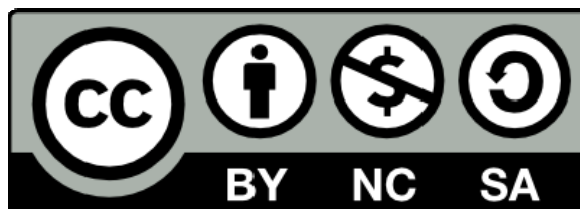


Good practice for transferring data

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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 – cpio creation

Archiving utility provided by most Linux distributions.

Common options:

- o create a new archive (copy-out mode)
- v verbose
- H use the given archive format (crc recommended)

No recursive flag – combine with “find” for directories

Example command:

```
find mydata/ | cpio -ovH crc > mydata.cpio
```



Archiving – cpio extraction and verification

-i extract from archive (copy-in mode)

-d create directories as necessary

```
cpio -id < mydata.cpio
```

--only-verify-crc verifies file checksums (skips extraction)

```
$> cpio -i --only-verify-crc < mydata.cpio
```

```
cpio: mydata/file: checksum error (0x1cd3cee8,  
should be 0x1cd3cf8f)
```

```
204801 blocks
```



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



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

