Grid Laboratory Of Wisconsin (GLOW)

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THE UNIVERSITY *of* WISCONSIN MADISON

http://www.cs.wisc.edu/condor/glow

UW "Enterprise Level" Grid

- Condor pools at various departments integrated into a campus wide grid

  - Grid Laboratory of Wisconsin

- Older private Condor pools at other departments
  - ~1000 ~1GHz Intel CPUs at CS
  - ~100 ~2GHz Intel CPUs at Physics
  - …

- Condor jobs flock from various departments to GLOW

- Excellent utilization
  - Especially when the Condor Standard Universe is used
    - Premption, Checkpointing, Job Migration

Grid Laboratory of Wisconsin

2003 Initiative funded by NSF/UW
Six GLOW Sites

- Computational Genomics, Chemistry

- Amanda, Ice-cube, Physics/Space Science

- High Energy Physics/CMS, Physics

- Materials by Design, Chemical Engineering

- Radiation Therapy, Medical Physics

- Computer Science

GLOW phases-1,2 + non-GLOW funded nodes already have ~1000 Xeons + 100 TB disk

Condor/GLOW Ideas

- Exploit commodity hardware for high throughput computing
  - The base hardware is the same at all sites
  - Local configuration optimization as needed
    - e.g., Number of CPU elements vs storage elements
  - Must meet global requirements
    - It turns out that our initial assessment calls for almost identical configuration at all sites
- Managed locally at 6 sites
  - Shared globally across all sites
  - Higher priority for local jobs
- Neighborhood association style
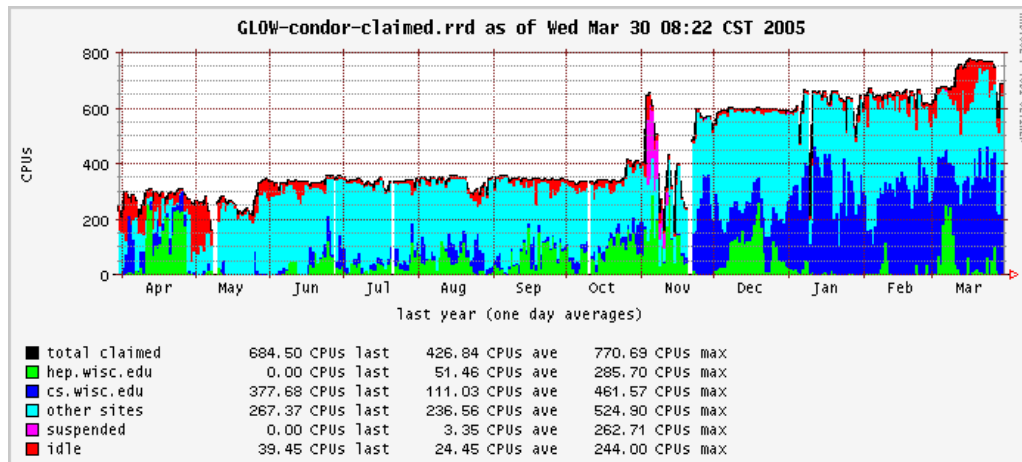 - Cooperative planning, operations …

GLOW Deployment

- **GLOW Phase-I and II are Commissioned**
  - CPU
    - 66 nodes each @ ChemE, CS, LMCG, MedPhys, Physics
    - 30 nodes @ IceCube
    - ~100 extra nodes @ CS (50 ATLAS + 50 CS)
    - 26 extra nodes @ Physics
    - Total CPU: ~1000
  - Storage
    - Head nodes @ at all sites
    - 45 TB each @ CS and Physics
    - Total storage: ~ 100 TB

- **GLOW Resources are used at 100% level**
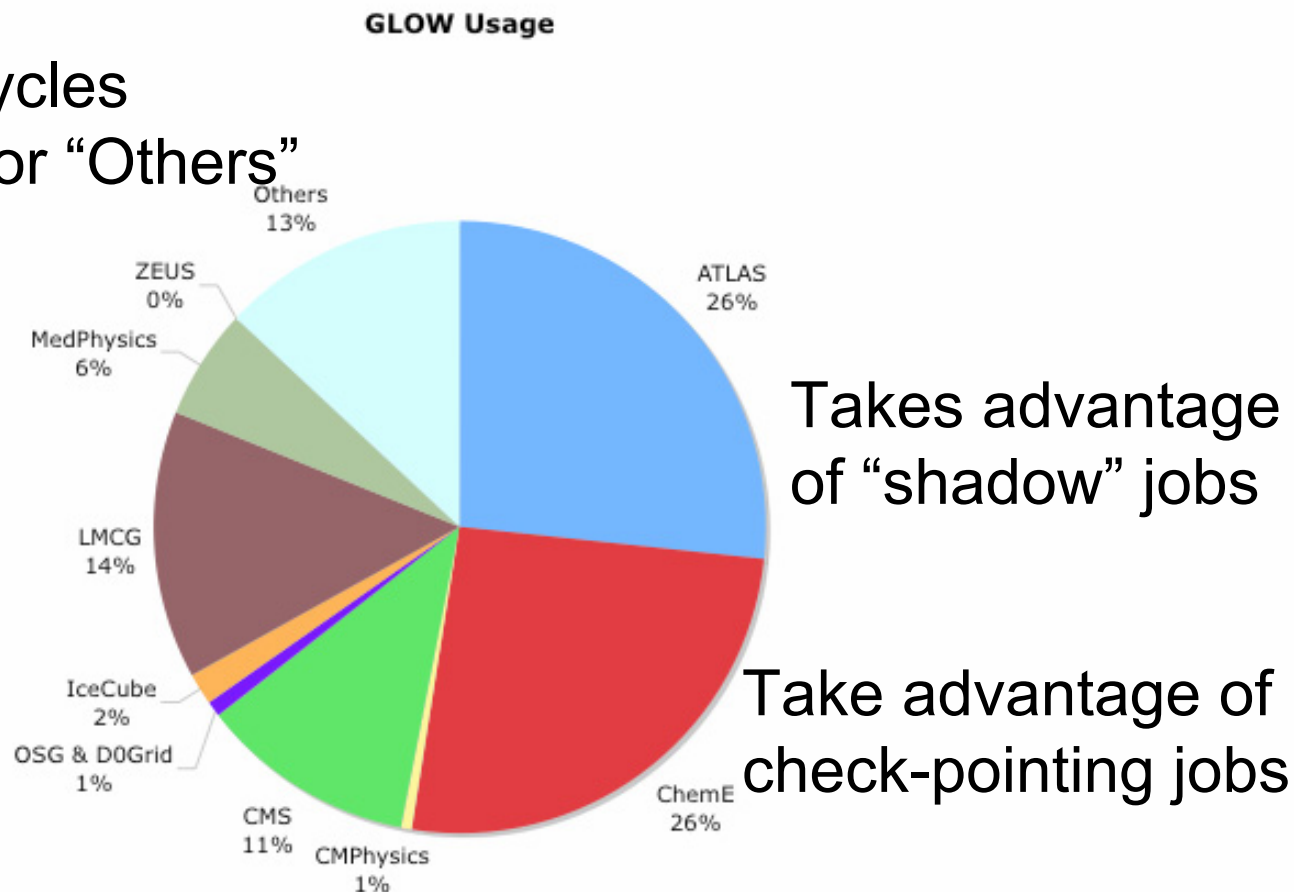 - Key is to have multiple user groups
- **GLOW continues to grow**
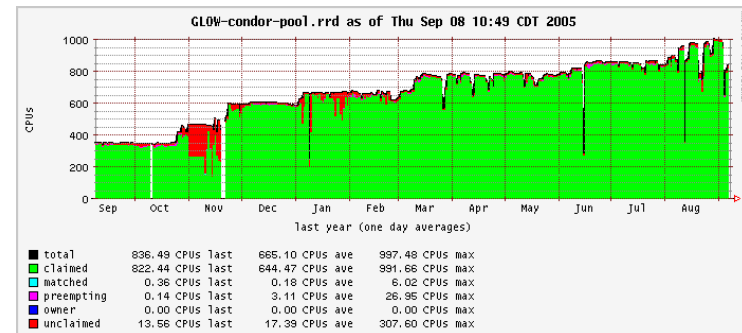
GLOW Usage

- **GLOW Nodes are always running hot!**
  - CS + Guests
    - Largest user
    - Serving guests - many cycles delivered to guests!
  - ChemE
    - Largest community
  - HEP/CMS
    - Production for collaboration
    - Production and analysis of local physicists
  - LMCG
    - Standard Universe
  - Medical Physics
    - MPI jobs
  - IceCube
    - Simulations

GLOW-condor-claimed.rrd as of Wed Mar 30 08:22 CST 2005

total claimed	684.50 CPUs last	426.84 CPUs ave	770.69 CPUs max
hep.wisc.edu	0.00 CPUs last	51.46 CPUs ave	285.70 CPUs max
cs.wisc.edu	377.68 CPUs last	111.03 CPUs ave	461.57 CPUs max
other sites	267.37 CPUs last	236.56 CPUs ave	524.90 CPUs max
suspended	0.00 CPUs last	3.35 CPUs ave	262.71 CPUs max
idle	39.45 CPUs last	24.45 CPUs ave	244.00 CPUs max

GLOW Usage Since February 2004

Leftover cycles
available for "Others"

GLOW Usage

Takes advantage
of "shadow" jobs

Take advantage of
check-pointing jobs

Others 13%
ZEUS 0%
MedPhysics 6%
ATLAS 26%
LMCG 14%
IceCube 2%
OSG & D0Grid 1%
CMS 11%
CMPhysics 1%
ChemE 26%

Over 7.6 million CPU-Hours (865 CPU-Years) served!

Example Uses

- ATLAS
  - Over 15 Million proton collision events simulated at 10 minutes each
- CMS
  - Over 10 Million events simulated in a month - many more events reconstructed and analyzed
- Computational Genomics
  - Prof. Shwartz asserts that GLOW has opened up new paradigm of work patterns in his group
    - They no longer think about how long a particular computational job will take - they just do it
- Chemical Engineering
  - Students do not know where the computing cycles are coming from - they just do it
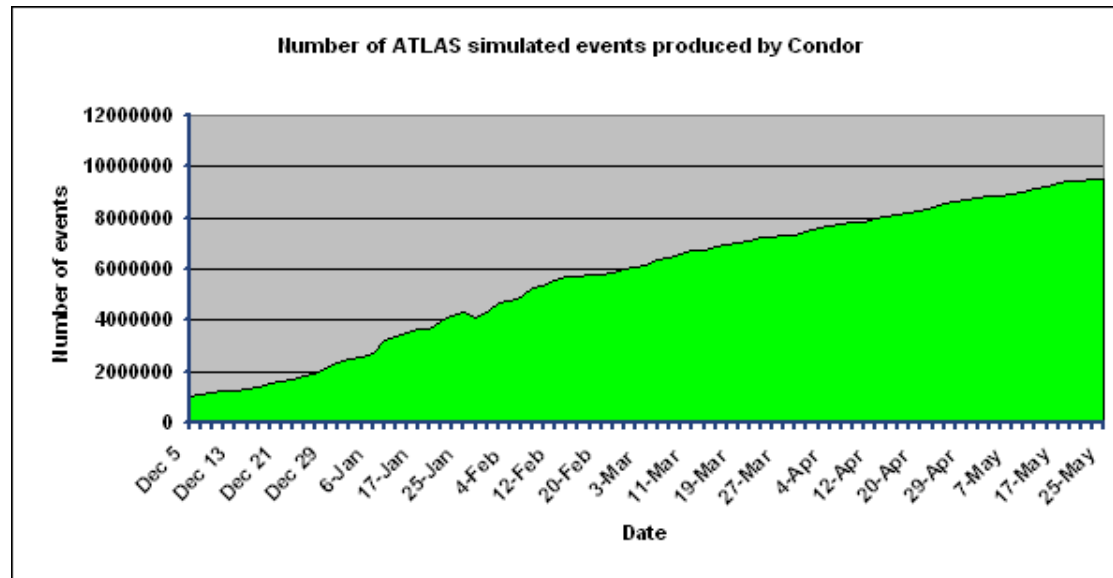
CMS Usage of UW Campus Grid

Seamless support for bursts of activity: Opportunistic use of friendly resources

Data intensive jobs Local CMS-GLOW storage w/ campus-wide computing elements - high speed campus network

Simulation

Reconstruction

Data Analysis
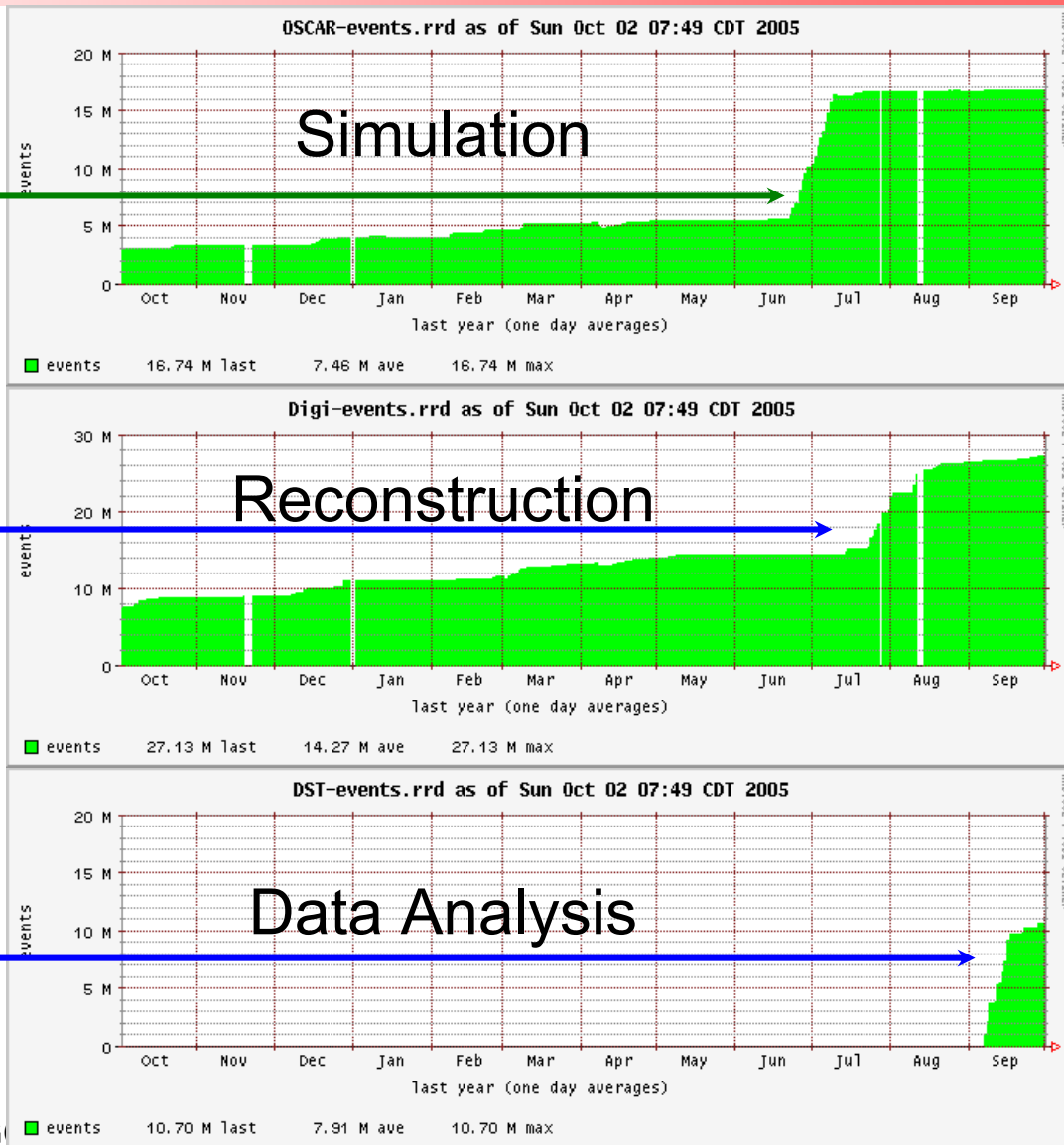
ATLAS Use of GLOW

- UW ATLAS group is sold on GLOW
  - First new member of GLOW

Number of ATLAS simulated events produced by Condor

  - Efficiently used idle resources
  - Used suspension mechanism to keep jobs in background when higher priority "owner" jobs kick-in

New GLOW Members

- Proposed minimum involvement
  - One rack with about 50 CPUs
- Identified system support person who joins GLOW-tech
  - Can be an existing member of GLOW-tech
- PI joins the GLOW-exec
- Adhere to current GLOW policies
- Sponsored by existing GLOW members
  - UW ATLAS group and other physics groups were proposed by CMS and CS, and were accepted as new members
    - UW ATLAS using bulk of GLOW cycles (housed @ CS)
  - Expressions of interest from other groups

GLOW & Condor Development

GLOW presents distributed computing researchers with an ideal laboratory of real users with diverse requirements

– Early commissioning and stress testing of new Condor releases in an environment controlled by Condor team
  • Results in robust releases for world-wide deployment
– New features in Condor Middleware, examples:
  • Group wise or hierarchical priority setting
  • Rapid-response with large resources for short periods of time for high priority interrupts
  • Hibernating shadow jobs instead of total preemption (HEP cannot use Standard Universe jobs)
  • MPI use (Medical Physics)
  • Condor-C (High Energy Physics and Open Science Grid)

Open Science Grid & GLOW

- OSG Jobs can run on GLOW
  - Gatekeeper routes jobs to local condor cluster
  - Jobs flock to campus wide, including the GLOW resources
  - dCache storage pool is also a registered OSG storage resource
  - Beginning to see some use
- Now actively working on rerouting GLOW jobs to the rest of OSG
  - Users do NOT have to adapt to OSG interface and separately manage their OSG jobs
  - New Condor code development

Summary

- Wisconsin campus grid, GLOW, has become an indispensable computational resource for several domain sciences

- Cooperative planning of acquisitions, installation and operations results in large savings

- Domain science groups no longer worry about setting up computing - they do their science!
  - Empowers individual scientists
  - Therefore, GLOW is growing on our campus

- By pooling together our resources we are able to harness larger than our *individual-share* at times of critical need to produce science results in a timely way

- Provides a working laboratory for computer science studies