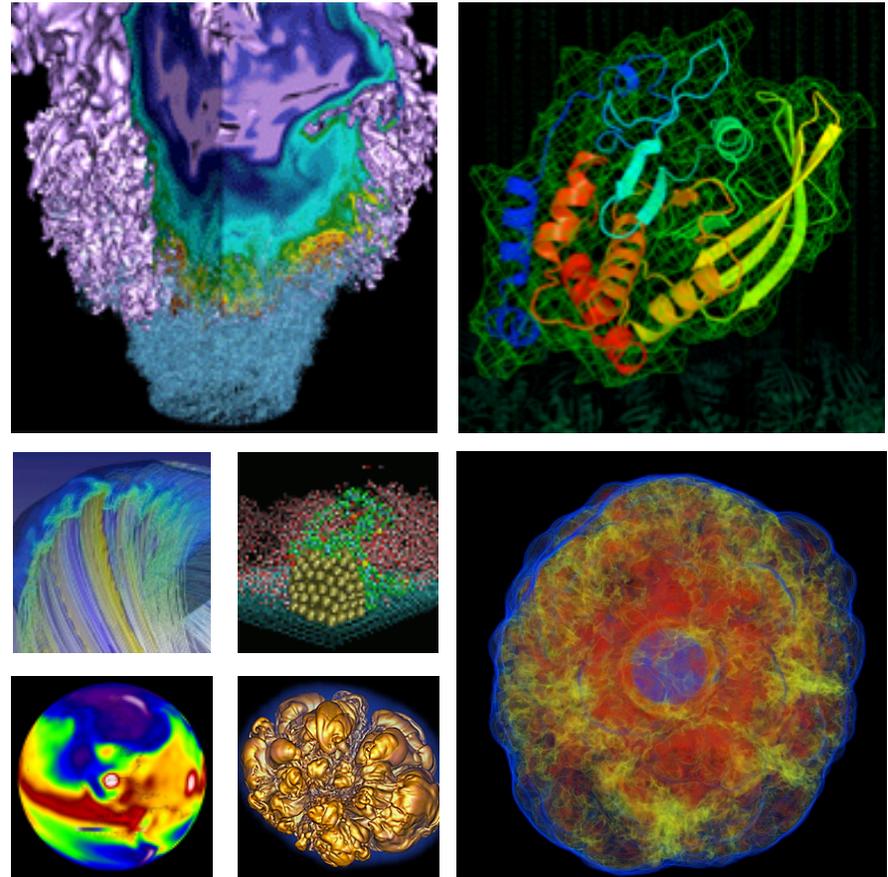


# Moving Data at NERSC



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# Dedicated Data Transfer Systems: Data Transfer Nodes



- **Data Transfer Nodes (DTN) are servers dedicated to data transfer at NERSC.**
    - Currently 4 Nodes → `dtn[01-04].nersc.gov`
  - **DTN features**
    - High bandwidth network interfaces
    - Access to global NERSC file systems
    - Tuned for efficient data transfers
    - Tuned for transferring large volumes of data between NERSC and other major facilities (ORNL, ANL etc.)
    - Can also move data between NERSC file systems and HPSS
- **Use the DTNs if you want to move large volumes of data in and out of NERSC**

# DTN Login Access

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- **All NERSC users have login access**
  - NERSC Users (non-JGI):
    - `ssh dtn01.nersc.gov` (or `dtn02`)
  - JGI Users:
    - `ssh dtn03.nersc.gov` (or `dtn04`)
- **Familiar module environment**
  - `module avail`
  - Limited software deployment for data transfer needs

# DTN File Systems

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- **Global File Systems are available**
  - /global/homes
  - /global/scratch2
  - /global/project
  - /global/projectb
  - /global/projecta
  - /global/dna
  - /global/seqfs
  - /global/common
- **Currently excludes system-specific file systems**
  - e.g. /scratchX on Hopper & Edison

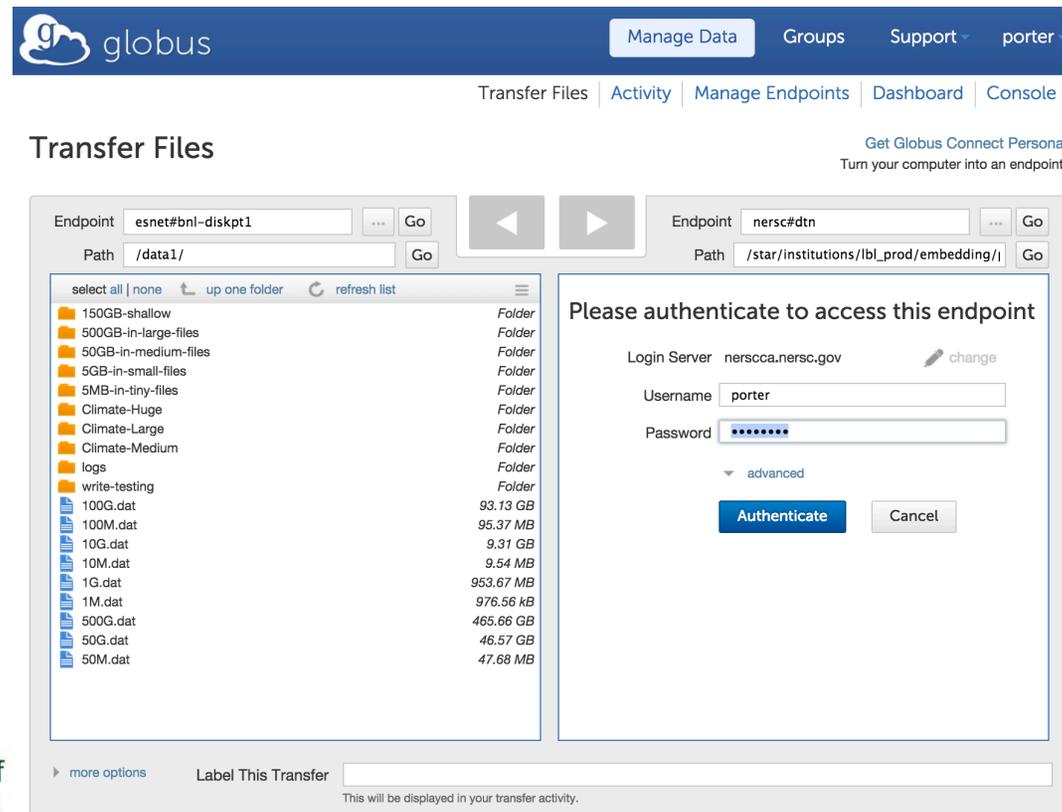
# Transfer Tools



- **Globus Online ... Globus.org**
  - Reliable transfers of large data sets between sites or systems
- **scp**
  - copying individual files and directories
- **GridFTP (globus-url-copy)**
  - high performance CLI w/ grid certificates
- **bbcp**
  - high performance CLI tool w/ minimal setup
- **hsi/htar**
  - for data transfer into & out of HPSS



- **Managed 3<sup>rd</sup> party transfers** <https://www.globus.org/>
  - Web based interface, currently requires Globus Account
- **Type nersc#dtn endpoint in the transfer window**
  - Activate with NERSC username & password



The screenshot shows the Globus web interface. At the top, there is a navigation bar with the Globus logo and links for "Manage Data", "Groups", "Support", and "porter". Below this, there are links for "Transfer Files", "Activity", "Manage Endpoints", "Dashboard", and "Console".

The main content area is titled "Transfer Files". On the right side, there is a link for "Get Globus Connect Personal" with the subtext "Turn your computer into an endpoint."

The interface is split into two main sections. The left section shows a file browser for the endpoint "esnet#bni-diskpt1" with the path "/data1/". It displays a list of folders and files, including "150GB-shallow", "500GB-in-large-files", "50GB-in-medium-files", "5GB-in-small-files", "5MB-in-tiny-files", "Climate-Huge", "Climate-Large", "Climate-Medium", "logs", "write-testing", and several ".dat" files with their respective sizes.

The right section shows an authentication dialog for the endpoint "nersc#dtn" with the path "/star/institutions/lb\_prod/embedding/". The dialog prompts for a "Login Server" (nerscca.nersc.gov), "Username" (porter), and "Password". There are "Authenticate" and "Cancel" buttons.

At the bottom of the interface, there is a "Label This Transfer" field and a note: "This will be displayed in your transfer activity."

# Globus.org Continued



- **Use point & click interface to submit**
  - Transfer happens in the background & retries on failure
  - You can status on Activity panel
  - Email notification on completion

Transfer Request Submitted Successfully. Task ID: 20d4f522-41e3-11e5-acba-22000b92c6ec

Endpoint: esnet#bnl-diskpt1 Path: /data1/ Endpoint: porter#star4 Path: /star/institutions/lb\_prod/embedd

| File/Folder          | Size      |
|----------------------|-----------|
| 150GB-shallow        | Folder    |
| 500GB-in-large-files | Folder    |
| 50GB-in-medium-files | Folder    |
| 5GB-in-small-files   | Folder    |
| 5MB-in-tiny-files    | Folder    |
| Climate-Huge         | Folder    |
| Climate-Large        | Folder    |
| Climate-Medium       | Folder    |
| logs                 | Folder    |
| write-testing        | Folder    |
| 100G.dat             | 93.13 GB  |
| 100M.dat             | 95.37 MB  |
| 10G.dat              | 9.31 GB   |
| 10M.dat              | 9.54 MB   |
| 1G.dat               | 953.67 MB |
| 1M.dat               | 976.56 kB |
| 500G.dat             | 465.66 GB |
| 50G.dat              | 46.57 GB  |
| 50M.dat              | 47.68 MB  |

Activity

Sort By: start date & time

- ✓ esnet#bnl-diskpt1 to porter#star4  
transfer completed a minute ago
- ✗ esnet#bnl-diskpt1 to porter#star2  
transfer cancelled a few moments ago
- ✓ nersc#pdsf to nersc#dtn  
transfer completed 22 days ago

### Globus Notification

To: Jeff Porter  
SUCCEEDED - 20d4f522-41e3-11e5-acba-22000b92c6ec

**TASK DETAILS**

Task ID : 20d4f522-41e3-11e5-acba-22000b92c6ec  
Task Type : TRANSFER  
Status : SUCCEEDED  
Is Paused : No  
Request Time : 2015-08-13 17:45:47Z  
Deadline : 2015-08-14 17:45:46Z  
Completion Time : 2015-08-13 17:46:08Z  
Total Tasks : 1  
Tasks Successful : 1  
Tasks Expired : 0  
Tasks Canceled : 0  
Tasks Failed : 0  
Tasks Pending : 0  
Tasks Retrying : 0  
Command : API 0.10 go  
Label : n/a  
Source Endpoint : esnet#bnl-diskpt1  
Destination Endpoint : porter#star4  
Sync Level : n/a  
Data Encryption : No  
Checksum Verification : Yes  
Delete : No  
Files : 1  
Files Skipped : 0  
Directories : 0  
Expansions : 0  
Bytes Transferred : 1000000000  
Bytes Checksummed (Sync): 0  
Effective MBits/sec : 380.952  
Faults : 0

- **Globus Connect** allows a private endpoint on your laptop
  - <https://www.globus.org/globus-connect>

# Other tools



- **Command line tools for use directly from the DTN nodes or from a remote node**

- scp
  - GridFTP (globus-url-copy)
    - <http://tinyurl.com/nersc-gridftp>
  - bbcp
    - <http://tinyurl.com/nerscbbcp>

| Tool  | Throughput           |
|---|----------------------|
| scp   | 140 Mbps (17.5 MB/s) |
| <a href="#">HPN patched scp</a> , 1 disk    | 760 Mbps (95 MB/s)   |
| <a href="#">HPN patched scp</a> , RAID disk | 1.2 Gbps (150 MB/s)  |
| GridFTP, 1 stream, 1 disk                   | 760 Mbps (95 MB/s)   |
| GridFTP, 1 stream, RAID disk                | 1.4 Gbps (175 MB/s)  |
| GridFTP, 4 streams, RAID disk               | 5.4 Gbps (675 MB/s)  |
| GridFTP, 8 streams, RAID disk               | 6.6 Gbps (825 MB/s)  |

- **Detailed instructions, syntax etc.**

- <http://tinyurl.com/nerscdtn>

<http://fasterdata.es.net/data-transfer-tools/>

# scp - Secure Copy

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- Uses SSH under the covers
- Good for “small” (~100s of MB)
- Simple cp-like syntax
  - `scp localfile user@host:remotefile`
- At NERSC, we deploy high performance modifications (HPN SSH) to get better throughput

# GridFTP



- **Grid tools available on NERSC systems via “module load globus”**
  - globus-url-copy
  - <http://tinyurl.com/nersc-gridftp>
- **Use Data Transfer nodes for wide-area transfers**
  - dtn01.nersc.gov
  - dtn02.nersc.gov
  - dtn03.nersc.gov
  - dtn04.nersc.gov
- **Use “grid” name for system specific file systems (often not optimal solution)**
  - hoppergrid.nersc.gov
  - edisongrid.nersc.gov
  - pdsfgrid.nersc.gov

# BaBar Copy (bbcp)



- **Developed for BaBar experiment at SLAC**
  - Somewhat complicated command-line
    - <https://www.nersc.gov/users/data-and-file-systems/transferring-data/bbcp/>
      - <http://tinyurl.com/nerscbbcp>
- **Peer-to-peer model (not client-server)**
  - Must be installed on each end
    - Easy to build and/or install
    - Available on all NERSC systems
  - Can do third-party transfers
  - Uses ssh authentication
  - Good for larger files

- **Backup or archive your data with HSI and HTAR**  
<http://www.nersc.gov/users/data-and-file-systems/hpss/getting-started/>  
(<http://tinyurl.com/nerschpss>)
- **Login to DTN node and use hsi/htar**
  - HSI for individual files and conditional access
  - HTAR for aggregation & optimization of storage/archival
- **Can also use Globus Online:**
  - External endpoint  $\leftrightarrow$  nersc#hpss
  - nersc#dtn  $\leftrightarrow$  nersc#hpss
  - But individual files only, does not support htar

# General Tips



- **Use DTNs as dedicated data transfer servers**
  - Tuned for WAN transfers
  - Fast network (ESnet), optimized configuration
    - See <http://fasterdata.es.net/> for more discussion
  - Dedicated support for data transfer
- **Don't use DTN nodes for non-data transfer purposes**
- **Use Globus for large, automated or monitored transfers**
- **scp is fine for smaller, one-time transfers (<100MB)**
  - Globus is also fine for small transfers
- **Plain “cp” or “rsync” is still used for local transfers**

# Performance Considerations

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- **Performance is often limited by the remote endpoint**
  - Not tuned for WAN transfers
  - Have limited network (~1Gb/sec) link.
  - These will lower performance < 100 MB/sec.
- **File system contention may be an issue**
  - For example, don't use your \$HOME directory!
  - Instead use /project, \$SCRATCH or \$GSCRATCH
- **If you don't think you are getting the performance you expect, let us know: [consult@nersc.gov](mailto:consult@nersc.gov)**

# For more information

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- **General DTN info**
  - <http://www.nersc.gov/systems/data-transfer-nodes/>
- **Data transfer info**
  - <http://www.nersc.gov/users/data-and-file-systems/transferring-data/>  
(<http://tinyurl.com/nerscdtn>)
- **Feedback / Problems?**
  - [consult@nersc.gov](mailto:consult@nersc.gov)
- **Globus Support**
  - <https://www.globus.org/support/>



**Thank you.**