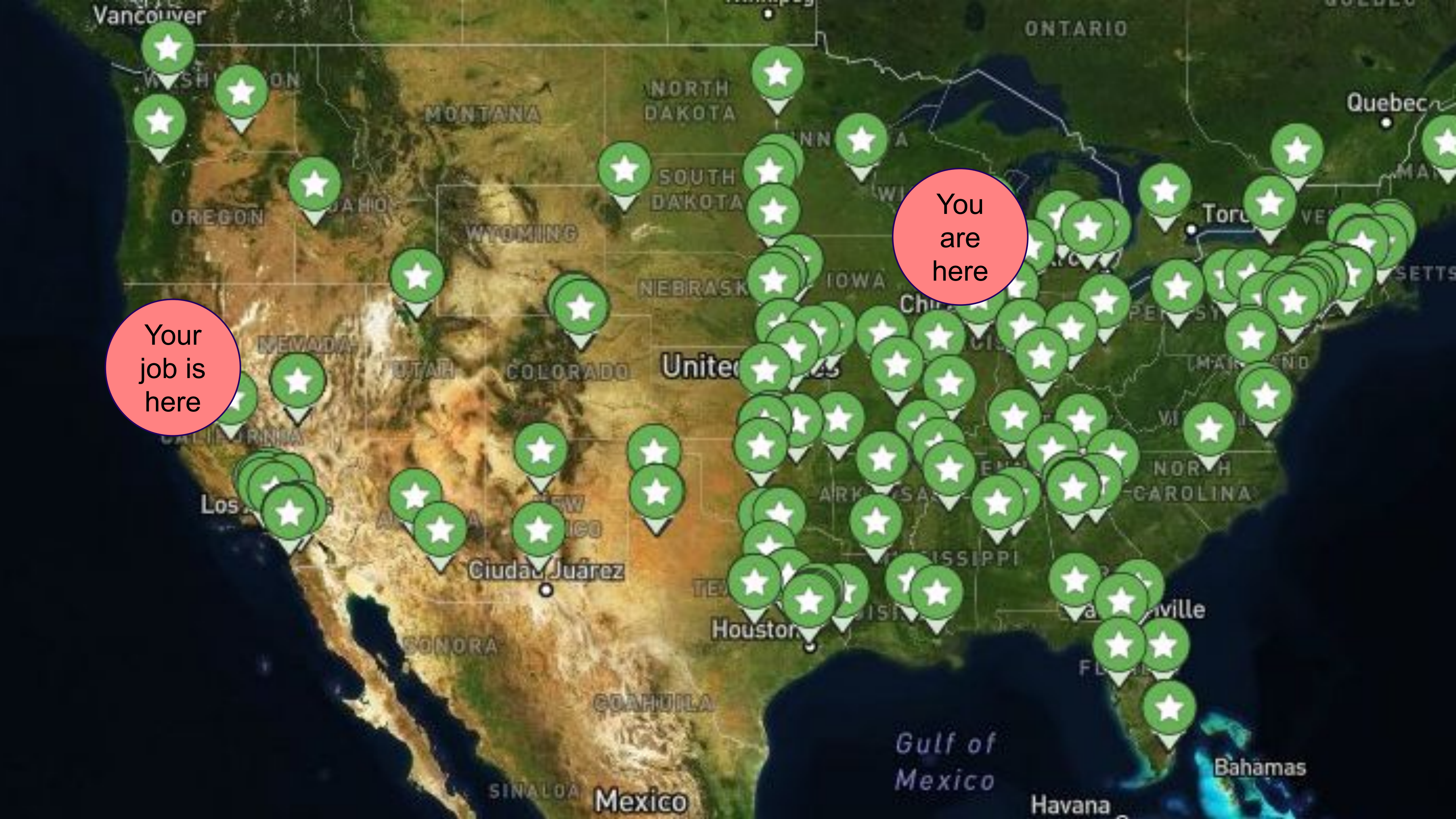
OSG

Handling Data on OSG

Wednesday, August 9

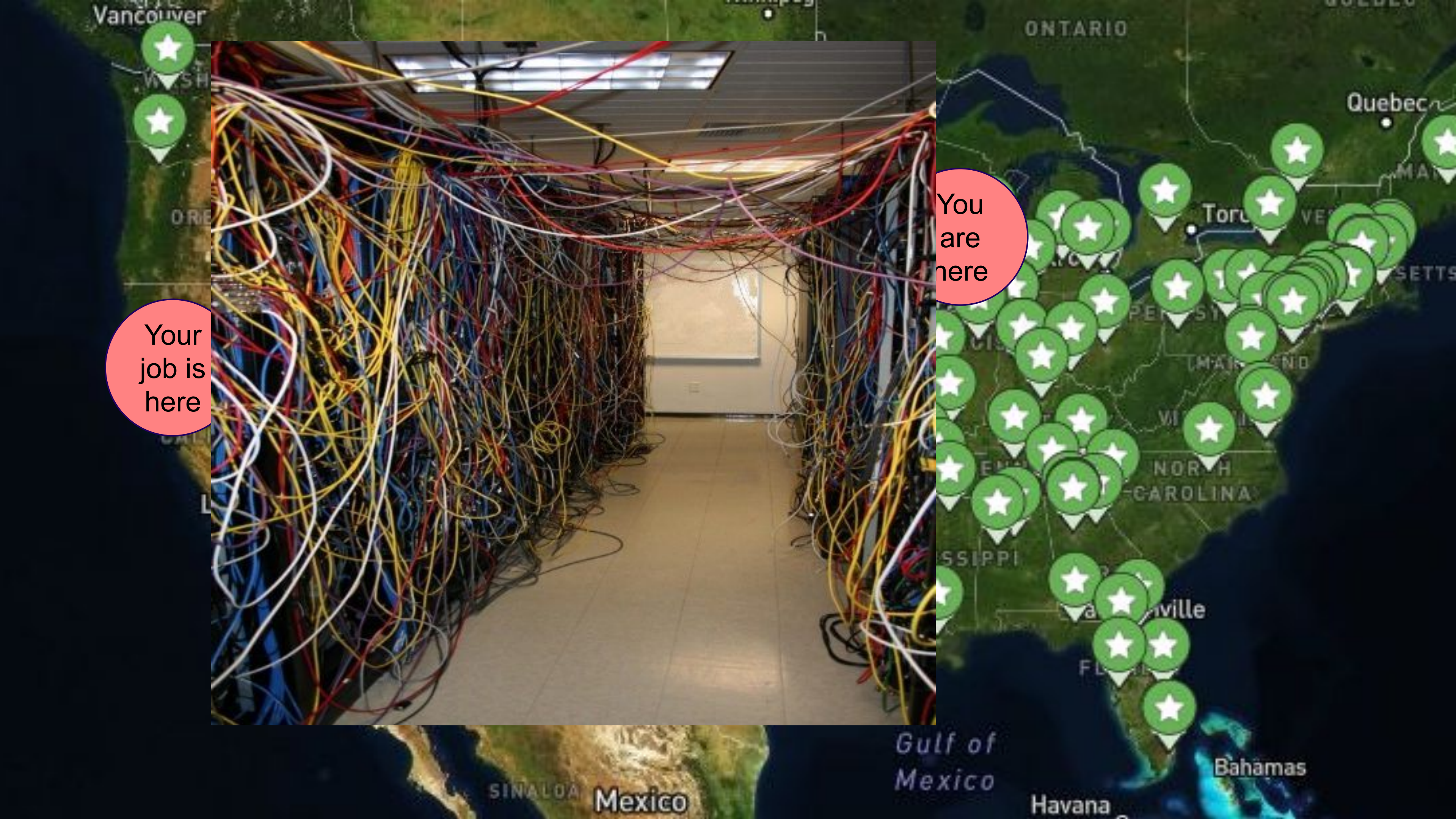
Mats Rynge

This work was supported by NSF grants MPS-1148698, OAC-1836650, and OAC-2030508



You are here

Your job is here



Your job is here

You are here

From yesterday…

```
container_image = py-cowsay.sif
```

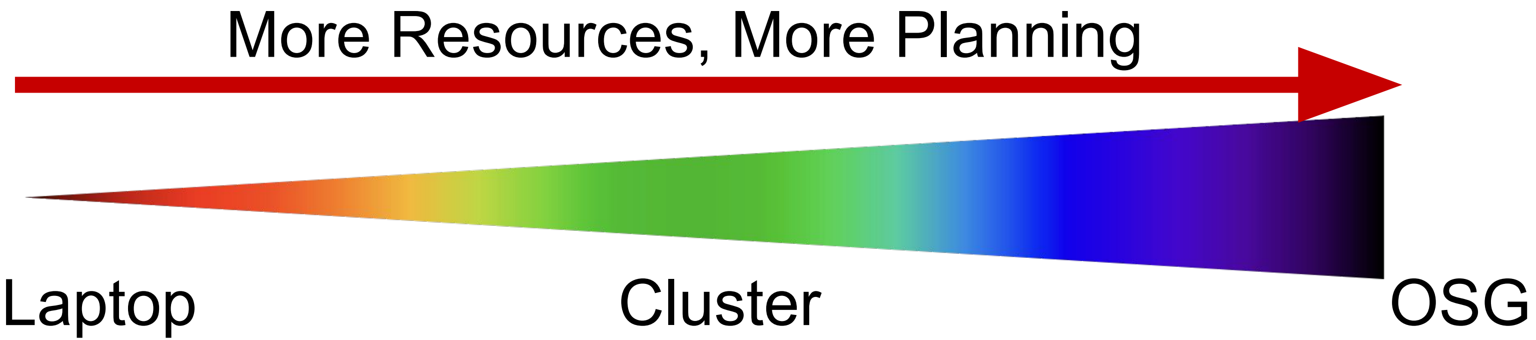
From yesterday…

```
container_image = py-cowsay.sif

queue 10000
```

Like all things

- I always think of HTC/OSG usage as a spectrum:



More Resources, More Planning

Laptop

Cluster

OSG

Handling Data on OSG

- Overview / Things to Consider
- HTCondor File Transfer
- OSDF
- Shared File Systems

What is ~~big~~ large data?

- In reality, “big data” is relative
  - What is ‘big’ for *you*? Why?

What is ~~big~~ large data?

- In reality, “big data” is relative
  - What is ‘big’ for *you*? Why?
- Volume, velocity, variety!
  - think: a million 1-KB files, versus one 1-TB file

Determining In-Job Needs

- “**Input**” includes *any* files needed for the job to run
  - `executable`
  - `transfer_input_files`
  - data ***and*** <u>software</u>

- “**Output**” includes any files produced for the job that *need to come back*
  - `output, error`

Data Management Tips

1. Determine your per-job needs
    a. minimize per-job data needs
2. Determine your batch needs
3. Leverage HTCondor and OSG data handling features!

First! Try to minimize your data

- split large input for better throughput
- eliminate unnecessary data
- file compression and consolidation
  - job input: prior to job submission
  - job output: prior to end of job
  - moving data between your laptop and the submit server

‘Large’ data: The collaborator analogy

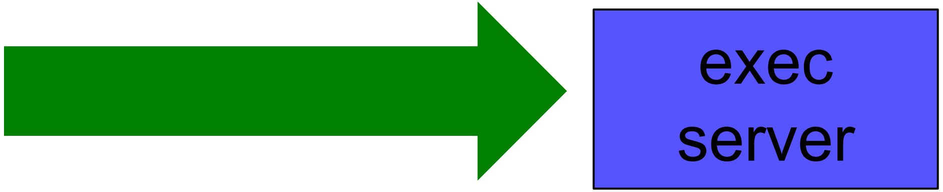
What method would you use to send data to a collaborator?

amount	method of delivery
words	email body
tiny – 100MB	email attachment (managed transfer)
100MB – GBs	download from Google Drive, Drop/Box, other web-accessible repository
TBs	ship an external drive (local copy needed)

Never underestimate the bandwidth of a station wagon full of tapes hurtling down the highway.

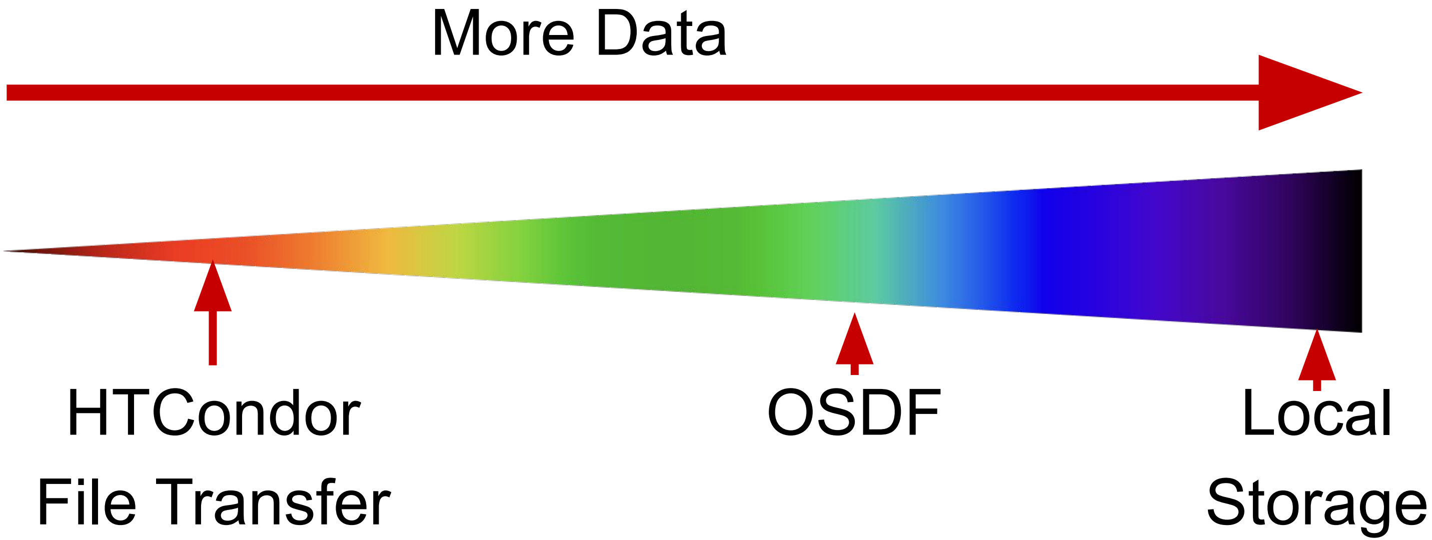
Andrew S. Tanenbaum (1981) – Professor Emeritus, Vrije Universiteit Amsterdam

Large *input* in HTC and OSG



file size	method of delivery
words	within executable or arguments?
tiny – 1GB per file	HTCondor file transfer (up to 1GB total per job)
1GB – 20GB	OSDF (regional replication)
20 GB – TBs	shared file system (local copy, local execute servers)

Transfers



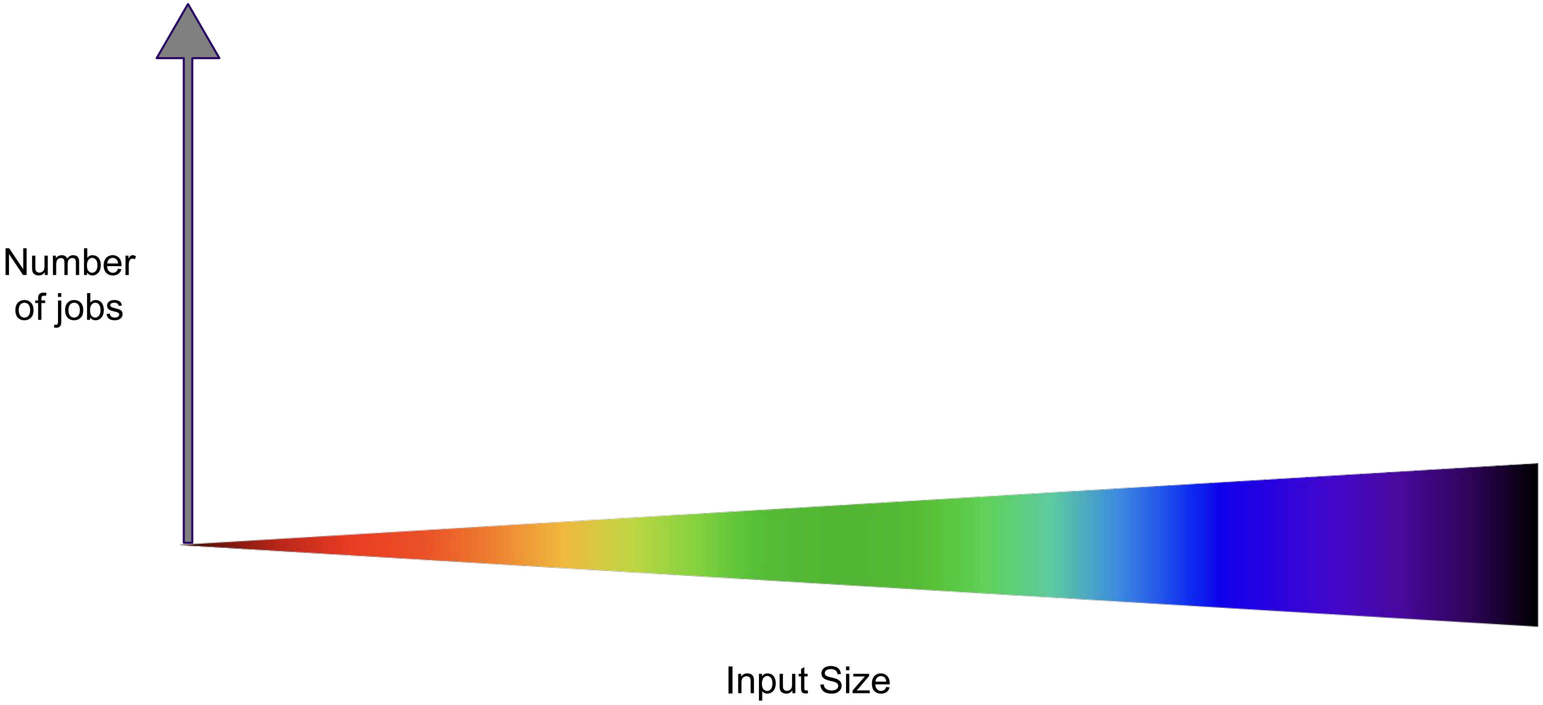
More Data

HTCondor File Transfer

OSDF

Local Storage

Rule of thumb - many dimensions



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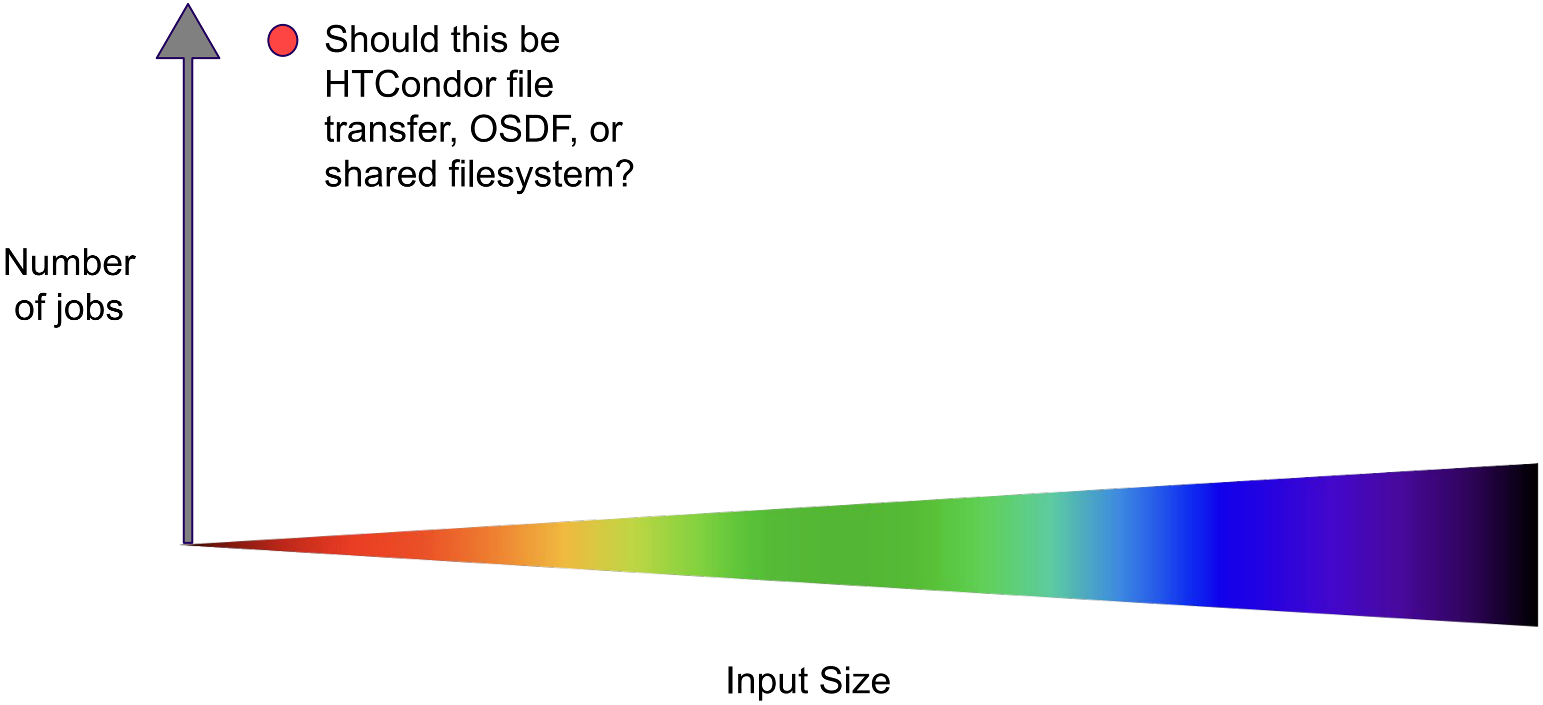
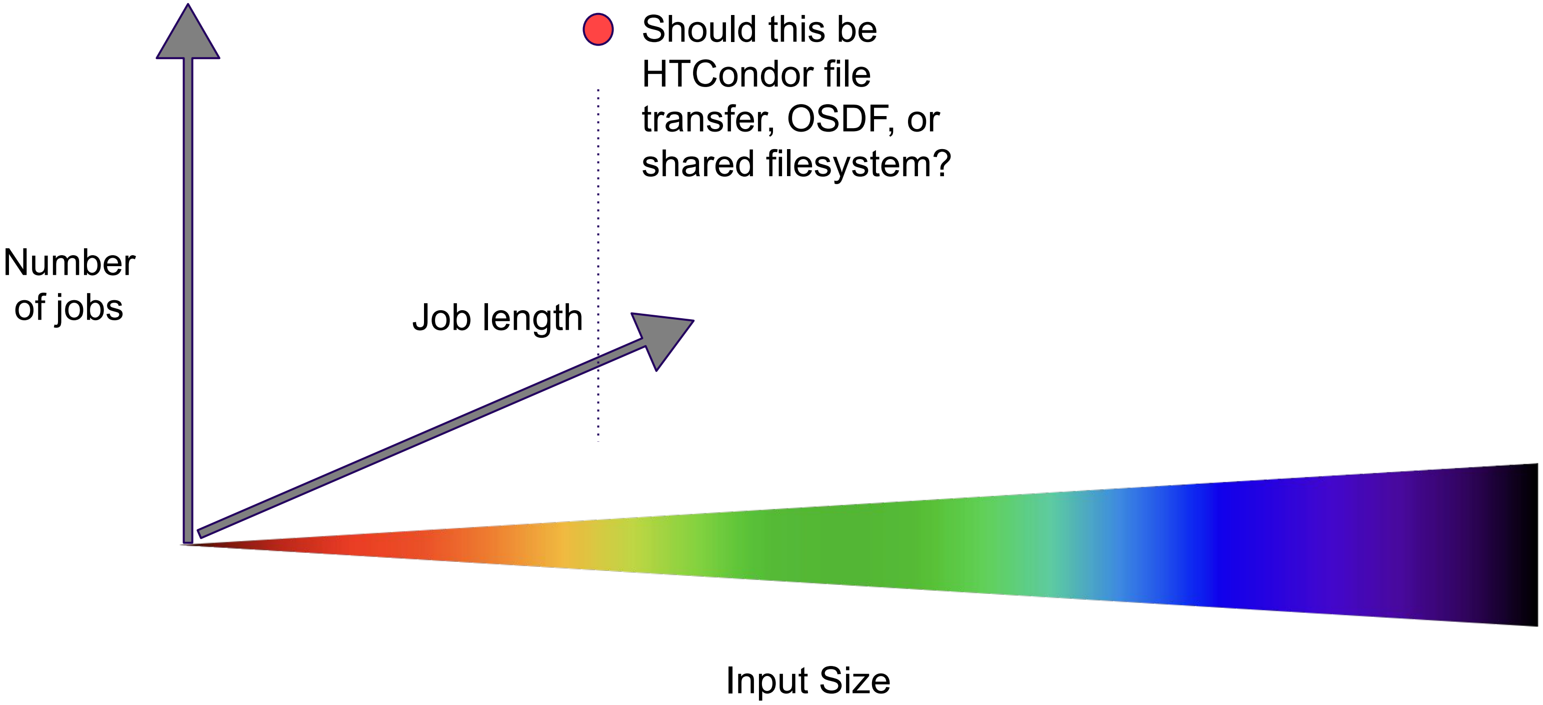


● Should this be HTCondor file transfer, OSDF, or shared filesystem?

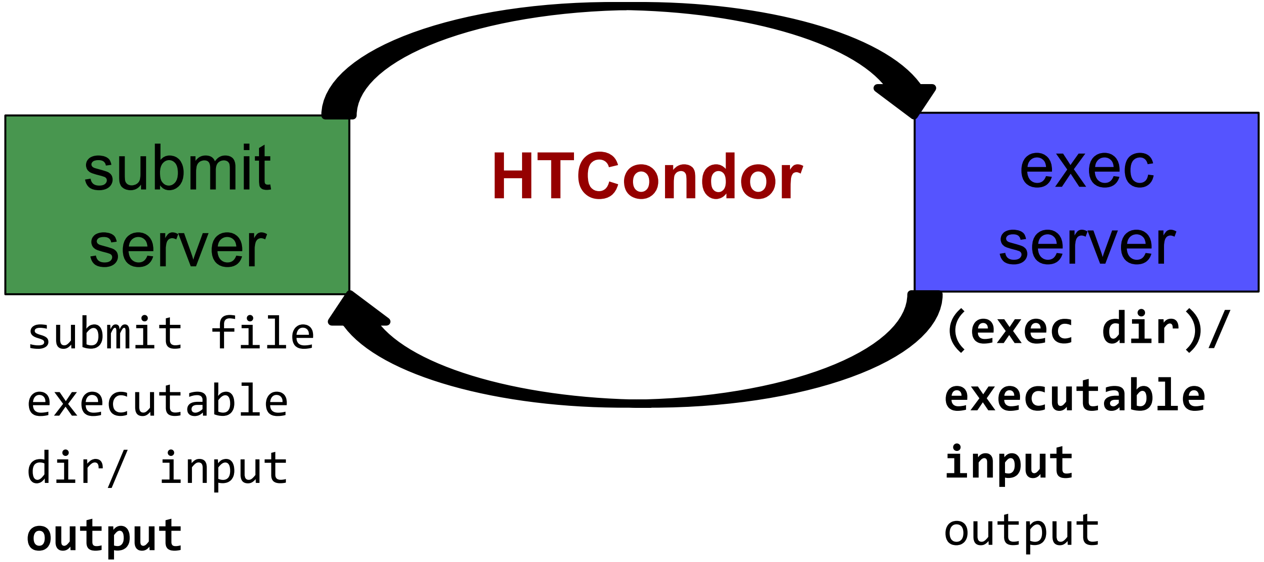
Rule of thumb - many dimensions


Should this be HTCondor file transfer, OSDF, or shared filesystem?
Number of jobs
Job length
Input Size

Handling Data on OSG

- ~~Overview / Things to Consider~~
- **HTCondor File Transfer**
- OSDF
- Shared File Systems and Other Options

Review: HTCondor Data Handling



submit server

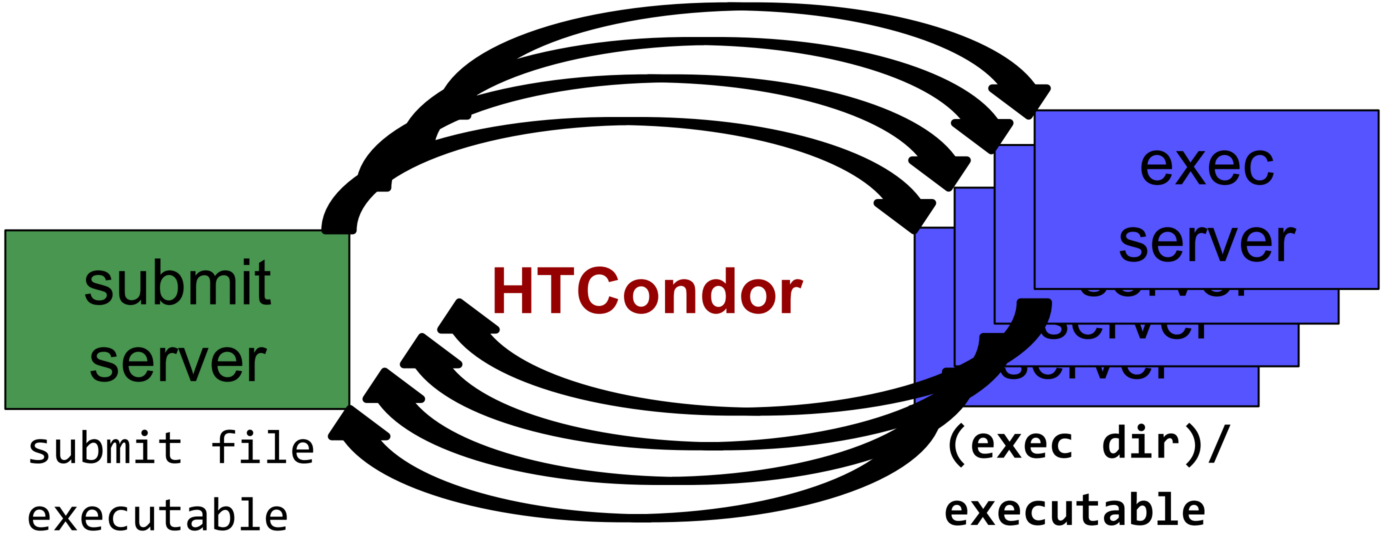
HTCondor

exec server

submit file
executable
dir/ input
output

(exec dir)/
executable
input
output

Network bottleneck: the submit server



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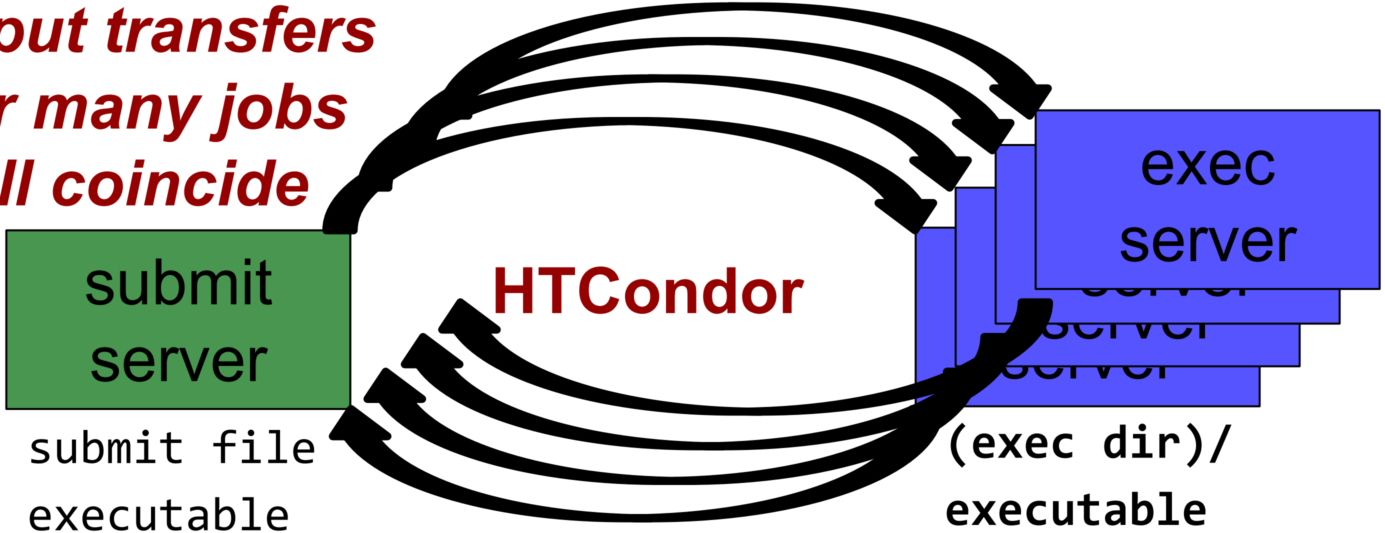
Network bottleneck: the submit server

Input transfers for many jobs will coincide



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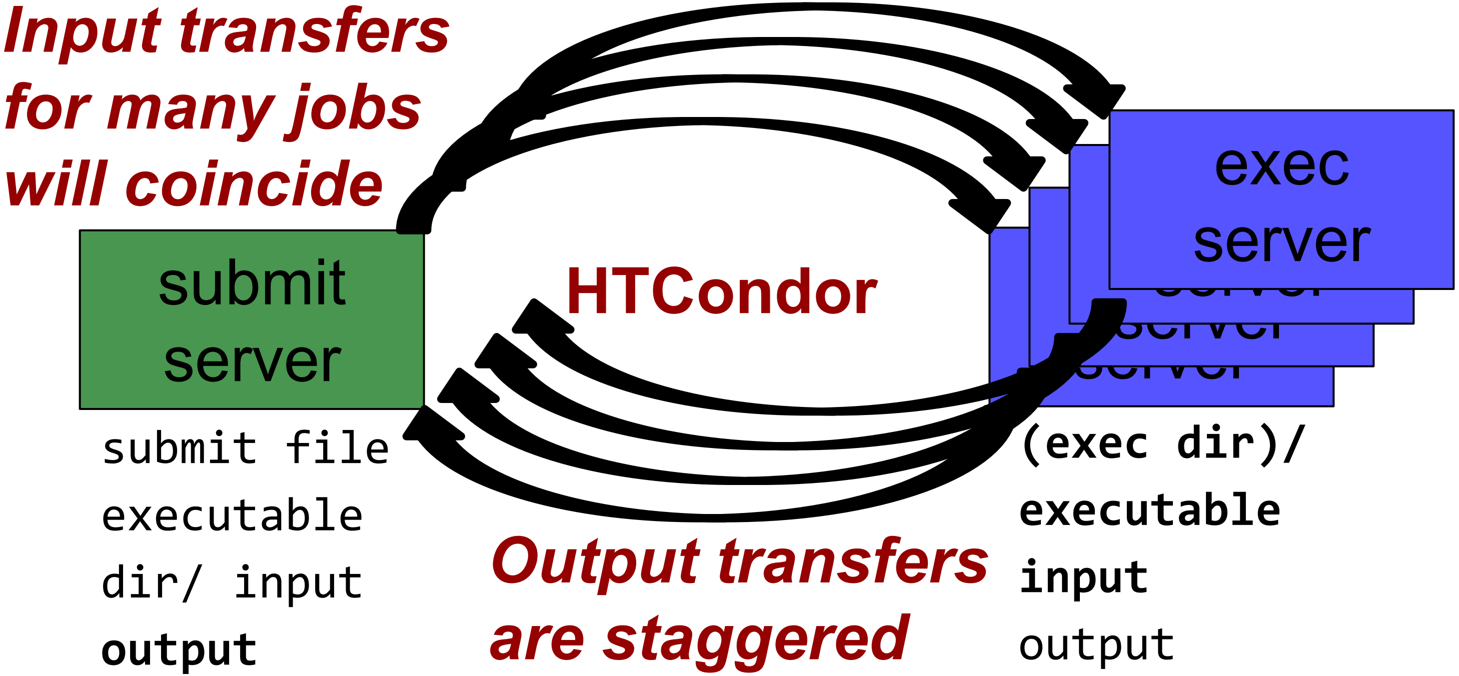
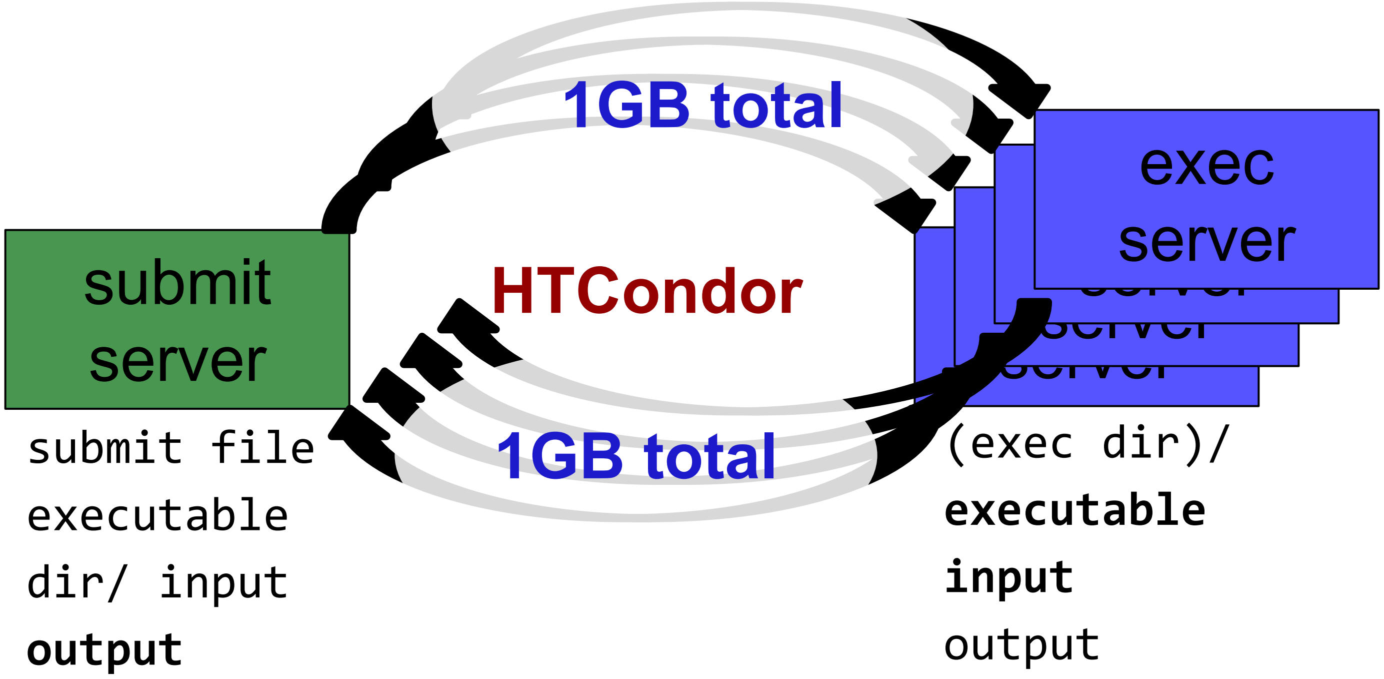

Input transfers for many jobs will coincide
submit server
HTCondor
exec server
server
server
server
Output transfers are staggered

```
submit file
executable
dir/ input
output
```

```
(exec dir)/
executable
input
output
```

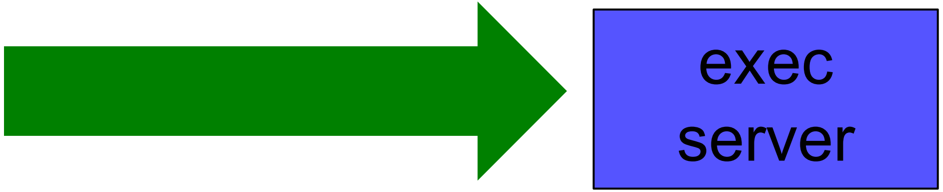
Hardware transfer limits



Handling Data on OSG

- ~~Overview / Things to Consider~~
- ~~HTCondor File Transfer~~
- **OSDF**
- Shared File Systems

Large input in HTC and OSG



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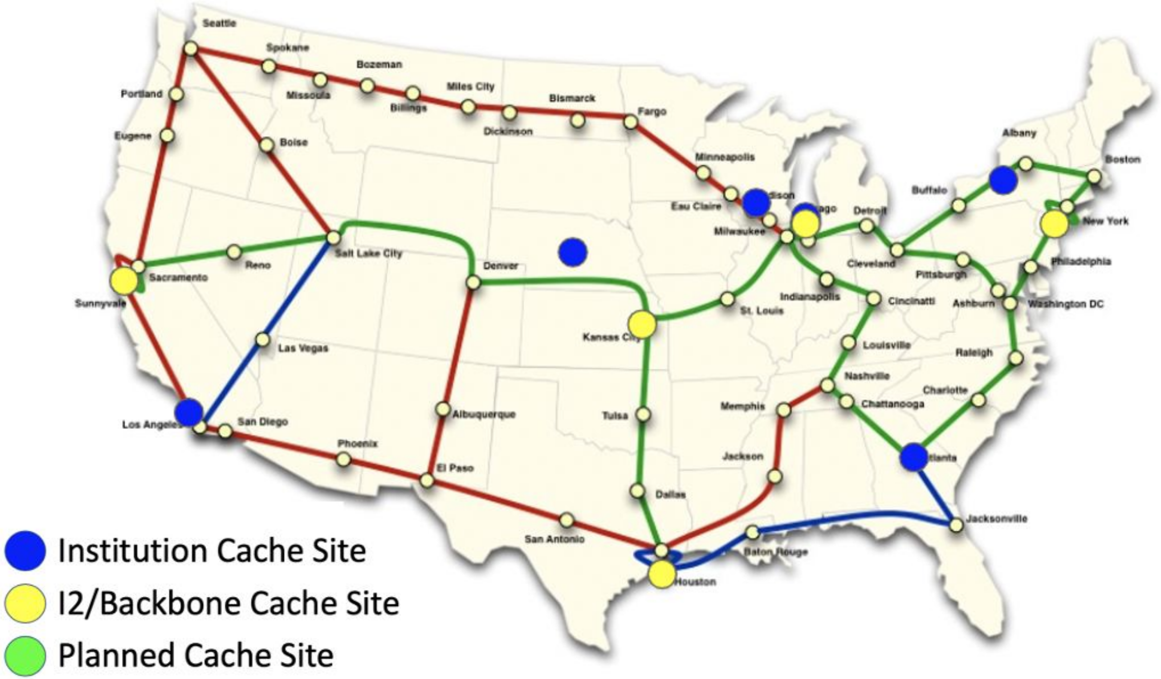
100MB – 1GB, shared	download from web server (local caching)
1GB – 20GB, unique or shared	OSDF (regional replication)
10 GB - TBs	shared file system (local copy, local execute servers)

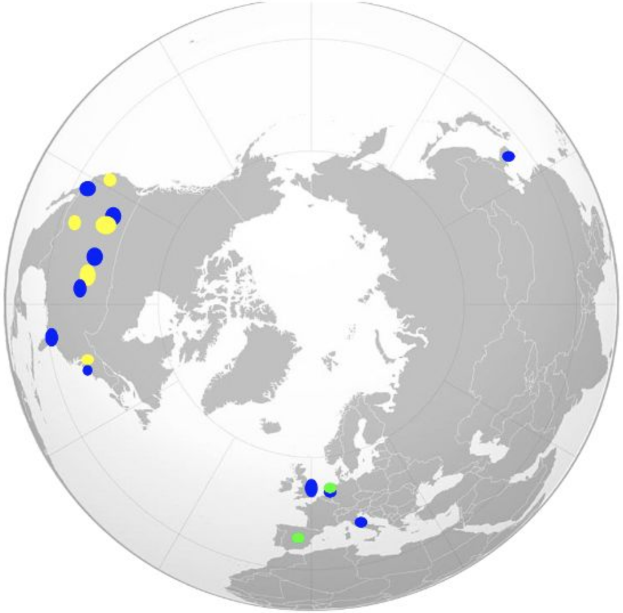
Open Science Data Federation (OSDF)



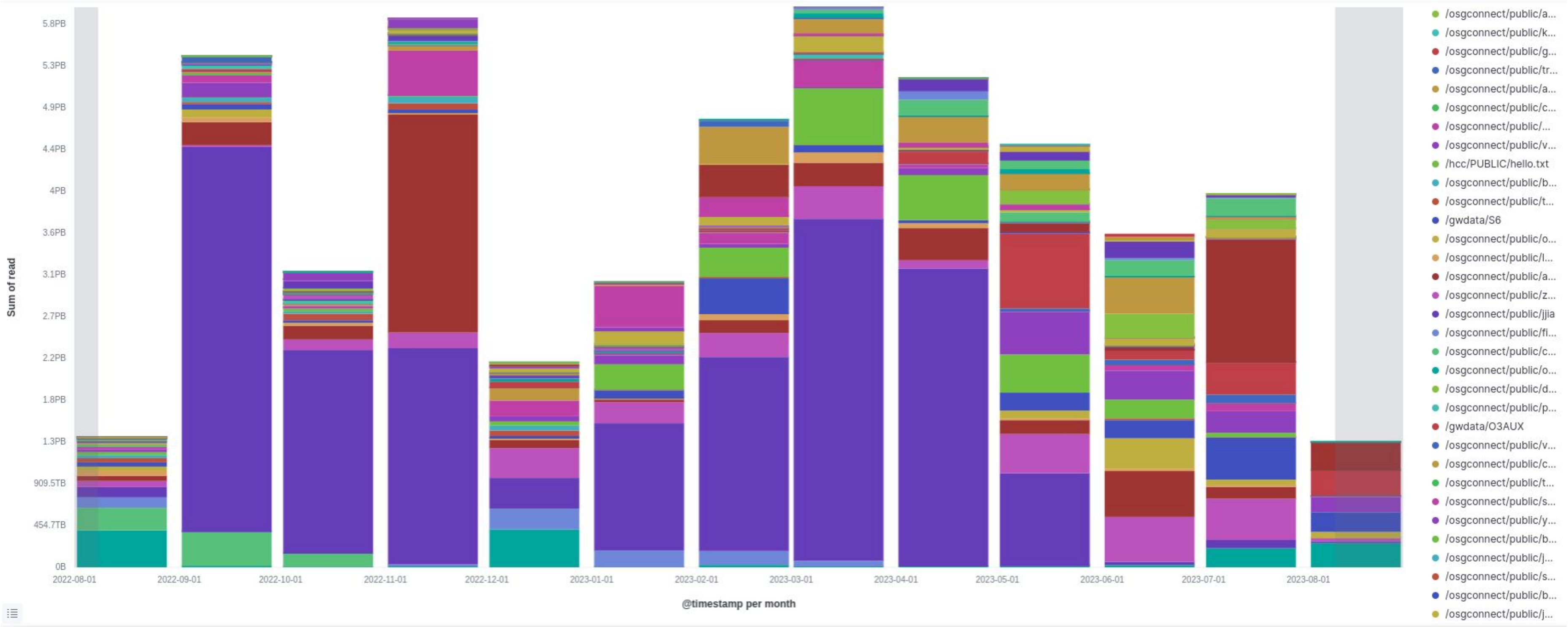
● Institution Cache Site

● I2/Backbone Cache Site

● Planned Cache Site



OSDF Usage on OSG

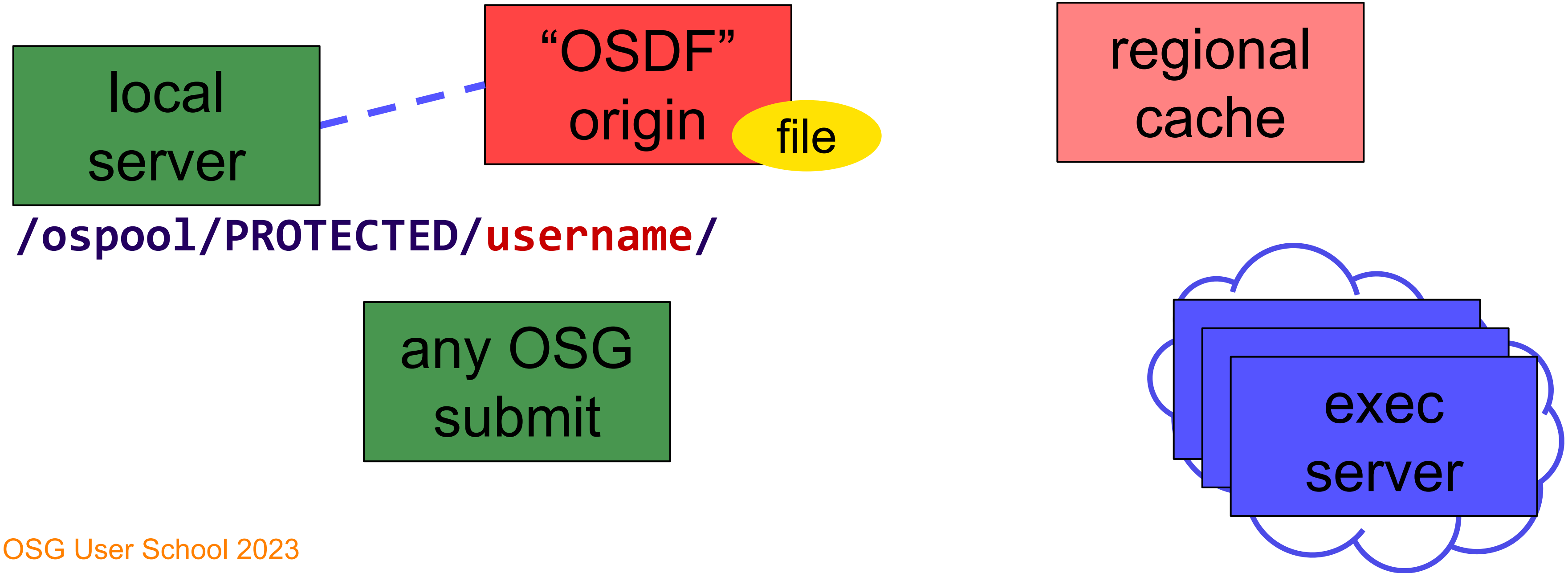


OSDF Considerations

- Available at ~95% of OSG sites
- Regional caches on *very fast* networks
  - **Recommended max file size: 20 GB**
- Can copy multiple files totaling >10GB
- Change name when update files

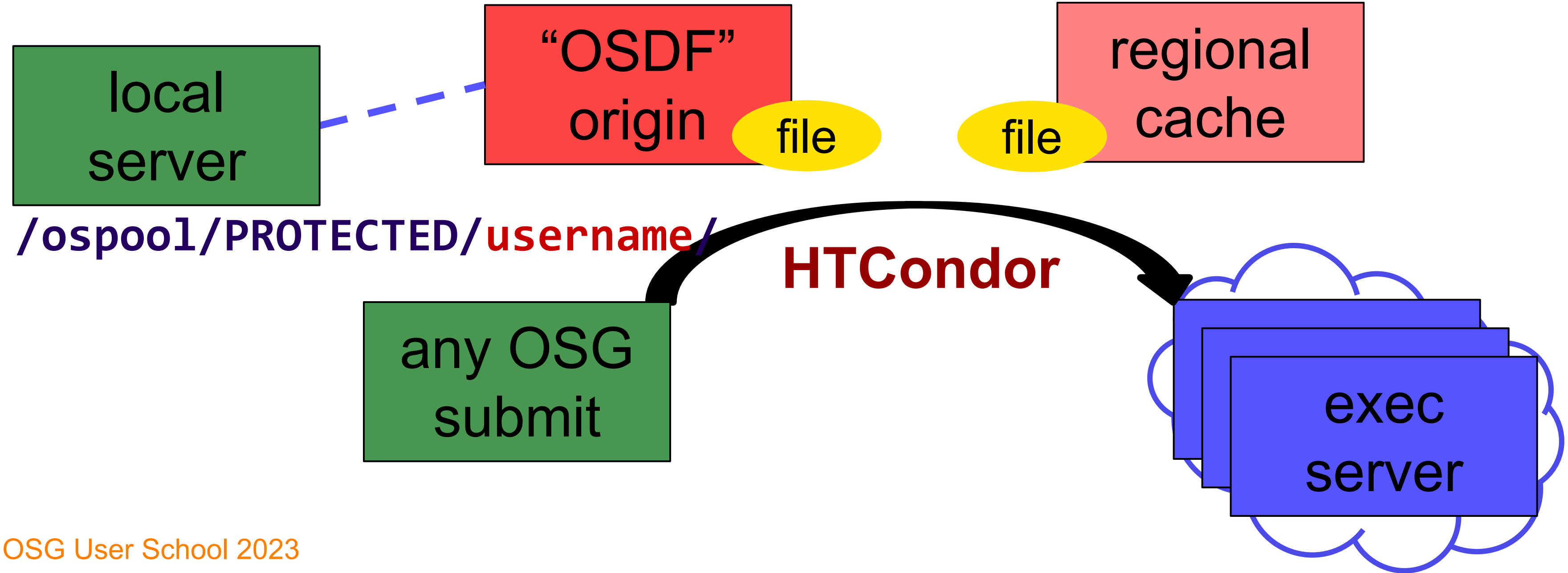
Placing Files in OSDF

- Place files in `/ospool/PROTECTED/username/`



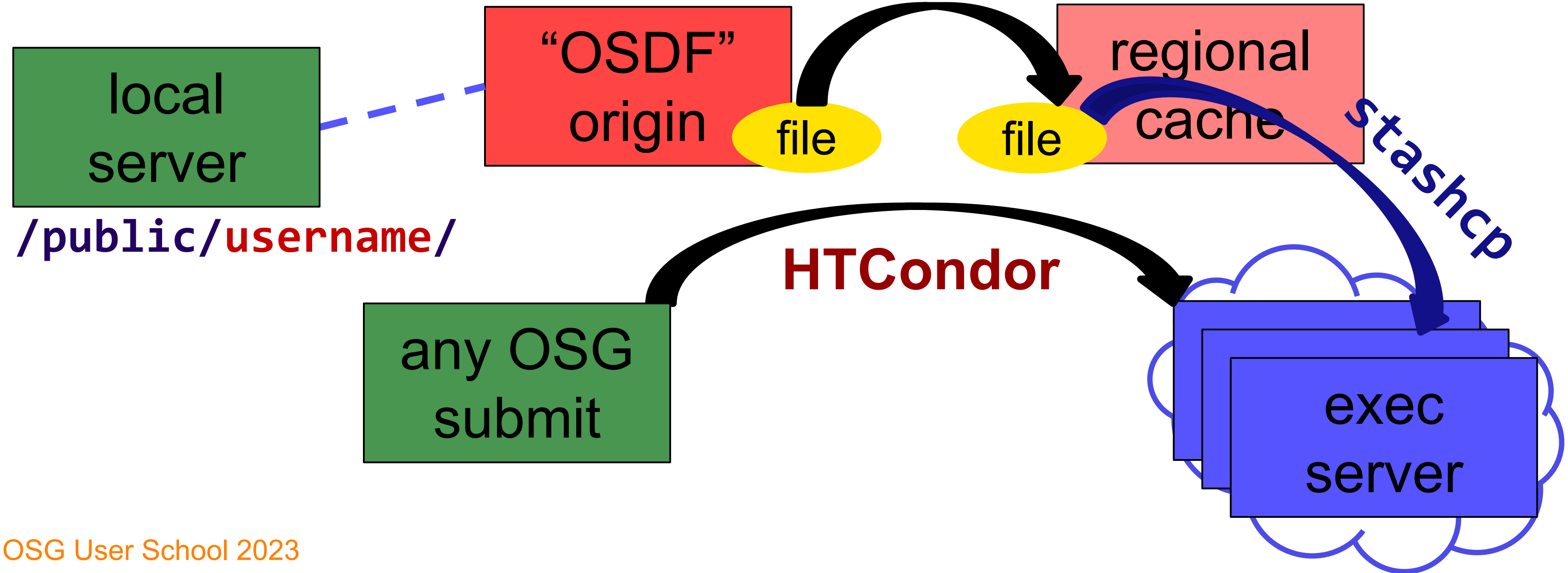
Obtaining Files in OSDF

- Use HTCondor transfer for other files

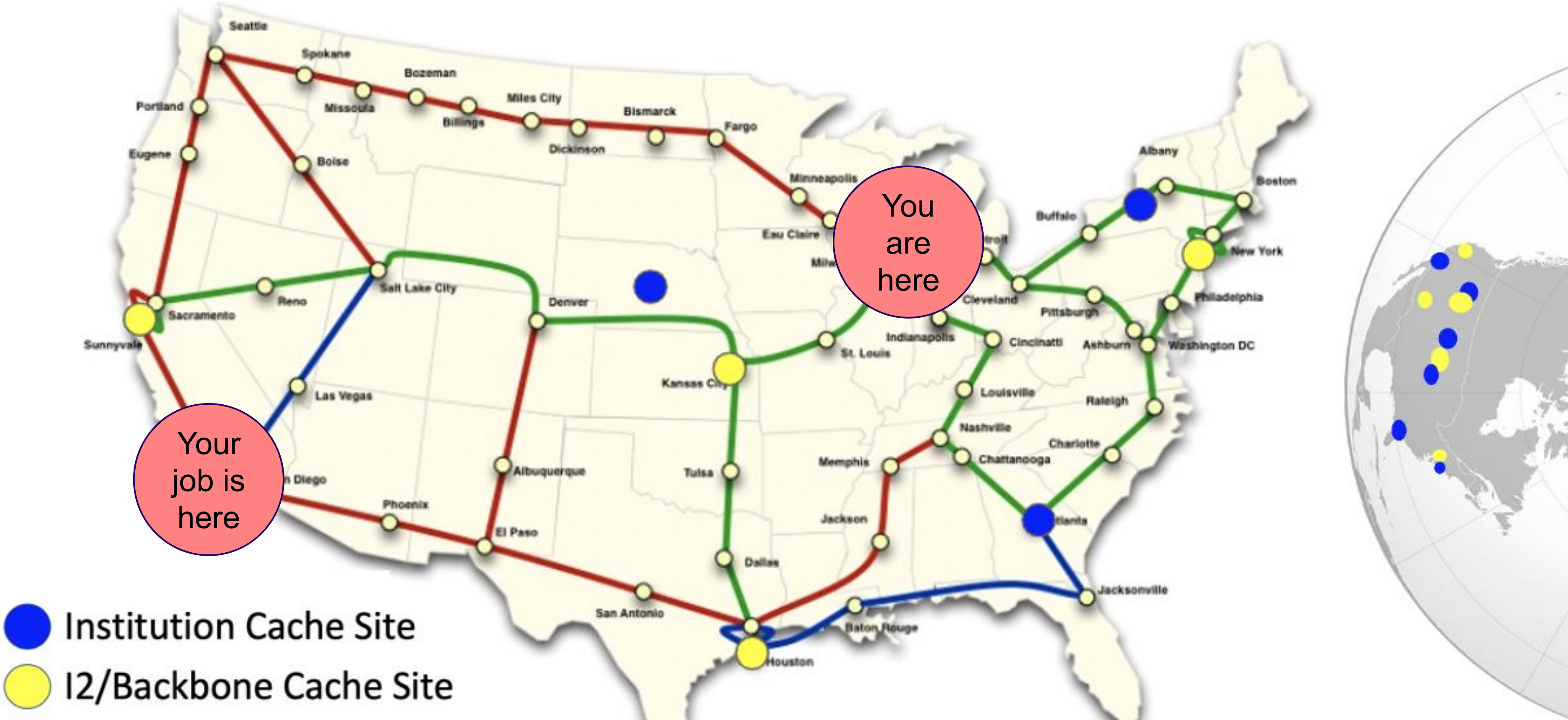


Obtaining Files in Stash

- Download using `stashcp` command



Open Science Data Federation (OSDF)



You are here

Your job is here

● Institution Cache Site

● I2/Backbone Cache Site

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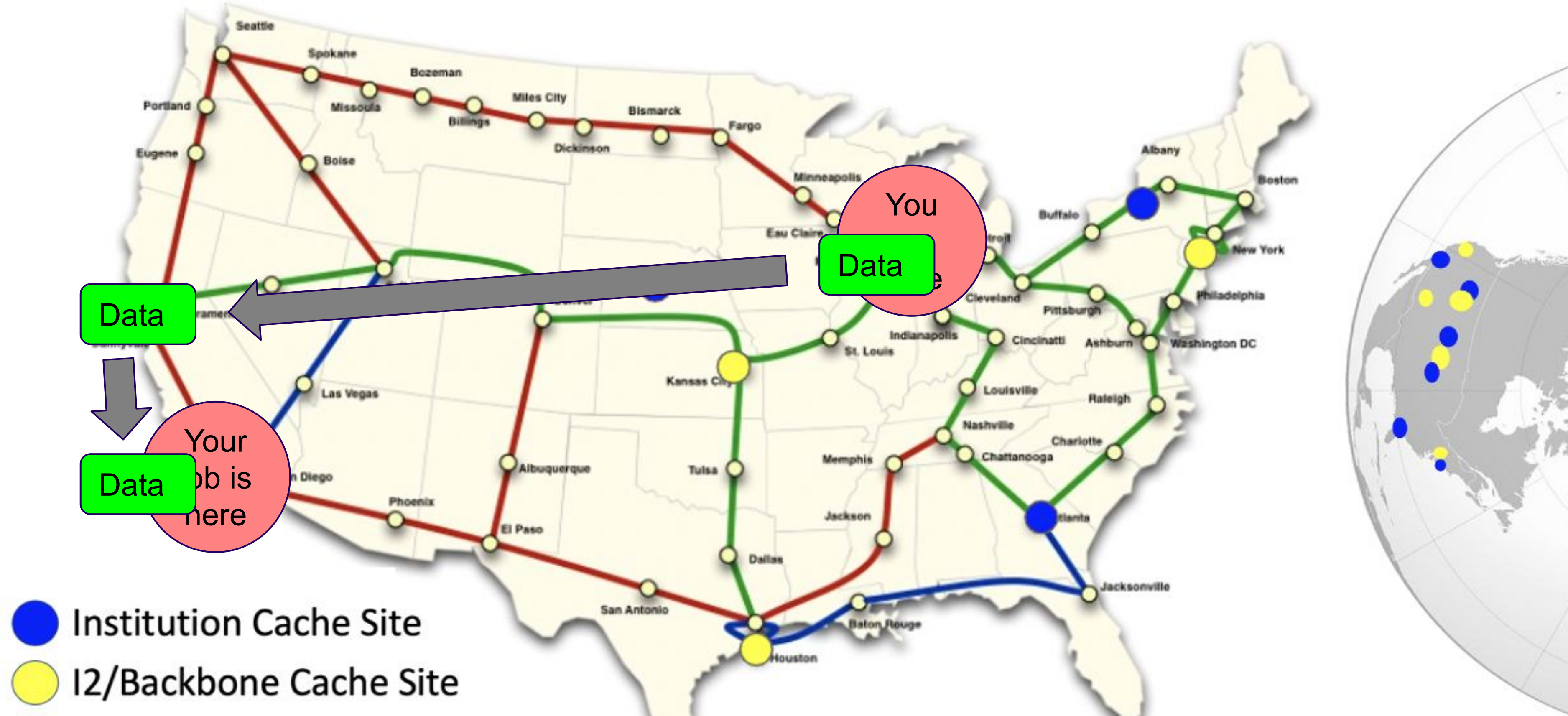

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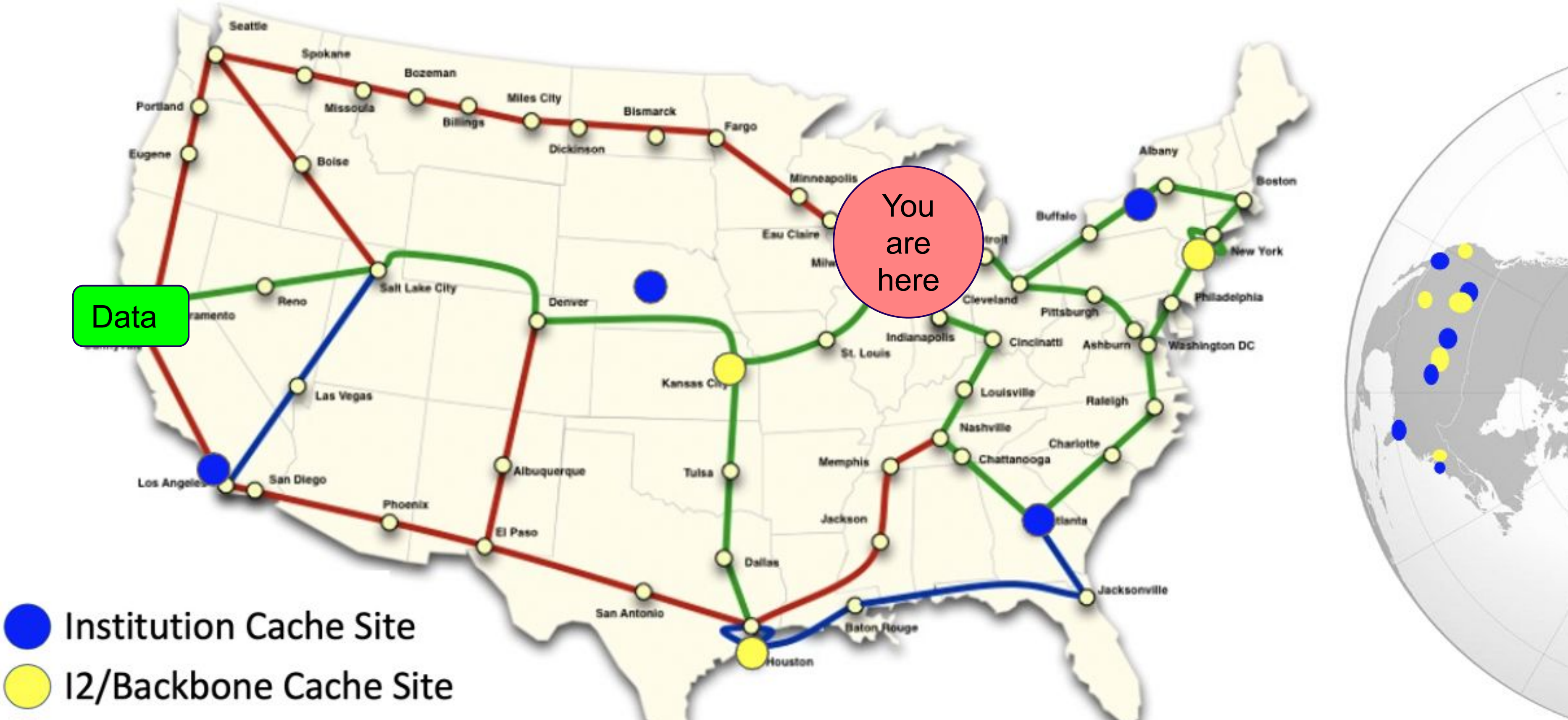

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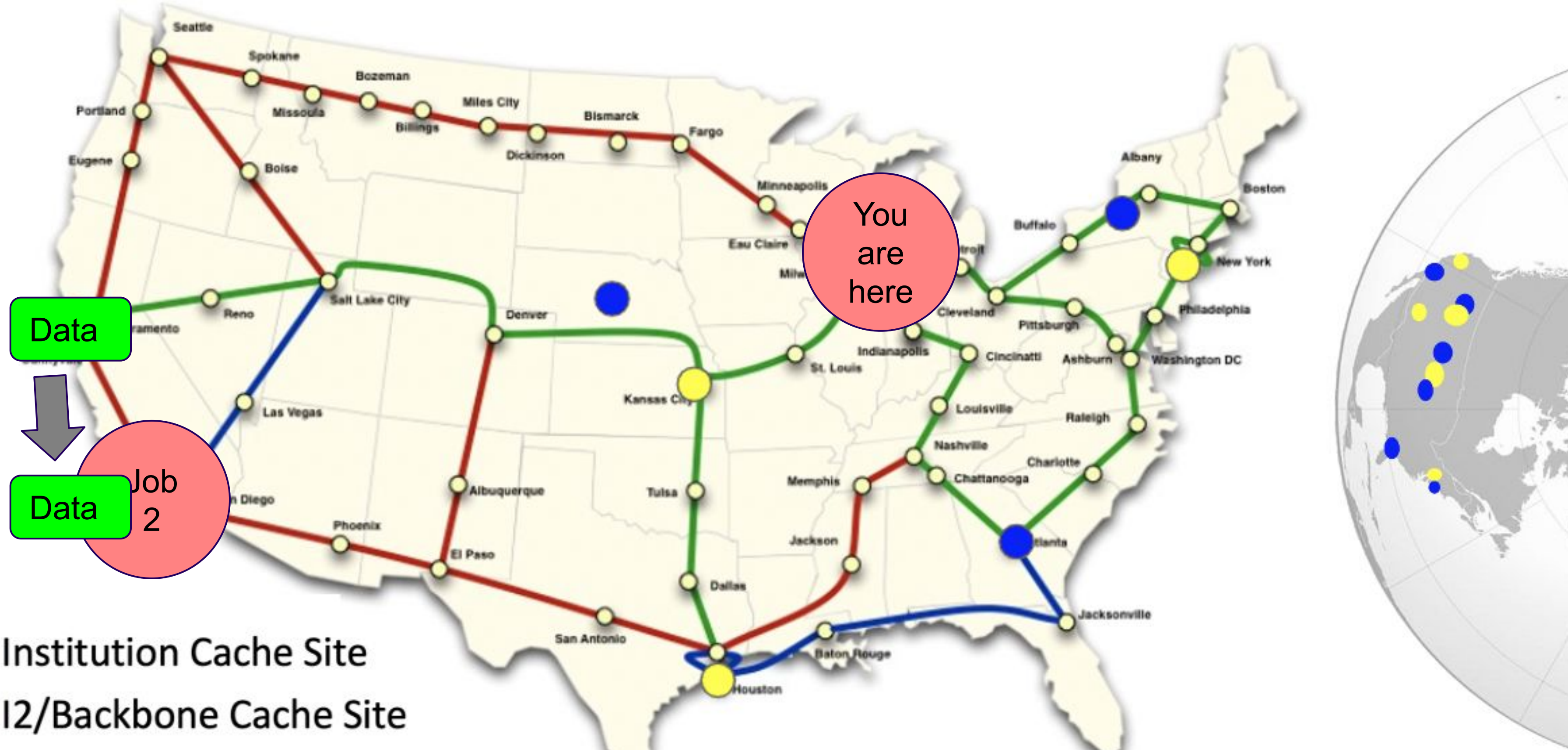

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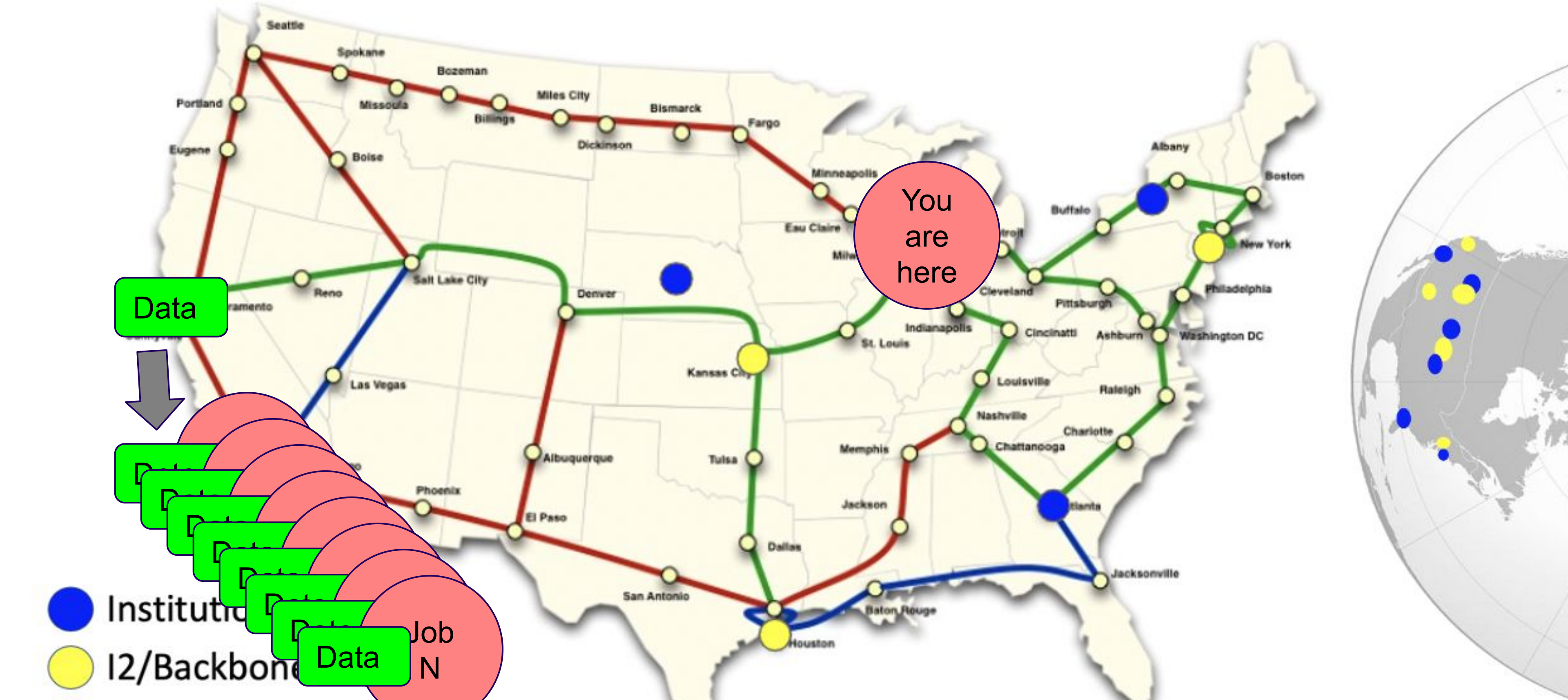


In the Submit File

```
transfer_input_files = osdf:///ospool/PROTECTED/USERNAME/…
```

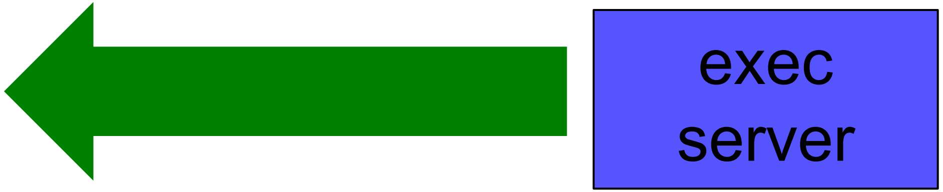
How about output?

Output for HTC and OSG

exec server

amount	method of delivery
~~words~~	~~within executable or arguments?~~
tiny – **1GB, total**	HTCondor file transfer
1GB - 20GB, unique or shared	OSDF
20GB+, total	shared file system (local copy, local execute servers)

Output for HTC and OSG



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~~words~~	~~within executable or arguments?~~
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1GB – 20GB, unique or shared	OSDF
20GB+, total	shared file system (local copy, local execute servers)

Writing to stash

```
transfer_output_remaps = "Output.txt = osdf:///ospool/PROTECTED/<username>/Output.txt"
```

Other Considerations

- Only use these options if you MUST!!
  - Each comes with limitations on site accessibility and/or job performance, and extra data management concerns

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Cleaning Up Old Data

Make sure to delete data when you no longer need it in the origin!!!

Servers do NOT have unlimited space!

- Some may regularly clean old data for you. Check with local support.

Quick Reference

Option	Input or Output?	File size limits	Placing files	In-job file movement	Accessibility?
HTCondor file transfer	Both	100 MB/file (in), 1 GB/file (out); 1 GB/tot (either)	via HTCondor submit node	via HTCondor submit file	anywhere HTCondor jobs can run
OSDF	Both	20 GB/file	via HTCondor submit server	transfer_*_file / stashcp command	OSG-wide (most sites), by anyone
Shared filesystem	Input, likely output	TBs (may vary)	via mount location (may vary)	use directly, or copy into/out of execute dir	local cluster, only by YOU (usually)

Acknowledgments

- This work was supported by NSF grants OAC-1836650, and OAC-2030508

Additional Slides

Shared Filesystem Details

(Local) Shared Filesystems

- data stored on file servers, but network-mounted to local submit and execute servers
- use local user accounts for file permissions
  - Jobs run as YOU!
  - readable (input) and writable (output, most of the time)
- *MOST* perform better with fewer large files (versus many small files of typical HTC)

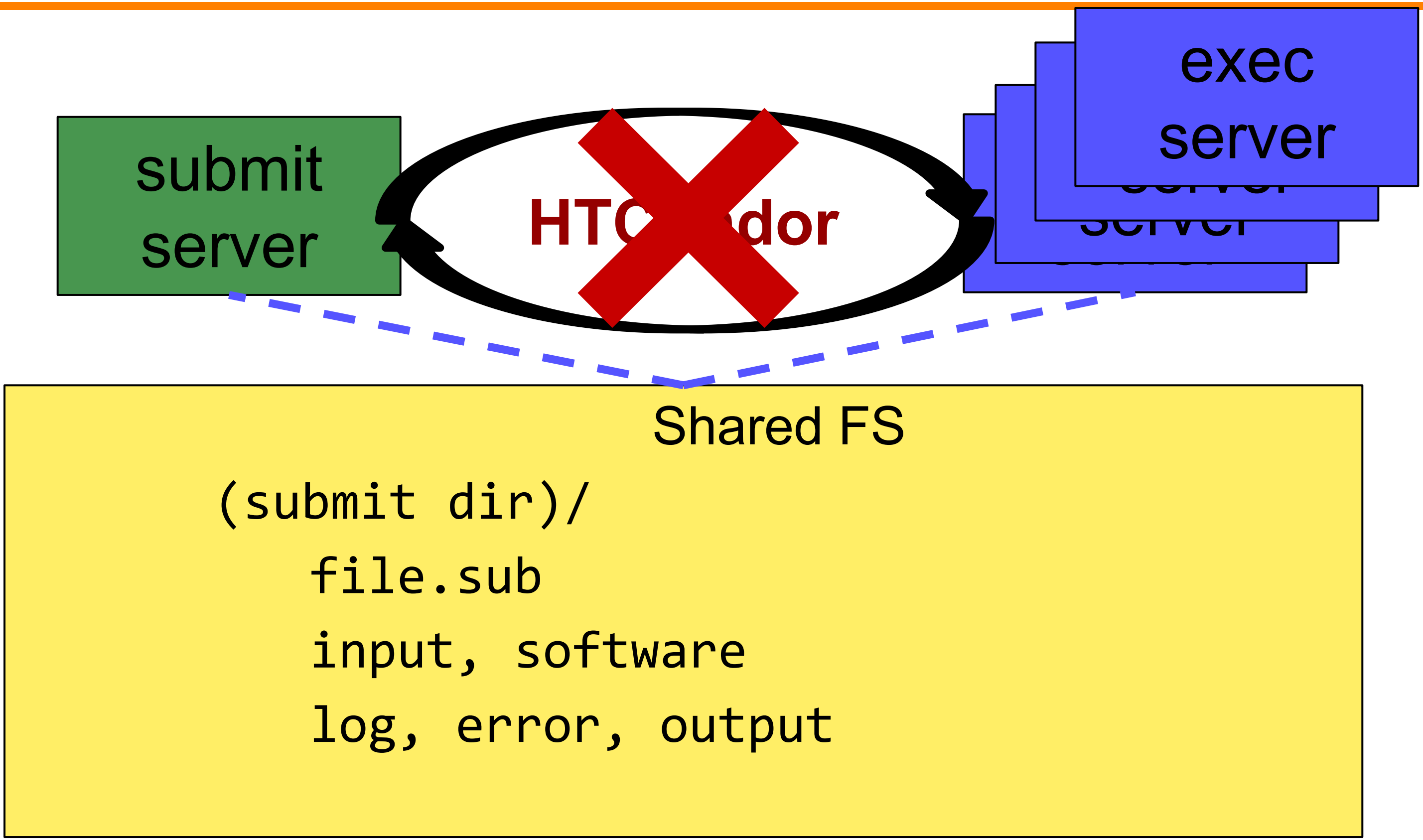
Shared FS Technologies

- *via network mount*
  - NFS
  - AFS
  - Lustre
  - **`/staging`** (may use NFS mount)
  - Isilon (may use NSF mount)
- *distributed file systems (data on many exec servers)*
  - HDFS (Hadoop)
  - CEPH

Shared FS Configurations

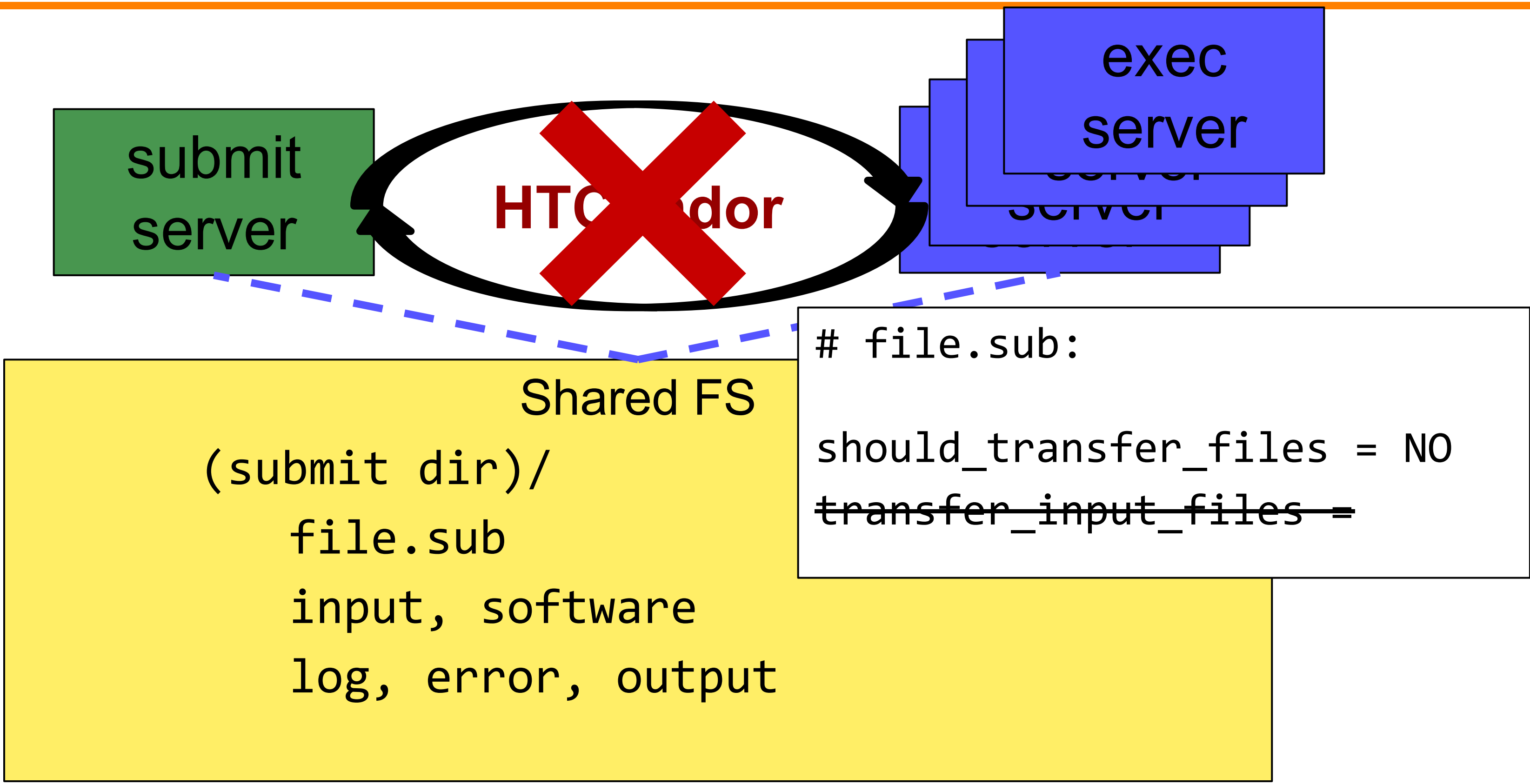
1. Submit directories *WITHIN* the shared filesystem
   - most campus clusters
   - limits HTC capabilities!!
2. Shared filesystem separate from local submission directories
   - supplement local HTC systems
   - treated more as a repository for VERY large data (>GBs)
3. Read-only (input-only) shared filesystem
   - Treated as a repository for VERY large input, only

Submit dir within shared FS



```
(submit dir)/
    file.sub
    input, software
    log, error, output
```

Submit dir within shared FS



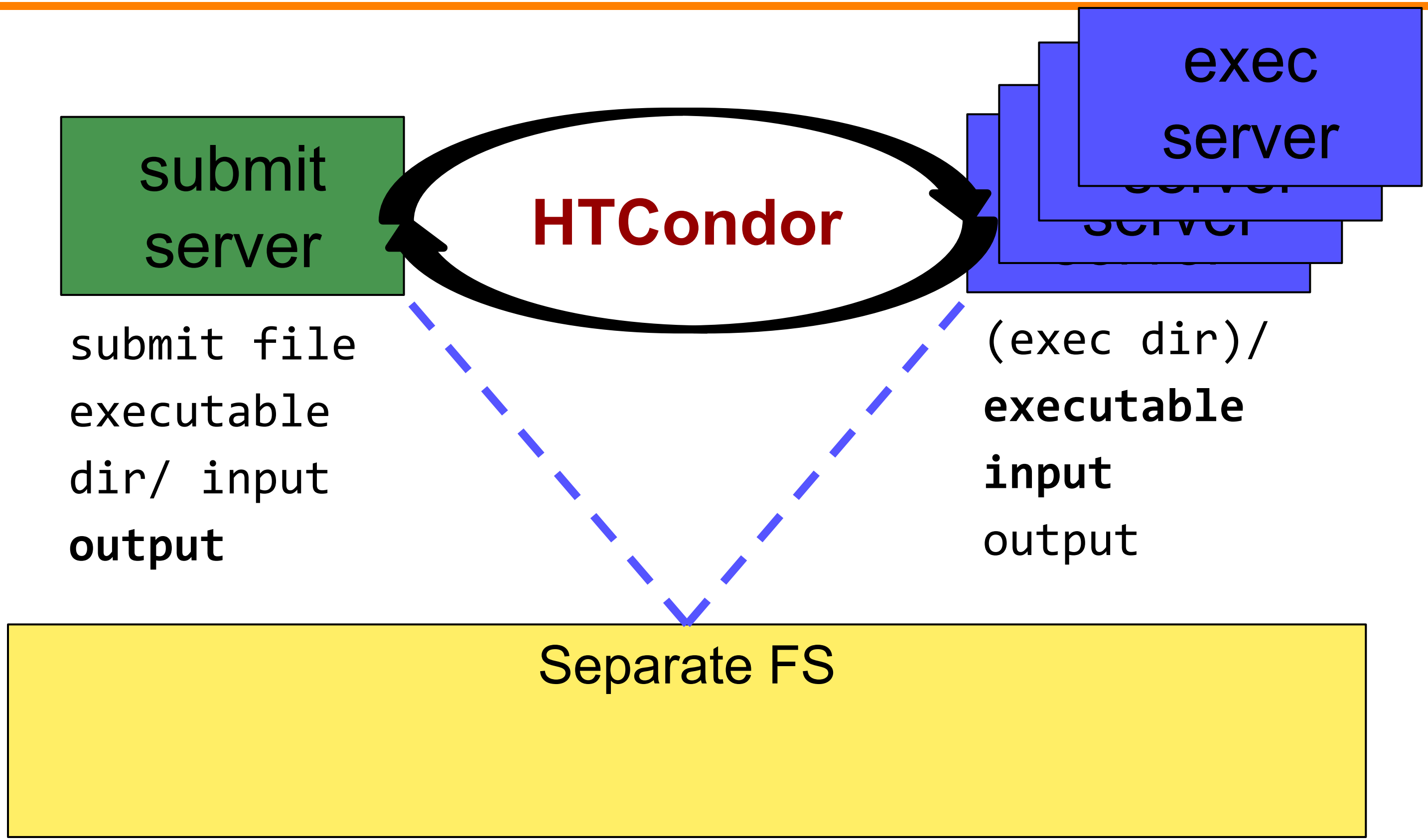
Shared FS

```
(submit dir)/
    file.sub
    input, software
    log, error, output
```

```
# file.sub:

should_transfer_files = NO
```
~~transfer_input_files =~~

Separate shared FS



```
submit file
executable
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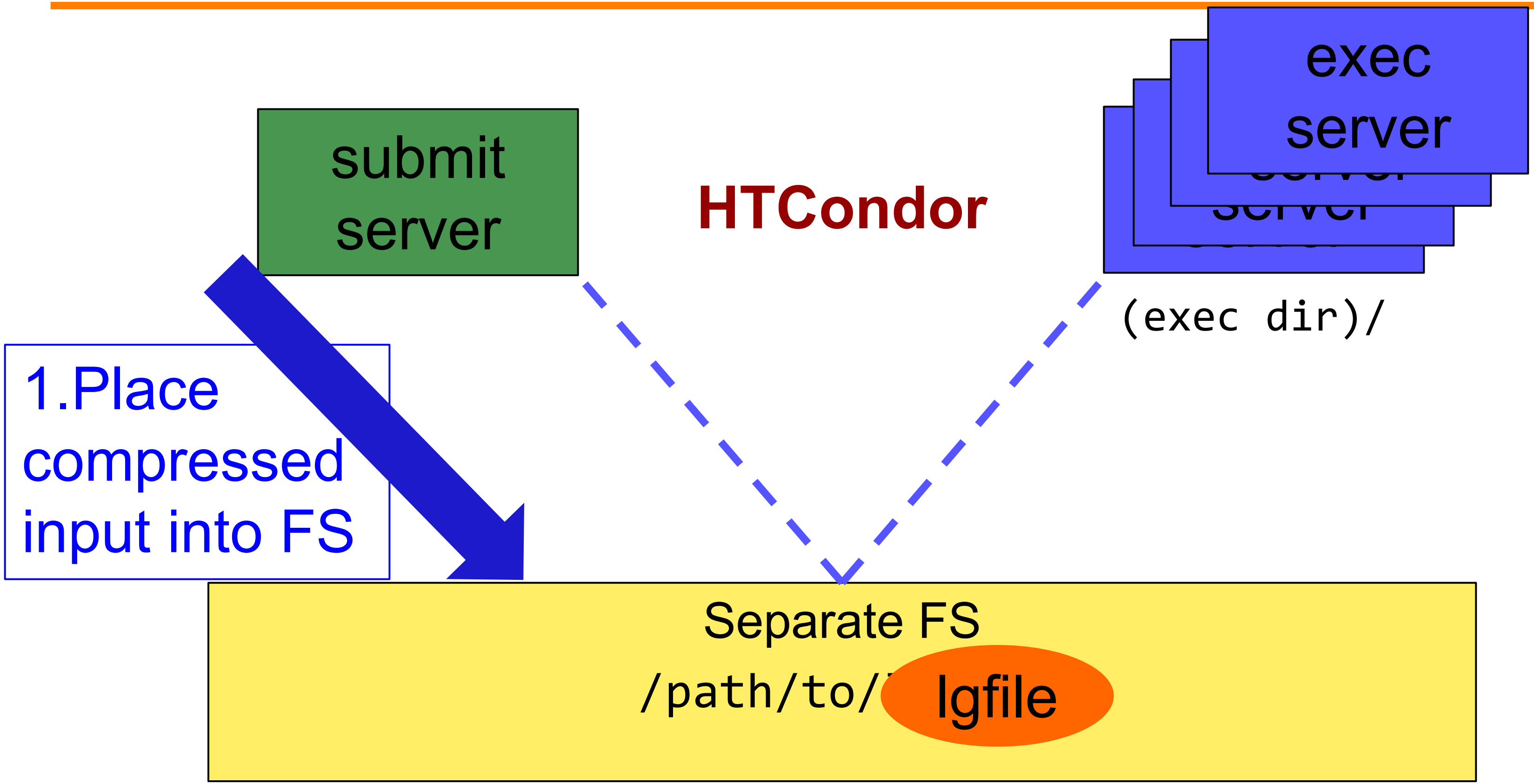
Separate shared FS - Input



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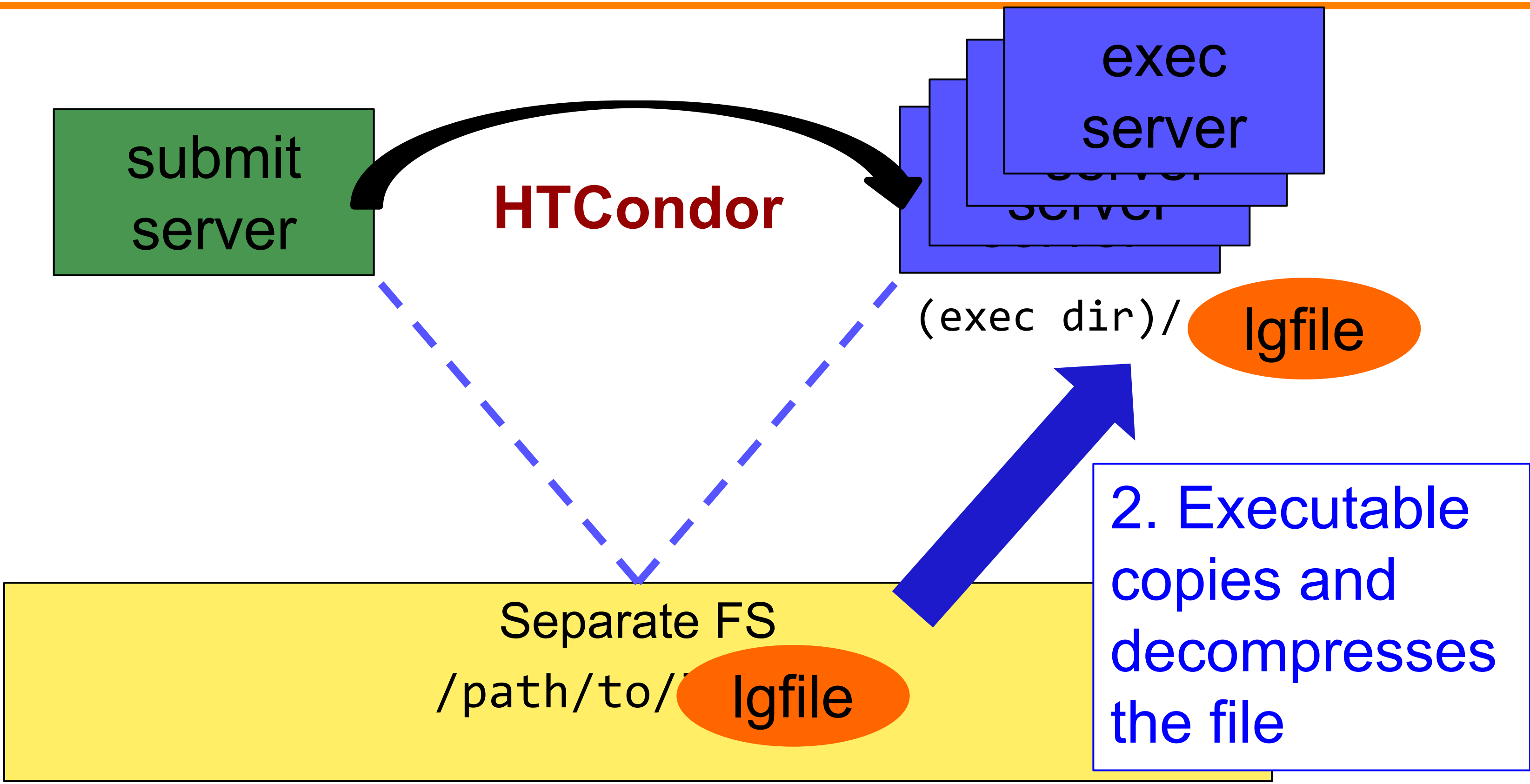
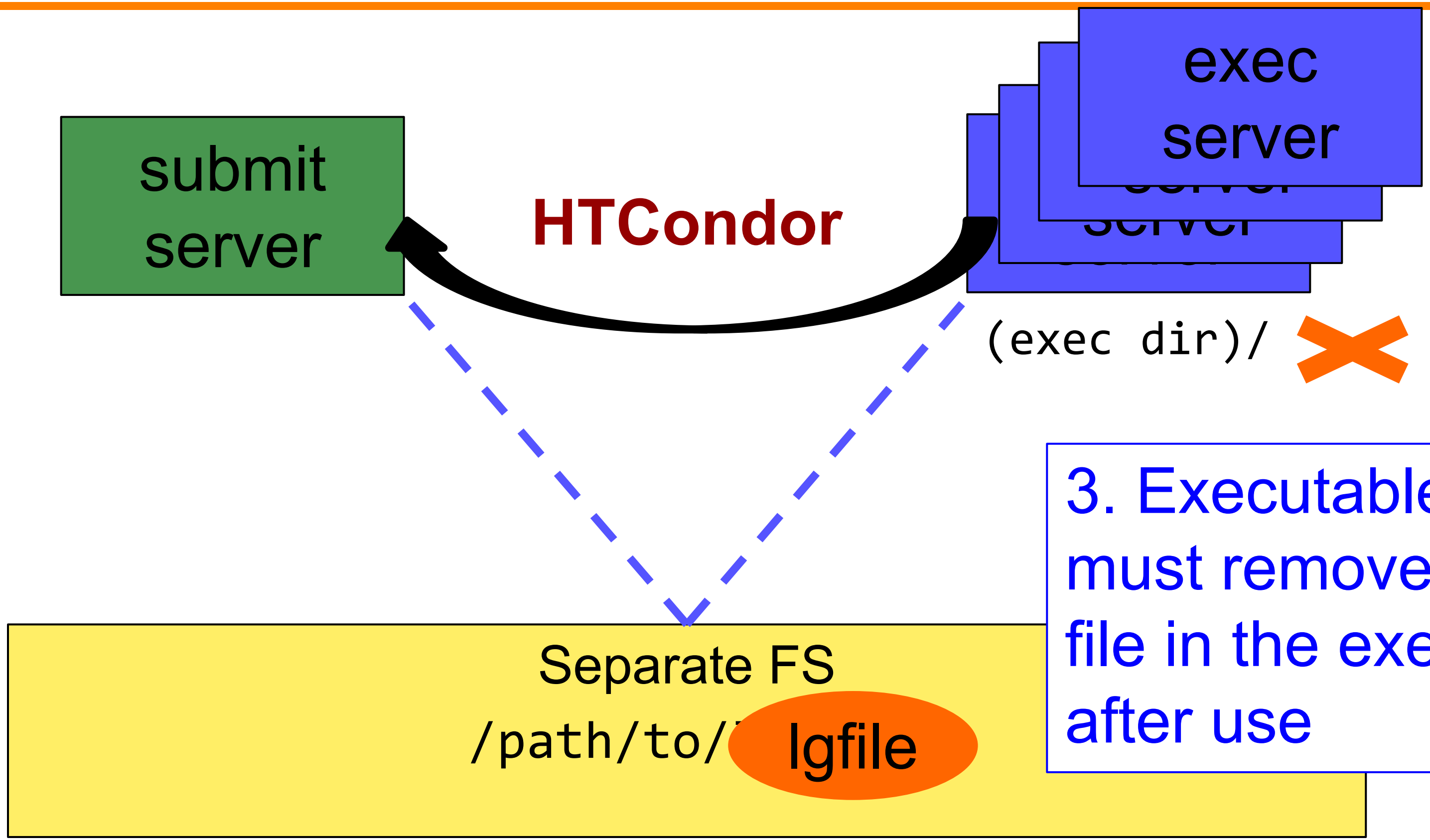


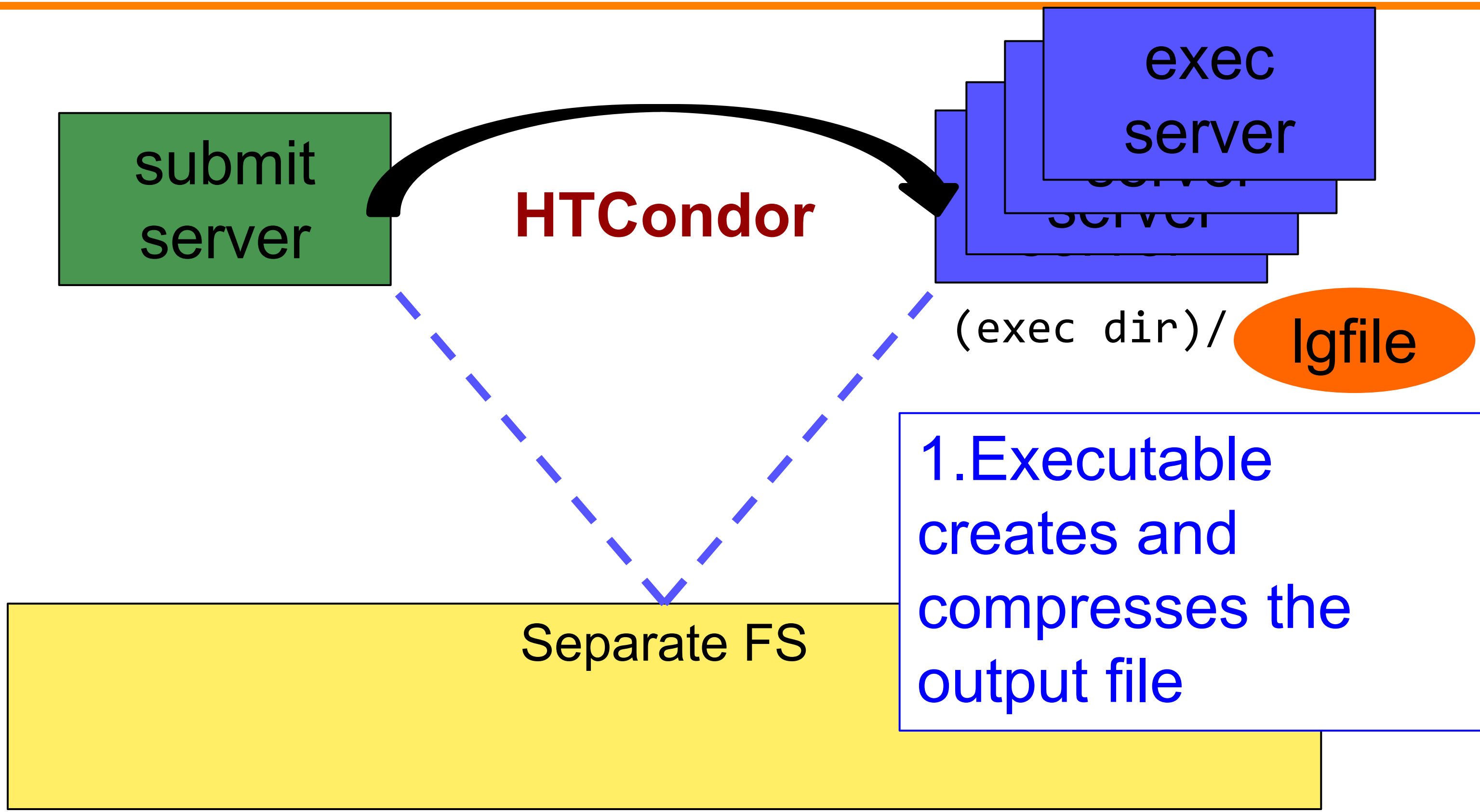
2. Executable copies and decompresses the file

Separate shared FS - Input



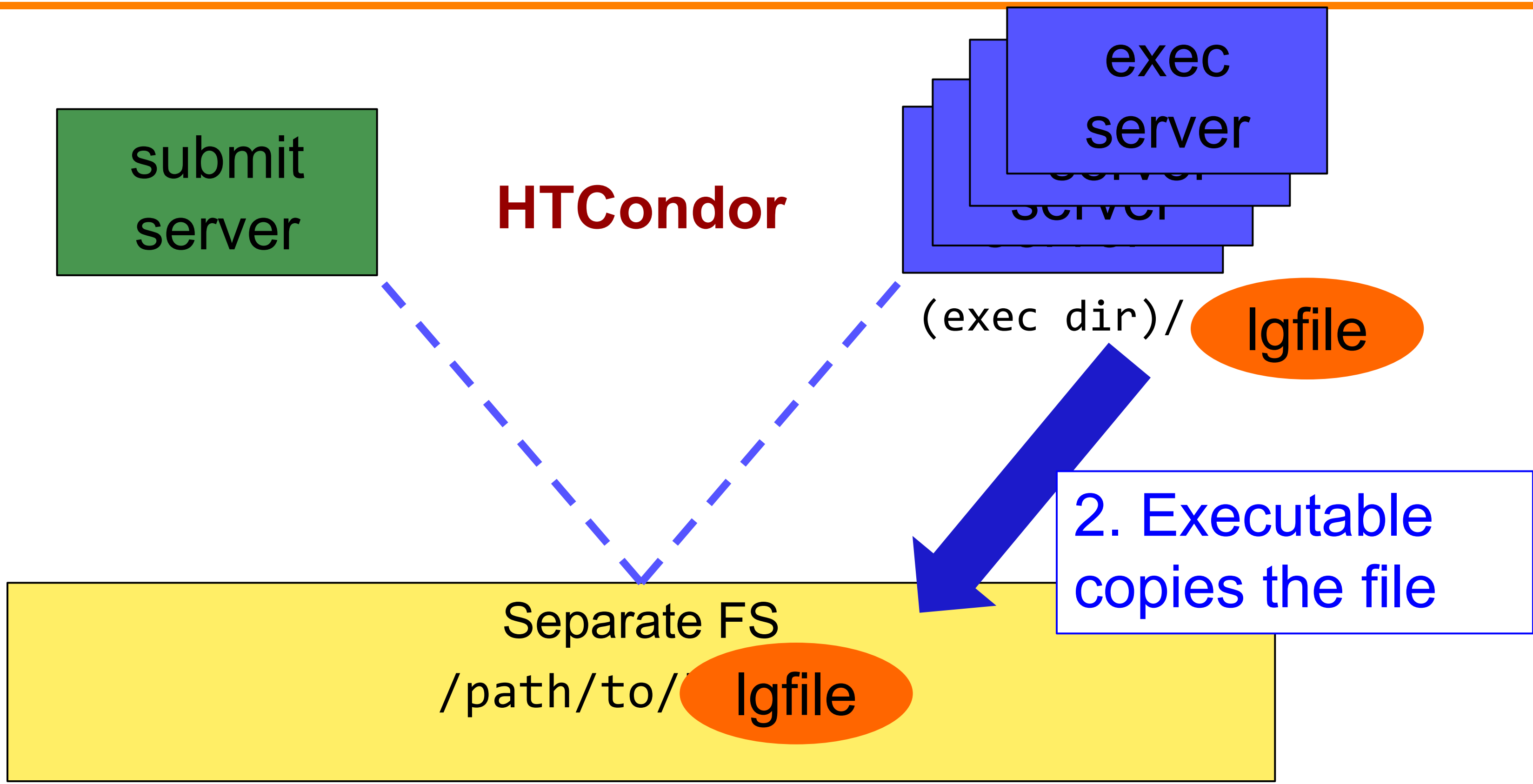
3. Executable must remove the file in the exec dir after use

Separate shared FS - Output



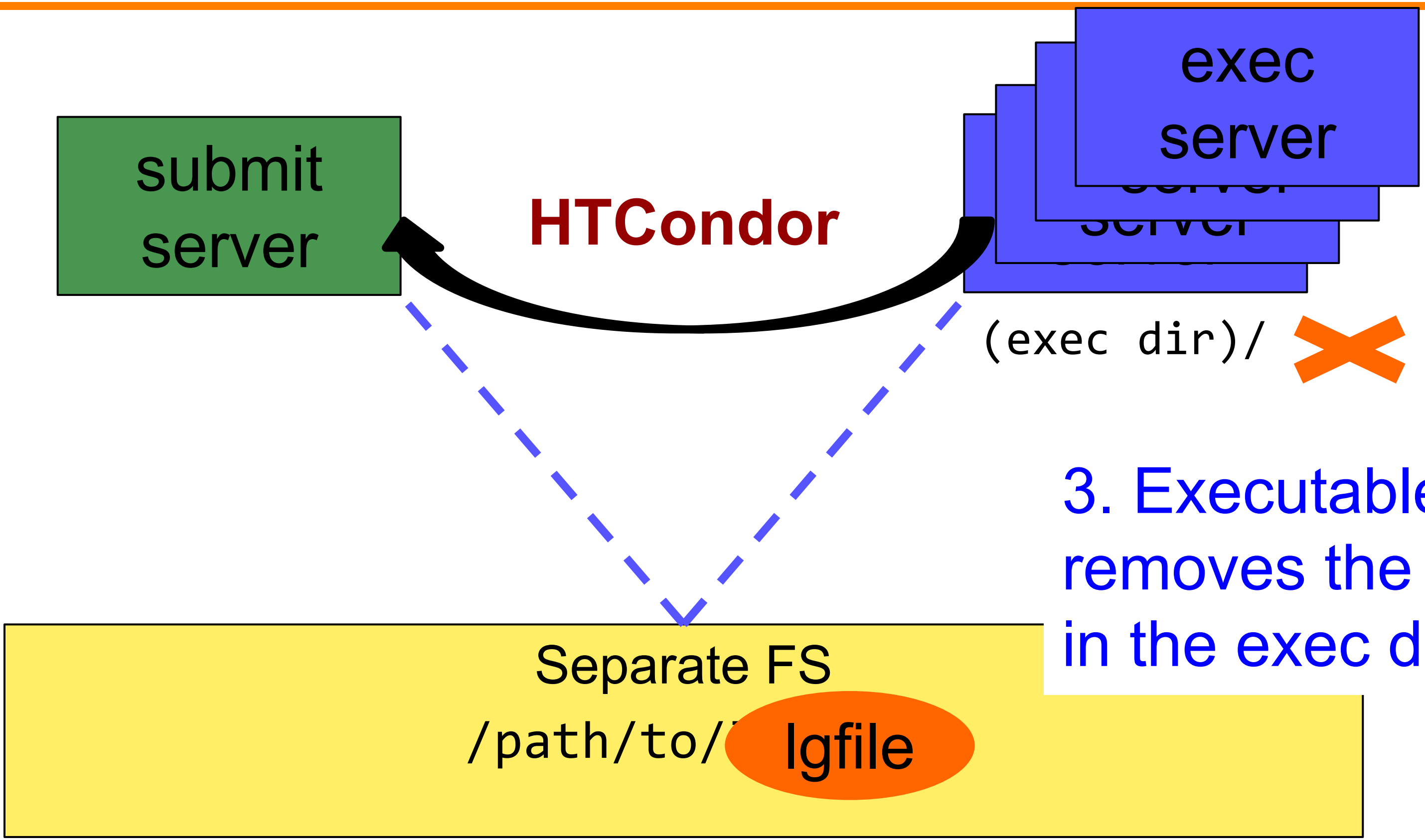
1. Executable creates and compresses the output file

Separate shared FS - Output



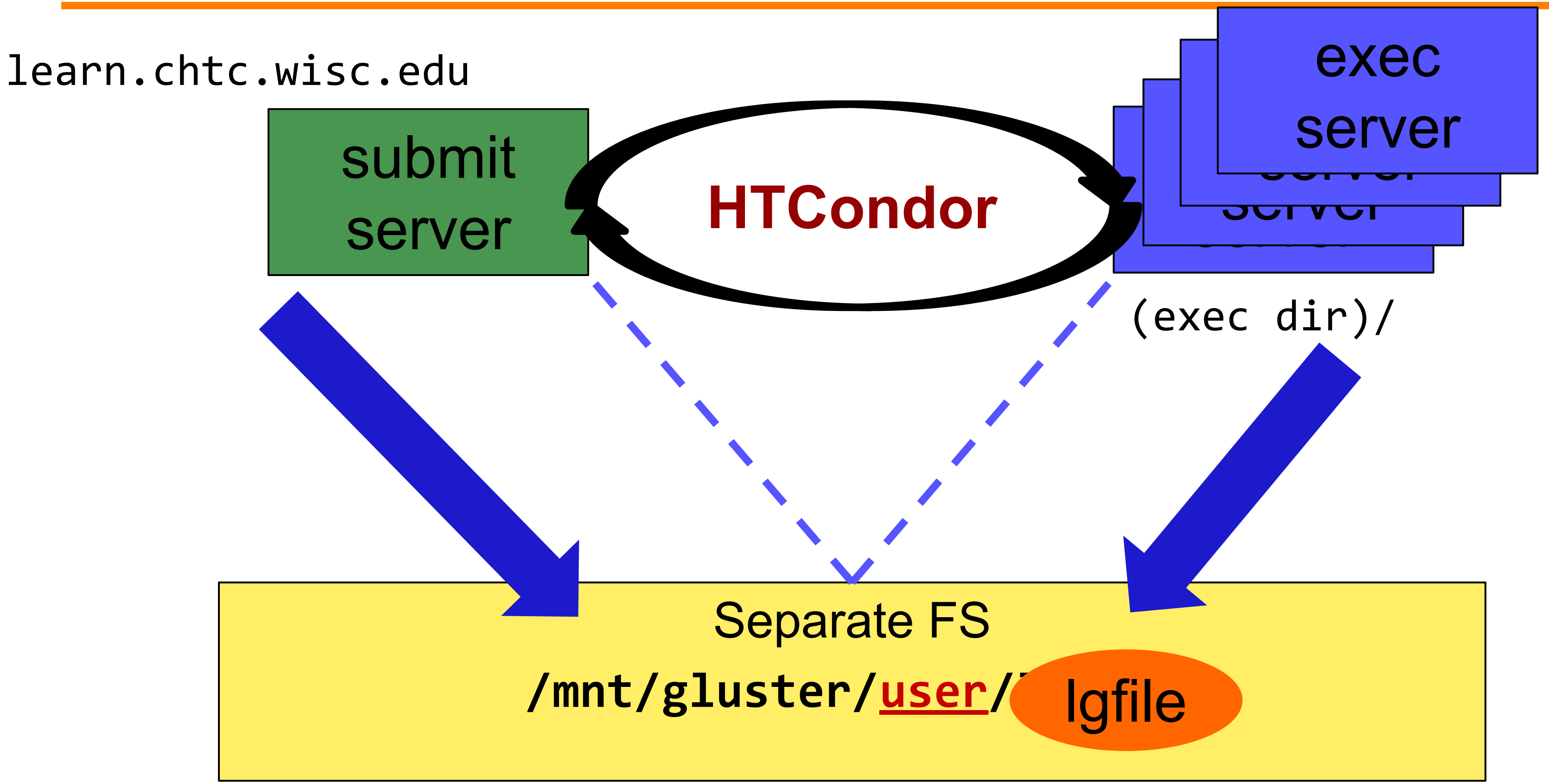
2. Executable copies the file

Separate shared FS - Output



3. Executable removes the file in the exec dir

At UW-Madison (Ex. 3.1-3.2)



`learn.chtc.wisc.edu`

submit server

HTCondor

exec server

`(exec dir)/`

Separate FS

`/mnt/gluster/user/`

lgfile