zFS file systems (aggregates) have a major and minor version stored inside them. The **zfsadm aggrinfo –long** command will show you these two numbers today:

  example: version 1.4 will be shown if you issue this command on z/OS 13.

- **V4 = Version 1.4**, and **V5 = Version 1.5**

  z/OS 2.1 introduces an optional version 1.5 aggregate (file system).

  This presentation simplifies the terminology to v4 file system (current version in the field) and v5 file system (new optional file system with z/OS 2.1).

- A v5 file system has the option to store directories in a new format (a tree) for fast lookup/insert/delete. The publications refer to directories stored in this new format as “extended (v5) directories”. This presentation simplifies it to v5 directory and refers to the original directory format available today in the field as v4 directory.

V4 and V5 Filesystems Comparison

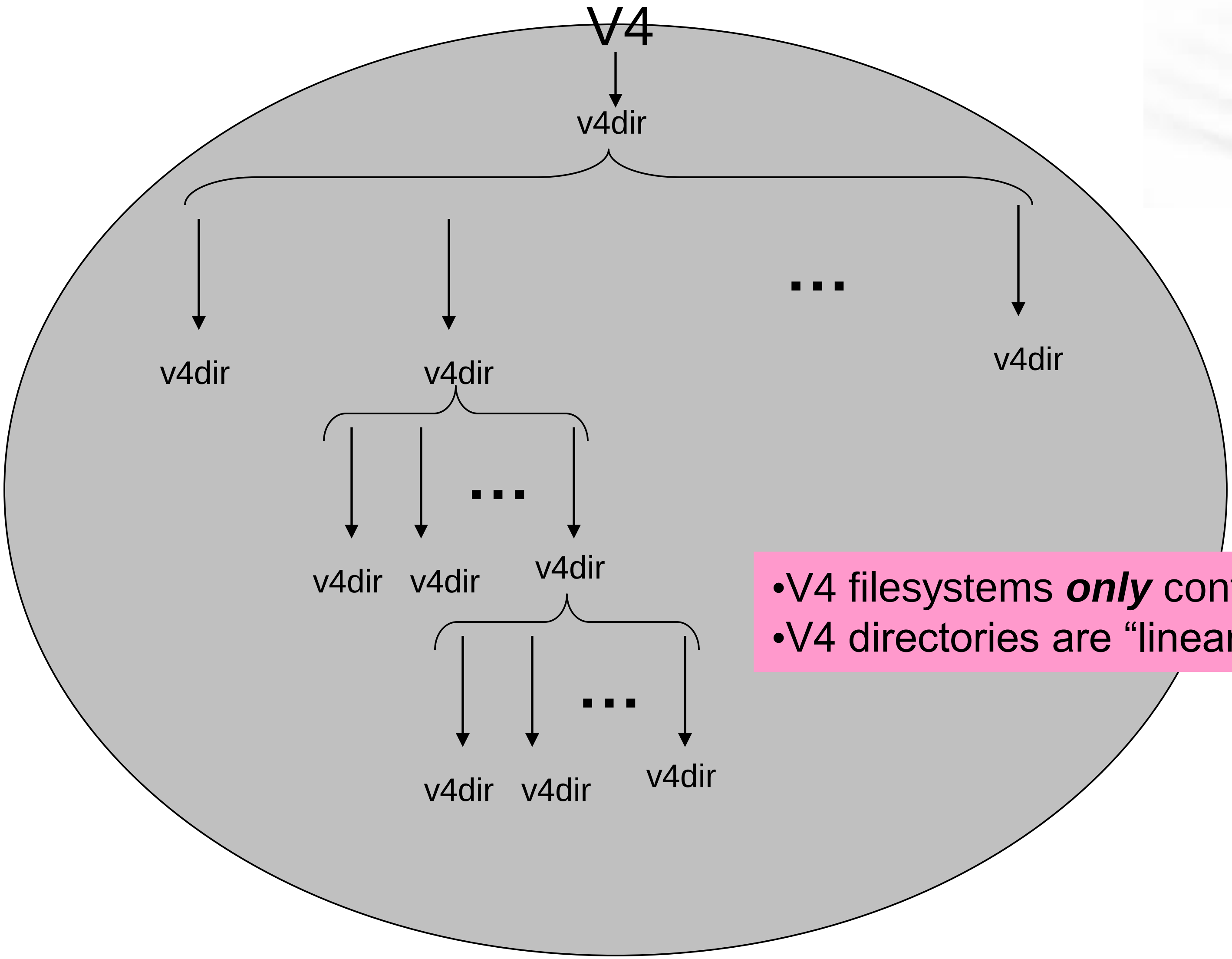
V4 filesystems **(in z/OS V1R13 and prior):**

- Has *linear* (v4) directory formats on disk
- V4 directories with thousands of names or more suffer significant performance degradation.
  - **>50,000 names and IBM recommends that HFS contain the directory** (but HFS is significantly worse for file IO)
- **V4 filesystems are still fully supported and will be for a long time (possibly forever)**

V5 filesystem **(optional, in z/OS V2R1+ only):**

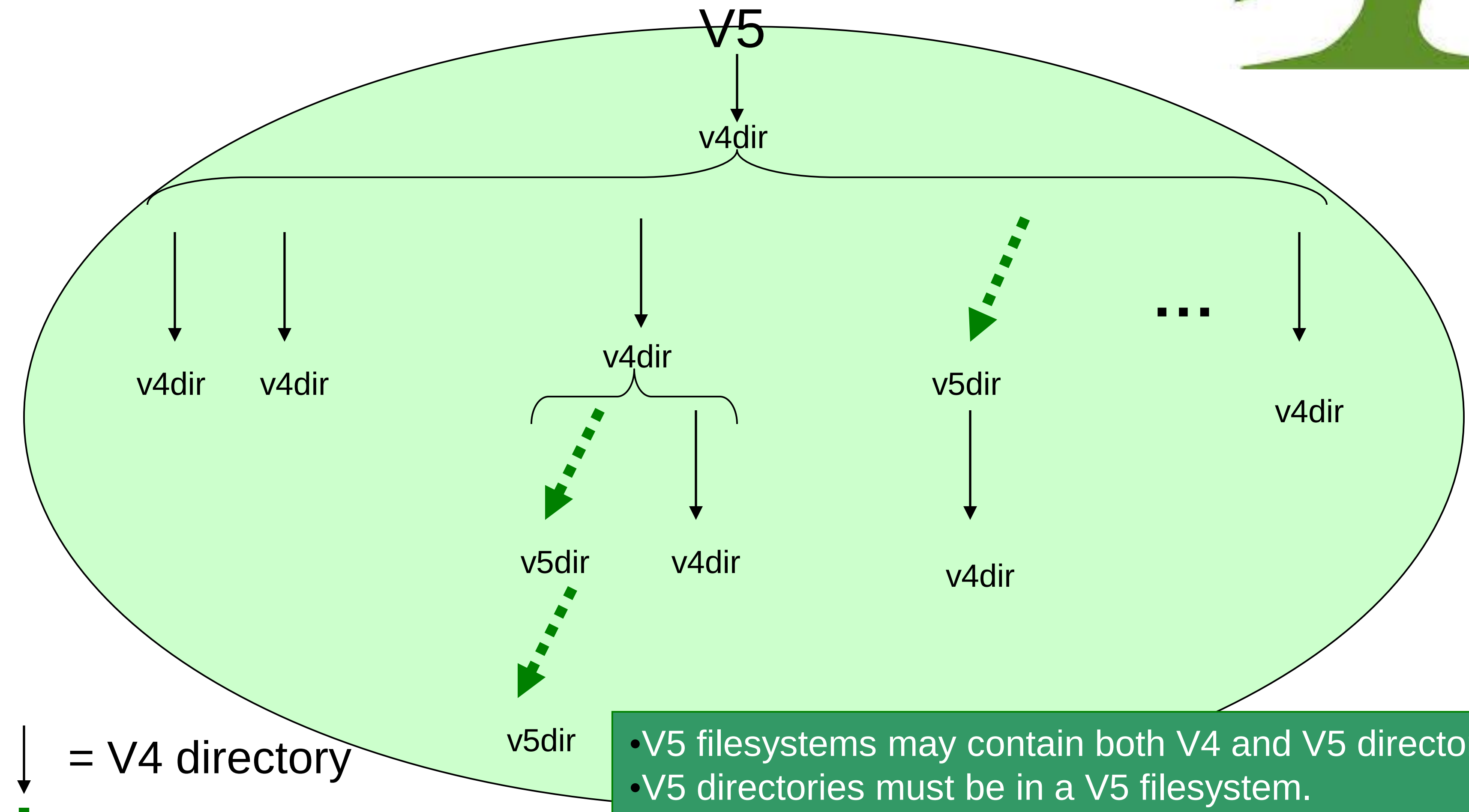
- Provides new *tree* (v5) directory format: faster insert/search/delete
- Can contain both v4 (linear) and v5 (tree) directories
- Optional, not the default on z/OS V2R1
- Can only be mounted on z/OS V2R1
- **IBM recommends you do not start to use V5 filesystems until you are fully on z/OS V2R1 with no plans to go back to prior releases.**

V4 and V5 Filesystems Comparison



- V4 filesystems ***only*** contain V4 directories
- V4 directories are “linear”

V4 and V5 Filesystems Comparison



V5

v4dir

v4dir v4dir v4dir v5dir ... v4dir

v5dir v4dir v4dir

v5dir

↓ = V4 directory

⇣ = V5 directory

- V5 filesystems may contain both V4 and V5 directories.
- V5 directories must be in a V5 filesystem.
- Filesystem will be implicity converted to V5, when the first V5 directory is converted, if not already converted.
- V5 directories are “tree”.

V5 Filesystems:

- **More than 4 billion = limit of sub-directories in a directory**
  - (v4 limit is 65,535)
- **16TB file system size limit (**file size still limited to 4TB**)**
  - (v4 limit is 4TB)
- **Can create a new v5 file system**
  - **zfsadm format, IOEAGFMT, IOEFSUTL**
- **New facilities to convert existing v4 file systems** (and their directories) to v5:
  - Offline conversion facility (**IOEFSUTL**):
    - can convert v4 to v5 and also v5 to v4
  - Online conversion facilities (**zfsadm convert, and IOEFSPRM CONVERTTOV5 option** …)
    - v4 to v5
- **New query and APIs** to determine directory version (4 or 5) (**zfsadm fileinfo**)

Version 5 File Systems – Disk Space Usage

- V5 file system pages use a prefix/postfix scheme to pack more names in a directory page than v4 if the names fit a common pattern at the beginning or end of the name.
  - Can result in 4X more names in a page over a v4 file system.
- V4 file systems can place a name in any directory page that can contain the name.
  - V5 directories must put the name in the page in the tree that is supposed to contain the name, thus leaving less flexibility in placement.
- Thus, there are cases where a v5 directory could use less space than a v4 directory and situations where it could use more.

➔ IBM expects that the disk space used by v5 directories to be roughly equivalent to v4 directories on average.

v5 File Systems – Conversion Info

- Any **new** directories created in a v5 file system will be v5.
- A v5 filesystem can contain both v4 and v5 directories.
  - To support migration of an existing v4 filesystem to v5.
- Options for conversion of existing directories:
  1. Leave them all v4 (new dirs will be v5)
  2. Convert them as they are accessed
  3. Convert them at the time the filesystem is converted (use IOEFSUTL off-line utility)

v5 File Systems – More Details

V5 File Systems Can Only Be Processed on z/OS 2.1

- zFS will not allow creation of a v5 or conversion of a v4 to v5 if R13 or prior members exist in a sysplex.
- R13 and prior systems will fail MOUNTs of v5 file systems.
- Do not use v5 file systems until all systems at your site are z/OS 2.1 or later.
- **IOEFSUTL converttov4** can convert a v5 file system back to v4 in most cases.

v5 File Systems – Conversion Details

- **Changing File System from v4 to v5:**
  - Fast operation, simply updates some global fields on disk.
    - After this conversion, any future directories created are v5
    - File system can be up to 16TB in size
    - And allows the individual directories to be converted from v4 to v5.

V5 File Systems – Conversion Details

- **Converting a v4 Directory to a v5 Directory:**
  - □ Stops user activity to the directory (if the file system is mounted)
  - □ Creates a new hidden v5 directory (gets deleted if system crashes at next mount time)
  - □ Copies names from original v4 directory to hidden v5
    - This could require disk space, and if file system space exhausted will dynamically grow file system if dynamic grow is allowed for the file system.
  - □ If prior step successful, atomically swaps the hidden v5 with the v4 making the v4 hidden.
    - A crash after this point in time will delete original hidden v4 and the new v5 remains.
  - □ Delete hidden v4 directory
  - □ Resume user activity

→ A conversion from v5 to v4 works the same way, just swap the terms v4 and v5.

A v4 to v5 conversion performance experience:

•3,500 names/sec on z9/FICON DASD

•10,000 names/sec on zEC12/FICON DASD

v5 File Systems – Kernel Parameters

- **Kernel Conversion Parameters (IOEPRMxx)**
  - □ **CHANGE_AGGRVERSION_ON_MOUNT** = **ON/OFF**
    - Will set file system version to 5 at R/W mount time, fast operation.
  - □ **CONVERTTOV5**=**ON/OFF**
    - Will set file system version to 5 (if not already) and convert root directory at R/W mount time (if not already in the new format)
    - Will convert each old-format v4 directory to the new format *upon first access.*
  - □ **FORMAT_AGGRVERSION** = **4/5** – controls whether zfsadm format, ioefsutl and ioeagfmt, by default create a version 4 or 5 file system.
    - This avoids the need to update existing programs and JCL to specify that you want a v5 file system.
    - Automount, ISHELL use this parameter.

v5 File Systems – More Parameters

- **MOUNT parameter**
  - □ **CONVERTTOV5 / NOCONVERTTOV5** – Overrides IOEPRMxx ***CONVERTTOV5*** setting for file system. If not specified then IOEPRMxx ***CONVERTTOV5*** option takes effect.

- **IOEAGFMT/zfsadm format – existing format programs**
  - □ ***-version4 / -version5*** – New parameters specify the version of the file system to create.
  - □ Default is to get value of **format_aggrversion** parameter from zFS kernel to determine file system version to create. zFS kernel must be active.

v5 File Systems – IOEFSUTL

- **IOEFSUTL – new batch program with 4 commands for non-mounted file systems:**

1. **Format** - Can format/create new file system (v4 or v5).
2. **Converttov5** – Converts a v4 file system and all its directories to v5.
3. **Converttov4** - Can convert existing version 5 file systems back to version 4 format:
   - IFF – no directory has more than 65,535 sub-directories
   - IFF – file system is < 4TB in size.
4. **Salvage** - Can verify and repair both v4 and v5 file systems like **ioeagslv** does.

→ **IOEFSUTL** is the IBM future direction for zFS batch programs, although **ioeagfmt** and **ioeagslv** will remain supported, new batch function will be placed in **ioefsutl**.

v5 File Systems – salvage program

- **IOEAGSLV – completely re-written to support both v4 and v5 file systems.**
  - Scales to largest zFS file systems
  - Has new messages that provide more details on the progress and results of the verification and repair.
  - Designed to repair in one pass, though two recommended if a repair required.

v5 File Systems –zfsadm convert

- **zfsadm convert** – **new z/OS UNIX shell command, operates on mounted file systems:**

zfsadm convert –aggrversion *filesysname*

- Only changes the v4 filesystem to v5 (no directories)

zfsadm convert –path *pathname*

- Convert a specific directory to v5
- If filesystem not already changed to v5, it will change to v5
- Makes sure local application do not have directory open, but cannot check NFS/SMB remote applications, so be careful.

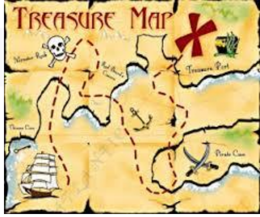
- Issuer must be owner with write access, and be UID 0 or have READ authority to SUPERUSER.FILESYS.PFSCTL

v5 File Systems – zfsadm fileinfo

- **zfsadm fileinfo – displays detailed file information:**
  - **zfsadm fileinfo -path <*pathname*> [{-globalonly | -localonly | -both}]**

```
path: /home/suimghq/lfsmounts/PLEX.ZFS.FS2/DCEIMGHQ.ftestLD.p6/.
   ★★★  global data     ★★★
  fid                       7,174515      anode                  130931,2028
  length                    33546240      format                 BLOCKED
  1K blocks                 21664         permissions            755
  uid,gid                   0,10          access acl             33,72
  dir model acl             33,72         file model acl         32,72
  user audit                F,F,F         auditor audit          N,N,N
  set sticky,uid,gid        0,0,0         seclabel               none
  object type               DIR           object linkcount       39686
  object genvalue           0x00000000    dir version            5
  dir name count            39686         dir data version       160308
  dir tree status           VALID         dir conversion         na
  file format bits          na,na,na      file charset id        na
  file cver                 na            charspec major,minor   na
  direct blocks             0x000D91FE    0x000D91FF    0x000D9200    0x000D9201
                            0x000D9202    0x000D9203    0x000D9204    0x000D9205
  indirect blocks           0x000D9206    0x00052199
  mtime        May 28 17:09:45 2013     atime        May 28 17:09:19 2013
  ctime        May 28 17:09:45 2013     create time  May 28 15:14:48 2013
  reftime      none
```

v5 File Systems - Exploitation Strategy

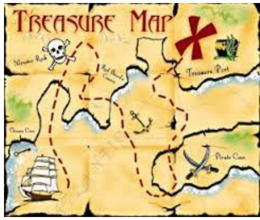


1. **Delay converting remaining HFS to zFS file systems until z/OS 2.1:**
   - Unless you have an immediate need to convert an HFS to zFS (typically due to file IO performance issues with HFS):
     - Wait until your site is at z/OS 2.1 and later before migrating the file system to zFS
       - *So you can use v5 format for improved directory performance and avoid a conversion from v4 to v5 format.*
2. **Do not use v5 until fully ready to commit to z/OS 2.1 for all systems.**
   - Going back to v4 via IOEFSUTL could be lengthy and manual, wait until it is safe before using v5.
     - There is no IOEPRMxx CONVERTTOV4 option.
3. **Set IOEPRMxx format_aggrversion=5:**
   - Future file systems get created as version 5
     - And avoids having to change JCL and other programs.

v5 File Systems - Exploitation Strategy…Cont’d

4. **Set IOEPRMxx change_aggrversion_on_mount=ON**
   - Safe since it is a fast operation and ensures future directories are v5 format.

5. **Determine if IOEPRMxx CONVERTTOV5 can be globally enabled**
   - This depends on how many directories are accessed at IPL time, the number of names in each and the known zFS conversion performance results and the expected amount of delay to the system IPL.
     - User has to decide if they can tolerate the expected one-time IPL delay
     - And if they can, simply specify **CONVERTTOV5**=ON in **IOEFSPRM**.



6. **And if cannot globally enable, then:**
   - Determine highest usage file systems via RMF, or **F ZFS,QUERY,FILESETS** and commands shown previously.
   - Also look at file systems with large directories, especially if they are high usage and then use the **CONVERTTOV5 MOUNT** parameter selectively.(Or **IOEFSUTL** for offline full conversion.)

Version 5 File Systems- Performance

z/OS 2.1 Improves zFS Directory Performance:

New v5 file system directory trees make directory name lookup, insertion, & removal fast for larger directories.

- Directory searches scale well as names are added to the dir
- Directory searches can be performed in parallel (most of the time) with directory updates to the same directory.

For **<u>both</u>** v4 and v5 file systems:

- **z/OS UNIX and zFS teams improved readdir+ performance for large directories.**

  → (used by **ls –l** and NFS server for example)
- **zFS greatly improved sysplex client directory operation performance** … by reducing communications between clients and servers for **readdir** operations.

Sample Performance Workload Descriptions:

- Performance results (on subsequent slides) were obtained using 3 workloads created by IBM:
  - All workloads involved many tasks processing 2,000 objects in each directory, for multiple directories, on multiple file systems
    - And adding “base names” solely to fill up the directories
  - **ptestDL2** – This workload did repeated lookup (name searches) by the tasks.
  - **ptestDL** – The tasks did repeated lookup and readdir functions.
  - **ptestDU** – The tasks performed directory create/update/remove/readdir/search.

- Definitions used:
  - **External Throughput (E)** – Number of operations per unit of time.
    - higher the number →lower the average operation response time.
  - **Internal Throughput (I)** – Number of operations per unit of processor time.
    - higher the number→ less CPU time each operation took.

- Tests were run varying the sizes of the involved directories to test scale-ability.

Version 5 File Systems – Performance Results ptestDL2

- **ptestDL2 (Directory Search) Results on zEC12 / FICON connected DASD**

	Monoplex Results			Sysplex Client Results		
Directory Sizes	R13 Operations / Second	z/OS 2.1 V4 Ratio over R13	**z/OS 2.1 V5** Ratio over R13	R13 Operations / Second I per processor	z/OS 2.1 V4 Ratio over R13	**z/OS 2.1 V5** Ratio over R13
0 Base Names (2,000 names per directory)	E=307703 I=307703	E∆ 1.005 I∆ 1.005	**E∆ 1.197** **I∆ 1.197**	E=232427 I=55067/proc	E∆ 0.996 I∆ 0.980	**E∆ 1.416** **I∆ 1.378**
18k Base Names (20,000 names per directory)	E=80840 I=80840	E∆ 0.964 I∆ 0.964	**E∆ 4.536** **I∆ 4.536**	E=44532 I=10536/proc	E∆ 0.933 I∆ 0.933	**E∆ 7.271** **I∆ 7.098**
48k Base Names (50,000 names per directory)	E=34598 I=34598	E∆ 0.964 I∆ 0.964	**E∆ 10.026** **I∆ 10.026**	E=18308 I=4333/proc	E∆ 0.918 I∆ 0.918	**E∆ 16.668** **I∆ 16.297**

- **V5 file system search performance scales almost linearly with directory size**
- V5 Sysplex client performance improves 40% even for small directories, 16X for directories with 50,000 names.
- **vnode_cache_size**=400000, **meta_cache_size**=100M, **metaback_cache_size**=2G
- V5 file system monoplex performance improves 20% for small directories, 10X for directories with 50,000 names.

Version 5 File Systems – Performance Results ptestDL

- **ptestDL (Dir. Search+Readdir) Results on zEC12 / FICON connected DASD**

	Monoplex Results			Sysplex Client Results		
Directory Sizes	R13 Operations / Second	**z/OS 2.1 V4** Ratio over R13	**z/OS 2.1 V5** Ratio over R13	R13 Operations / Second I per processor	**z/OS 2.1 V4** Ratio over R13	**z/OS 2.1 V5** Ratio over R13
0 Base Names (2,000 names per directory)	E=297285 I=297345	E∆ 1.002 I∆ 1.002	**E∆ 1.167** **I∆ 1.167**	E=216433 I=50474/proc	E∆ 1.064 I∆ 1.078	**E∆ 1.454** **I∆ 1.452**
18k Base Names (20,000 names per directory)	E=33908 I=33918	**E∆ 2.032** **I∆ 2.032**	**E∆ 5.978** **I∆ 5.977**	E=2620 I=638/proc	**E∆ 12.834** **I∆ 8.840**	**E∆ 77.549** **I∆ 51.830**
48k Base Names (50,000 names per directory)	E=12717 I=12720	**E∆ 2.258** **I∆ 2.258**	**E∆ 9.160** **I∆ 9.160**	E=384 I=97/proc	**E∆ 35.490** **I∆ 22.237**	**E∆ 276.67** **I∆ 174.81**

- Since readdir is in the mix, its response time is dependent on directory size
- V5 monoplex performance: improves 17% for small, 9X for larger directories.
- V5 sysplex client performance improves 45% for small, 277X for larger directories
- Sysplex clients do server communication for attributes of base files
  - →**This is why ETR differs from ITR, we improved performance for client to server communications for both v4 and v5 file systems, hence the large improvement.**

Version 5 File Systems – Performance Results ptestDU

- **ptestDU (Dir. Reading and Writing) Results on zEC12 / FICON connected DASD**

	Monoplex Results			Sysplex Client Results			
Directory Sizes	R13 Operations / Second	z/OS 2.1 V4 Ratio over R13	**z/OS 2.1 V5** Ratio over R13	R13 Operations / Second I per processor	z/OS 2.1 V4 Ratio over R13	**z/OS 2.1 V5** Ratio over R13	
0 Base Names (2,000 names per directory)	E=109584 I=119372	E∆ 1.055 I∆ 1.022	**E∆ 1.167** **I∆ 1.167**	E=65384 I=11076/proc	E∆ 1.053 I∆ 1.059	**E∆ 1.249** **I∆ 1.226**	
18k Base Names (20,000 names per directory)	E=31688 I=31943	E∆ 1.566 I∆ 1.483	**E∆ 3.313** **I∆ 3.586**	E=7441 I=1675/proc	**E∆ 3.528** **I∆ 2.780**	**E∆ 8.940** **I∆ 6.822**	*
48k Base Names (50,000 names per directory)	E=12667 I=12682	E∆ 1.741 I∆ 1.751	**E∆ 6.158** **I∆ 7.069**	E=830 I=205/proc	**E∆ 17.472** **I∆ 12.568**	**E∆ 65.110** **I∆ 47.891**	*

- V5 monoplex performance: improves 17% for small, 7X for larger directories.
- V5 sysplex client performance improves 25% for small, 65X for larger directories
- Results from last two rows in table hurt by small meta cache size:
  - →Due to zFS storage constraints, it was not possible to run with larger cache
  - * → z/OS V2.2 Preview! zFS kernel is planned to support 64-bit addressing (AMODE64), allowing you to use much larger data and object caches, and to support running zFS in the z/OS UNIX (OMVS) address space. It is expected to yield further performance gain for all workloads using zFS file systems

Judging v5 Benefits for Your Site

- **Typical Customer Usage Pattern:**

1. Directory search (lookup) most common operation, or at least one of the most frequent. (ptestDL2)
2. File Open/Read/Write/Close the next most common operations (ptestDU)

→**Note: z/OS 2.1 file IO performance is equivalent to z/OS 13 file IO performance.**

3. Directory update operations generally a much lower percentage of calls to zFS.

→**F ZFS,QUERY,KNPFS** will show you your workload characteristics in terms of what operations are most common for you.

Judging v5 Benefits for Your Site…Cont'd

- **The Bigger the Directory...**
  - As shown in the prior slides, directory performance is improved even for smaller directories (2,000 names). Directories over 10,000 names will likely see non-trivial reduction in directory operation time inside zFS!
  - The **F ZFS,QUERY,FILESETS** can be used to identify your most active file systems.
  - And the **ls –slk** will show your directory size on disk in kilobytes.
    - → Any directory over 160K in size is going to get a benefit with v5

Note: Above commands can be used to help determine v4→v5 conversion candidates.

Benefits for your site: Performance Summary

- **Sysplex Client – Nice Performance Gain with V5 (and even V4)**
- **Summary:**
  - **If zFS (or HFS) is heavily used in your installation, AND you have:**
    - **High usage zFS or HFS file systems, or file systems with active larger directories AND/OR**
    - **You are using zFS sysplex RWSHARE support and access data on a non-owner,**
  - **Then zFS V5 File System and the z/OS 2.1 enhancements are going to help your environment.**

Backup Information

- New Salvager
- Quiesce Updates

New Salvager - Summary

- **Completely rewritten in z/OS 2.1:**
  - Scales to largest file systems, avoiding abends present with the previous salvager.
  - Runs much faster
    - Note: Large file systems may still take a long time to verify and repair
  - Uses official z/OS messages for all communications to the user
  - The inputs to the program are mostly the same
    - Can specify a dataset that contains parameters much like the zFS kernel and/or use parmlib search.
  - But the output messages are completely different as shown in following slides.
- **Supports both V4 and V5 File Systems.**
- **Invoked via:**
  - **IOEAGSLV** – for compatibility with existing programs.
  - **IOEFSUTL salvage** – preferred method of invocation for the future.
- **Can Verify and Repair in One Pass**
  - If corrupt, will mark file system damaged, and if not repaired, a subsequent **MOUNT** would show message number **IOEZ00783E**.
  - However IBM recommends that if corruptions are found:
    - Perform a second repair pass to prove file system is truly corrected.
      - *If not corrected then report the problem to IBM.*
    - Should always be certain a file system is truly fixed before using it.

New Salvager – Sample Verification

```
IOEZ00559I zFS IOEFSUTL: Initializing z/OS zFS
Version 02.01.00 Service Level s15.
Created on Tue Feb 5 09:15:55 EST 2013.
Address space asid x1C
IOEZ00178I CFCIMGNJ.PARMLIB(IOEFSPRM) is the configuration dataset currently in use
IOEZ00707I Log file size 107 8K blocks, verified correct
IOEZ00729I Verification of aggregate SUIMGNJ.HIGHRISK.TEST started
IOEZ00705I Formatted v5 aggregate size 10800 8K blocks, dataset size 10800 8K blocks
IOEZ00707I Log file size 107 8K blocks, verified correct
IOEZ00709I Bitmap size 2 8K blocks, verified correct
IOEZ00782I Salvage has verified 17 of 175 pages in the anode table.
IOEZ00782I Salvage has verified 34 of 175 pages in the anode table.
....
IOEZ00782I Salvage has verified 153 of 1530 directories in the directory tree.
IOEZ00782I Salvage has verified 306 of 1530 directories in the directory tree.
....
IOEZ00722I Primary file system size 465 8K blocks, verified correct
IOEZ00739I Salvage processed 1573 directory pages, 4128 anodes, 3 indirect blocks and 175
anode table pages.
IOEZ00730I Verification of aggregate SUIMGNJ.HIGHRISK.TEST completed, no errors found
```

- **Note that the new program has progress indicators to show its still running**
- **Shows how many objects were processed**.

New Salvager – Sample Repair Case where File System was Corrupt

```
....
IOEZ00729I Verification of aggregate SUIMGNJ.HIGHRISK.TEST1 started
IOEZ00705I Formatted v5 aggregate size 41040 8K blocks, dataset size 41040 8K blocks
IOEZ00707I Log file size 107 8K blocks, verified correct
IOEZ00709I Bitmap size 6 8K blocks, verified correct
IOEZ00703E Corruption: Anode Table (T3): direct block index=6 physPage=8
IOEZ00704E Expected: Anode Table (T3): physPage=8 not alllocated to another object
IOEZ00703E Corruption: Anode Table (T2): allocated=12032 visible=12032
IOEZ00704E Expected: Anode Table (T2): calculated allocated=12024 visible=12024
...
IOEZ00723E Primary file system on aggregate SUIMGNJ.HIGHRISK.TEST1 is corrupted
IOEZ00703E Corruption: Bitmap (B18): bits array in Bitmap physPage 00000001 logPage/offset/value=<0 2319
000000FF>
IOEZ00703E Corruption: Bitmap (B18): represented physPage 1386
IOEZ00704E Expected: Bitmap (B18): bits array in Bitmap physPage 00000001 logage/offset/value=<0 2319
00000000>
.....
IOEZ00739I Salvage processed 16916 directory pages, 47972 anodes, 5 indirect blocks and 1500 anode table
pages.
IOEZ00733I Verification of aggregate SUIMGNJ.HIGHRISK.TEST1 completed and the aggregate is in error
IOEZ00735I Salvage found 16 minor errors of aggregate SUIMGNJ.HIGHRISK.TEST1
IOEZ00753I Salvage is repairing anode table pages.
IOEZ00755I Salvage is repairing the ZLC list.
IOEZ00756I Salvage is repairing file, directory, and ACL objects.
IOEZ00757I Salvage is repairing bitmap pages.
IOEZ00758I Salvage repaired 1 anode table pages, 0 partially free pages, 0 zlc pages, 0 indirect blocks.
IOEZ00787I Repair of aggregate SUIMGNJ.HIGHRISK.TEST1 completed
```

- **Message 703E/704E generally intended for IBM support.**

- **Messages 733I/758I/787I intended for user, shows if file system is corrupted and how many errors were repaired and if repair was successful.**

- You should run the program one more time and verify it indicates the file system is no longer corrupted if you see these.

Quiesce Updates - Summary

- **Problem: D OMVS,F does not show quiesced status for zFS file systems:**
  - zFS was handling file system quiesce operations independent of z/OS Unix
  - z/OS Unix displays did not properly show file system quiesce status.
- **IBM has corrected problem in z/OS 2.1:**
  - NORWSHARE file system quiesce now handled by z/OS Unix
    - Guarantees z/OS Unix display command correct.
  - RWSHARE file system quiesce still handled by zFS
    - But zFS notifies z/OS Unix of the quiesce, and z/OS Unix shows it in a “PFS Exception” string in its display commands.
  - zFS has also updated its **zfsadm aggrinfo –long** command to show

```
USSZFS.PLEX01.ZFS (R/W COMP QUIESCED): 2134143 K free out of total 2160000
version 1.4
auditfid D6C5F9F6 F7F70010 0000
266767 free 8k blocks; 7 free 1K fragments
21616 K log file; 56 K filesystem table
312 K bitmap file
Quiesced by job TOTTEN26 on system NP5 on Wed Feb 6 13:31:07.687179 2013
```

Quiesce Updates – z/OS UNIX Display Examples

- **NORWSHARE Examples:**
  - **D OMVS,F,N=USSZFS.PLEX01.ZFS**

```
PXO045I 15.14.39 DISPLAY OMVS 252
OMVS 0011 ACTIVE OMVS=(ST,R1,X9)
TYPENAME DEVICE ----------STATUS----------- MODE       MOUNTED   LATCHES
ZFS    425     QUIESCED            RDWR        01/30/2013   L=245
NAME=USSZFS.PLEX01.ZFS 15.13.24 Q=245
PATH=/u/totten/testdir
MOUNT PARM= norwshare
OWNER=NP5        AUTOMOVE=Y CLIENT=N
QSYSTEM=NP5 QJOBNAME=TOTTEN26 QPID= 50595795
```

- **df -Pkv /u/totten/testdir**

```
Filesystem              1024-blocks            Used         Available    Capacity     Mounted on
USSZFS.PLEX01.ZFS                  0            0            0            0%
ZFS,         Read/Write,           Device:401,               ACLS=Y
norwshare
File System Owner : NP5            Automove=Y                Client=N
Quiesce Owner :         NP5 Quiesce            Jobname : TOTTEN26     Quiesce PID :50595795
Filetag : T=off codeset=0
Aggregate Name : USSZFS.PLEX01.ZFS
```

Quiesce Updates – z/OS Unix Display Examples

- **RWSHARE Examples:**
  - **D OMVS,F,N=USSZFS.PLEX01.ZFS**

```
BPXO045I 15.07.53 DISPLAY OMVS 248
OMVS 0011 ACTIVE OMVS=(ST,R1,X9)
TYPENAME  DEVICE ----------STATUS-----------          MODE         MOUNTED   LATCHES
ZFS     423     ACTIVE                    RDWR         01/30/2013    L=245
NAME=USSZFS.PLEX01.ZFS 15.05.59 Q=0
PATH=/u/totten/testdir
MOUNT PARM= rwshare
OWNER=NP5 AUTOMOVE=Y CLIENT=N
PFS INFO:
PFS EXCP: QUIESCED
```

- **df -Pkv /petzfs1**

```
Filesystem                  1024-blocks                 Used          Available     Capacity      Mounted on
OMVSSPT.PETZFS1.ZFS    2492640                      973353         1519287       40%           /petzfs1
ZFS, Read/Write, Device:8793, ACLS=Y
File System Owner : Z1         Automove=U      Client=N
Filetag : T=off    codeset=0
Aggregate Name : OMVSSPT.PETZFS1.ZFS
PFS EXCP: QUIESCED
```

References

- SA23-2283-00 z/OS V2R1.0 Using REXX and z/OS UNIX System Services
- SA23-2280-00 z/OS V2R1.0 UNIX System Services Command Reference
- SA23-2285-00 z/OS V2R1.0 UNIX System Services File System Interface Reference
- SA23-2284-00 z/OS V2R1.0 UNIX System Services Messages and Codes
- GA32-0884-00 z/OS V2R1.0 UNIX System Services Planning
- SA23-2282-00 z/OS V2R1.0 UNIX System Services Programming Tools
- SA23-2281-00 z/OS V2R1.0 UNIX System Services Programming: Assembler Callable Services Reference
- SA23-2279-00 z/OS V2R1.0 UNIX System Services User’s Guide

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