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IBM Spectrum Scale | Spectrum Scale Immutability

Agenda

- **Overview**

Details

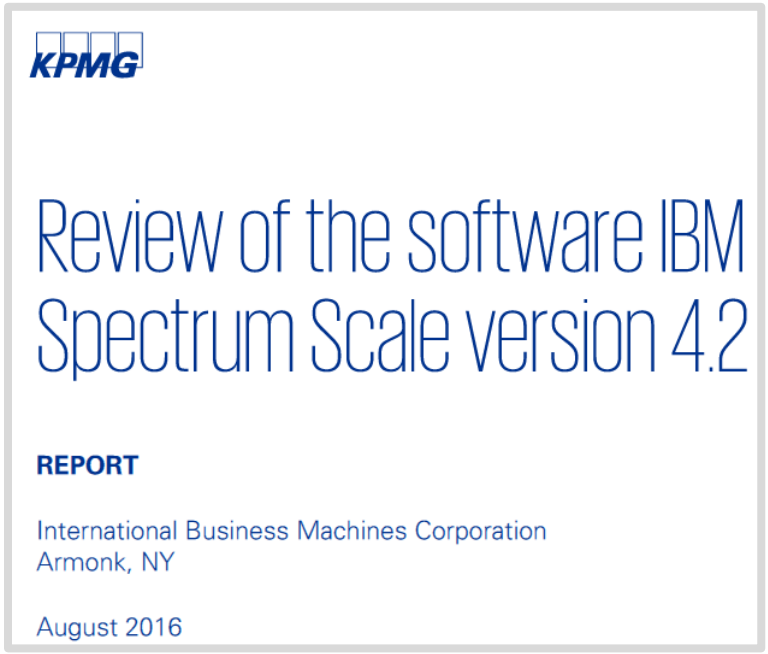
Overview

- Immutability means preventing changes and deletion of files during retention time
- Spectrum Scale Immutability provides WORM storage in GPFS fileset
  - Immutable files cannot be changed or deleted during retention period
    - Deletion is possible when retention time is expired
- Managing immutability works similar to NetApp® SnapLock®
  - Retention time can be set with last access date
  - WORM protection can be set by removing write permission

- Spectrum Scale also supports append-only mode similar to SnapLock
  - An empty file can be set to append-only by removing and adding write permission
  - Append-only file allows appends at the end
  - Append-only file can be made immutable by removing write permission once again

Spectrum Scale immutability – certified for compliance

- The immutability function in IBM Spectrum Scale Version 4.2 has been assessed for compliance in accordance to **US SEC17a-4f** rules, **German and Swiss laws and regulations** by a recognized auditor.



Assessment report: http://www.kpmg.de/bescheinigungen/RequestReport.aspx?41742
Certificate: https://www.kpmg.de/bescheinigungen/RequestReport.aspx?41743

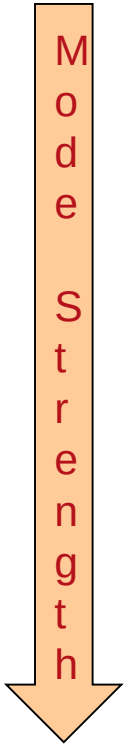
Immutable filesets

- Fileset is a logical partition in the file system allowing certain operations
  - Fileset is a directory in file system
  - Operations are immutability, snapshots*, quota, AFM caching*
- GPFS filesets can be configured with Integrated Archive Manager (IAM) mode
  - Possible for dependent and independent fileset
  - Honors the last access date as retention time
  - Makes the fileset „immutable“
- Files in immutable fileset can be set to immutable or append-only
  - Using standard POSIX or Spectrum Scale commands
  - Leverages file attributes immutable and appendOnly
  - Files in a immutable fileset are mutable when not set to immutable

* Independent filesets only

IAM modes

- **none**: Default setting for a normal fileset
- **advisory (ad)**: Allows setting retention times and WORM protection
  - But files can be deleted with the proper permission, whatsoever.
- **noncompliant (nc)**: Advisory mode plus
  - Files cannot be deleted if retention time is not expired.
  - But retention times can be reset and files can be deleted but not changed
- **compliant (co)**: noncompliant mode plus
  - Retention time cannot be reset.
  - When retention time has expired files can be deleted but not changed



- Modes can be upgraded, but not downgraded
- To set IAM use command: `mmchfileset -iam-mode`

Agenda

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Immutability is based on Extended Attributes

- GPFS 3.4 introduced two EA for files and directories: Immutable and AppendOnly
  - Immutability: files cannot be modified, appended or deleted
  - Append-Only: files cannot be modified or deleted, but appended
  - Applicable for any file and directory in a filesystem or fileset
  - Can be set and reset with command `mmchattr –i | -a`

- Spectrum Scale 4.1.1 introduced the concept of immutable filesets
  - Files within a immutable fileset can be set to immutable / append-only
  - Retention time can be set and is honored
  - Resetting these attributes is not possible in compliant IAM mode
  - Attributes immutability, append-only and retention times can be set with:
    - Standard file system commands: `touch –at and chmod –w`
    - GPFS command: `mmchattr –E | -i | -a`

Immutable and regular filesets

- File can be set to immutable in regular fileset and immutable fileset

Operation	Regular fileset	Immutable fileset*
Reset immutability attribute	yes	no
Reset append-only attribute	yes	no
Set immutability using mmchattr	yes	yes
Set append only using mmchattr	yes	yes
Set retention time using mmchattr	Yes	Yes
Set immutability using chmod	No	yes
Set append only using chmod	No	yes
Set retention time using touch	No	Yes
IAM mode set on fileset	No	yes
Set directory immutable	Yes	No

* Compliant mode

Managing immutability through Spectrum Scale

- Making fileset immutable:

```
mmchfileset filesystem fileset –iam-mode [mode]
```

- Setting retention time for file

```
touch –at MMddhhmmss filename   OR
mmchattr –E yyyy-mm-dd[@hh:mm:ss] filename
```

- Setting file immutable

```
chmod –w filename    OR
mmchattr –i yes filename
```

- Setting file to append-only
  - Create Empty file

```
chmod –w filename; chmod +w filename   OR
mmchattr –a yes
```

Showing immutability setting

- Show fileset immutability mode
  `mmlsfileset fs fset –iam-mode`

```
# mmlsfileset fs1 imm-test1 --iam-mode
Filesets in file system 'fs1':
Name       Status    Path                    IAM mode
imm-test1  Linked    /gpfs/fs1/imm-test1     compliant
```

- Show file immutability setting
  `mmlsattr –L filename`

```
#mmlsattr -L file0
file name:            file0
metadata replication: 1 max 2
data replication:     1 max 2
immutable:            no
appendOnly:           yes
indefiniteRetention:  no
expiration Time:      Thu Jul 16 00:00:00 2015
flags:
storage pool name:    system
fileset name:         imm-test1
snapshot name:
creation time:        Tue Jul 14 15:28:45 2015
Windows attributes:   ARCHIVE
Encrypted:            no
```

Managing immutable files through NFS using POSIX commands

- Setting retention time for file

```
touch –at MMddhhmmss filename
```

- Setting file immutable

```
chmod –w filename
```

- Show file retention setting

```
stat filename
File: ‘filename’
Size: 1               Blocks: 0
Access: (0444/-r--r--r--)
Access: 2016-05-03 17:00:00.000000000 +0200
Modify: 2016-05-03 14:31:59.462278718 +0200
Change: 2016-05-03 14:32:16.915516097 +0200
```

- Limitations
  - Append only mode does not work

Managing immutable files through SMB using PowerShell

- Set retention time via last access data

```
(dir filename).LastAccessTime = "yyyy-mm-dd hh:mm:ss"
```

- Set file to immutable (read-only)

```
(dir filename).Attributes = "ReadOnly"
```

- Show file retention setting

```
(dir * | select Name,LastAccessTime,Attributes
Name       LastAccessTime              Attributes
----       --------------              ----------
file1      03.05.2016 16:00:00         ReadOnly, Archive
file2      03.05.2016 16:02:17         Archive
```

- Limitations with SMB:
  - Retention time cannot be changed once file is set to immutable
  - Expired files cannot be deleted
  - Append only does not work

Additional options and functions

- Deletion of file systems with compliant filesets (mmdelfs)
  - Cluster-wide configuration parameter “indefiniteRetentionProtection” prevents this
    - Once set to yes deletion of file system is no longer possible
    - Cannot be set back to no once set to yes
- Deletion of compliant filesets (mmdelfileset)
  - Not possible at GPFS 4.2 and higher
- Backup and restore using mmbackup
  - Works with TSM B/A client 7.1.3 and above
  - In-place restore cannot overwrite and existing immutable file
  - Out-of-place restore does not set the immutability attribute and retention time
    - Using Spectrum Scale 4.2.1 and TSM 7.1.6 set immutability attributes on restore
- Spectrum Protect for Space Management 7.1.4 and above supports this

Considerations & limitations

- IAM mode can be set on existing fileset,
  - Existing files do not become immutable automatically
- When fileset is in compliance mode immutability flag cannot be removed from file
- Immutable filesets are not supported on AFM cache
- Recommendation is to to manage immutability with either touch/chmod or mmchattr commands
- Append-only mode is not possible through SMB or NFS
  - Retention time cannot be changed via SMB once file is immutable.

Links

- KPMG Assessment report:
  http://www.kpmg.de/bescheinigungen/RequestReport.aspx?41742
- Knowledge Center: Immutability
  http://www-01.ibm.com/support/knowledgecenter/STXKQY_4.1.1/com.ibm.spectrum.scale.v4r11.adv.doc/bl1adv_integratedarchiveplatform.htm?lang=en
- Spectrum Scale Immutability Whitepaper:
  http://www-03.ibm.com/support/techdocs/atsmastr.nsf/WebIndex/WP102620
- Spectrum Scale Immutabilitiy blog:
  https://www.ibm.com/developerworks/community/blogs/storageneers/entry/Insight_to_the_IBM_Spectrum_Scale_GPFS_Immutability_function?lang=en
  http://storagecommunity.org/easyblog/entry/ibm-spectrum-scale-immutability
- Immutability on SMB, NFS
  https://www.ibm.com/developerworks/community/blogs/c8abdf40-97a5-47e6-93be-47abc3ed45b4/entry/Achieving_WORM_like_functionality_from_NFS_SMB_clients_for_data_on_Spectrum_Scale?lang=en
- Spectrum Scale Security Redpaper:
  https://www.redbooks.ibm.com/redbooks.nsf/RedpieceAbstracts/redp5426.html
- Spectrum Scale Redbook
  http://w3.itso.ibm.com/redpieces/abstracts/sg248254.html?Open
- Spectrum Scale Wiki
  http://www.ibm.com/developerworks/wikis/display/hpccentral/General+Parallel+File+System+(GPFS)

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