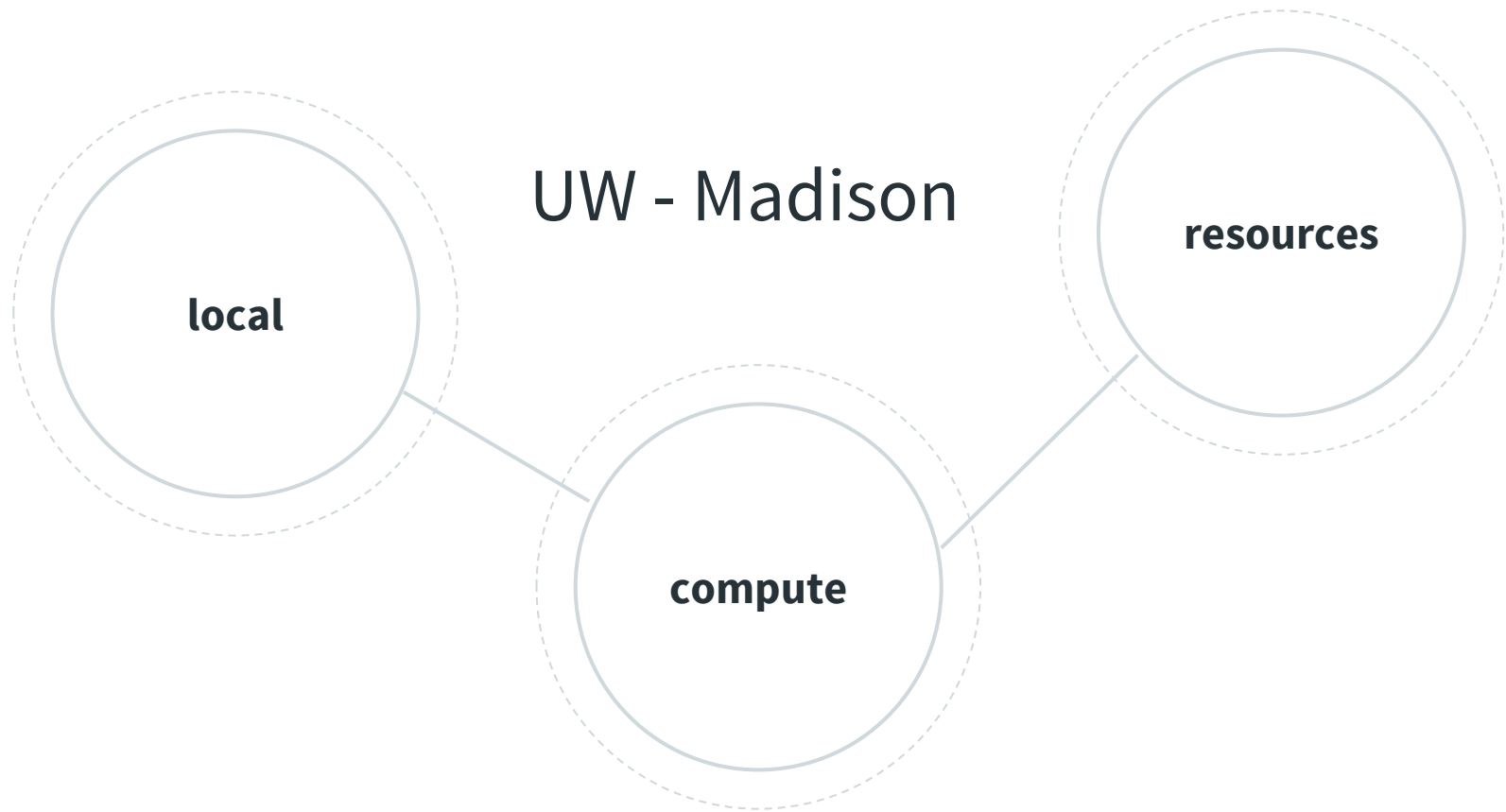


A decorative background graphic consisting of a network of nodes and edges. The nodes are represented by circles of varying sizes and colors (gray, blue, and white with blue outlines). The edges are thin gray lines connecting the nodes. The network is more dense on the left side and becomes sparser towards the right.

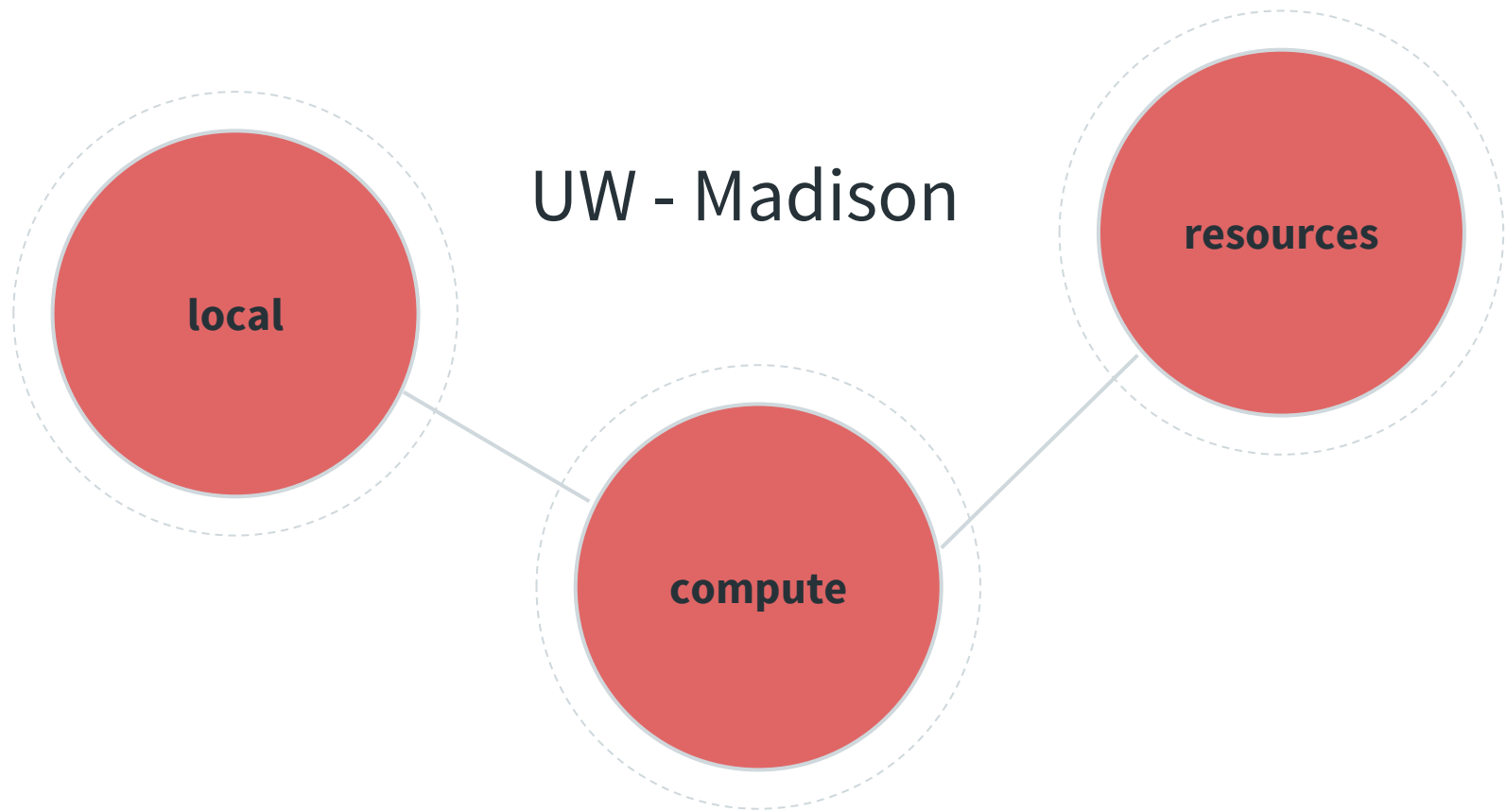
# Introduction to DHTC

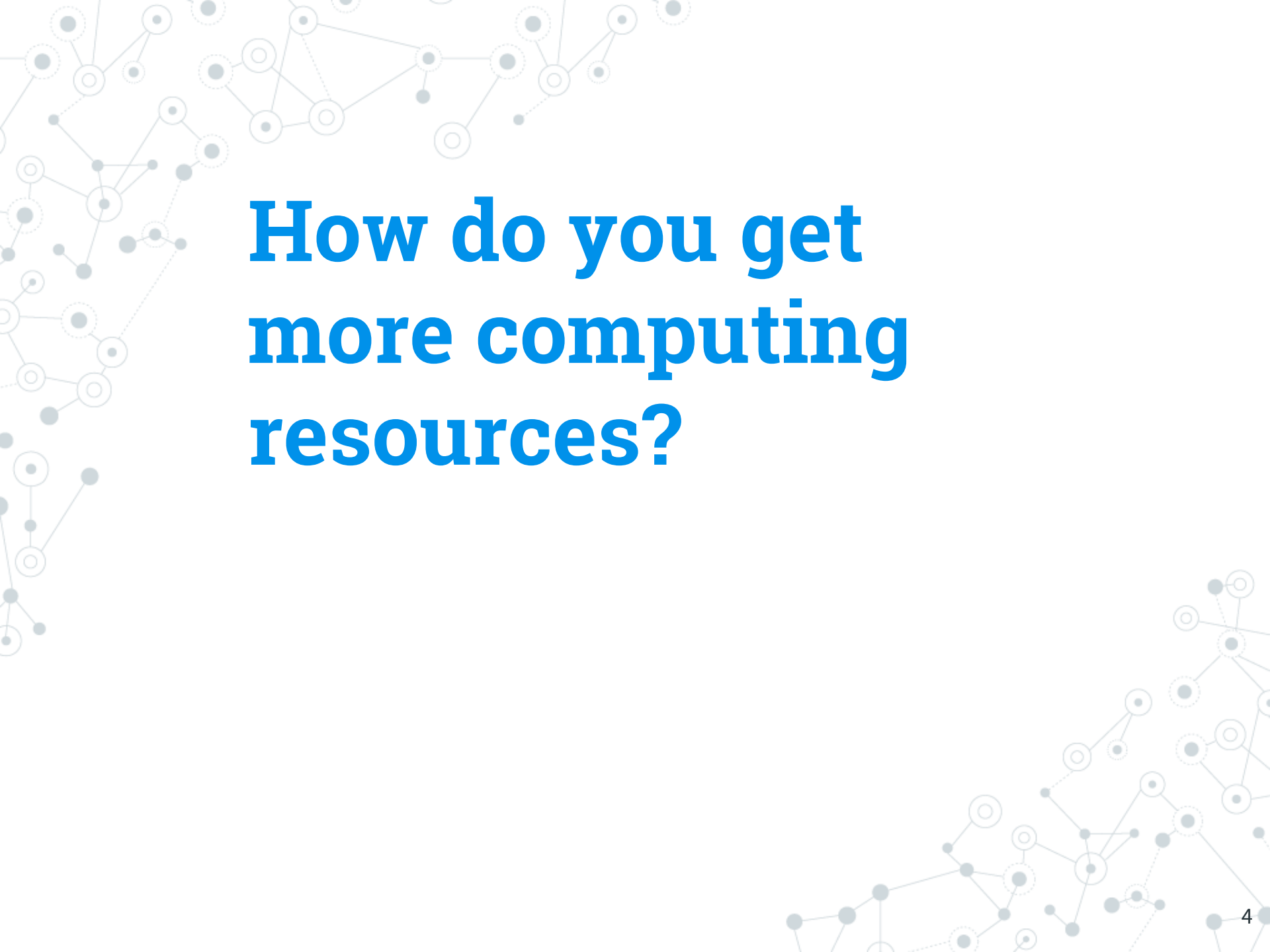
Brian Lin  
OSG Software Team  
University of Wisconsin - Madison  
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## Local High Throughput Computing



# Local High Throughput Computing



A decorative background featuring a network diagram with nodes and connecting lines, primarily located on the left and bottom right sides of the slide. The nodes are represented by circles of varying sizes, some with concentric circles, and the lines are thin and grey.

**How do you get  
more computing  
resources?**


# #1: Buy Hardware

Who doesn't love to play with new toys?





## #1: Buy Hardware

- ◎ Costs \$\$\$
    - Initial cost
    - Maintenance
    - Management
    - Power and cooling
  - ◎ Takes time
  - ◎ Rack/floor space
  - ◎ Obsolescence
  - ◎ Plan for peak loads, pay for all loads
- 

# #2: Use the Cloud

Everyone's favorite  
buzzword!



## #2: Use the Cloud - Paying Per Cycle

- e.g. Amazon Web Services, Rackspace
- Fast spin-up
- Costs \$\$\$
- Still needs expertise + management
- Does it fit with your university's policies?

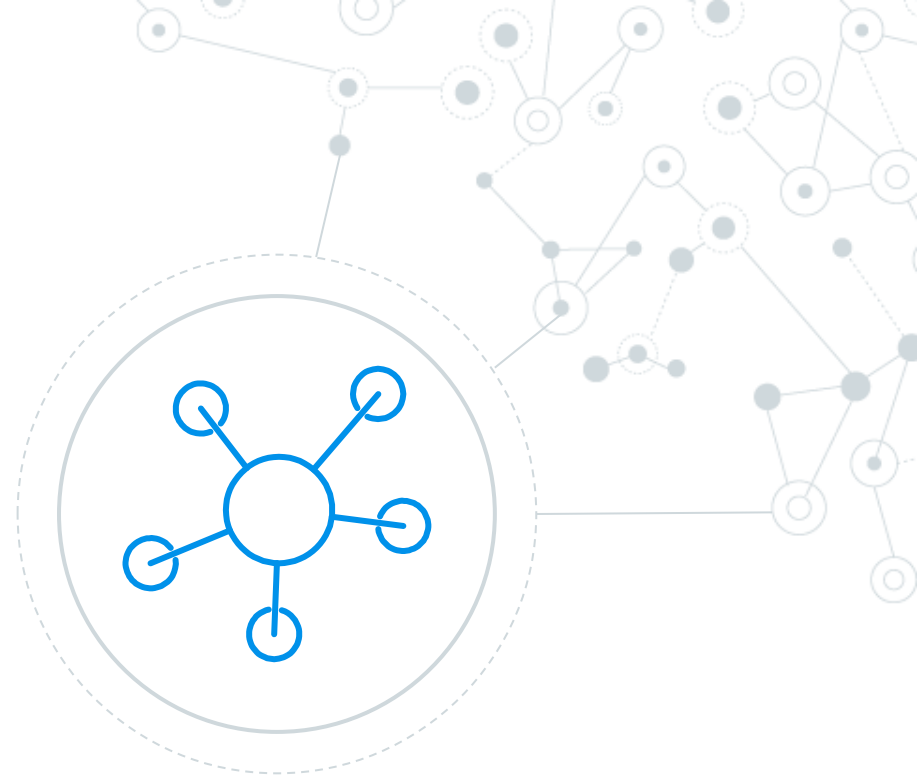


## #2: Use the Cloud - 'Managed' Clouds

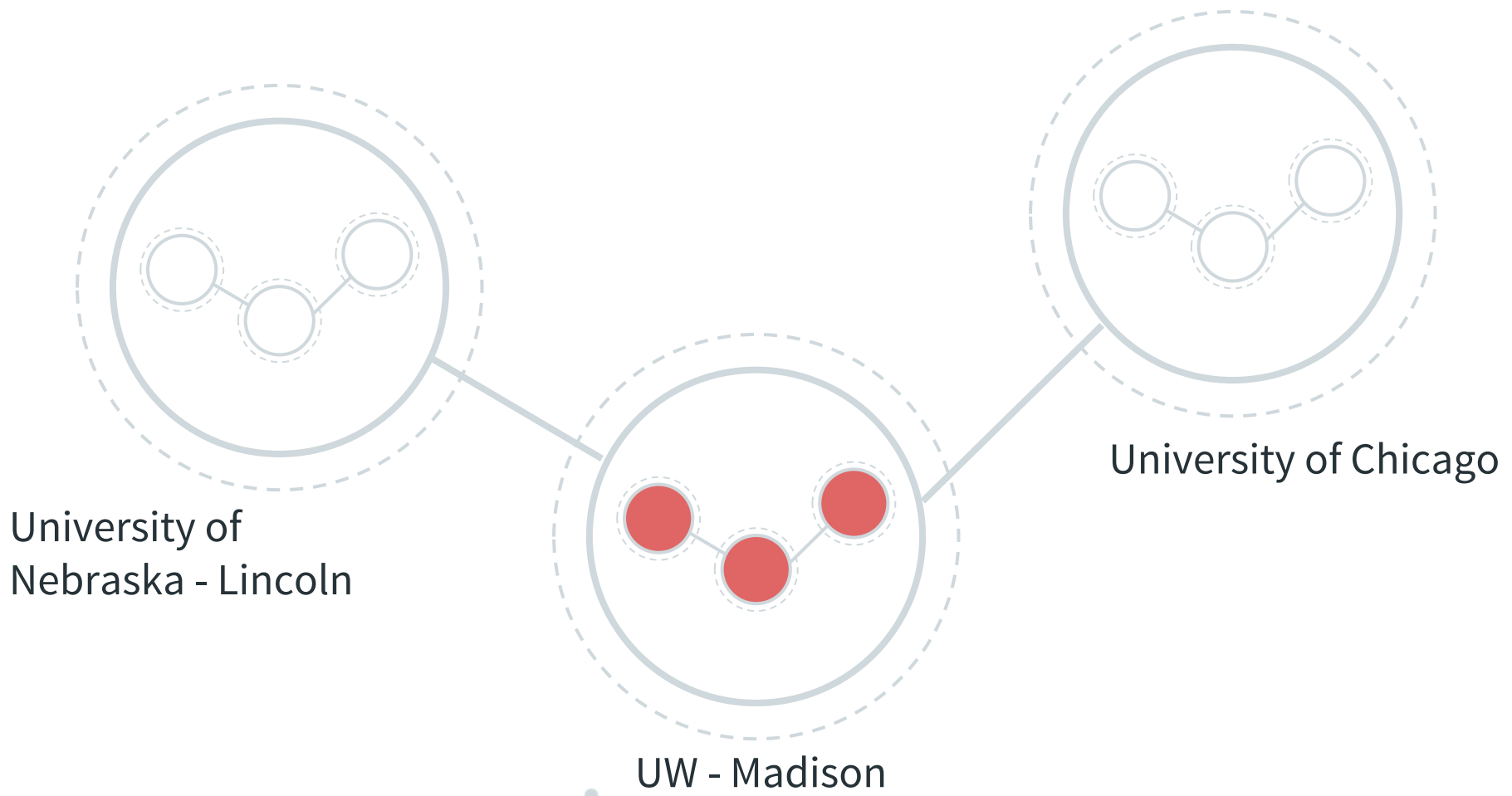
- e.g. Cycle Computing, Globus Genomics
- Pay someone to manage your cloud resources — still costs \$\$\$
- Researchers have used this to great success. See HTCondor Week 2015 talks:
  - [http://research.cs.wisc.edu/htcondor/HTCondorWeek2015/presentations/CottonB\\_CycleComputing.pptx](http://research.cs.wisc.edu/htcondor/HTCondorWeek2015/presentations/CottonB_CycleComputing.pptx)
  - <http://research.cs.wisc.edu/htcondor/HTCondorWeek2015/presentations/Madduri-CondorWeek-2015.pptx>

# #3: Share Resources

Sharing is caring, it can be fun!



# Distributed High Throughput Computing



A decorative network diagram in the top-left corner, featuring a complex web of interconnected nodes and lines. The nodes are represented by circles of varying sizes, some with concentric rings, and the lines are thin and grey. The overall structure is organic and sprawling, resembling a molecular or biological network.

i.

# Manual Job Partitioning

Let's start sharing!



## Manual Job Partitioning

- Obtain sharing agreements
- Query each site for idle resources
- Partition and submit jobs based on availability





## Manual Job Partitioning – Shortcomings

- ◎ More sharing agreements = more account management
- ◎ Fewer sharing agreements = fewer available resources
- ◎ Query + partition is tedious and inaccurate





ii.

# Automatic Job Partitioning

Let the computers do the work

## Automatic Job Partitioning – Shortcomings

- ◎ Same shortcomings as manual job partitioning
- ◎ Don't want to/can't share our resources
- ◎ Not all sites use HTCondor — other job schedulers e.g., SLURM, PBS, etc.
- ◎ Pools are independent



# What are our requirements?

This may be harder than we originally thought...





## Sharing Resource: Requirements

- Minimal account management
- No manual job partitioning
- Single pool
- Don't have to learn additional job schedulers
- Don't have to share our own resources

A decorative network diagram in the top-left corner, featuring a complex web of interconnected nodes and lines. The nodes are represented by circles of varying sizes, some with concentric rings, and the lines are thin and grey. The diagram is partially cut off by the left edge of the slide.

iii.

# Overlay Systems

Let the OSG do the heavy lifting

## Overlay Systems – What Are They?

- ◎ OSG as a resource broker — leasing
- ◎ Leased resources appear in a new pool
- ◎ Matchmaking occurs, jobs run as normal except...
  - The lease expires after a certain amount of time
  - Leases can be revoked

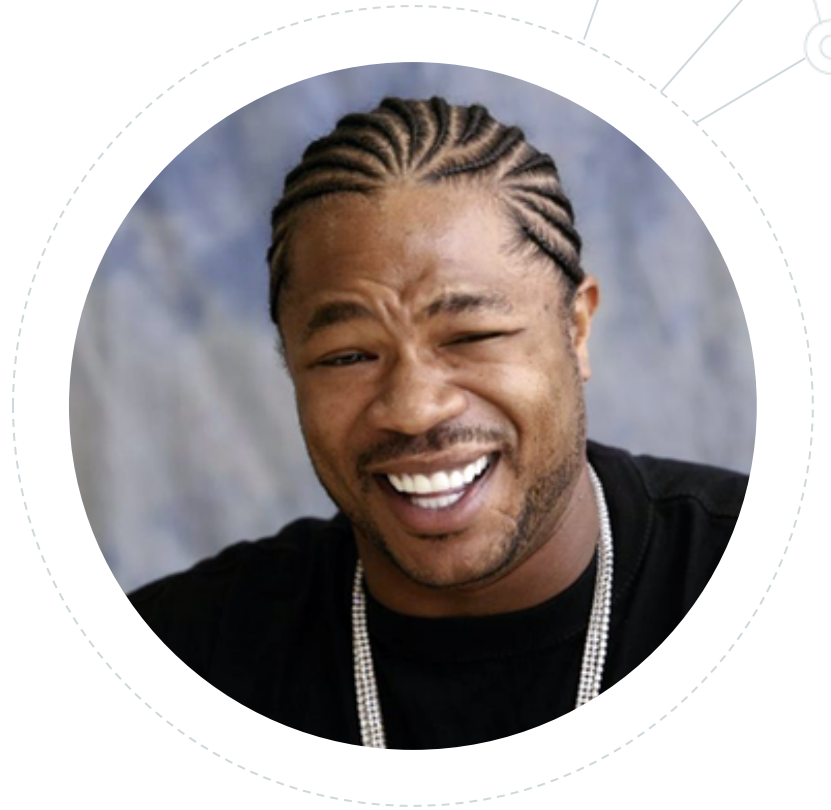


## Overlay Systems – How Do They Work?

- ◎ Pilot jobs (or pilots) are just jobs
- ◎ Pilots are sent to sites with idle resources
- ◎ Pilot payload = HTCondor Startd!
- ◎ Startd reports to your OSG pool

# Yo Dawg, I Heard You Like Jobs...

When your job runs in the OSG, it runs within a pilot job.



Source: <http://www.reactionface.info/face/laughing-xzibit>



## Overlay Systems – OSG's Role

- ◎ Monitors supply (idle slots)
  - Site location
  - Site job scheduler
- ◎ Monitors demand (idle jobs)
  - Job submission location
- ◎ Submits pilots based on supply, demand, and site policy




## Overlay Systems – Collection of Pools

- ◎ Your OSG pool is just one of many
- ◎ Separate pools for each [virtual] organization (VO)
- ◎ You will be part of the OSG VO





## Overlay Systems – Leasing the Cloud

- ◎ What if there aren't enough idle resources?
  - ◎ Combine overlay system with cloud technology
  - ◎ Solutions in the works but not production ready
  - ◎ Expect some of your jobs to run in the cloud in the next few years
- 

## Credits

Special thanks to all the people who made and released these awesome resources for free:

- ◎ Presentation template by [SlidesCarnival](#)
- ◎ Photographs by [Unsplash](#) & [Death to the Stock Photo](#) ([license](#))



**Thanks!**

**Any questions?**

