Data Management: Best Practices for Groups

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Outline

- Purpose and goals
- Hassles with shared data
- Fundamentals of file access permissions
- Modifying and maintaining file access permissions
- Organizing and tracking data
- Transferring data
- Group and data lifecycle

Purpose of Group and Shared Data

- Shared data processing using similar methods
- Software development and testing (version control?)
- Pooled storage for single lab or core (not archiving!)

Group

- group1 (user1, user2, user3)

Problem 1

- user2 and user3 can't write in new directories

```
[user3]$ cd /data/group1/project1
[user3]$ mkdir 190320_test
```

```
[user2]$ cd /data/group1/project1/190320_test
[user2]$ mkdir subdir
mkdir: cannot create directory 'subdir': Permission denied
[user2]$ ls -ld .
drwxr-x--- 1 user3  group1  1024 Mar 21 12:00 .
```

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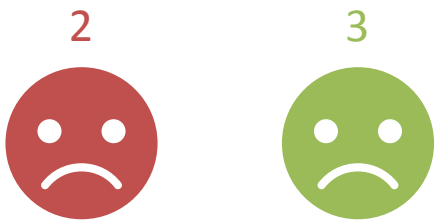
Problem 2

- Group members can (or can't) delete each other's files

```
[user2]$ touch /data/group1/project1/datafile.txt
-rw-rw---- 1 user2  group1  1024 Mar 21 12:00 datafile.txt
```

```
[user3]$ rm /data/group1/project1/*
```

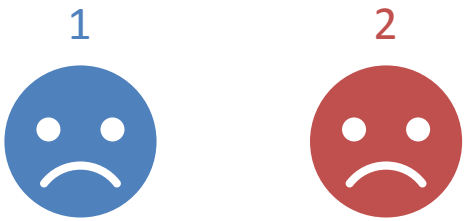


Problem 3

- Slurm job output not accessible by group

```
[user1]$ sbatch /data/group1/bin/shared_script.sh
12345678
```

```
[user2]$ ls -l /data/group1/project2/12345678_output
-rw------- 1 user2  user1  1024 Mar 21 12:00 logfile.out
-rw------- 1 user2  user1  1024 Mar 21 12:00 results.out
```



Problem 4

- Files are difficult to find
- Data becomes lost
- Traversing data is very slow

```
[user1]$ time ls /data/group1/working/output
real    23m5.003s
user    0m7.603s
sys     0m3.022s
[user1]$ ls /data/group1/working/output | wc -l
1500100
```

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Problem 5

- There is not enough storage to hold all our data

```
[user3]$ ./run_script.sh
run_script.sh: write error: Disk quota exceeded
```

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FUNDAMENTALS

UNIX Account

- A user account on a UNIX system has two numeric attributes, user id (uid) and group id (gid)

```
$ id user1
uid=1(user1) gid=1(user1) groups=1(user1)
```

- A user always belongs to their own group

UNIX Files

- A file on a UNIX system has three attributes: read, write, execute
- These attributes can be set for: owner, group, world

```
$ ls -l file
-rw-r----- 1 user1  user1  1024 Mar 21 12:00 file
```

- Attributes can be represented as a single number: **mode**

```
$ stat -c %a file
640
```

UNIX mask

- A user account on a UNIX system has a default **mask** value for the mode, as seen with the **umask** command:

```
$ umask
027
```

- This value acts as a bit filter when determining file mode

UNIX File Permissions

- The default permission mode of a file is 666
- The resulting permission on a created file depends on the **current mask** of the user
- The default mask value on HPC is set to 027
- To calculate mode of file, subtract 027 from 666:
- 666 – 027 = 640

UNIX Directory Permissions

- Directories have 777 as the default permission.
- 777 – 027 = 750

```
$ ls -ld dir
-rwxr-x--- 1 user1  user1  4096 Mar 21 12:00 dir
```

```
$ stat -c %a dir
750
```

UNIX Groups

- A UNIX group is a set of user accounts with a unique group name and group identification number (group and gid)
- The purpose of a UNIX group is to allow the members of the group to share files
- File sharing is done on the basis of permissions for the UNIX group of the file

UNIX Groups

- Users belong to their own ***primary*** group

```
$ groups user1
user1 : user1
$ groups user2
user2 : user2
$ groups user3
user3 : user3
```

UNIX Groups

- A new group can be created to hold multiple users (only by sysadmin)
- This is a ***secondary*** group

```
$ getent group group1
group1:x:2001:user1,user2,user3
```

UNIX Groups

- The ***primary*** group is listed before ***secondary*** groups

```
$ groups user1
user1 : user1 group1
$ groups user2
user2 : user2 group1
$ groups user3
user3 : user3 group1
```

- A user can belong to more than one secondary group

Sharing Files

- /home directories are strictly for individuals
- /scratch and /tmp are temporary
- /data directories can be used, but…

Shared Data Directories

- A shared data directory is created for the group

```
$ ls -ld /data/group1/
drwxrws--- 2 user1 group1 4096 Mar 21 12:00 /data/group1/
```

- user1 is the ***group owner***, who has management responsibility
- The PI has ultimate authority over the data

Group Sharing

- By default, members of a group still create files with their ***primary*** group

```
[user1]$ touch file1
-rw-r----- 1 user1  user1  1024 Mar 21 12:00 file1
```

```
[user2]$ touch file2
-rw-r----- 1 user2  user2  1024 Mar 21 12:00 file2
```

```
[user3]$ touch file3
-rw-r----- 1 user3  user3  1024 Mar 21 12:00 file3
```

Changing group

- Users can change the group of their own files and directories

```
[user1]$ ls -l file1
-rw-r----- 1 user1  user1  1024 Mar 21 12:00 file1
[user1]$ chgrp group1 file1
[user1]$ ls -l file1
-rw-r----- 1 user1  group1  1024 Mar 21 12:00 file1
```

- This can be pretty tedious

Shared Data Directories

- The /data directory has ***setgid*** set:

```
$ ls -ld /data/group1/
drwxrws--- 2 user1 group1 4096 Mar 21 12:00 /data/group1/
```

- This causes all new files and directories created to inherit the group

```
[user3]$ touch file
[user3]$ ls -l file
-rwxr----- 1 user3 group1    0 Mar 21 12:00 file
```

Shared Data Directories

- The setgid bit also propagates setgid

```
[user3]$ ls -ld /data/group1
drwxrws--- 2 user1 group1 4096 Mar 21 12:00 /data/group1/
[user3]$ mkdir dir
[user3]$ ls -ld dir
drwxr-s--- 1 user3 group1 4096 Mar 21 12:00 dir
[user3]$ mkdir dir/sub
[user3]$ ls -ld dir/sub
drwxr-s--- 1 user3 group1 4096 Mar 21 12:00 dir/sub
```

MAINTENANCE

Changing Permissions

- Permissions can be changed with ***chmod***:

```
$ ls -l file
-rw-r----- 1 user1  user1  1024 Mar 21 12:00 file
$ chmod 660 file
$ ls -l file
-rw-rw---- 1 user1  user1  1024 Mar 21 12:00 file
```

- Usually done with symbolic representation:

```
$ ls -ld dir
-rwxr-x--- 1 user1  user1  4096 Mar 21 12:00 dir
$ chmod g+w dir
$ ls -ld dir
-rwxrwx--- 1 user1  user1  4096 Mar 21 12:00 dir
```

Generic shared /data

```
$ tree -pugF /data/group1/
/data/group1
├── [drwxr-s--- user2 group1   ]  bin/
├── [drwxrws--- user1 group1   ]  project1/
├── [drwxrws--- user1 group1   ]  project2/
├── [drwxr-s--- user3 group1   ]  reference/
├── [drwxr-s--- user1 group1   ]  user1/
├── [drwxr-s--- user2 group1   ]  user2/
├── [drwxr-s--- user3 group1   ]  user3/
└── [drwxrws--- user1 group1   ]  working/
```

Problem 1: umask

- Custom mask

```
[user3]$ echo umask 007 >> ~/.bashrc
[user3]$ source ~/.bashrc
[user3]$ cd /data/group1/project1
[user3]$ mkdir 190320_test
[user3]$ ls -ld 190320_test
drwxrws--- 1 user3  group1  1024 Mar 21 12:00 190320_test
```

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```
[user2]$ cd /data/group1/project1/190320_test
[user2]$ mkdir subdir
[user2]$ ls -ld subdir
drwxrws--- 1 user2  group1  1024 Mar 21 12:00 subdir
```

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Problem 2: stickybit

- Allows group members to create and edit files, but not delete them

```
[user1]$ chmod +t project1
[user1]$ ls -ld project1
drwxrws--T 1 user1  group1  4096 Mar 21 12:00 project1
```

- Shorthand:

```
[user1]$ mkdir -m 3770 project1
```

- Sticky bit is **not** inherited or propagated

Problem 3: sbatch options

- Run job as group explicitly

```
[user1]$ sbatch --gid=group1 --partition=norm --time=10 \
  --gres=lscratch:10 submit.sh
12345678
...
[user1]$ ls -l
-rw-rw-r-- 1  user1  group1  728 Mar 20 12:00 slurm-
12345678.out
```

Problem 3: sbatch options

- Run job with explicit umask

```
[user2]$ SLURM_UMASK=007 sbatch --partition=norm \
  --gid=group1 --time=10 --gres=lscratch:10 submit.sh
87654321
...
[user2]$ ls -l
-rw-rw---- 1  user2  group1  728 Mar 20 12:00 slurm-
87654321.out
```

Set mask to 007

- Edit ~/.bashrc

```
[user2]$ cat ~/.bashrc
# .bashrc

# Source global definitions
if [ -f /etc/bashrc ]; then
        . /etc/bashrc
fi

umask=007
```

Shared Data Directories and ACLs

- All new /data directories (GPFS) allow ***Access Control Lists*** (ACLs)
- ACLs allow for more fine-grained access controls

ACLs

- An ACL can be seen with getfacl

```
$ getfacl /data/group1/
# file: /data/group1/
# owner: user1
# group: group1
# flags: -s-
user::rwx
group::rwx
mask::rwx
other::---
```

Setting ACL with setfacl

```
[user1]$ cd /data/group1/
[user1]$ ls -ld project1
drwxr-s--- 2  user1  group1 4096 Mar 22 12:00 project1
[user1]$ setfacl -m u:user2:rwx project1
[user1]$ ls -ld project1
drwxrws---+ 2  user1  group1 4096 Mar 22 12:00 project1
[user1]$ getfacl project1
# file: project1/
# owner: user1
# group: group1
# flags: -s-
user::rwx
user:user2:rwx
group::r-x
mask::rwx
other::---
```

ACLs override group permissions

- Standard UNIX group permissions become the ACL mask
- The mask is the maximum access type for all members of the ACLs

Effect of chmod

```
[user1]$ ls -ld project1
drwxrws---+ 2  user1  group1 4096 Mar 22 12:00 project1
[user1]$ getfacl project1
user:user2:rwx
group::r-x
mask::rwx
[user1]$ chmod g-w project1
drwxr-s---+ 2  user1  group1 4096 Mar 22 12:00 project1
[user1]$ getfacl project1
user:user2:rwx          #effective:r-x
group::r-x
mask::r-x
```

Multiple ACs per file

```
[user1]$ setfacl -m u:user3:r-x project1
[user1]$ getfacl project1
# file: project1
# owner: user1
# group: group1
# flags: -s-
user::rwx
user:user2:rwx          #effective:r-x
user:user3:r-x
group::r-x
mask::r-x
other::---
```

Copying ACLs to new files

- Use --set-file=-

```
[user1]$ setfacl project1 | --set-file=- project2
[user1]$ getfacl project2
# file: project1
# owner: user1
# group: group1
# flags: -s-
user::rwx
user:user2:rwx
user:user3:r-x
group::rwx
mask::rwx
other::---
```

Propagate ACLs By Default

```
[user1]$ setfacl -m d:u:user2:rwx project2
[user1]$ getfacl project2
# file: project1
# owner: user1
# group: group1
# flags: -s-
user::rwx
user:user2:rwx
user:user3:r-x
group::rwx
mask::rwx
other::---
default:user::rwx
default:user:user2:rwx
default:group::rwx
default:mask::rwx
default:other::---
```

Propagate ACLs By Default

```
[user1]$ mkdir project2/190320_test1
[user1]$ getfacl project2/190320_test1
# file: project2/190320_test1
# owner: user1
# group: group1
# flags: -s-
user::rwx
user:user2:rwx
user:user3:r-x
group::rwx
mask::rwx
other::---
default:user::rwx
default:user:user2:rwx
default:group::rwx
default:mask::rwx
default:other::---
```

Default ACLs supersede umask

- Setting umask 077 should disallow all group access, but default ACLs win…

```
[user1]$ umask 077
[user1]$ mkdir project2/190320_test2
[user1]$ ls -l project2
drwxrws---+ 2  user1 group1 4096 Mar 22 15:02 190320_test1
drwxrws---+ 2  user1 group1 4096 Mar 22 15:02 190320_test2
[user1]$ touch user1/project1/190320_test2/file
[user1]$ ls -l user1/project1/190320_test2/file
-rw-rw---- 1  user1 group1 4096 Mar 22 15:02 file
```

Shared /data directory

```
$ tree -pugF /data/group1/
/data/group1
├── [drwxr-s---+ user2 group1   ]  bin/
├── [drwxrws---+ user1 group1   ]  project1/
├── [drwxrws---+ user1 group1   ]  project2/
├── [drwxr-s--- user3 group1    ]  reference/
├── [drwxr-s--- user1 group1    ]  user1/
├── [drwxr-s--- user2 group1    ]  user2/
├── [drwxr-s--- user3 group1    ]  user3/
└── [drwxrws--T user1 group1    ]  working/
```

Ongoing Maintenance

- Permissions can get messed up very easily
- Moving, rather than copying files
- Applications explicitly set permissions
- Slurm runs as primary group

```
[user1]$ ls -l project2
-rwxrwxrwx 1  user2 user2  4321 Mar 22 12:00 file.out
drwx------ 2  user1 user1 4096 Mar 22 15:00 results1
-rwx------ 1  user3 group1 12345 Mar 22 12:00 results1.txt
```

find … -exec chmod

- Bulldoze over permissions

```
[user1]$ find . -exec chmod g+rwx {} +
```

- More precision with conditional execute

```
[user1]$ find . -exec chmod g+rwX {} +
```

find … -exec setfacl

- find can't detect ACLs

```
[user1]$ setfacl -R –m g:group1:rwX,d:g:group1:rwX,o:--- .
```

Carefully find

- Running find on >1M files can take >10 minutes
- Automating is possible, but should be done on a cluster node
- Should be targeted not blind blanket

find … -exec chmod

- find and chmod

```
[user1]$ find . -perm /u+r -user user1 ! -perm /g+r \
  -exec chmod g+r {} +
[user1]$ find . -perm /u+w -user user1 ! -perm /g+w \
  -exec chmod g+w {} +
[user1]$ find . -perm /u+x -user user1 ! -perm /g+x \
  -exec chmod g+x {} +
```

- find and chgrp

```
[user1]$ find . -user user1 ! -group group1 \
  -exec chgrp group1 {} +
```

Targeted setfacl

- Redundant chmod updates ctime

```
[user1]$ stat file -c %z
2019-03-22 12:00:00.000000000 -0400
[user1]$ chmod g+rwx file
[user1]$ stat file -c %z
2019-03-25 09:00:00.000000000 -0400
[user1]$ chmod g+rwx file
[user1]$ stat file -c %z
2019-03-25 09:00:07.747292784 -0400
```

Targeted setfacl

- Redundant setfacl does not change ctime

```
[user1]$ stat file -c %z
2019-03-22 12:00:00.000000000 -0400
[user1]$ setfacl -m g:group1:rwX
[user1]$ stat file -c %z
2019-03-25 09:00:00.000000000 -0400
[user1]$ setfacl -m g:group1:rwX
[user1]$ stat file -c %z
2019-03-25 09:00:00.000000000 -0400
```

Targeted setfacl

- Combine find and setfacl

```
[user1]$ find . –ctime -1 –exec \
  setfacl –m g:group1:rwX,d:g:group1:rwX,o:--- {} +
```

- ctime changes when a file is modified or permissions are changed

Index projects

- Use updatedb and locate to index files

```
[user1]$ cd /data/group1
[user1]$ updatedb \
  --database-root project1 \
  --output project1.db --require-visibility no
```

- Searchable with locate

```
[user1]$ locate --database=project1.db this_file
/gpfs/gsfs11/users/group1/project1/dir/dir/this_file.txt
```

updatedb and locate

- >1M files can take ~2-3 minutes to index
- Searching is much, much faster than find
- Can pass results to grep

```
[user1]$ locate --database=project1.db / | grep this | \
  grep that | grep other
```

- Can only search by name, not by properties (size, mtime, permissions)

ORGANIZATION AND MONITORING

Setting Boundaries

- Many problems can be solved through structural design
- Design subdirectories for different purposes

Organize Files

- No more than 1000 files per directory
- File/directory names should be systematic and logical
- Store date, keywords in name

```
$ ls /data/group1/project2/C5/
190320_r1/      190320_r2/      190320_r3/      190320_r4/
190321_r1/      190321_r2/      190321_r3/      190321_r4/
README.txt      r1.bam          r1.bam.bai      r2.bam
r2.bam.bai      r3.bam          r3.bam.bai      r4.bam
r4.bam.bai      template.sh
```

Metadata

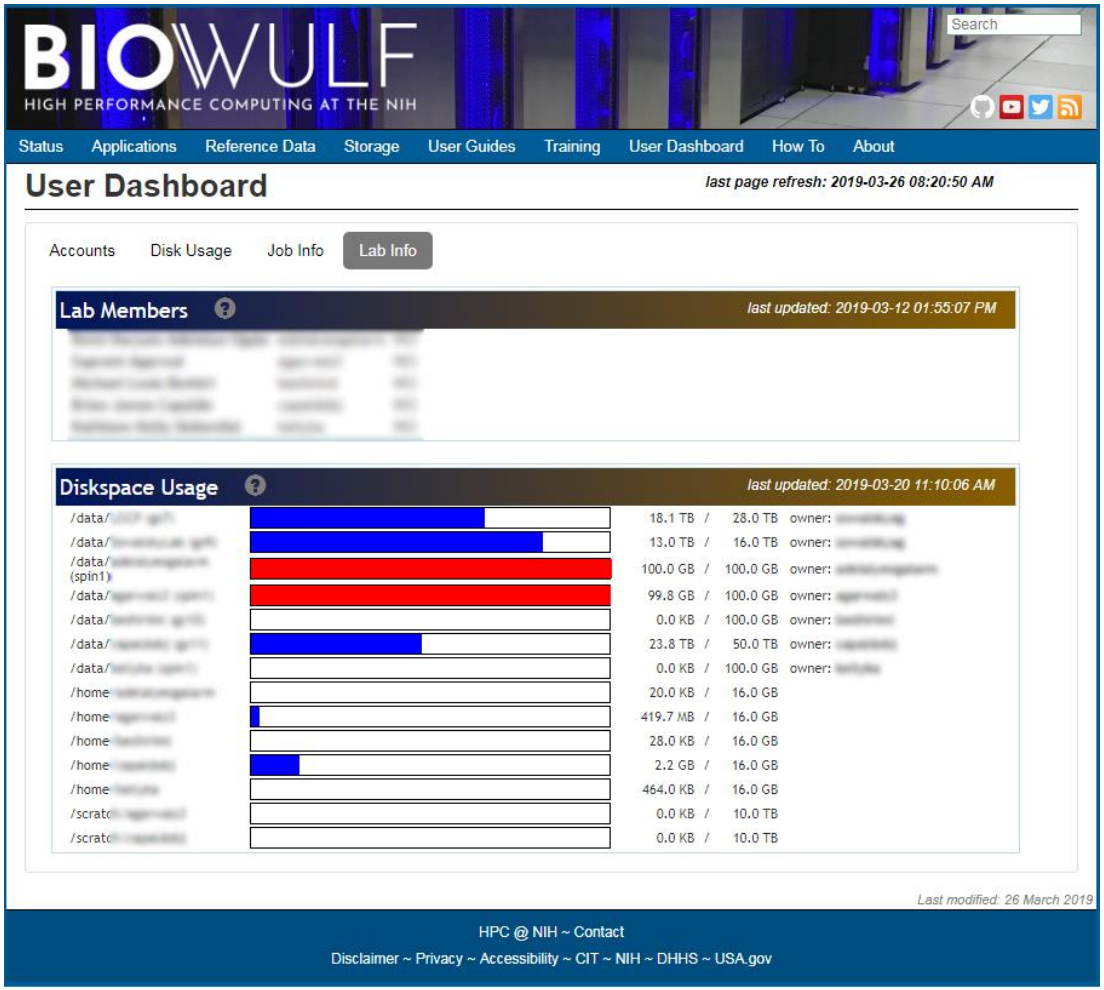
- Document data as it is added

```
$ cat /data/group1/project2/C5/190320_r1/README.txt
================================
2019-03-20, user2
Run 1, trial C5, project1
See submit_r1.sh for methodology and commands run
Used template.sh to generate submit_r1.sh
```

Segregate by expected lifetime

- How long do you expect the file to be needed?
- /lscratch if only for lifetime of job
- /data if for a few months
- /home if for longer

Dashboard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Search
Status
Applications
Reference Data
Storage
User Guides
Training
User Dashboard
How To
About
User Dashboard
last page refresh: 2019-03-26 08:20:50 AM
Accounts
Disk Usage
Job Info
Lab Info
Lab Members
last updated: 2019-03-12 01:55:07 PM
Diskspace Usage
last updated: 2019-03-20 11:10:06 AM
/data/ 18.1 TB / 28.0 TB owner:
/data/ 13.0 TB / 16.0 TB owner:
/data/ (spin1) 100.0 GB / 100.0 GB owner:
/data/ 99.8 GB / 100.0 GB owner:
/data/ 0.0 KB / 100.0 GB owner:
/data/ 23.8 TB / 50.0 TB owner:
/data/ 0.0 KB / 100.0 GB owner:
/home 20.0 KB / 16.0 GB
/home 419.7 MB / 16.0 GB
/home 28.0 KB / 16.0 GB
/home 2.2 GB / 16.0 GB
/home 464.0 KB / 16.0 GB
/scratch 0.0 KB / 10.0 TB
/scratch 0.0 KB / 10.0 TB
Last modified: 26 March 2019
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checkquota

```
$ checkquota
Mount                      Used      Quota  Percent    Files    Limit
/data:                417.8 GB   500.0 GB   83.56%   441553 31129581
/gs10(group1):        100.6 GB     5.0 TB    0.21%    40667 31457280
/home:                 12.1 GB    16.0 GB   75.62%   108094      n/a

ObjectStore Vaults
user1:                  5.7 MB   465.7 GB    0.00%      n/a      n/a
```

FILE TRANSFER AND ARCHIVING

Compression

- Use gzip to compress files

```
$ ls -l
-rw-r--r-- 1 user1  group1 641955988 Sep 22  2018 bogus_R1_001.fastq
-rw-r--r-- 1 user1  group1 643754231 Sep 22  2018 bogus_R2_001.fastq
$ gzip *.fastq
$ ls -l
-rw-r----- 1 user1  group1 134381309 Sep 22  2018 bogus_R1_001.fastq.gz
-rw-r----- 1 user1  group1 134873947 Sep 22  2018 bogus_R1_001.fastq.gz
```

Compression Algorithms

- 247 MB typical file on /spin1

Command	C time	Size	Ratio	D time
gzip	15.8 s	66 M	26.7%	2.2 s
bzip2	61.6 s	47 M	19.0%	10.8 s
xz	199.0 s	32 M	12.9%	3.7 s

- Additional compression settings (1..9), default is 6
- Compression depends on randomness of data

Compress Limitations

- Not all files can be compressed

Ext	File Type	gzip	xz -9
.bam	gzip compressed data, extra field	100%	100%
.tiff	TIFF image data, little-endian	99.2%	99.2%
.jpg	JPEG image data, EXIF standard	97.2%	97.2%
.png	PNG image data, …	97.7%	95.9%
.hdf	Hierarchical Data Format (v5)	92.7%	90.9%
.mrc	CCP4 Electron Density Map	92.8%	82.1%
.pdf	PDF document	100%	56.6%
.tif	TIFF image data, big-endian	7.3%	4.7%
.bed	ASCII text, with very long lines	9.2%	4.3%

Compress Projects

- As projects wrap up, compress files into tarball

```
[user1]$ cd /data/group1
[user1]$ tar czf project1.tgz project1
```

- Also searchable:

```
[user1]$ tar tzf project1.tgz this_file
project1/dir/dir/this_file.txt
```

Archiving Data

- HPC is NOT suitable for archival storage
- Regular backups are NOT done
- Users are encouraged to seek out alternative means of archiving their data

Push to Object Storage

- Short-term archiving

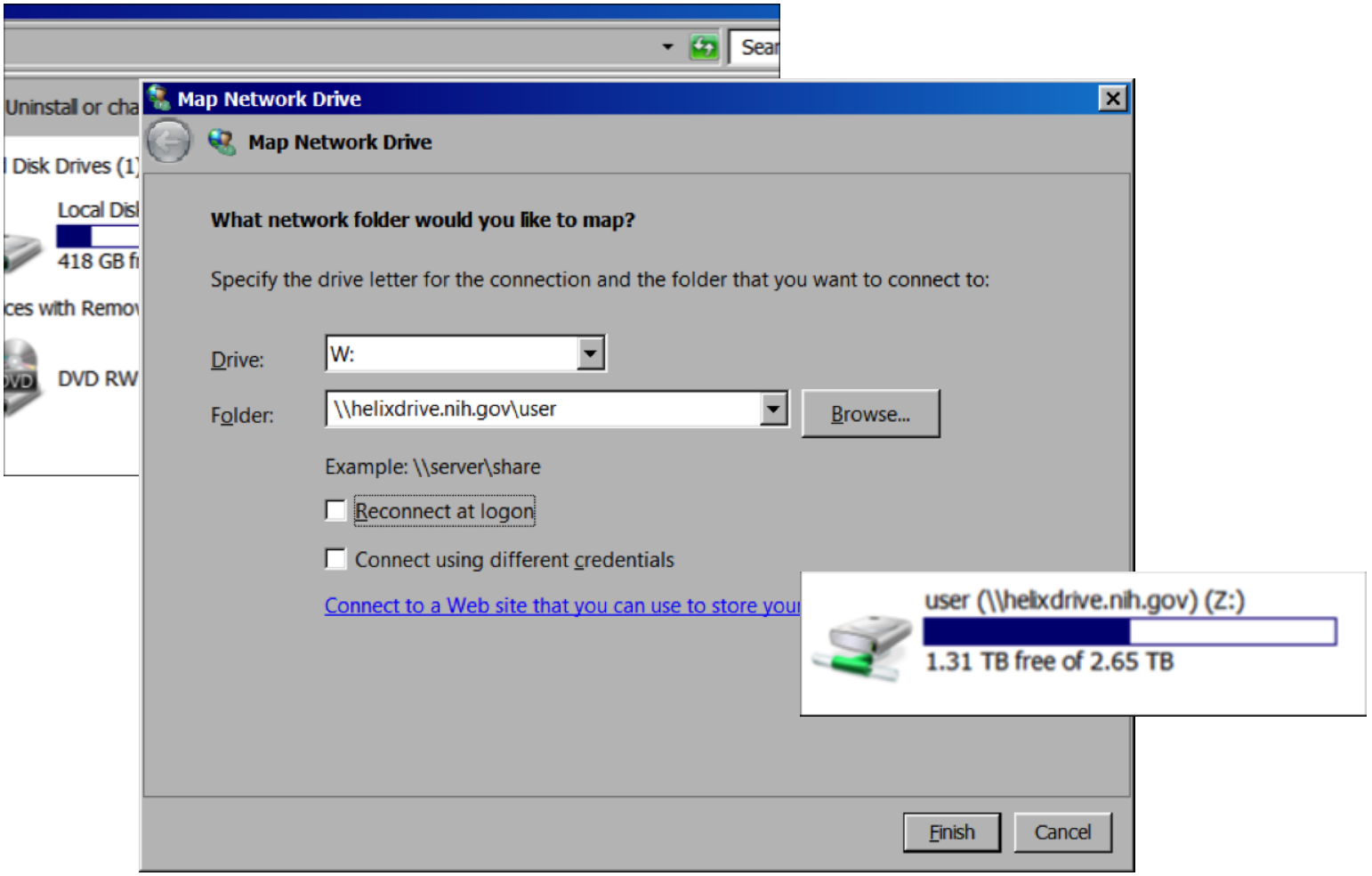
```
[user1]$ obj_put -v -p "group1/" project1.tgz
```

- https://hpc.nih.gov/storage/object.html
- Vaults can hold files for 7 years

Transfer: Helixdrive

- Allows local mount of exported file systems
- /home, /data, /scratch
- Available for Windows, Macs and Linux
- Speed: slow
- Reliability: moderate
- Ease: high

Transfer: Helixdrive



Transfer: Helixdrive

```
$ mount -t cifs -o
rw,vers=2.0,nosetuids,sec=ntlmsspi,user=user1,domain=NIH.g
ov //helixdrive.nih.gov/group1 /mnt/biowulf_group1
```

Transfer: rsync

- Can be run to/from helix.nih.gov
- Available for Mac, Linux
- There are rsync wrapper clients for Windows
- Speed: moderate
- Reliability: high
- Ease: high/low, depends on OS

SSH Keys

- Must have at least 2048 bit encryption
- Must have a secret passphrase
- Length beats complexity
- SSH keys do NOT override AD password expiration and shell locking
- https://hpc.nih.gov/docs/sshkeys.html

rsync Using SSH Keys

```
$ rsync -avz -e "ssh -i foo_rsa“ \
  user1@helix.nih.gov:/data/group1/project1 \
  /path/on/desktop/
```

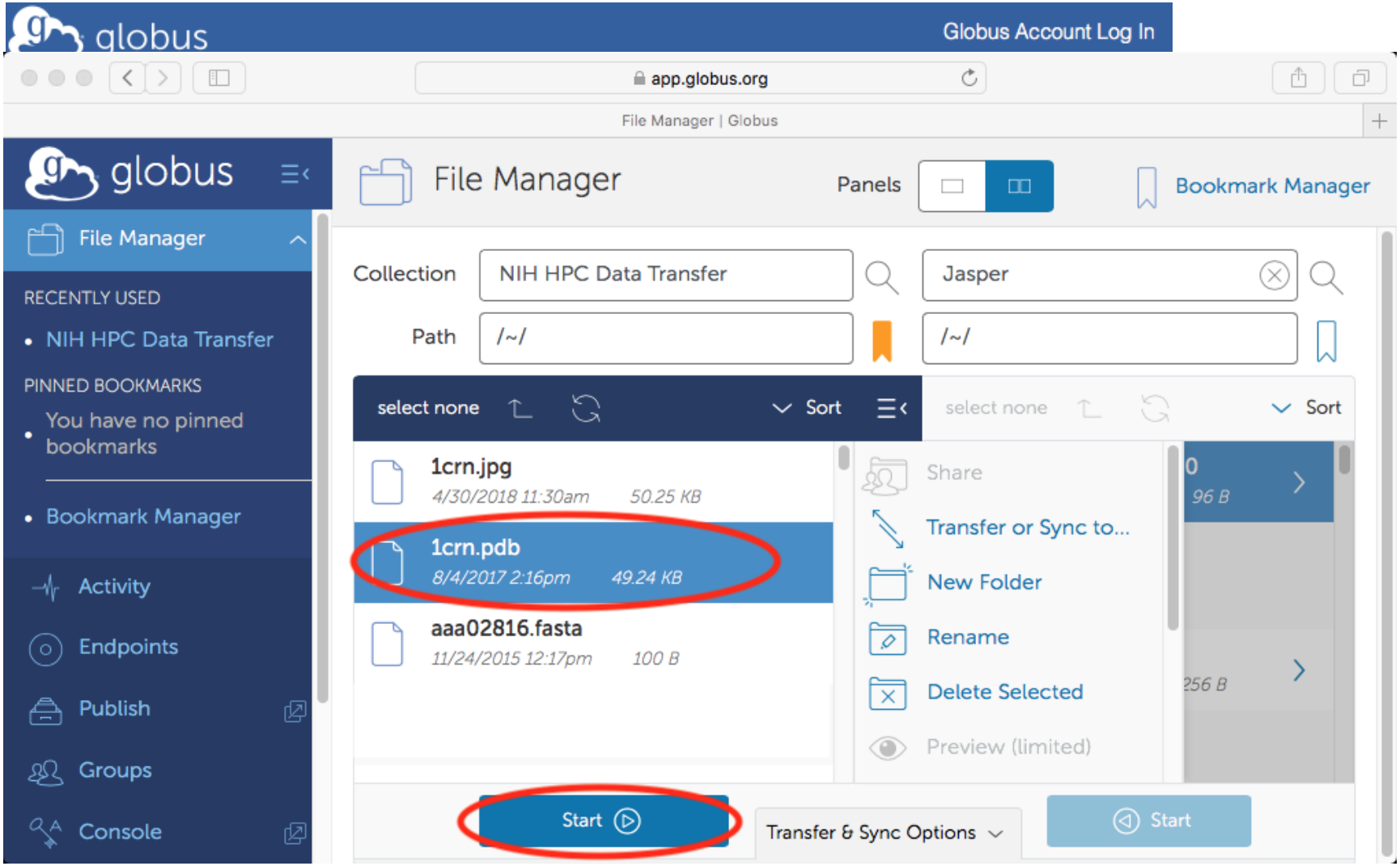
Key Storage Agents

- ssh-agent (Linux, Mac)
- pageant (Windows, with PuTTY)
- Stores private key and passphrase, allows single authentication, multiple connects

Transfer: Globus

- Service provided by University of Chicago
- Requires local client and port availability
- Available for Windows, Mac, Linux
- Speed: fast
- Reliability: high
- Ease: moderate

Transfer: Globus



Transfer: Globus CLI

- Takes some doing, but very worth it

```
[user1]$ globus transfer --recursive --no-verify-checksum \
    d8eb36b6-6d04-11e5-ba46-22000b92c6ec:/path/to/local/dir/ \
    e2620047-6d04-11e5-ba46-22000b92c6ec:/data/group1/project1/
Message: The transfer has been accepted and a task has been created and
queued for execution
Task ID: 6924b21e-f54b-11e6-ba69-22000b9a448b
```

- Can be incorporated into batch scripts

Transfer: Amazon & Google Cloud

- Cloud-based storage obtained outside of HPC
- Various clients available
- Must be run from helix.nih.gov
- Speed: ?
- Reliability: ?
- Ease: low

Transfer: Google Cloud

- https://cloud.google.com/storage/docs/gsutil

```
[user1@helix ~]$ module load google-cloud-sdk
[user1@helix ~]$ gcloud init
```

```
[user1@helix ~]$ gsutil -m cp gs://my_bucket/* /data/group1/project3/.
```

Transfer: Google Drive

- gdrive can automate transfers

```
[user1@helix ~]$ module load gdrive
[+] Loading gdrive 2.1.0 on helix.nih.gov
[user1@helix ~]$ gdrive download 1YQI2m_403yq-TLxJ1QHtkzKE7_c_9Gal
Authentication needed
Go to the following url in your browser:
https://accounts.google.com/o/oauth2/
auth?access_type=offline&client_id=...
Enter verification code: ...
Downloading cloudfile.zip -> cloudfile.zip
Downloaded 1YQI2m_403yq-TLxJ1QHtkzKE7_c_9Gal at 86.0 MB/s, total 23.6 GB
```

Transfer: Amazon Web Services

- https://docs.aws.amazon.com/cli/latest/reference/

```
[user1@helix ~]$ module load aws
[user1@helix ~]$ aws s3 cp /data/group1/project2 \
  s3://mybucket/myfolder –recursive
[user1@helix ~]$ cd /data/group1/project3
[user1@helix project3]$ aws s3 sync s3://mybucket/project3 project3
```

GROUP AND DATA MANAGEMENT

Group Communication

- Who has access to what?
- Is the data being maintained?

Group Owner

- The group owner has the responsibility of managing members and permissions
- Can authorize changes

Group Lifecycle Plan

- What to do when a user leaves?
- Long-term archive?

Data Management Plan

- Create a plan or projection of what data is needed and what will be generated
- Have a rough idea of scale (100GB? 100TB?)
- How long will data be needed?
- Who should have access?
- Who has management responsibility?

HPC Data Lifecyle Policies

- Data is ultimately owned by PI
- When an account is deleted, the data is kept for **six months, then deleted**
- The PI is alerted with options
  - Change permissions (in shared /data directory)
  - Merge into another directory
  - Transfer the contents (size-dependent)
  - Delete the data

Questions? Comments?

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