What's new in HTCondor? What's coming?

HTCondor Week 2014

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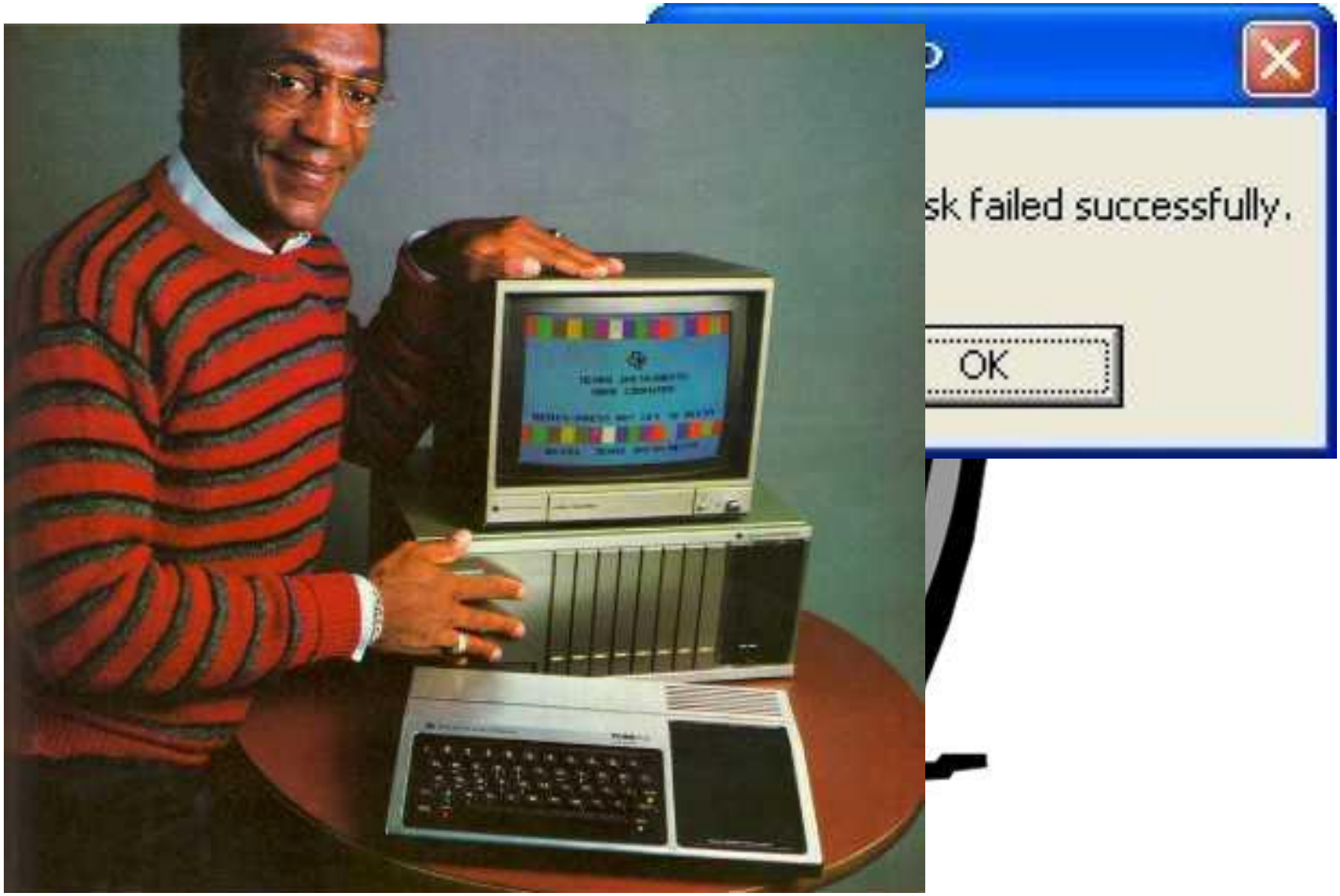
CENTER FOR HIGH THROUGHPUT COMPUTING

HTCondor


sk failed successfully.
OK

Release Situation

- Development Series
  - HTCondor v8.1.6 frozen (release candidate for v8.2.0), in beta test, release to web 5/20/14.
  - Development on series v8.1.x over, v8.3.x release scheduled for 7/1/14.
- Stable Series
  - June 5th: HTCondor v8.2.0
  - v8.0.6 will *likely* be the last v8.0.x released
  - Last Year: Condor v8.0.0 (June 6th 2013)
- Since HTCondor Week 2012: 14 releases, 3375 commits by 32 contributors, resolved tickets: 170 stable series, 397 dev series

Platforms tested with v8.2.0

32bit Debian 6
32bit Scientific Linux 5
32bit Scientific Linux 6
64Bit Debian 6 (squeeze),
64Bit Debian 7 (wheezy),
64Bit Fedora 19
64Bit Fedora 20
64Bit MacOSX 8
64Bit MacOSX 9

64Bit Red Hat 5
64Bit Red Hat 6
64Bit Red Hat 7
64Bit Scientific Linux 5
64Bit Scientific Linux 6
(and 7 when it becomes available)
64Bit Ubuntu 12.04 LTS
64Bit Ubuntu 14.04 LTS
64Bit Windows 7 SP1
64Bit Windows 8.1

- Continue to push into distro repositories

New goodies with v8.0

- HTCondor-CE
- Bosco
- DAGMan additions
- EC2 S t, O
- Severa c
- Class or
- Gene e rces
- Pytho rfaces
- Job Sandboxing

- Interactive jobs
- Open development pr ss
- a y more…

Last Year's News

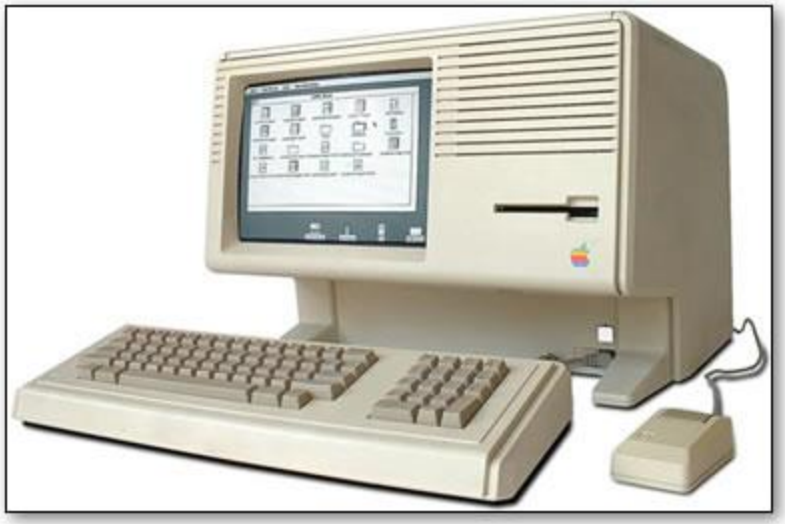
CENTER FOR HIGH THROUGHPUT COMPUTING

HTCondor

Challenge Areas

"...we have identified six key challenge areas that we believe will drive HTC technologies innovation in the next five years."

- **Evolving resource acquisition models**
- **Hardware complexity**
- **Widely disparate use cases**
- **Data intensive computing**
- **Black-box applications**
- **Scalability**



EC2 Grid job improvements

- Hardening, better failure handling
  - Especially for spot instances
  - Errors used to result in orphaned instances
  - Reduced calls to service EC2 jobs
- Better support for OpenStack
  - Recognize and handle protocol changes
  - Recognize API differences from Amazon
- condor_ssh_to_job supports EC2 jobs


My other computer
is YOUR data center
THE HEARTBLEED BUG

Google Compute Engine Jobs

- New grid-type “gce”
- Similar to EC2 support
- Basic instance parameters
  - GCE zone
  - Machine type
  - VM Image
  - Instance-specific data

A Brief History of BOINC

- Berkeley Open Infrastructure for Network Computing
- Grew out of SETI@Home, began in 2002
- Middleware system for *volunteer computing*

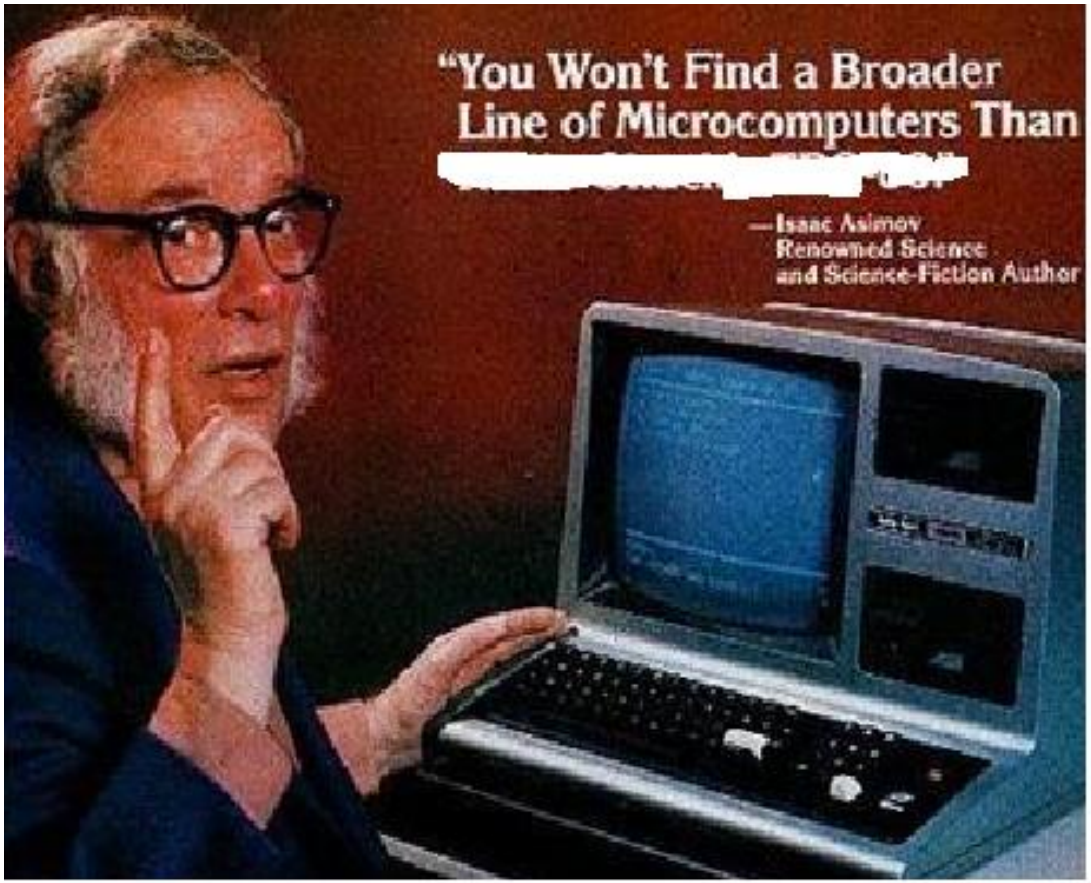
Previous Work

- Previous work
  - Backfill state and Work-Fetch Hooks
  - HTCondor execute machine becomes a BOINC client when otherwise idle
- Now, we're doing the reverse…

HTCondor submitting jobs to BOINC

- New grid universe type: boinc
  - Submit file format very similar to other job types
  - Application must be described to BOINC server first
    - Manual step at present
- Why?
  - Easy accessibility for campus users, OSG VOs
  - “Submit locally, run globally”
  - Use in workflows

Scalability

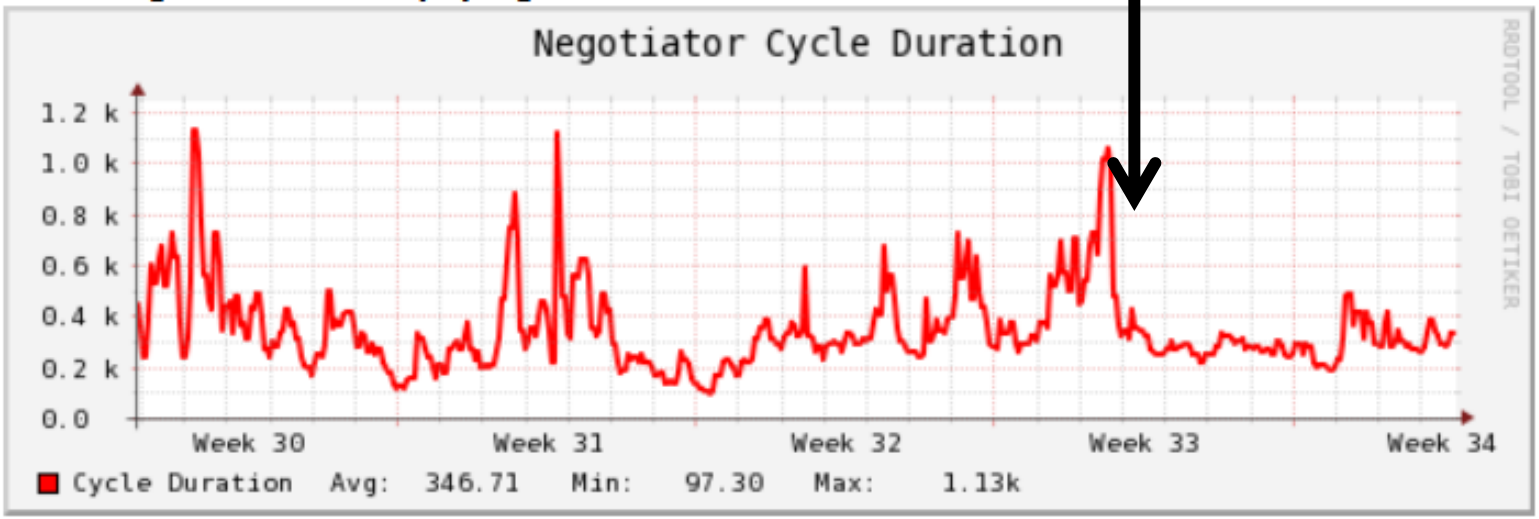


Improve matchmaking protocol esp over slow links

- "…CMS has stood up a new submit machine in Switzerland, trying to connect to a central manager in the US. Round trip ping time is on the order of 200 ms, and they see that the negotiation is much slower to those schedds, topping at 5Hz"

Improve matchmaking protocol esp over slow links, cont

2013-Aug-21 22:20:19 by sfiligoi:



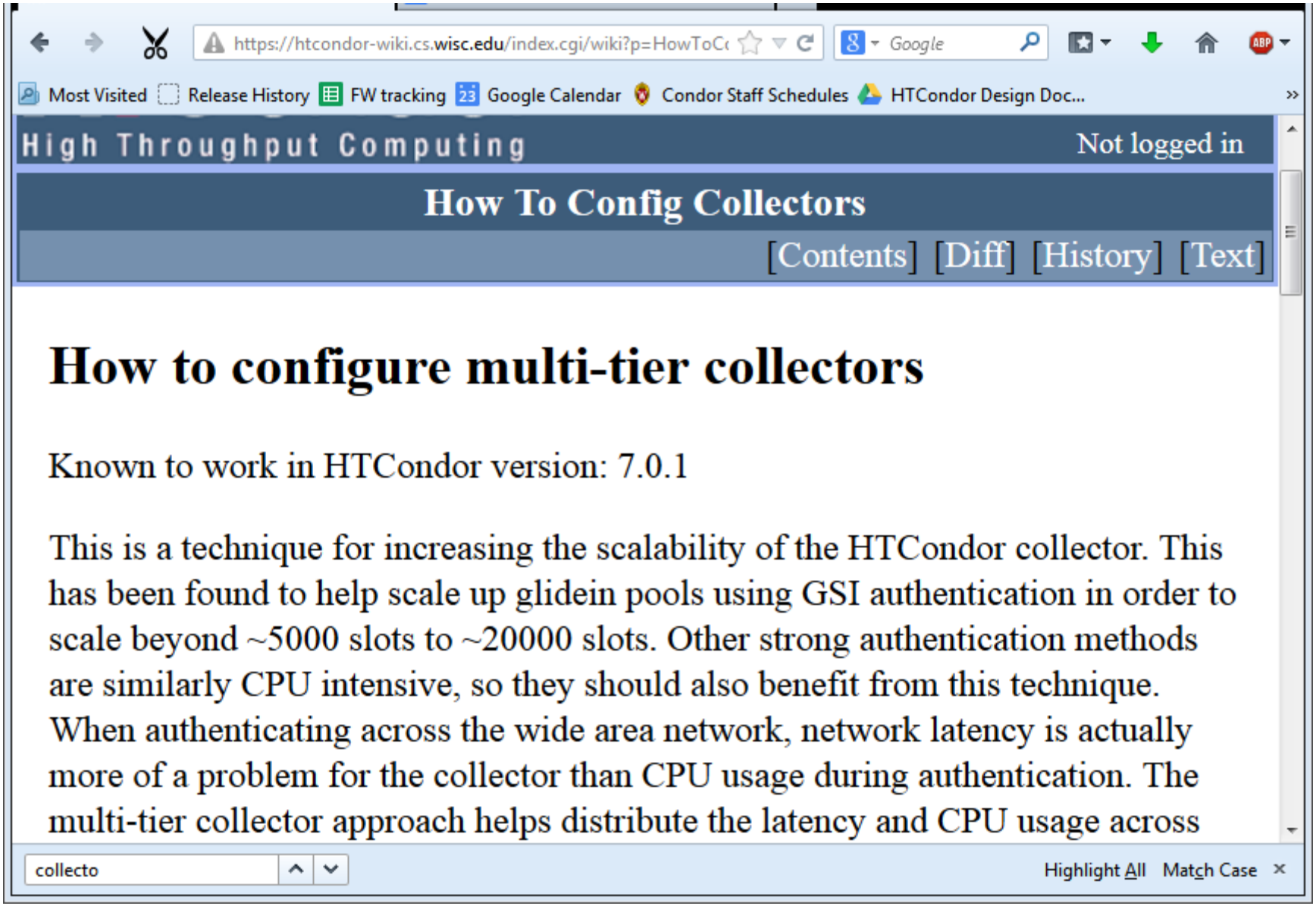
The new patch helped CMS quite a bit. See the attached picture; you can see the difference before and after the patch was applied ("week 33"). Now we just need it in the official binaries.

2013-Aug-22 10:41:30 by tannenba:

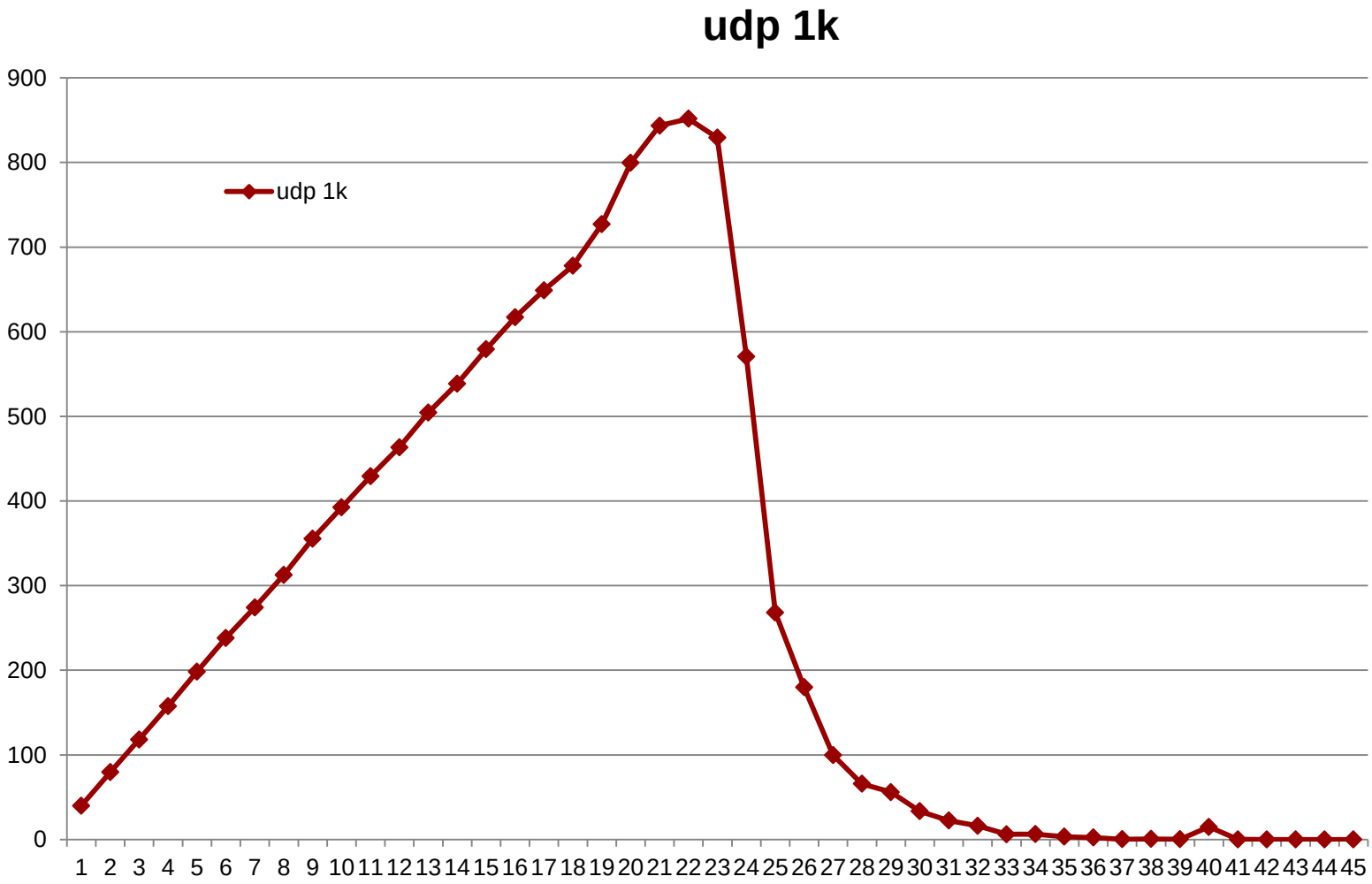
^^^ It is being released in HTCondor v8.1.1.

US CMS Scale Work

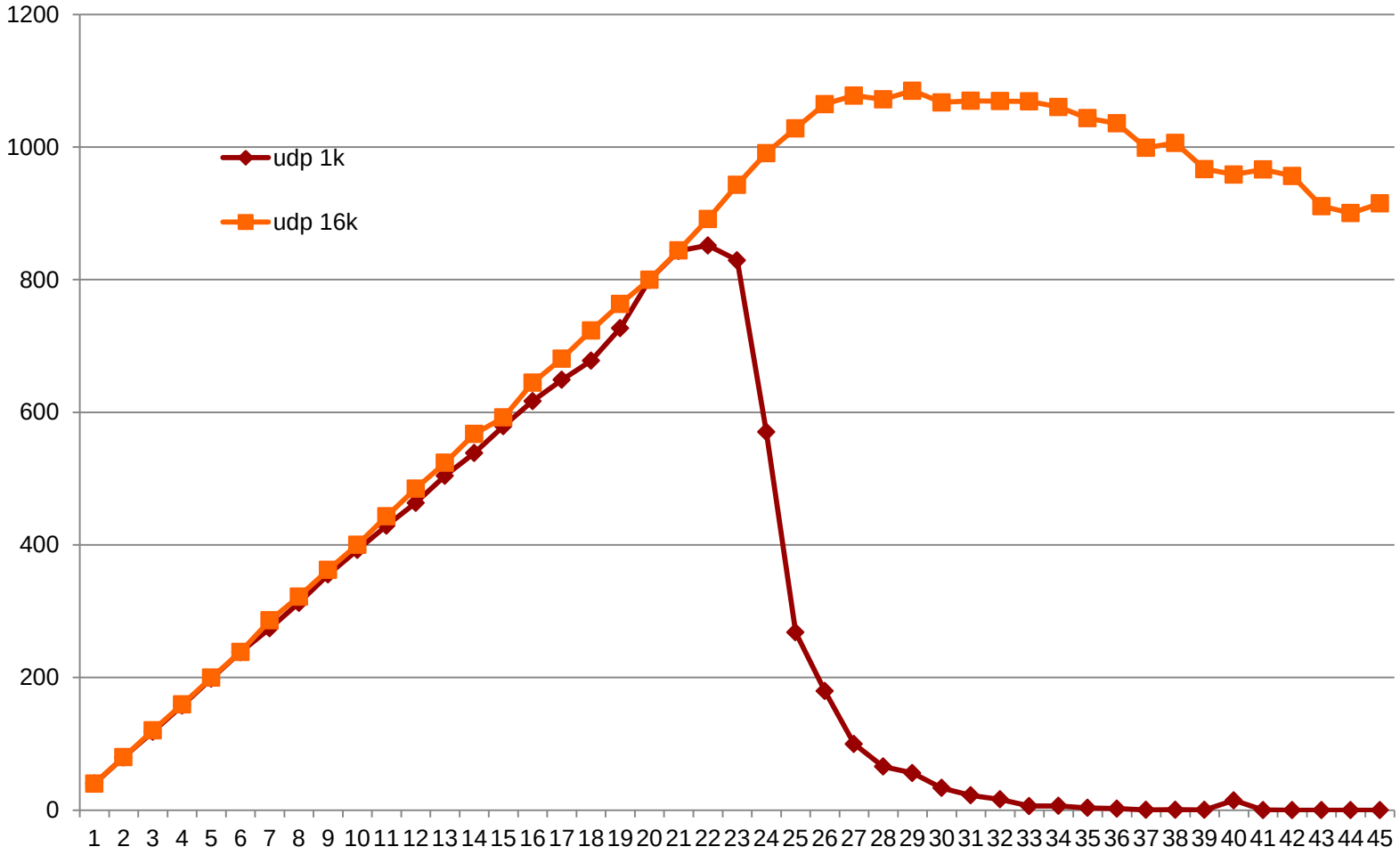
- Currently in production with ~50k slots
- Testing now for a target of 250k slots
- Glidein nodes around the world
  - Network latency
  - CCB / shared_port
  - Strong security (GSI)
- Knocking over bottlenecks
  - “Collector only handling 100 updates/sec!”


https://htcondor-wiki.cs.wisc.edu/index.cgi/wiki?p=HowToC
Google
Most Visited
Release History
FW tracking
Google Calendar
Condor Staff Schedules
HTCondor Design Doc...
High Throughput Computing
Not logged in
How To Config Collectors
[Contents] [Diff] [History] [Text]
How to configure multi-tier collectors
Known to work in HTCondor version: 7.0.1
This is a technique for increasing the scalability of the HTCondor collector. This has been found to help scale up glidein pools using GSI authentication in order to scale beyond ~5000 slots to ~20000 slots. Other strong authentication methods are similarly CPU intensive, so they should also benefit from this technique. When authenticating across the wide area network, network latency is actually more of a problem for the collector than CPU usage during authentication. The multi-tier collector approach helps distribute the latency and CPU usage across
collecto
Highlight All
Match Case

Collector Update Rate



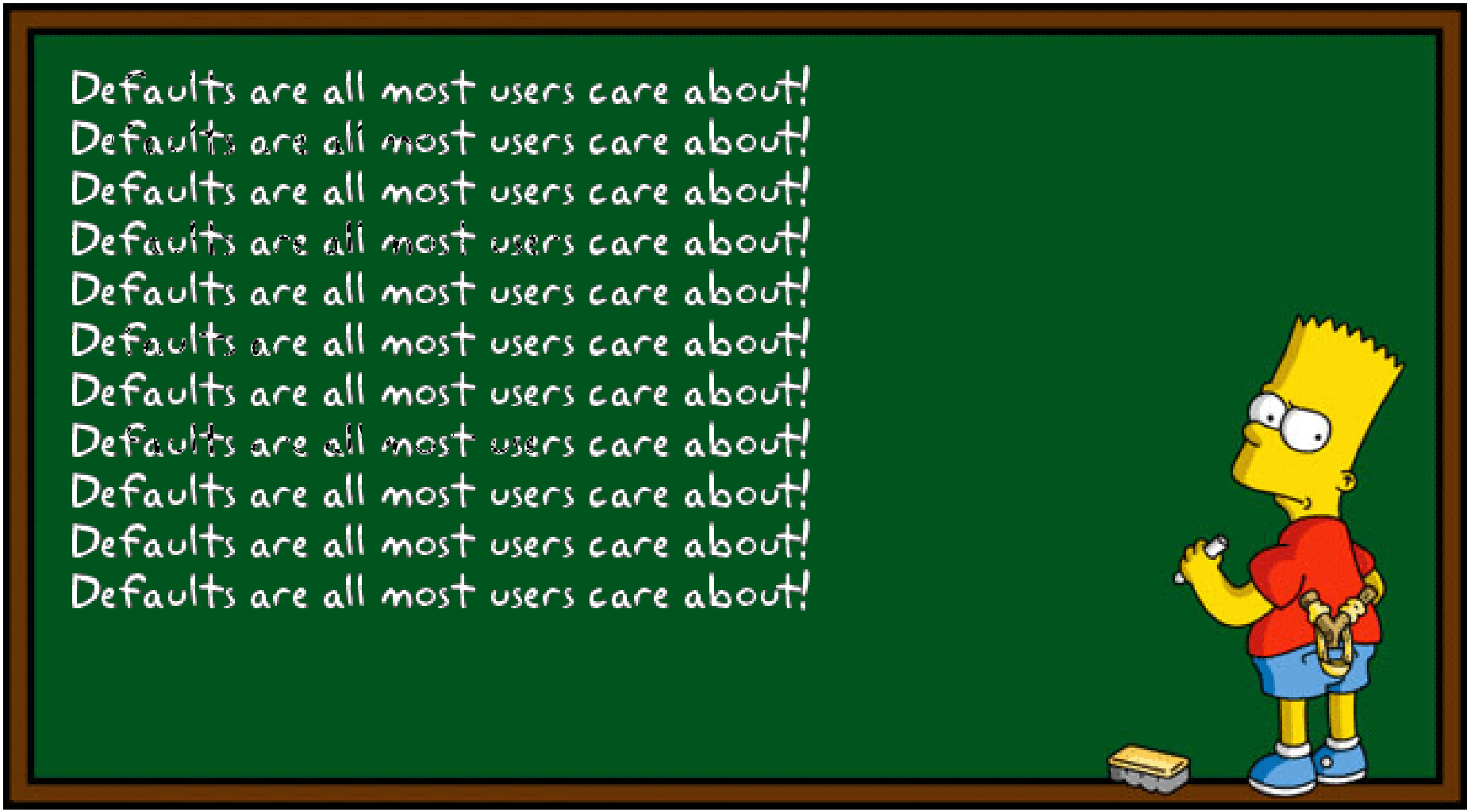
Update w/ jumbo UDP datagrams



More scalability changes

- Schedd restart time improved
- Reduced max time to detect a disappeared node now 6 minutes, was 2 hours.
- Non-blocking I/O
- Do not fork schedd to process condor_q
  - Why? Observed schedd child process grow at ~500MB/sec
- Do not fork to process incoming connections to condor_shared_port

HTCondor Configuration File



More power

- New configuration language constructs
  - **`$(<knob>:<default>)`**
  - **`include`**
  - **`if, else, elif, endif`**
  - **`use <category>:<option>`**

- Use meta-knobs
  - See categories and options with condor_config_val
  - Examples:

```
use role:execute
use policy:always_run_jobs
use feature:gpus
```

GPU Support

- HTCondor can now automatically
  - Discover, Bind, Sandbox, Monitor, and Manage GPUs
- CUDA and OpenCL
- Both static slots and partitionable slots supported!
- How?
  - Add to config file

```
use feature:gpus
```

  - Sample submit file

```
request_cpus = 1
request_gpus = 1
executable = hola_gpus.exe
queue
```

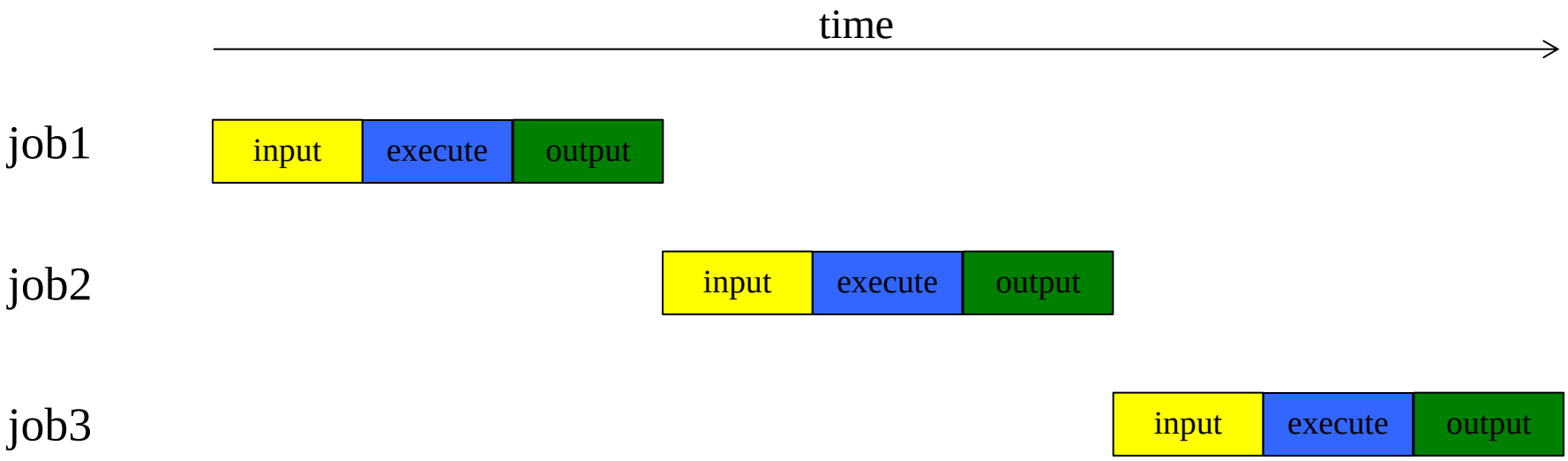
Data Intensive Computing

ASYNC_STAGEOUT

- What is it?
  - Allows the execution of a job to be overlaid with the transfer of output files of a different job
  - Conditions apply:
    - Both jobs must be from the same user
    - Submitted from the same submit point
    - Jobs must explicitly choose to participate

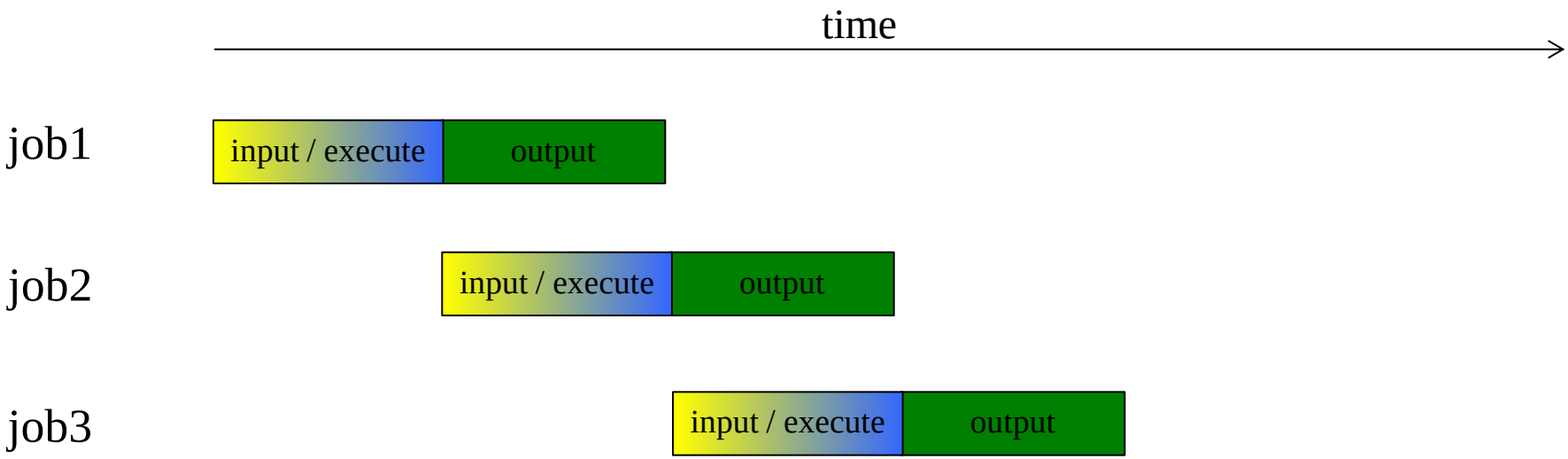
ASYNC_STAGEOUT, cont

- Normal HTCondor operation for a single compute slot has three phases. Several consecutive jobs look like this:



ASYNC_TRANSFER

- The “input/execute” phase and the “output” phase can be done concurrently, also known as “pipelining”:



ASYNC_STAGEOUT

- How does it work?
- The schedd can now tell a startd to move a job from one slot to another.
- The execute node is configured to create dedicated “transfer slots” for each traditional execute slot.
  - The transfer slot will not run jobs
  - Jobs are moved into the transfer slot when they signal the phase transition, but only if the transfer slot is idle.
  - Typically, transfer slots are not visible, but like everything in HTCondor, there’s a knob for that!

ASYNC_STAGEOUT

- A single core machine (with the transfer slot configured to be visible):

```
% condor_status
Name                OpSys      Arch   State     Activity LoadAv Mem    ActvtyTime

slot1@ingwe.cs.wis LINUX      X86_64 Unclaimed Idle      0.250 15816  0+00:00:11
xfer2@ingwe.cs.wis LINUX      X86_64 Unclaimed Idle      0.000   124  0+00:00:10
                     Total Owner Claimed Unclaimed Matched Preempting Backfill

        X86_64/LINUX     2     0       0         2       0          0        0

               Total     2     0       0         2       0          0        0
```

ASYNC_STAGEOUT

- To work, the submit node, execute node, and the job itself must participate.
- If any party does not participate, normal job execution results. (i.e. no overlay)
- The job explicitly signals the transition to output phase using a chirp command:

```
condor_chirp phase output
```

ASYNC_STAGEOUT

- What does it look like from the user perspective?
- Example executable file:

```
#!/bin/sh

echo "Executing..."
sleep 120

echo "Transferring..."
condor_chirp phase output
sleep 120
```

ASYNC_STAGEOUT

- What does it look like from the user perspective?
- Normal job execution for first 120 seconds:

```
% condor_q


-- Submitter: ingwe.cs.wisc.edu : <128.105.121.64:56450> : ingwe.cs.wisc.edu
 ID      OWNER            SUBMITTED     RUN_TIME ST PRI SIZE CMD
1255.0   zmiller         4/29 11:26   0+00:01:29 R  0   0.0  async.sh 120
1255.1   zmiller         4/29 11:26   0+00:00:00 I  0   0.0  async.sh 120
1255.2   zmiller         4/29 11:26   0+00:00:00 I  0   0.0  async.sh 120
1255.3   zmiller         4/29 11:26   0+00:00:00 I  0   0.0  async.sh 120
1255.4   zmiller         4/29 11:26   0+00:00:00 I  0   0.0  async.sh 120

5 jobs; 0 completed, 0 removed, 4 idle, 1 running, 0 held, 0 suspended
```

ASYNC_STAGEOUT

- What does it look like from the user perspective?
- After 120 seconds another job starts:

```
% condor_q


-- Submitter: ingwe.cs.wisc.edu : <128.105.121.64:56450> : ingwe.cs.wisc.edu
 ID      OWNER            SUBMITTED     RUN_TIME ST PRI SIZE CMD
1255.0   zmiller         4/29 11:26   0+00:02:09 R  0   0.0  async.sh 120
1255.1   zmiller         4/29 11:26   0+00:00:03 R  0   0.0  async.sh 120
1255.2   zmiller         4/29 11:26   0+00:00:00 I  0   0.0  async.sh 120
1255.3   zmiller         4/29 11:26   0+00:00:00 I  0   0.0  async.sh 120
1255.4   zmiller         4/29 11:26   0+00:00:00 I  0   0.0  async.sh 120

5 jobs; 0 completed, 0 removed, 3 idle, 2 running, 0 held, 0 suspended
```

ASYNC_STAGEOUT

- What does it look like from the user perspective?
- You can see the first job has moved:

```
% condor_q -run


-- Submitter: ingwe.cs.wisc.edu : <128.105.121.64:56450> : ingwe.cs.wisc.edu
 ID      OWNER           . SUBMITTED     RUN_TIME HOST(S)
1255.0   zmiller          4/29 11:26   0+00:02:44 xfer2@ingwe.cs.wisc.edu
1255.1   zmiller          4/29 11:26   0+00:00:38 slot1@ingwe.cs.wisc.edu
```

ASYNC_STAGEOUT

- What does it look like from the user perspective?
- Eventually first job finishes:

```
% condor_q


-- Submitter: ingwe.cs.wisc.edu : <128.105.121.64:56450> : ingwe.cs.wisc.edu
 ID      OWNER            SUBMITTED     RUN_TIME ST PRI SIZE CMD
1255.1   zmiller         4/29 11:26   0+00:02:01 R  0   0.0  async.sh 120
1255.2   zmiller         4/29 11:26   0+00:00:00 I  0   0.0  async.sh 120
1255.3   zmiller         4/29 11:26   0+00:00:00 I  0   0.0  async.sh 120
1255.4   zmiller         4/29 11:26   0+00:00:00 I  0   0.0  async.sh 120

4 jobs; 0 completed, 0 removed, 3 idle, 1 running, 0 held, 0 suspended
```

ASYNC_STAGEOUT

- What does it look like from the user perspective?
- And another job starts… and so on…

```
% condor_q


-- Submitter: ingwe.cs.wisc.edu : <128.105.121.64:56450> : ingwe.cs.wisc.edu
 ID      OWNER            SUBMITTED     RUN_TIME ST PRI SIZE CMD
1255.1   zmiller         4/29 11:26   0+00:02:07 R  0   17.1 async.sh 120
1255.2   zmiller         4/29 11:26   0+00:00:05 R  0   0.0  async.sh 120
1255.3   zmiller         4/29 11:26   0+00:00:00 I  0   0.0  async.sh 120
1255.4   zmiller         4/29 11:26   0+00:00:00 I  0   0.0  async.sh 120

4 jobs; 0 completed, 0 removed, 2 idle, 2 running, 0 held, 0 suspended
```

ASYNC_STAGEOUT

- To enable on your cluster, just use the meta-knob:

```
use EXPERIMENTAL:ASYNC_STAGEOUT
```

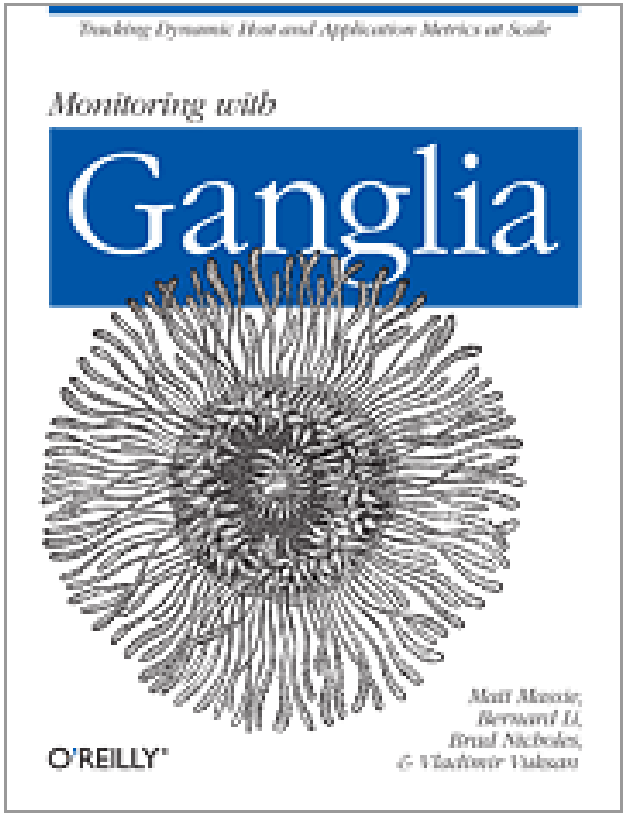
- See ticket #4291

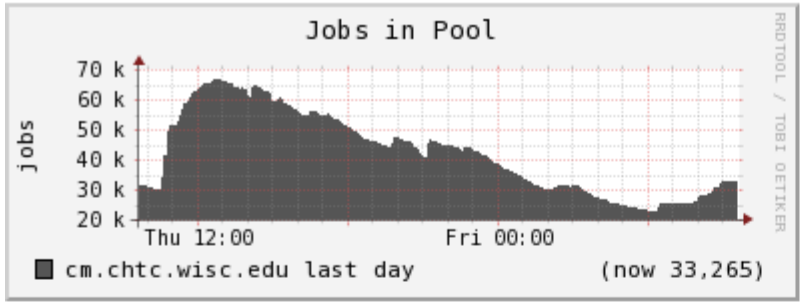
Is my pool healthy?

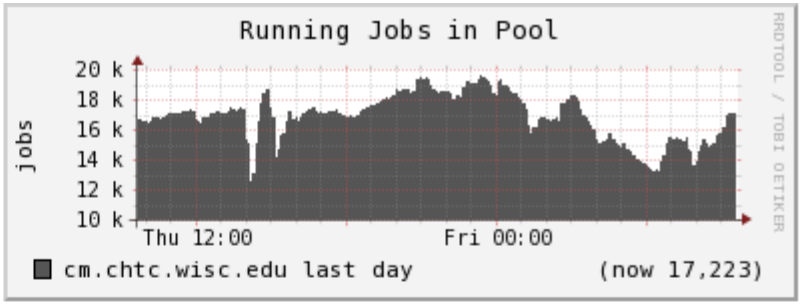
We added a lot of metrics in HTCondor v7.9.x, but how to spot trends?

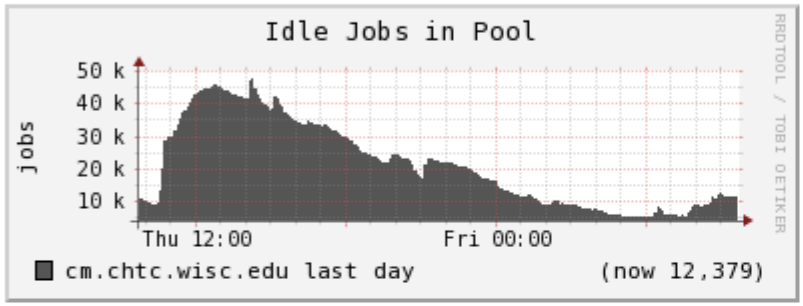
Operational monitoring over time with condor_gangliad

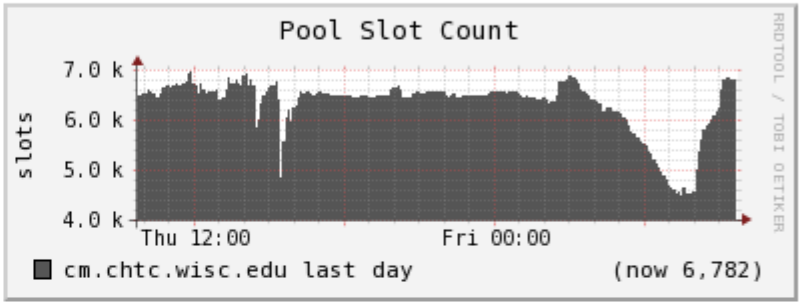
- Monitor your cluster with familiar tools
- Measure utilization
- Diagnose problems
- View usage over time
- Easy to configure
  - Esp if already using ganglia

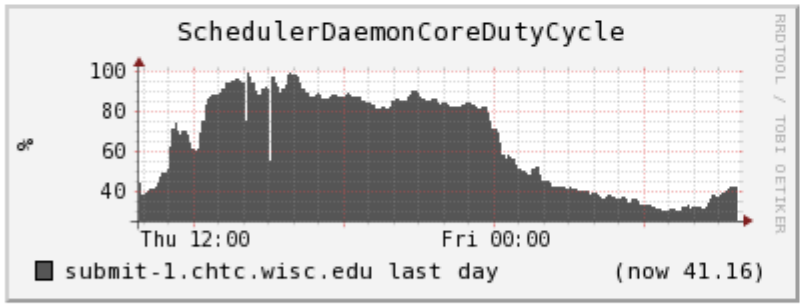


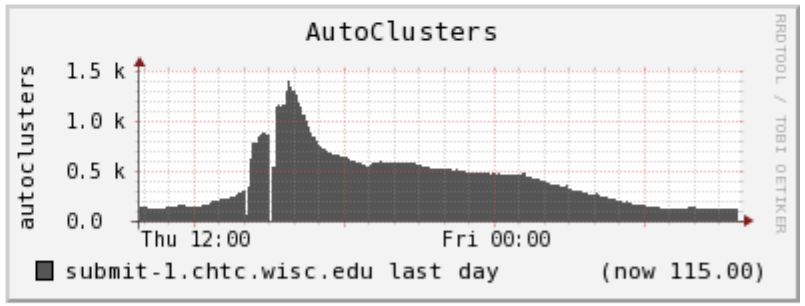

Jobs in Pool
jobs
70 k
60 k
50 k
40 k
30 k
20 k
Thu 12:00
Fri 00:00
cm.chtc.wisc.edu last day
(now 33,265)
RRDTOOL / TOBI OETIKER

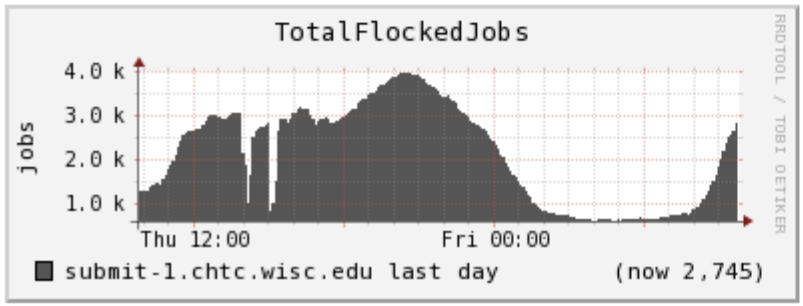

Running Jobs in Pool
jobs
20 k
18 k
16 k
14 k
12 k
10 k
Thu 12:00
Fri 00:00
cm.chtc.wisc.edu last day
(now 17,223)
RRDTOOL / TOBI OETIKER

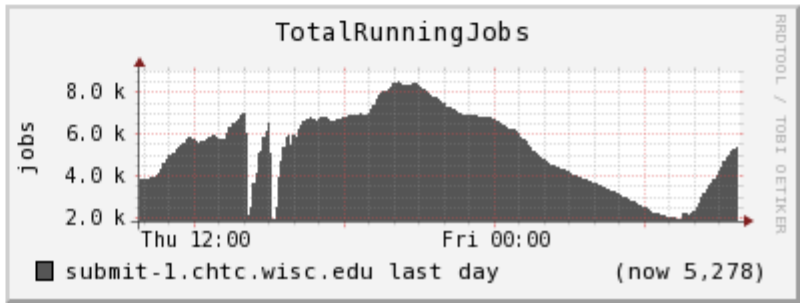

Idle Jobs in Pool
jobs
50 k
40 k
30 k
20 k
10 k
Thu 12:00
Fri 00:00
cm.chtc.wisc.edu last day
(now 12,379)
RRDTOOL / TOBI OETIKER


Pool Slot Count
slots
7.0 k
6.0 k
5.0 k
4.0 k
Thu 12:00
Fri 00:00
cm.chtc.wisc.edu last day
(now 6,782)
RRDTOOL / TOBI OETIKER

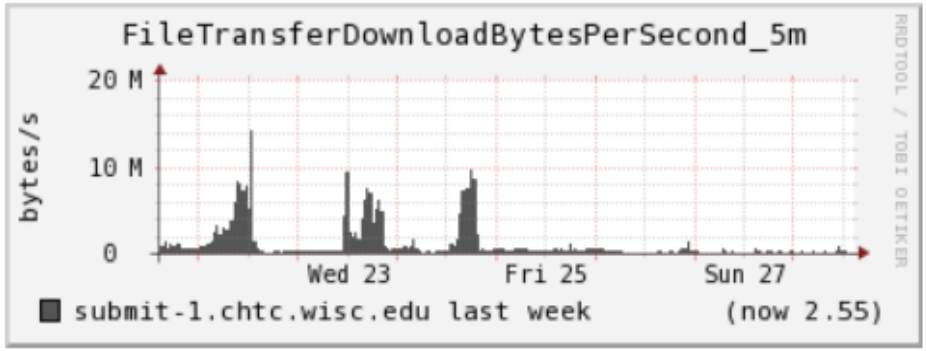

SchedulerDaemonCoreDutyCycle
%
100
80
60
40
Thu 12:00
Fri 00:00
submit-1.chtc.wisc.edu last day
(now 41.16)
RRDTOOL / TOBI OETIKER

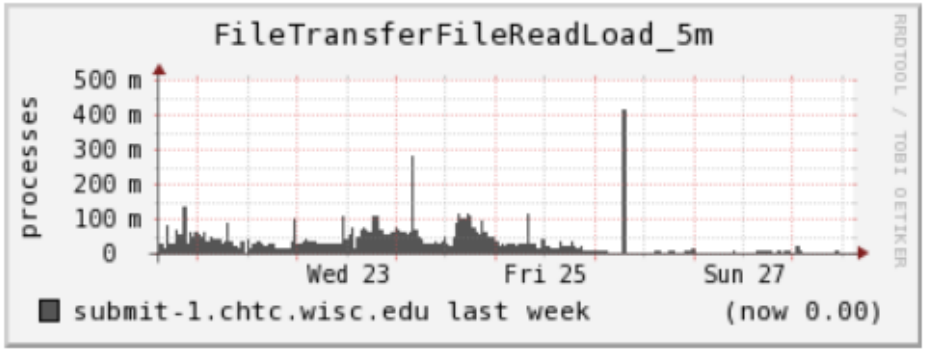

AutoClusters
autoclusters
1.5 k
1.0 k
0.5 k
0.0
Thu 12:00
Fri 00:00
submit-1.chtc.wisc.edu last day
(now 115.00)
RRDTOOL / TOBI OETIKER

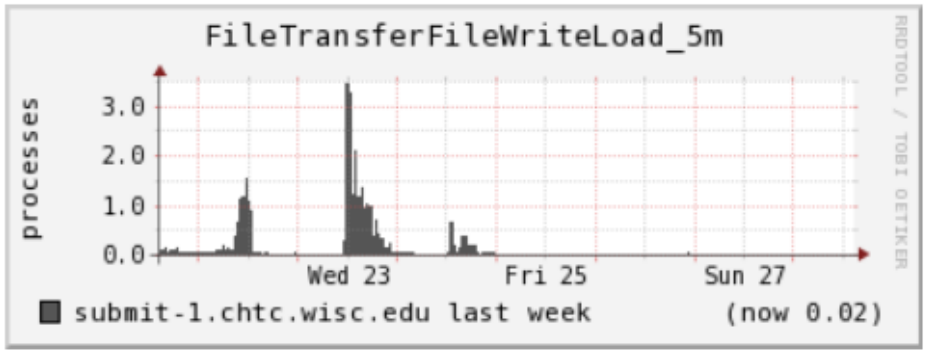

TotalFlockedJobs
jobs
4.0 k
3.0 k
2.0 k
1.0 k
Thu 12:00
Fri 00:00
submit-1.chtc.wisc.edu last day
(now 2,745)
RRDTOOL / TOBI OETIKER

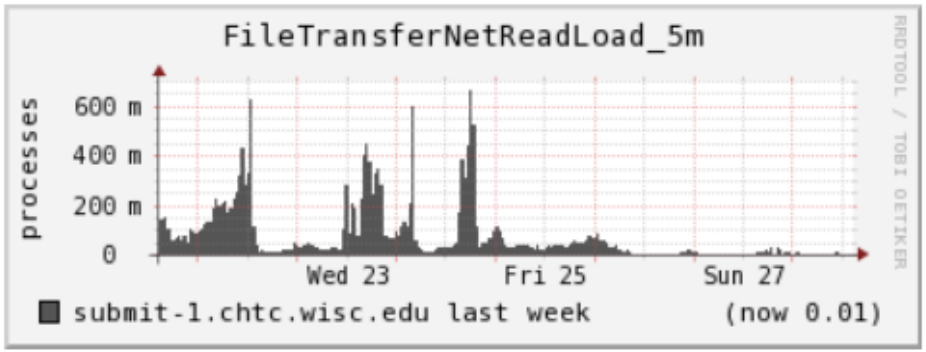

TotalRunningJobs
jobs
8.0 k
6.0 k
4.0 k
2.0 k
Thu 12:00
Fri 00:00
submit-1.chtc.wisc.edu last day
(now 5,278)
RRDTOOL / TOBI OETIKER

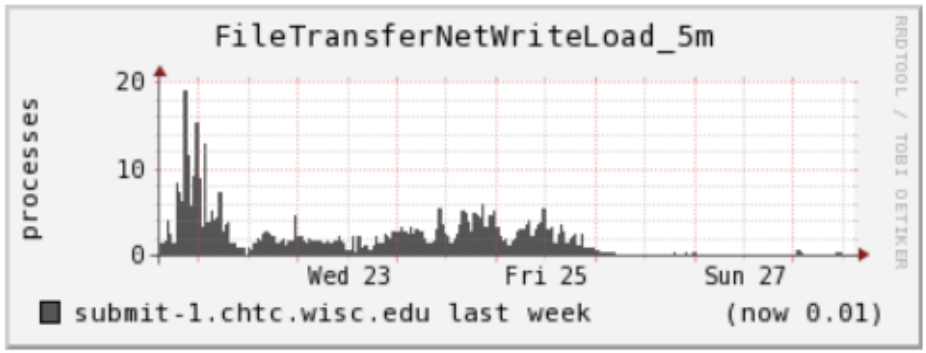
HTCondor File Transfer metrics (6)

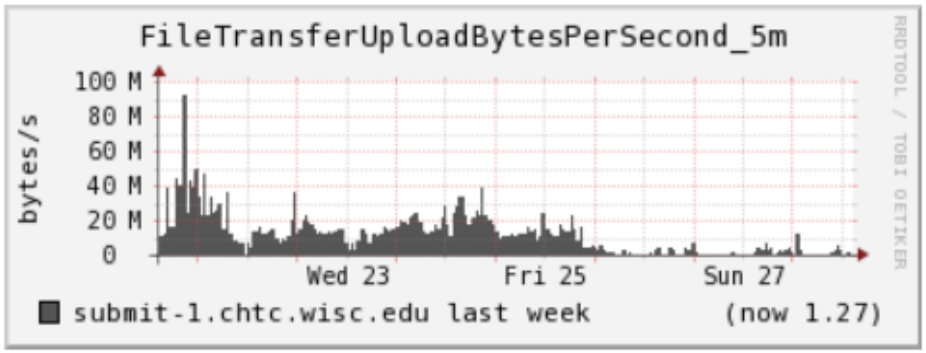




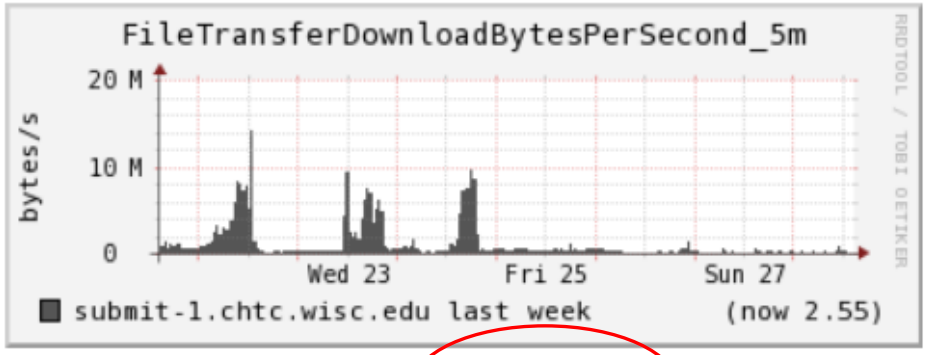


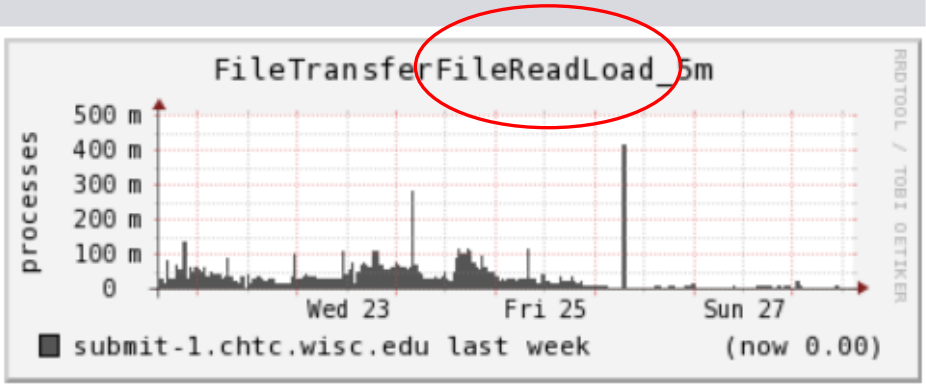


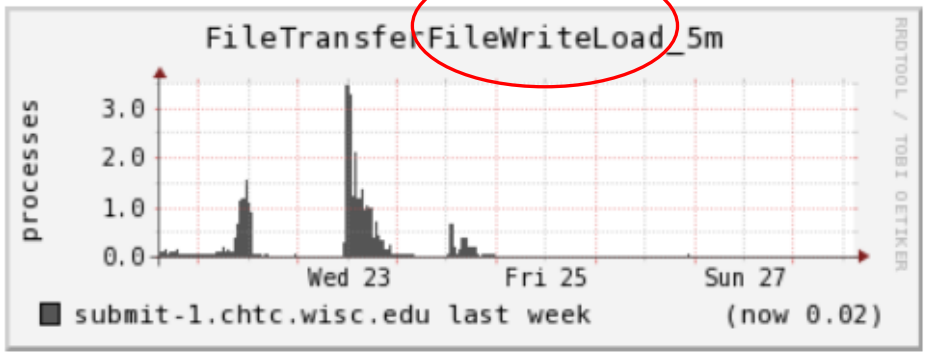


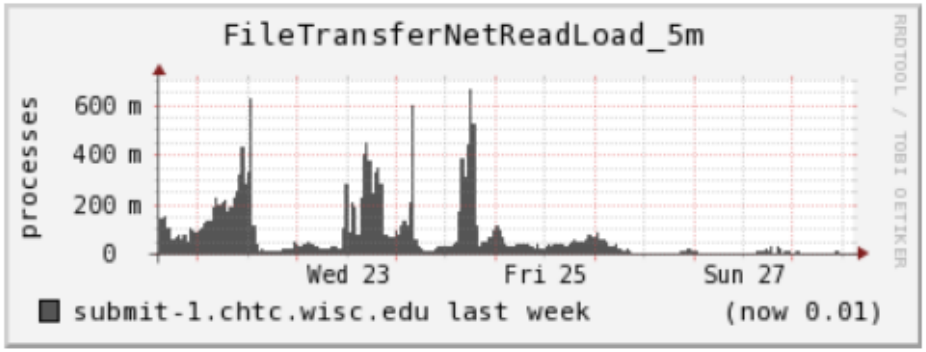


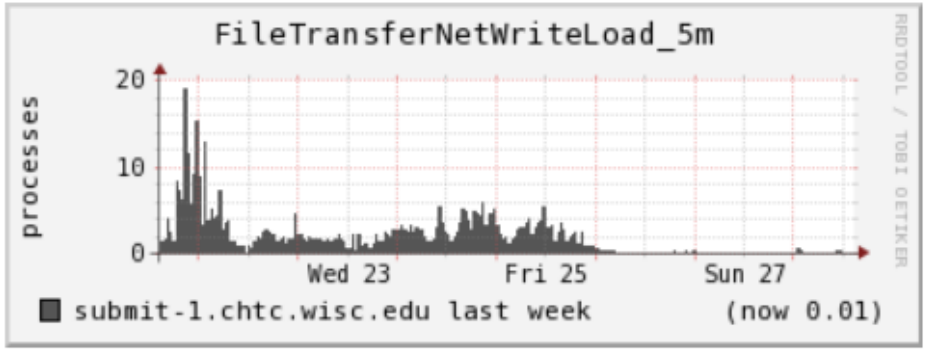
HTCondor File Transfer metrics (6)

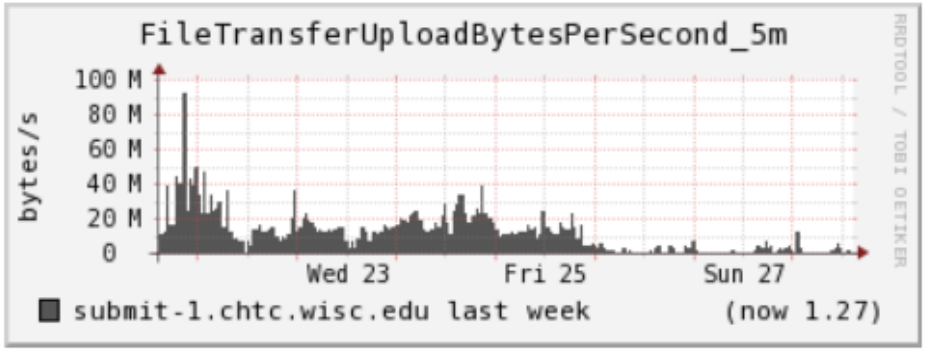












File Transfer Management

- Could
  concu ds.

File Transfer Management

› Could
concu ds.

› New c

FILE_TR OTTLE

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file trans ep the
disk loa a
specifie

Schedd overloaded, now what?

- condor_sos <whatever….>, eg
  - condor_sos condor_q
  - condor_sos condor_hold toddt
  - condor_sos –schedd –direct my_schedd
- Every superuser command is an SOS

Save Our Schedd!

condor_job_report script

- New script in ~condor/bin
- Email report shows preempted jobs:

```
The following users have run vanilla jobs without
+is_resumable = true, that have hit the
MaxJobRetirementTime yesterday.

# of User Jobs
---- ----
3 wbrooks2@submit.chtc.wisc.edu
6 quefeng@submit.chtc.wisc.edu
7 davisa@submit.chtc.wisc.edu
44 asiahpirani@discovery.wisc.edu
```

condor_job_report script

Shows statistics about job runtimes

- Short jobs
- Quartiles
- mean runtime
- restarts of same job

More monitoring

- Monitoring jobs via BigPanDAmon
- Publication of useful metrics, such as
  - Number of job preemptions (by startd)
  - Number of autoclusters (by schedd)
- condor_status -defrag

New DAGMan features

- More info and improved structure in node status file
- Metrics reporting (used by Pegasus)
- DAG files can now be > 2.2 GB
- DAGMAN_DEFAULT_NODE_LOG has been made more powerful, so that it can be defined in HTCondor configuration files
- Non-workflow log mode is now deprecated
- Node retry number is now available as VARS macro

startd RANK for pslots

- Startd RANK expressions for pslots now works
- Pslot slot ads now have info about dslots
- In new classad arrays:
- If startds has four dslots running, looks like

```
childCpus = { 1,1,4,1 }
childCurrentRank = { 0.0,0.0,0.0,0.0 }
childState = {"Claimed","Claimed","Claimed","Claimed"
```

- But not user prio yet
- Future work: no dslots in collector!


HAL 9000


FUTURE

VM Universe enhancements for admins

- Test a VM on start-up. (#3789)
- Test VM networking on start-up. (#3960)
- And periodically re-check both.
- Advertise health of VMU on a host. (#3976)
  - Include testing results and job attempts.

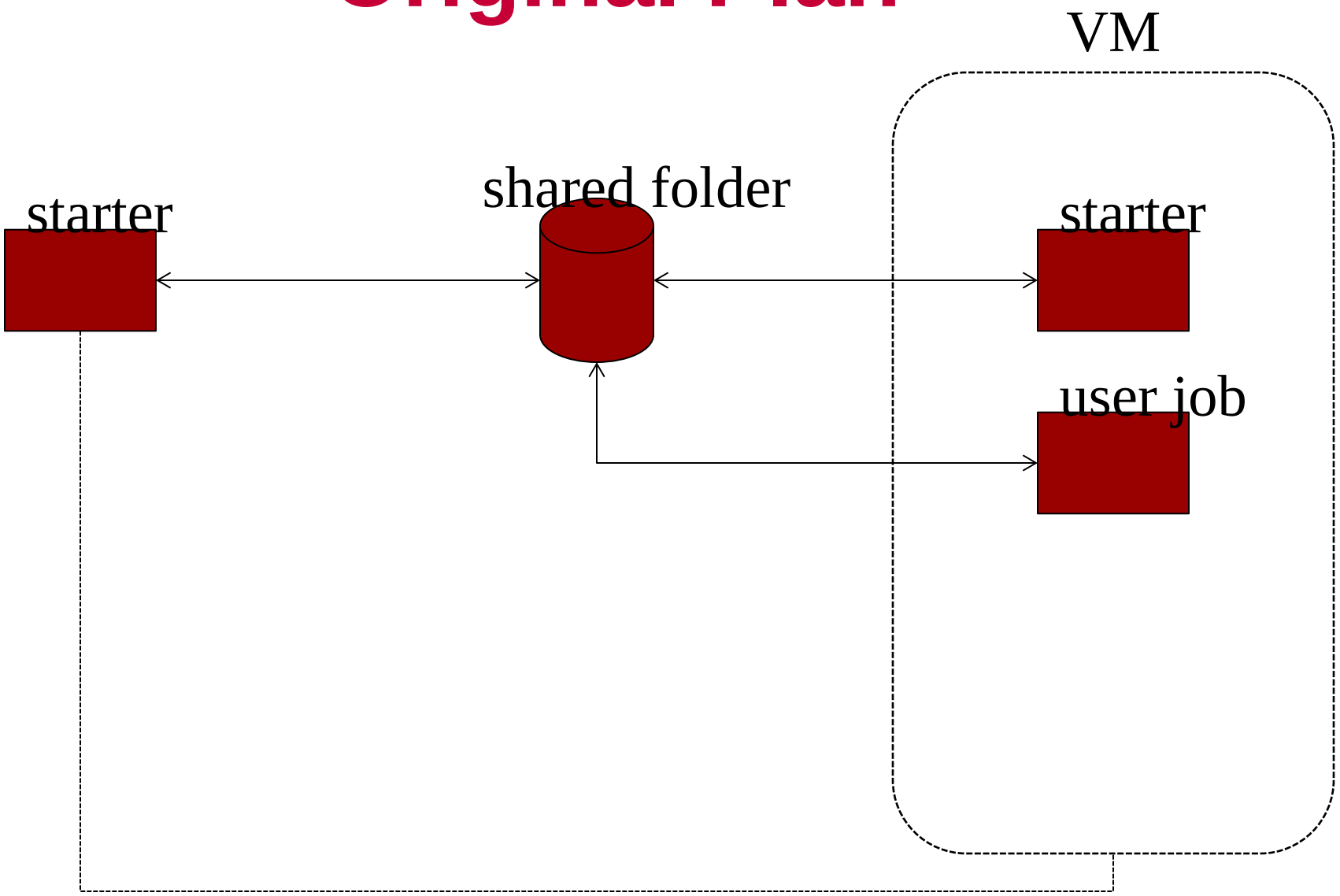
VM Universe enhancements for users

- Clean up submission problems
  - vm_memory vs RequestMemory (#3907)
  - file transfer
    - spurious (?) warnings (#3908)
    - doesn't play well with file-transfer plugins (#4167)
    - interaction with vm_no_output_vm (#2556)
- Support an exit status code (#3961)

KVM-Enabled Checkpointing of vanilla universe jobs

- Swap standard universe's constraints for the constraints of VMs
  - Moves some burdens from user to admin
- Transparent to application and user?
  - Admin could set default VM to one that looks like the host OS
- Combine vanilla and VM universe

Original Plan



Native OpenStack Support

- Speak OpenStack's NOVA protocol
  - Better supported than EC2 compatibility interface
  - Allows better error handling
  - Provides richer set of controls on instances
  - Potential to obtain and manage resources beyond servers

Continue to push on…

- Network enhancements
  - Zhe Zhang's talk yesterday (LARK)
  - Alan DeSmet's talk tomorrow (source routing, IPv6)
- First-class facility in HTCondor for caching job input data sets on execute nodes
  - Give feedback on our design! See http://goo.gl/8sxQJb
- HTPC scheduling mechanisms
  - Built-in vs expressions
- Less tuning out of the box (think Skype…)
  - shared_port and collector hierarchy on by default, …
- Grouping of jobs (and machines?)
- Horizontal scaling
- Provide operators more visibility into their pool

Thank You!

Image Credit: Apple Inc.