HTPC - High Throughput Parallel Computing (on the OSG)

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Rough Outline

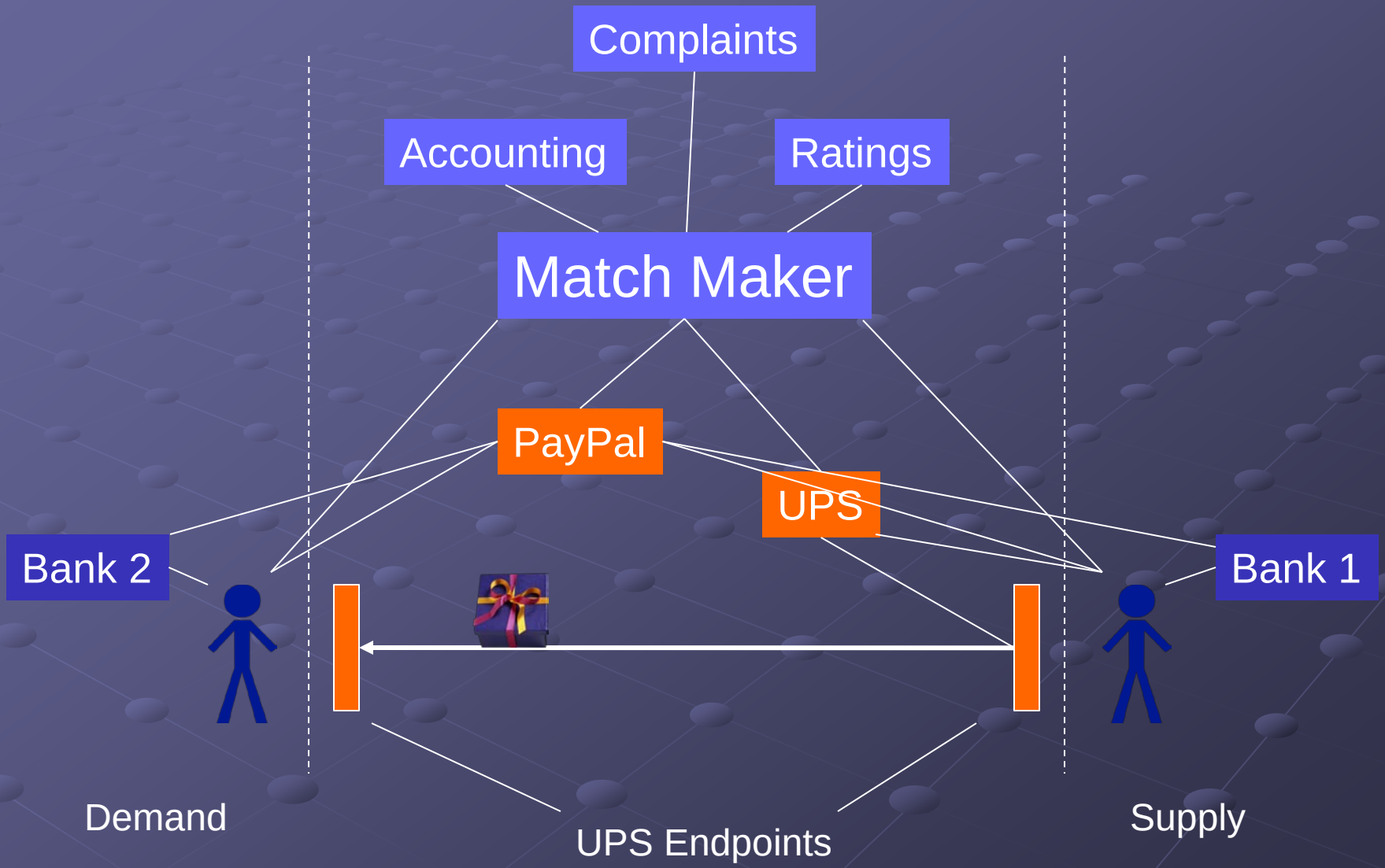
- What is the OSG? (think ebay)
- HTPC as a new paradigm
- Advantages of HTPC for parallel jobs
- How does HTPC work?
- Who is using it?
- The Future
- Conclusions

Making sense of the OSG

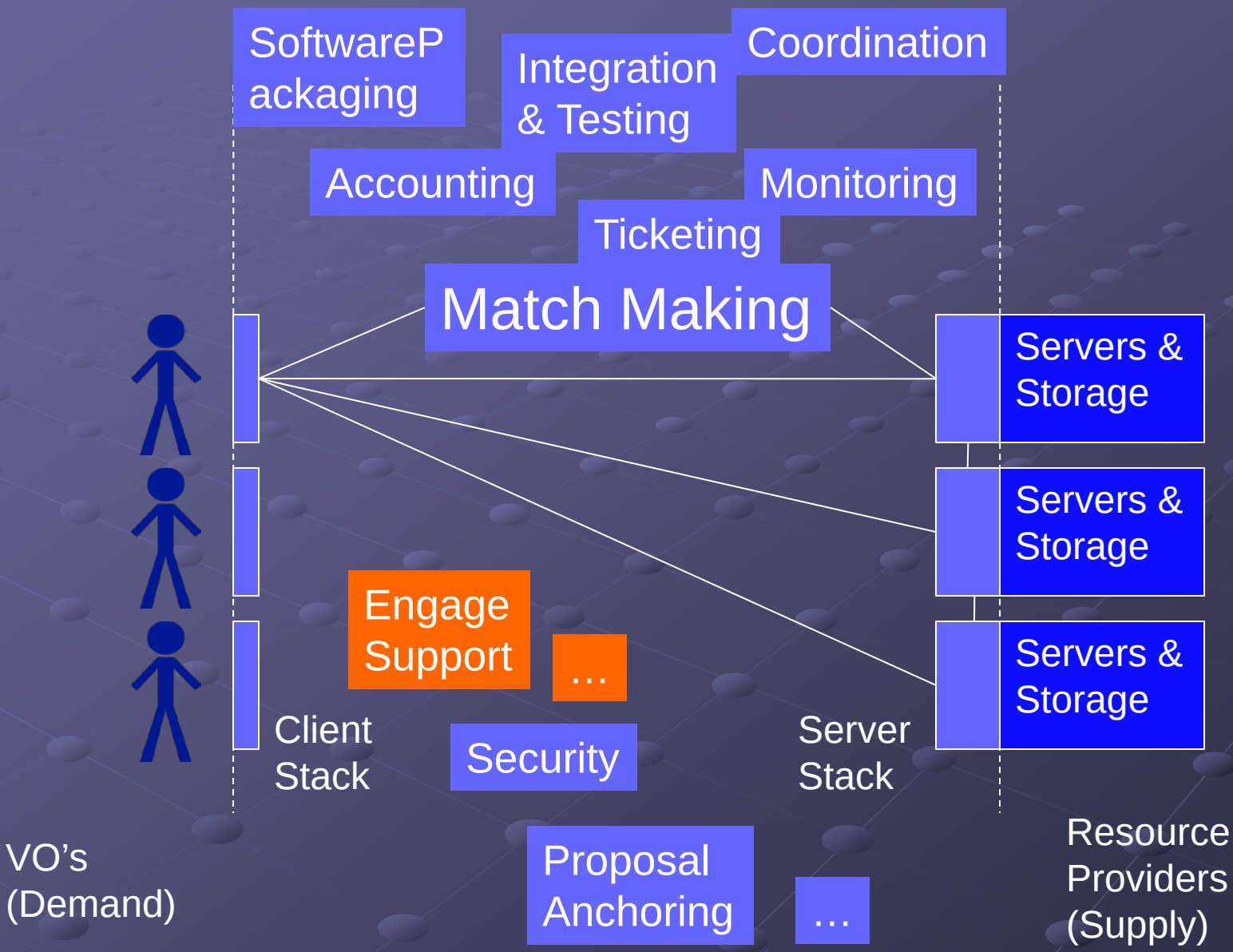
- OSG = Technology + Process + Sociology
- 70+ sites (& growing) -- Supply
  - contribute resources to the OSG
- Virtual Organizations -- Demand
  - VO's are Multidisciplinary Research Groups
- Sites and VOs often overlap
- OSG Delivers:
  - ~1M CPU hours every day
  - 1 Pbyte of data transferred every day

eBay (naïve)

eBay (more realistic)



OSG-Bay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& Testing
Coordination
Accounting
Monitoring
Ticketing
Match Making
Servers &
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Storage
Engage
Support
...
Client
Stack
Security
Server
Stack
VO's
(Demand)
Proposal
Anchoring
…
Resource
Providers
(Supply)

Where does HTPC fit?

The two familiar HPC Models

- High Throughput Computing (e.g. OSG)
  - Run ensembles of single core jobs
- Capability Computing (e.g. TeraGrid)
  - A few jobs parallelized over the whole system
  - Use whatever parallel s/w is on the system

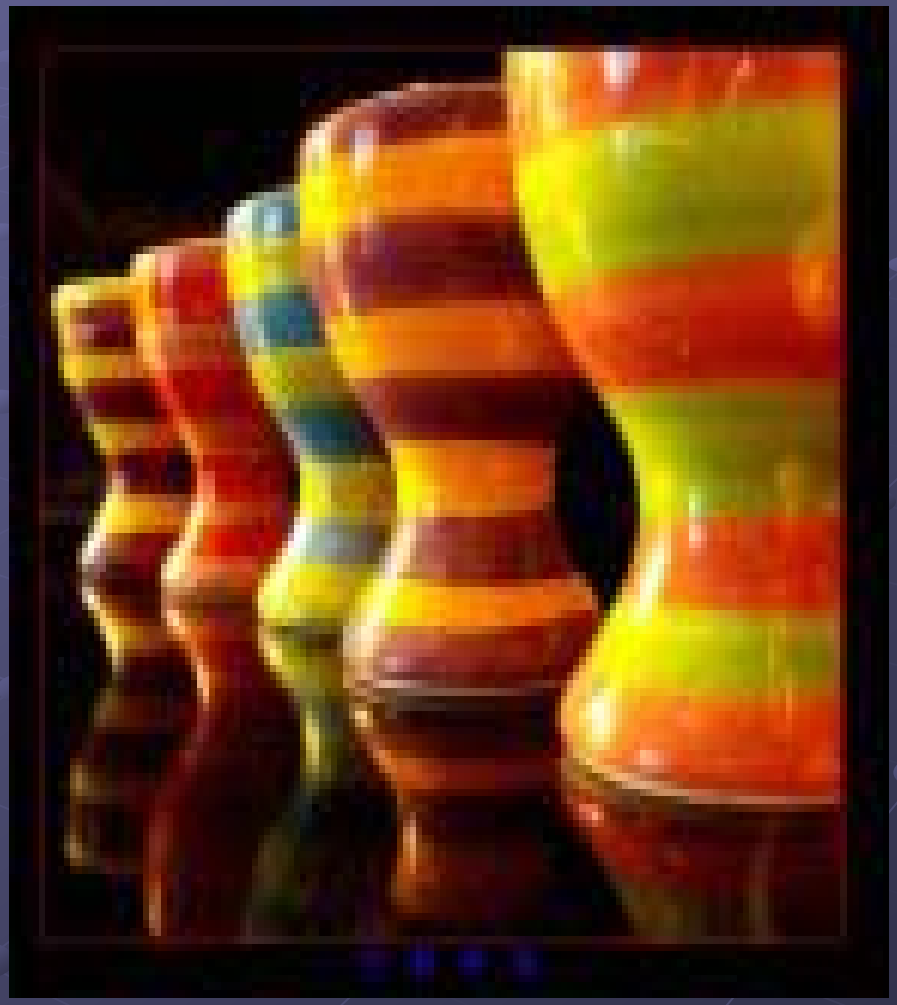
HTPC – an emerging model

Ensembles of small-way parallel jobs

(10’s – 1000’s)

Use whatever parallel s/w you want ☺

(It ships with the job)



Tackling Four Problems

- Parallel job portability
- Effective use of multi-core technologies
- Identify suitable resources & submit jobs
- Job Management, tracking, accounting, …

Current plan of attack

- Force jobs to consume an entire processor
  - Today 4-8+ cores, tomorrow 32+ cores, …
  - Package jobs with a parallel library
    - HTPC jobs as portable as any other job
    - MPI, OpenMP, your own scripts, …
    - Parallel libraries can be optimized for on-board memory access
  - All memory is available for efficient utilization
  - Submit the jobs via OSG (or Condor-G)

Problem areas

- Advertising HTPC capability on OSG
- Adapting OSG job submission/mgmt tools
  - GlideinWMS
- Ensure that Gratia accounting can identify jobs and apply the correct multiplier
- Support more HTPC scientists
- HTPC enable more sites

What's the magic RSL?

- Site Specific
  - We're working on documents/standards
- PBS
  - (host_xcount=1)(xcount=8)(queue=?)
- LSF
  - (queue=?)(exclusive=1)
- Condor
  - (condorsubmit=('+WholeMachine' true))

Examples of HTPC users:

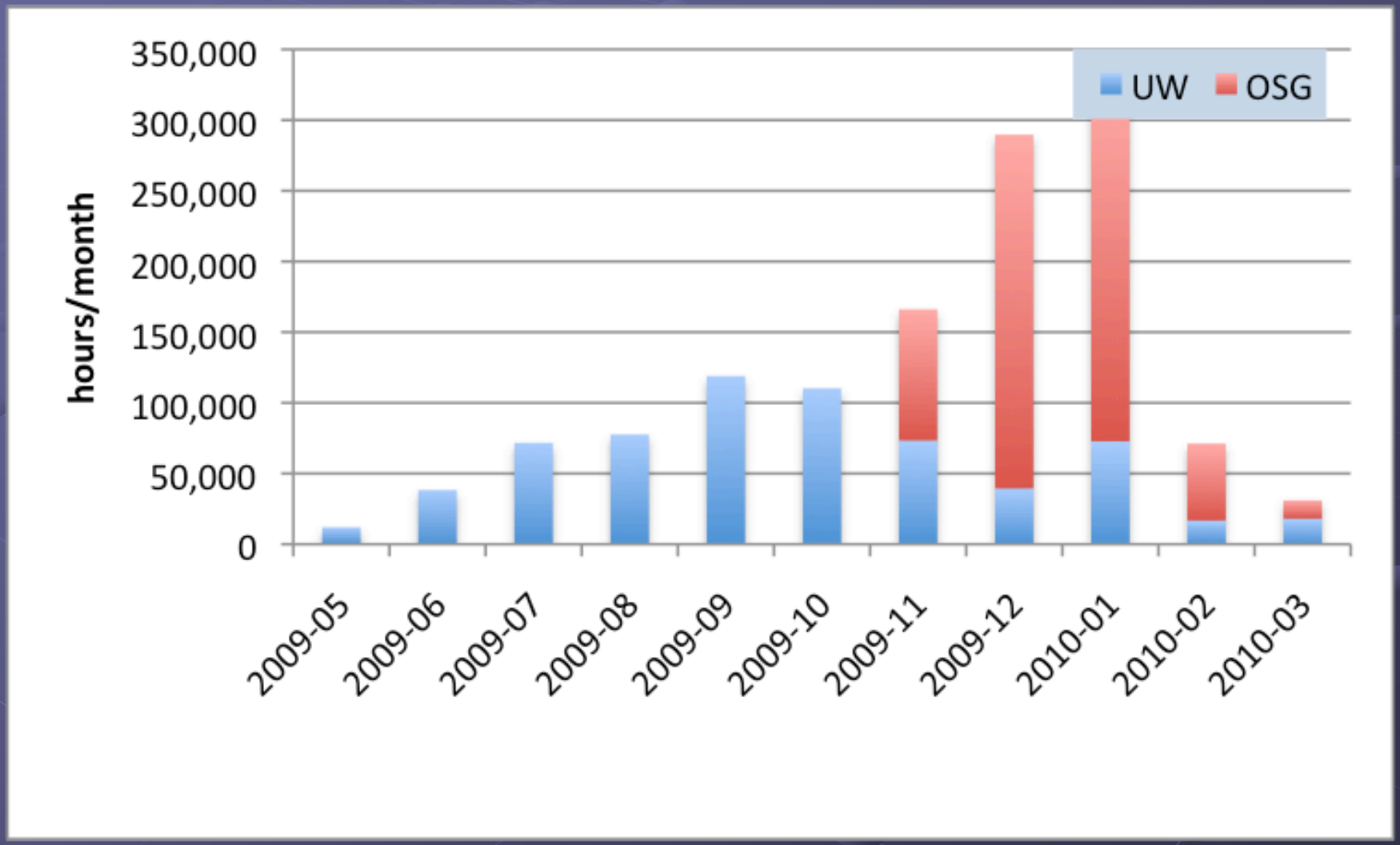
- Oceanographers:
  - Brian Blanton, Howard Lander (RENCI)
    - Redrawing flood map boundaries
  - ADCIRC
    - Coastal circulation and storm surge model
    - Runs on 256+ cores, several days
  - Parameter sensitivity studies
    - Determine best settings for large runs
    - 220 jobs to determine optimal mesh size
    - Each job takes 8 processors, several hours

Examples of HTPC users:

- Chemists
  - UW Chemistry group
  - Gromacs
  - Jobs take 24 hours on 8 cores
  - Steady stream of 20-40 jobs/day

  - Peak usage is 320,000 hours per month
    - Written 9 papers in 10 months based on this

Chemistry Usage of HTPC



OSG sites that allow HTPC

- OU
  - The first site to run HTPC jobs on the OSG!
- Purdue
- Clemson
- Nebraska
- San Diego, CMS Tier-2

Your site can be on this list!

Future Directions

- More Sites, more cycles!
- More users
  - Working with Atlas (AthenaMP)
  - Working with Amber 9
  - There is room for you…
- Use glide-in to homogenize access

Conclusions

- HTPC adds a new dimension to HPC computing – ensembles of parallel jobs
- This approach minimizes portability issues with parallel codes
- Keep same job submission model
- Not hypothetical – we're already running HTPC jobs
- Thanks to many helping hands

Additional Slides

- Some of these are from Greg Thain (UWisc)

The players

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Computation Inst.

University of Chicago

Miron Livny

U Wisconsin

John McGee

RENCI

Greg Thain

U Wisconsin

Key Developer

Funded by NSF-STCI

Configuring Condor for HTPC

- Two strategies:
  - Suspend/drain jobs to open HTPC slots
  - Hold empty cores until HTPC slot is open

- http://condor-wiki.cs.wisc.edu

How to submit

```
universe = vanilla
requirements = (CAN_RUN_WHOLE_MACHINE =?= TRUE)
+RequiresWholeMachine=true
executable = some job
arguments = arguments
should_transfer_files = yes
when_to_transfer_output = on_exit
transfer_input_files = inputs
queue
```

MPI on Whole machine jobs

Whole machine mpi submit file

```
universe = vanilla
requirements = (CAN_RUN_WHOLE_MACHINE =?= TRUE)
+RequiresWholeMachine=true
executable = mpiexec
arguments = -np 8 real_exe
should_transfer_files = yes
when_to_transfer_output = on_exit
transfer_input_files = real_exe
queue
```

How to submit to OSG

```
universe = grid
GridResource = some_grid_host
GlobusRSL = MagicRSL
executable = wrapper.sh
arguments = arguments
should_transfer_files = yes
when_to_transfer_output = on_exit
transfer_input_files = inputs
transfer_output_files = output
queue
```