IBM Spectrum Scale: Support for macOS

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Agenda

- **SMB – The preferred Protocol**

- **VFS Module "fruit"**

- **Configuration Model**

- **Known Issues**

- **Limitations**

- **Summary**

SMB – The preferred Protocol

- Starting from OS X 10.9 (Mavericks) Apple made SMB2 the default network file protocol

- Apple Filing Protocol (AFP) is deprecated

- Apple has its own proprietary SMB client and server implementation (independent from Microsoft or Samba)

- Apple specific extensions to SMB2 (a.k.a. SMB AAPL extensions) to increase browsing speed in Apple Finder application

  - Some SMB2 protocol fields carry different information

- macOS resource forks are stored in Alternate Data Streams

- POSIX file owner, group, and mode bits are mapped to S-1-55-88-* ACL entries (not used on Spectrum Scale)

Samba VFS Module "fruit"

- Most Apple specific Samba enhancements are placed in a VFS module

  - `vfs objects = shadow_copy2 syncops` **`fruit streams_xattr`** `gpfs fileid time_audit`

- Features

  - Handling of AAPL SMB2 Create Contexts

  - Provide additional information in SMB2_QUERY_DIRECTORY requests

  - Alternate Data Streams are stored in Extended Attributes

  - Existing Apple DoubleFiles are automatically converted into Alternate Data Streams

- "fruit" will not

  - Improve network throughput or latency when accessing files (other than avoiding access to Apple Double files)

  - Avoid strange access patterns seen with Apple Finder

SMB2 Create Contexts

- Additional flags or attributes included in SMB2_CREATE requests and responses

- In create requests used to specify how a SMB2_CREATE must be processed

- In create responses used to specify how a SMB2_CREATE was processed

- Flexible mechanism to enhance the SMB2 protocol

```
⊟ ExtraInfo SMB2_CREATE_TIMEWARP_TOKEN SMB2_CREATE_DURABLE_HANDLE_REQUEST SMB2_C
  ⊟ Chain Element: SMB2_CREATE_TIMEWARP_TOKEN "TWrp"
      Chain Offset: 0x00000020
    ⊞ Tag: TWrp
      Blob Offset: 0x00000018
      Blob Length: 8
    ⊟ Data: Timestamp
        Timestamp: Feb 12, 2020 17:39:26.000000000 CET
  ⊞ Chain Element: SMB2_CREATE_DURABLE_HANDLE_REQUEST "DHnQ"
  ⊞ Chain Element: SMB2_CREATE_QUERY_MAXIMAL_ACCESS_REQUEST "MxAc"
  ⊞ Chain Element: SMB2_CREATE_QUERY_ON_DISK_ID "QFid"
```

SMB2 Create Context AAPL – Request from macOS Client

```
ExtraInfo SMB2_AAPL_CREATE_CONTEXT SMB2_CREATE_QUERY_MAXIMAL_ACCESS_REQUEST
  Chain Element: SMB2_AAPL_CREATE_CONTEXT "AAPL"
    Chain Offset: 0x00000030
    Tag: AAPL
      Blob Offset: 0x00000010
      Blob Length: 4
    Blob Offset: 0x00000018
    Blob Length: 24
    Data: AAPL Create Context request
      AAPL Create Context request
        Command code: Server query (1)
        Reserved: 0x00000000
        Query bitmask: 0x0000000000000007, Server capabilities, Volume capabilities, Model information
          .... .... .... .... .... .... .... .... .... .... .... .... .... .... ...1 = Server capabilities: True
          .... .... .... .... .... .... .... .... .... .... .... .... .... .... ..1. = Volume capabilities: True
          .... .... .... .... .... .... .... .... .... .... .... .... .... .... .1.. = Model information: True
        Client/Server capabilities: 0x000000000000000f, Supports READDIRATTR, Supports macOS copyfile, UNIX-based, Supports NFS ACE
          .... .... .... .... .... .... .... .... .... .... .... .... .... .... ...1 = Supports READDIRATTR: True
          .... .... .... .... .... .... .... .... .... .... .... .... .... .... ..1. = Supports macOS copyfile: True
          .... .... .... .... .... .... .... .... .... .... .... .... .... .... .1.. = UNIX-based: True
          .... .... .... .... .... .... .... .... .... .... .... .... .... .... 1... = Supports NFS ACE: True
  Chain Element: SMB2_CREATE_QUERY_MAXIMAL_ACCESS_REQUEST "MxAc"
```

SMB2 Create Context AAPL – Response from Samba

```
⊟ ExtraInfo SMB2_AAPL_CREATE_CONTEXT SMB2_CREATE_QUERY_MAXIMAL_ACCESS_REQUEST
  ⊟ Chain Element: SMB2_AAPL_CREATE_CONTEXT "AAPL"
      Chain Offset: 0x00000050
    ⊟ Tag: AAPL
        Blob Offset: 0x00000010
        Blob Length: 4
      Blob Offset: 0x00000018
      Blob Length: 56
    ⊟ Data: AAPL Create Context response
      ⊟ AAPL Create Context response
          Command code: Server query (1)
          Reserved: 0x00000000
```



```
        ⊟ Query bitmask: 0x0000000000000007, Server capabilities, Volume capabilities, Model information
            .... .... .... .... .... .... .... .... .... .... .... .... .... .... ...1 = Server capabilities: True
            .... .... .... .... .... .... .... .... .... .... .... .... .... .... ..1. = Volume capabilities: True
            .... .... .... .... .... .... .... .... .... .... .... .... .... .... .1.. = Model information: True
        ⊟ Client/Server capabilities: 0x0000000000000007, Supports READDIRATTR, Supports macOS copyfile, UNIX-based
            .... .... .... .... .... .... .... .... .... .... .... .... .... .... ...1 = Supports READDIRATTR: True
            .... .... .... .... .... .... .... .... .... .... .... .... .... .... ..1. = Supports macOS copyfile: True
            .... .... .... .... .... .... .... .... .... .... .... .... .... .... .1.. = UNIX-based: True
            .... .... .... .... .... .... .... .... .... .... .... .... .... .... 0... = Supports NFS ACE: False
        ⊟ Volume capabilities: 0x0000000000000000
            .... .... .... .... .... .... .... .... .... .... .... .... .... .... ...0 = Supports Resolve ID: False
            .... .... .... .... .... .... .... .... .... .... .... .... .... .... ..0. = Case sensitive: False
            .... .... .... .... .... .... .... .... .... .... .... .... .... .... .0.. = Supports full sync: False
        Model string: MacSamba
  ⊞ Chain Element: SMB2_CREATE_QUERY_MAXIMAL_ACCESS_REQUEST "MxAc"
```

ReadDirAttr Extension

- Return macOS specific information in FileIdBothDirInformation information level

    - Finder Info (→ ShortName)

    - Resource Fork Length (→ ShortName)

    - Access rights, Unix mode (→ EaSize, ReservedField)

- Avoid additional network round trips to query information required by Finder Application

    - SMB2_CREATE → SMB2_GETINFO → SMB2_CLOSE

Configuration Model in Spectrum Scale

- macOS support can be **only enabled** and is enabled for all SMB shares within cluster!

- Enabling requires SMB service to be stopped

- How to enable:

    ```
    mmsmb config change --vfs-fruit-enable
    ```

- Disabling macOS support requires involving IBM support

    - All GPFS file systems must be scanned and resource forks stored in Alternate Data Streams must be converted back to AppleDouble files

    - May result in a lengthy cluster outage (depends on file system size, number of files to be converted)

Limitations with macOS

- Alternate Data Streams are limited to 50KB per file / 16KB per single stream

    → Size limitation for Extended Attributes

- Alternate Data Streams support is advertised to all SMB clients (not only macOS clients)

    → Keep eye on 50KB/16KB limitation

- No ACL Management is possible

- Spotlight Search is not supported

    - Would require additional services running on Spectrum Scale cluster nodes

- Time Machine is not supported

    - Time Machine requires durable file handles

Known Issues: macOS FileIDs / CNID

- FileIDs are a HFS+ heritage where files are identified via a unique, monotonically-increasing number (Catalog Node ID)

- FileIDs are returned on request to the macOS client

- Returning FileID = 0 or setting "`File_ids_off=yes`" in `/etc/nsmb.conf` made macOS to ignore the returned FileIDs

- At least since macOS 10.14 behavior changed and macOS requires correct FileIDs otherwise strange access errors can show up

- The upcoming Spectrum Scale release will generate semantically correct FileIDs

  → remove "`File_ids_off=yes`" setting in `/etc/nsmb.conf`

Known Issues

- No native support for Volume Snapshot Services (VSS)

    - Manual access to GPFS Snapshots used for VSS (`.snapshots/@GMT-<timestamp>`) is not working

    - Limitation within SMB2 protocol implementation of Samba

    - Lookup of `@GMT-<timestamp>` directory entries is not possible

    - Access to other snapshots is possible with upcoming Spectrum Scale release (non `@GMT-<timestamp>` entires)

- When HSM is used offline bit is ignored

    - Apple Finder can cause recall storms when accessing directories containing migrated files

Summary

- Spectrum Scale does now support SMB AAPL extensions

- Major performance improvements when working with Apple Finder & large directories

- Resource Forks are stored in Alternate Data Streams / limited in size

Thank you!

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