Good practice for transferring data

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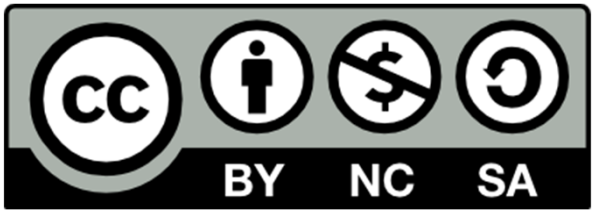

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Useful Links

- Data Management Guide:
  - http://www.archer.ac.uk/documentation/data-management/
- User Guide – ARCHER file systems:
  - http://www.archer.ac.uk/documentation/user-guide/resource_management.php#sec-3.3
- Globus Online:
  - https://www.globus.org/

Spoilers!

- Combine small files into single larger archive files before transferring
- Use the right tool:
  - Do you really need to use rsync?
  - Is a parallel data transfer tool really required?
- Watch out for compression/encryption overheads
- Be aware of the weakest link in the transfer chain

Overview

- ARCHER/RDF file systems and layout
- Combining files – archiving
- Copying data: ARCHER to/from RDF
- Transferring data: on/off the RDF

ARCHER/RDF file systems

ARCHER/RDF file systems

`/home`: backed-up, NFS, available on login, serial and service nodes.

`/work`: **not backed-up**, Lustre parallel file system, available on login, serial, service and compute nodes.

RDF: backed-up only for disaster proofing **(accidental deletion recovery not supported)**, GPFS, available on login nodes (and serial nodes).

Accessing the RDF

Directly mounted on ARCHER login and serial nodes at:

```
/epsrc
/nerc
/general
```

RDF additionally has its own Data Transfer Nodes (DTNs): **dtn01.rdf.ac.uk**, **dtn02.rdf.ac.uk**. Should be used when transferring between the RDF and a remote machine.

RDF also has a Data Analytic Cluster (DAC): **login.rdf.ac.uk.** Can use the scheduler here for long-running archiving and compression tasks

Combining files: archiving

Archiving – Motivation

More efficient use of the file system – single file requires fewer metadata operations to move/copy/access.

Can dramatically improve performance, especially with a large number of small files.

Example, 23GB of data = ~13000 32KB-5MB files:

```
$> time cp -r mydata /general/z01/z01/user/

real    59m47.096s
user    0m0.148s
sys     0m37.358s
```

Archiving – Motivation

Same files in an archive:

```
$> time cp mydata.tar /general/z01/z01/user/

real    3m3.698s
user    0m0.008s
sys     0m33.958s
```

Some initial overhead required for archive creation (~15 mins) but time saved on subsequent accesses.

Serial queues on ARCHER or RDF DAC should be used for any long running tasks.

Archiving – Utilities

Common archiving utilities on ARCHER/RDF:

- tar
- cpio
- zip

Some technical differences but choice mostly personal preference.

Generally recommend forgoing compression to speed up process but there is a compression/transfer time trade-off.

Archiving – tar creation

Ubiquitous “tape archive” format.

Common options:

-c create a new archive
-v verbosely list files processed
-W verify the archive after writing
-l confirm all file hard links are included in the archive
-f use an archive file

Example command:

```
tar -cvWlf mydata.tar mydata/
```

Archiving – tar extraction and verification

-x extract from an archive

```
tar -xf mydata.tar
```

-d "diff" archive file against a set of data

```
$> tar -df mydata.tar mydata
mydata/damaged_file: Mod time differs
mydata/damaged_file: Size differs
```

Note: tar archives do not store file checksums

Original data must be present during verification.

Archiving – zip creation

Widely used and supported by most major systems, including current versions of Windows.

Common options:

-r recursively archive files and directories

-0-9 compression level (-0 recommended on ARCHER)

Example command:

```
zip -0r mydata.zip mydata
```

Note: zip files **do not preserve hard links** (data is copied).

Archiving – zip extraction and verification

Uses a separate utility for extraction.

```
unzip mydata.zip
```

-t test archive (zip file stores CRC values by default)

```
$> unzip -t mydata.zip
Archive: mydata.zip
      testing: mydata/  OK
      testing: mydata/file    OK
No errors detected in compressed data of mydata.zip.
```

Copying data: ARCHER to/from RDF

Copying – Local Copy

```
cp –r source /epsrc/gid/gid/destination
```

Copying to the mounted RDF filesystem exactly the same as a normal copy between directories.

```
rsync –r source /epsrc/gid/gid/destination
```

Pro: rsync will not attempt to transfer files that already exist.

Con: this “mirroring” requires a large number of metadata operations, slowing performance.

Recommend rsync over cp when resynchronising a previously copied directory containing large files.

Usually best not to use “-z” (compression) option to rsync

Copying – Local Copy

Remember: must be done on a node where the two file systems are mounted:

- ARCHER login nodes
- ARCHER serial nodes

Transferring data: on/off RDF

Transfer – Utilities

Via SSH

- scp
- rsync

For very large transfers

- Globus Online
- (bbcp)

Copying – SSH Tools

For remote transfers DTNs should be used.

```
scp –r source user@dtn01.rdf.ac.uk:[destination]
```

Analogue of standard cp.

```
rsync –r –e ssh source
user@dtn01.rdf.ac.uk:[destination]
```

Same utility for both local and remote transfers.

Can also transfer data directly off ARCHER (without RDF) but need to use the serial queues/PP nodes as no DTNs available.

Copying – SSH Performance

All traffic encrypted – secure but performance penalty.

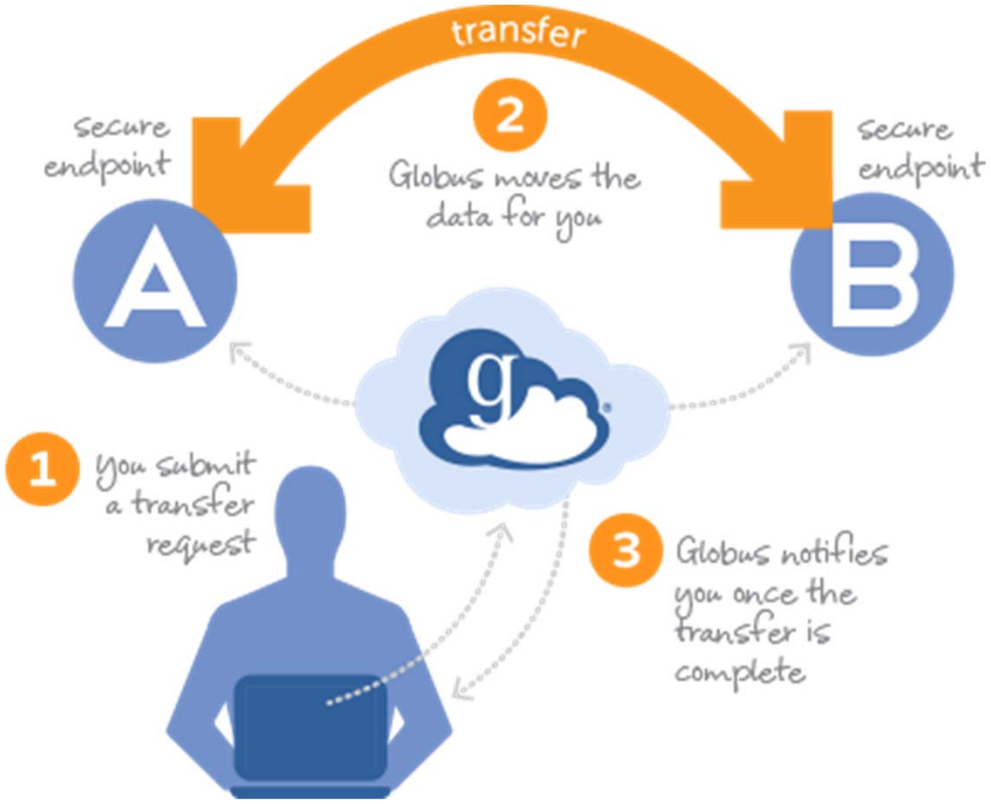
Different ciphers can be used to improve speed.

Algorithm “arcfour” usually fastest but least secure:

```
scp -c arcfour …
rsync -e “ssh -c arcfour” …
```

Lots of files also introduce a large overhead so combine using and archiving tool wherever possible.

Large Transfers – Globus Online



Register for an account at: https://www.globus.org/

- Endpoint for RDF is called **Archer RDF** or **archer#rdf**
- Use your RDF username and password to activate the endpoint

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Large Transfers – Globus Online – Performance

Uses GridFTP parallel file transfer to get best performance. Performance is limited by:

- Network bandwidth between two endpoints
  - Often large for two servers at different locations
  - Can be limited for transfers to local laptop/workstation (e.g. wifi, 1 Gpbs ethernet)
- Storage access bandwidth
  - Large for large files on parallel file system
  - Small for many small files
  - Can be small for local storage (e.g. single disk, over USB)

Summary

Summary

- RDF mounted directly on ARCHER login nodes. DTNs available for remote transfers
- Archiving improves performance for copying and transfer. Be aware of metadata operation bottleneck with lots of (small) files.
- Beware compression in rsync – can lead to bottleneck on CPU performance (avoid "-z" rsync option to mitigate)
- Beware encryption in ssh – can lead to bottleneck on CPU performance (use *arcfour* to mitigate)
- Globus Online can access best performance for large data transfers
- Be aware of the weakest link in your data transfer chain (e.g. low network bandwidth, low storage bandwidth)

For advice contact: support@archer.ac.uk