



International Conference on Computing
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Cloud versus Cloud: the Blessings and Challenges of Cloud Computing for Science

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Cloud versus Cloud



Custom user environments!
On-demand access!
Elastic computing!
Growth and cost management!
Capital expense -> operational expense!



You mean I have to install my own OS?
How long does it take to deploy 5000 nodes on a cloud? And how long will the comp take?
This resource keeps disappearing on me!
And it is unreliable if it shows up at all!
It costs too much! And what if Amazon raises prices?

10/20/10



NIMBUS

www.nimbusproject.org

A Crash Introduction to Infrastructure-as-a-Service Cloud Computing

10/20/10



www.nimbusproject.org

Nimbus Goals

High-quality, extensible, customizable,
open source implementation

Higher-level IaaS Tools

Context
Broker

Elastic
Scaling Tools

Nimbus
Clients

Enable users to use IaaS clouds

Infrastructure-as-a-Service Tools

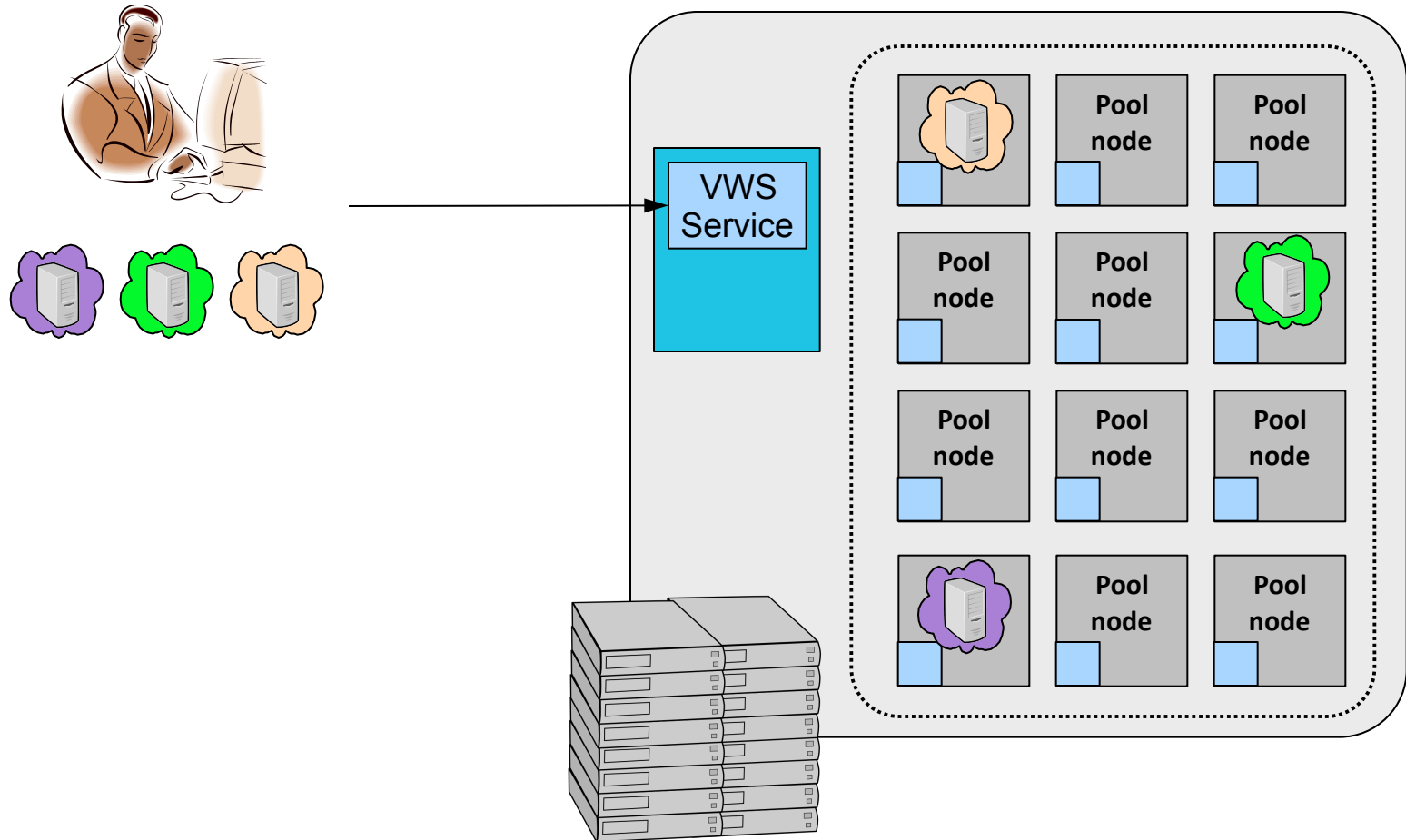
Workspace Service

Cumulus

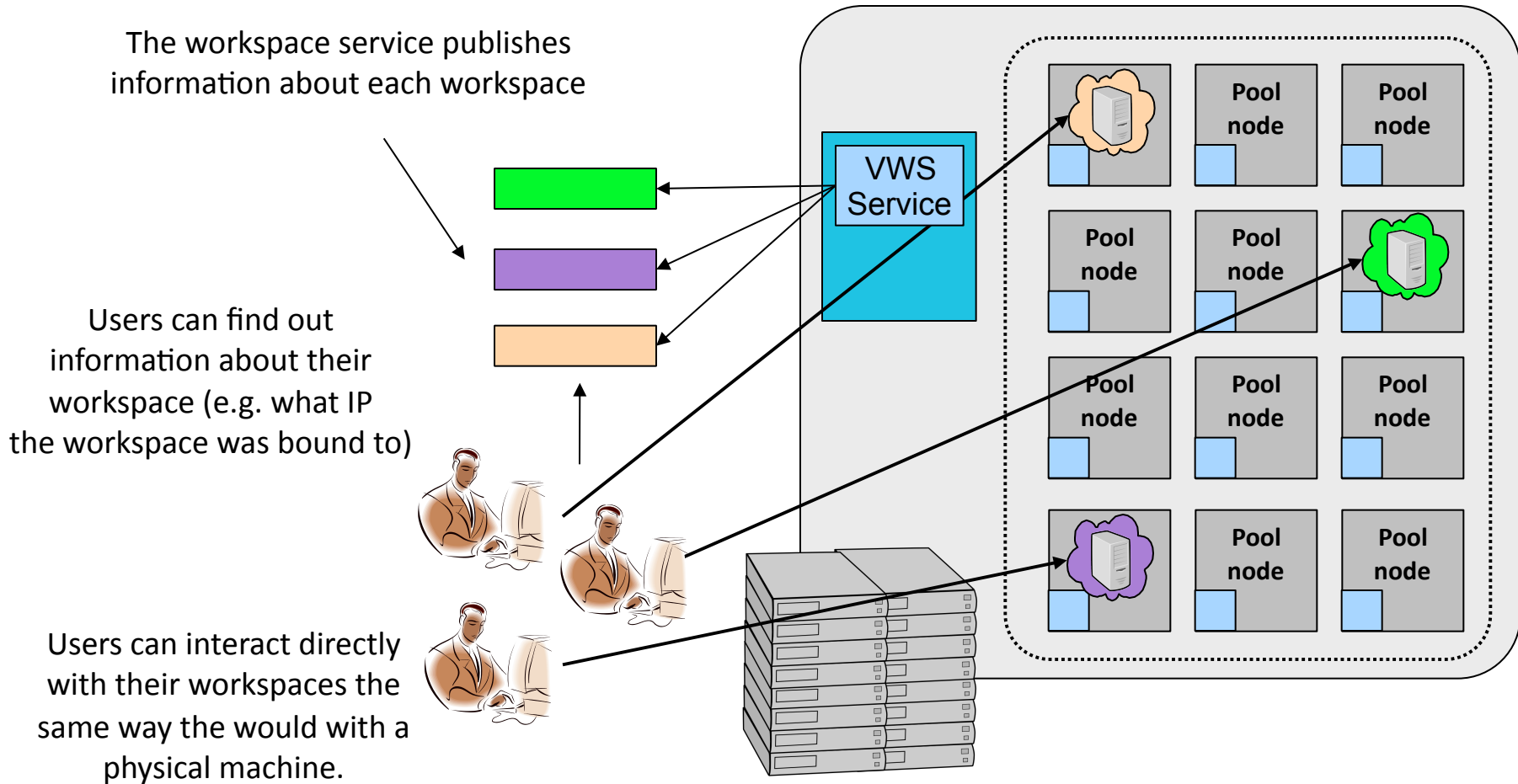
Enable providers to build IaaS clouds

Enable developers to extend, experiment and customize

IaaS



IaaS



Working with Hybrid Clouds

Creating Common Context

Nimbus Elastic Provisioning

interoperability automatic scaling
HA provisioning policies



private clouds
(e.g., FNAL)

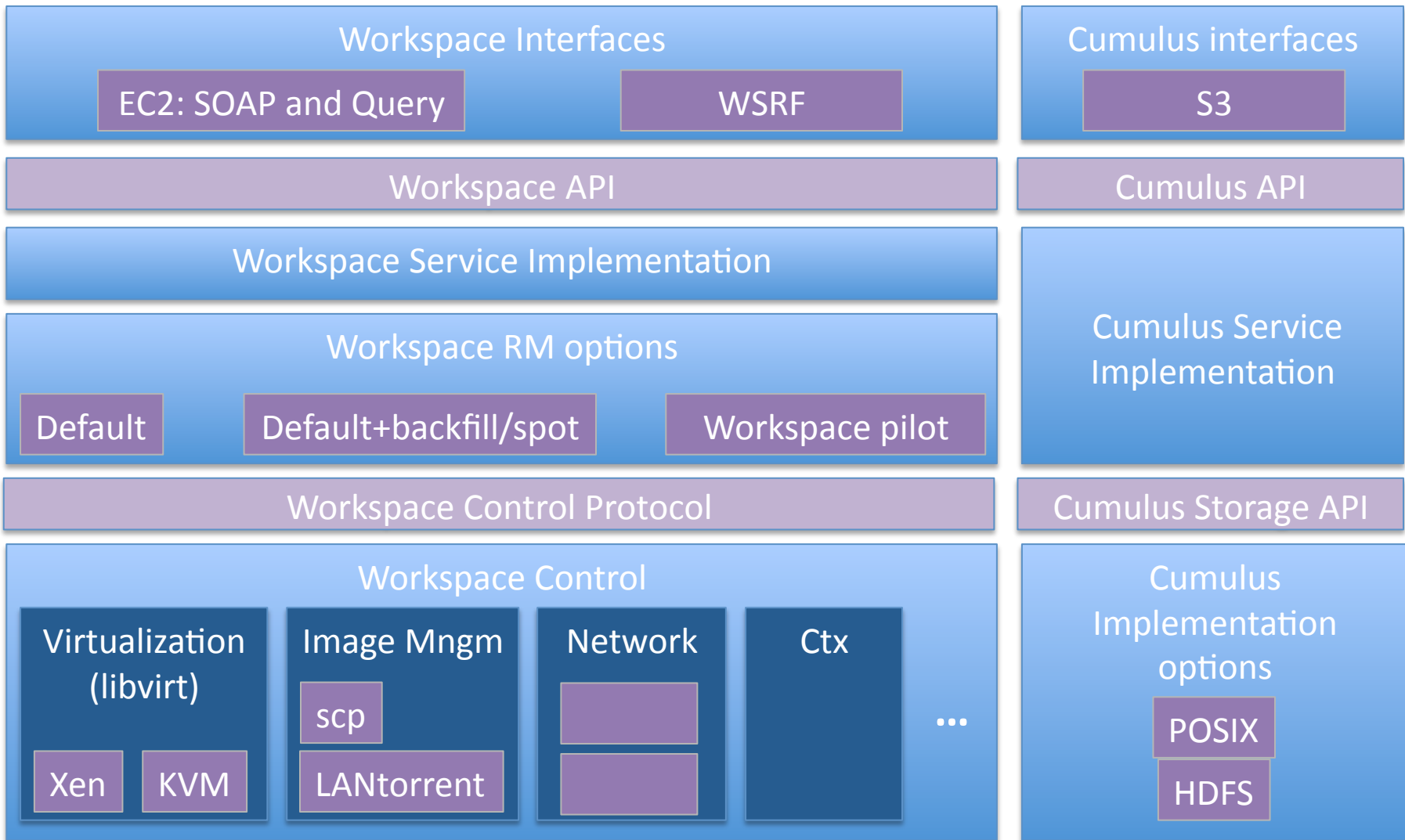


community clouds
(e.g., Science Clouds)



public clouds
(e.g., EC2)

Nimbus IaaS



Applications and Ecosystem

10/20/10

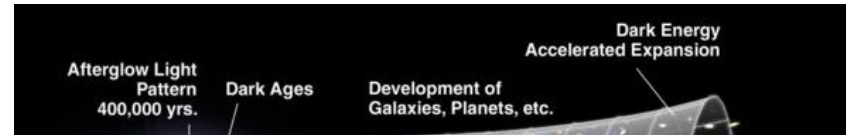


www.nimbusproject.org



Work by Jerome Lauret (BNL) et al.

- STAR: a nuclear physics experiment at Brookhaven National Laboratory
- Virtual OSG clusters
- Science Clouds -> EC2 runs
- Production runs on EC2 since 2007
- The Quark Matter 2009 deadline: producing just-in time results
- The issue of cost



Priceless?

- Compute costs: \$ 5,630.30
 - ♦ Fdsf 300+ nodes over ~10 days,
 - ♦ Instances, 32-bit, 1.7 GB memory:
 - EC2 default: 1 EC2 CPU unit
 - High-CPU Medium Instances: 5 EC2 CPU units (2 cores)
 - ♦ ~36,000 compute hours total
- ♦ Data transfer costs: \$ 136.38
 - ♦ Small I/O needs : moved <1TB of data over duration

s: \$ 4.69

all data transferred at run time

TECTONIC QUIETS

- The people: STAR @ MIT – Adam Kocoloski, Jan Balewski, Mathew Walker
- Our test
 - A 100 jobs, week long simulation cost ~ \$1,510
 - A year long CPU @ 100 jobs saturation ~ 79k\$
 - EC2+Nimbus
 - 300+ nodes for 10 days in 2008 (non-optimized) ~ \$5,600

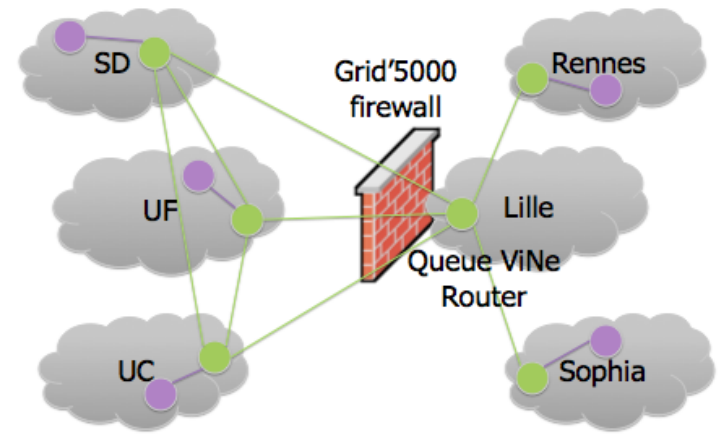
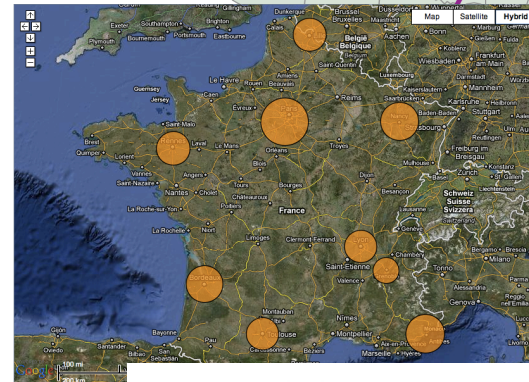
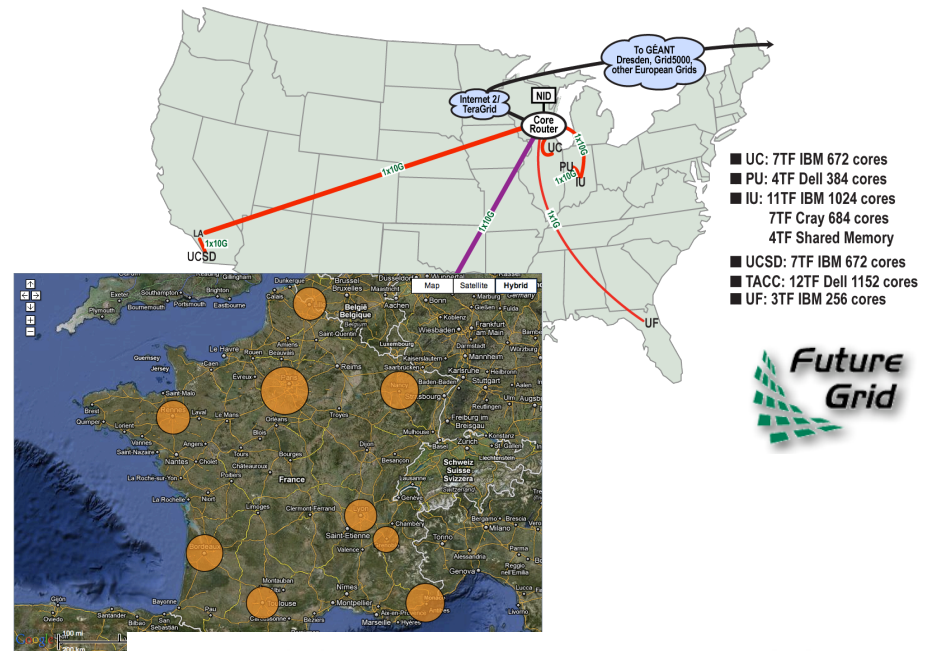


- Large NSF-funded observatory
- Requirements for adaptive, reliable, elastic computing
- Cloud computing a vital part of resource strategy
- Highly Available services that run on resources from many clouds based on user requirements
- Nimbus is developing this provisioning infrastructure
 - Release in Spring 2011
- Scalability and reliability tests on 100s of EC2, FutureGrid and Magellan resources

Trail-blazing project

Sky Computing

- Sky Computing = a Federation of Clouds
- Nimbus clouds in FutureGrid and Grid' 5000
- Combine resources obtained in multiple clouds
- Deployed a virtual cluster of over 1000 cores on Grid5000 and FutureGrid – largest ever of this type
- Grid'5000 Large Scale Deployment Challenge award
- Demonstrated at OGF 29 06/10
- TeraGrid '10 poster





BABAR

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Canadian Efforts

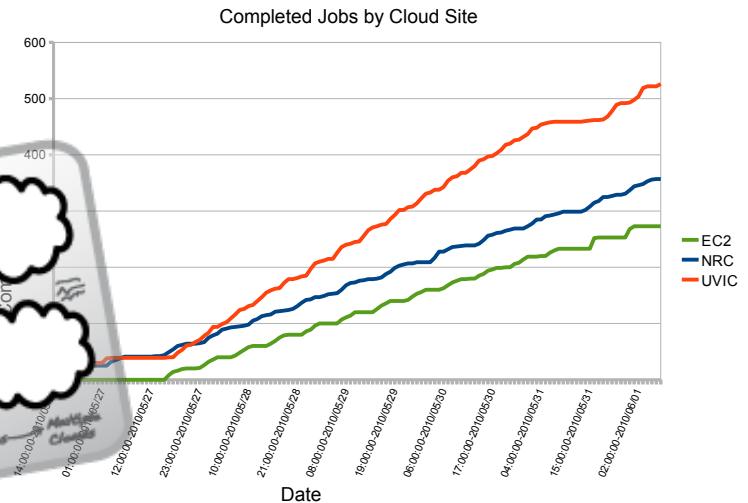
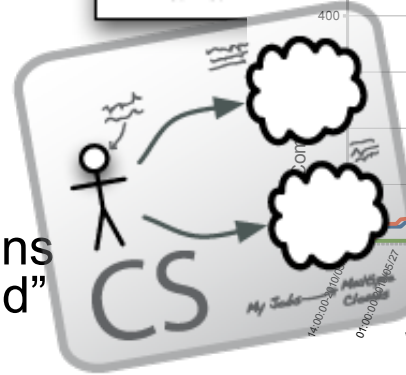
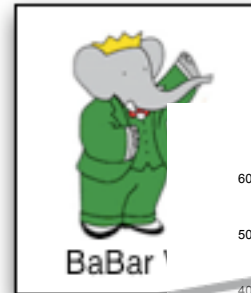
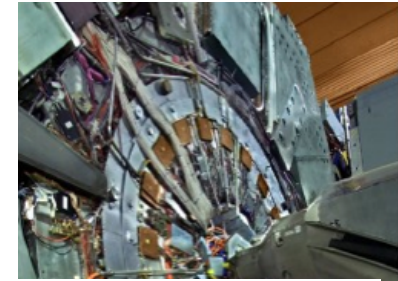
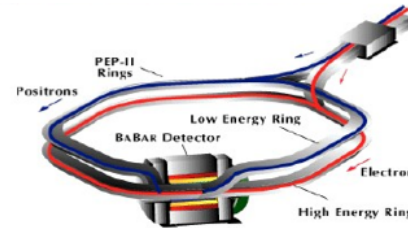


University of Victoria

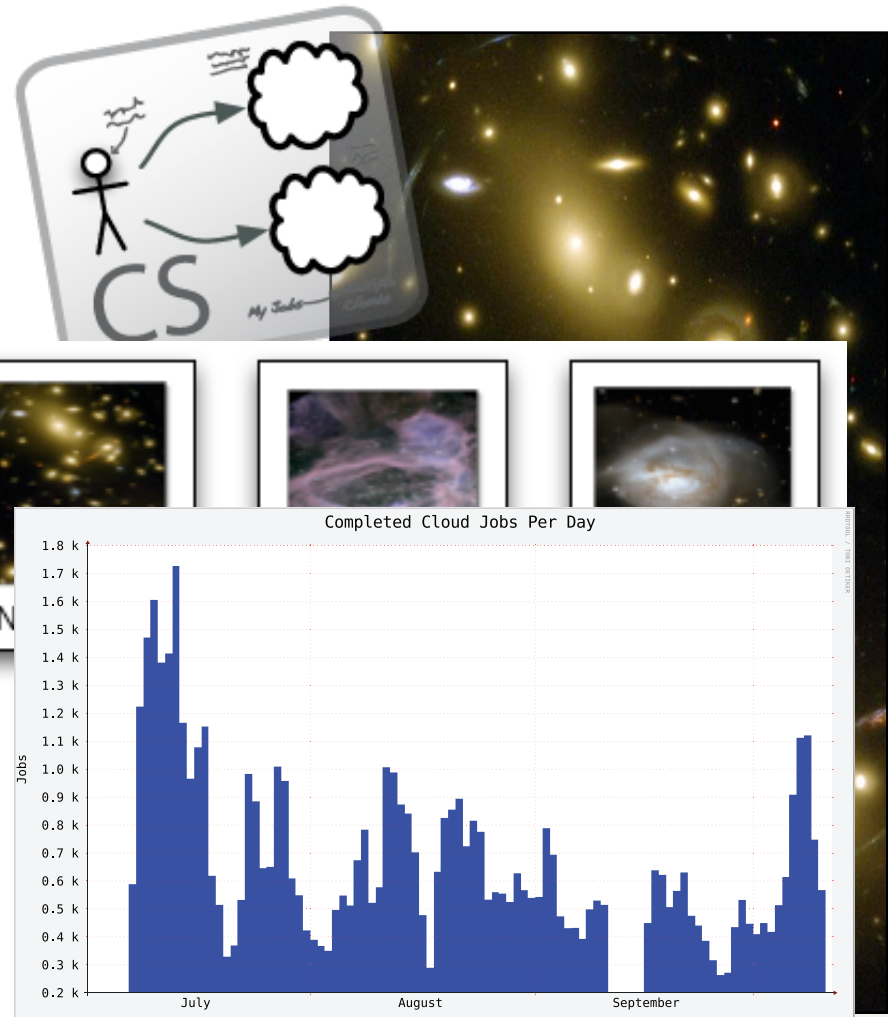
NRC-CMRC

Work by the UVIC team

- BarBar Experiment at SLAC in Stanford, CA
- Using clouds to simulating electron-positron collisions in their detector
- Exploring virtualization as a vehicle for data preservation
- Features:
 - Distributed clouds
 - Appliance preparation and management
 - Cloud Scheduler
- CHEP 2010 poster
 - PO-WED-64 “A Batch System for HEP Applications on a Distributed IaaS Cloud”



- Provide infrastructure for six observational astronomy survey projects
- Running on a Nimbus cloud on WestGrid
- Dynamic Condor pool for astronomy
- Appliance creation and management
- MACHO experiment Dark Matter search
- In production operation since July 2010





Sam Angiuoli
 Institute for Genome Sciences
 University of Maryland School of Medicine

- The emergent need for processing
- A virtual appliance for automated and portable sequence analysis
 - A platform for building appliances representing push-button pipelines
 - From desktop to cloud
 - Running on EC2, Magellan and Science Clouds
- <http://clovr.org>

Genome Analyzer

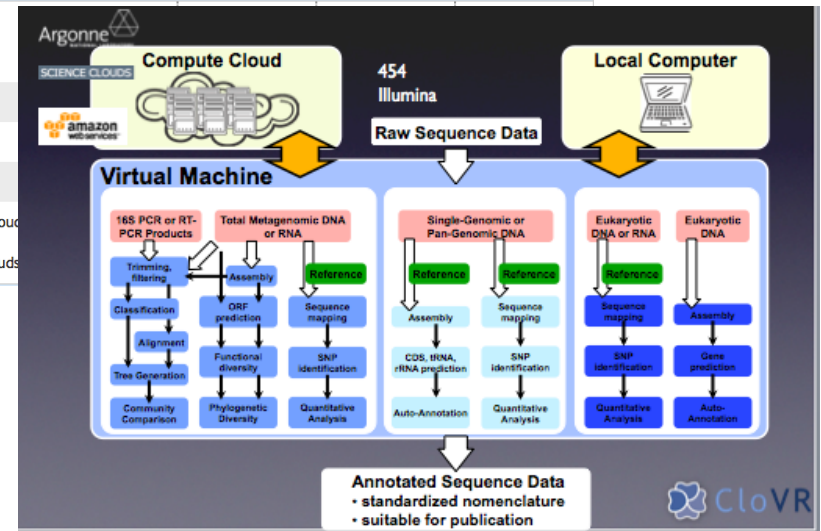
IIx

Edition Comparison

	Skeleton	Base	Standard
Ubuntu 10.04	✓	✓	✓
Grid Engine	✗	✓	✓
Hadoop	✗	✓	✓
Ganglia	✗	✓	✓
Vappio	✗	✓	✓
Ergatis	✗	✗	✓

Platforms

- EC2
- Eucalyptus
- VirtualBox
- VMware
- Xen
- Magellan Cloud
- Science Clouds



Blessings

- Deploy custom, user-owned and user-controlled environments on remote resources
- On-demand access
- Elastic processing
- Growth and cost management
- Capital expense -> operational expense

Challenges (Some of)

- Appliance management
- Lack of reliability
- Elasticity, but how?
- Performance of deployment and runtime
- Cost

Appliance Management

I want to manage my own VMs!



I don't want to manage my own VMs!



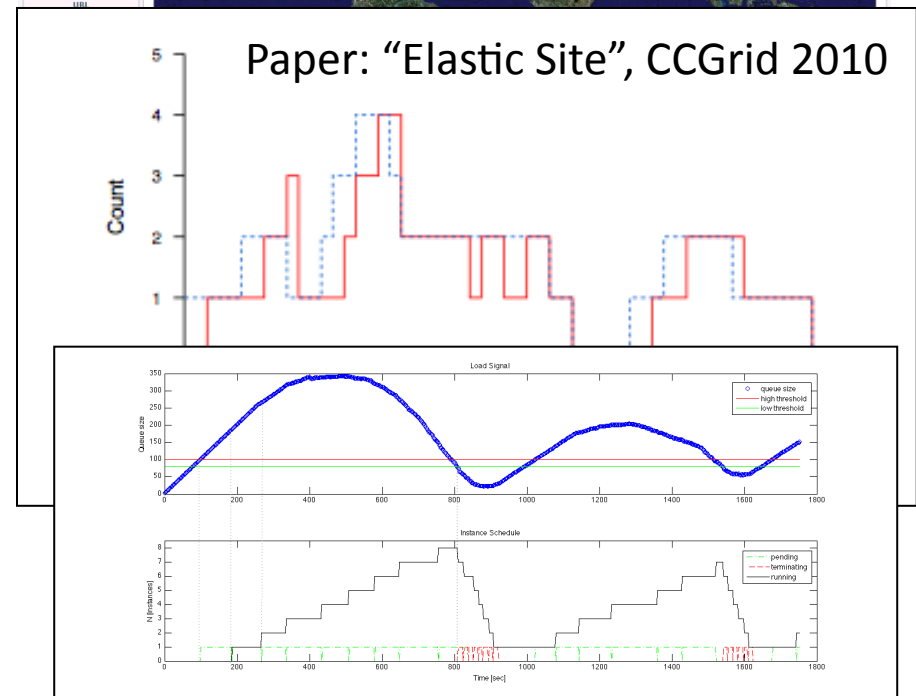
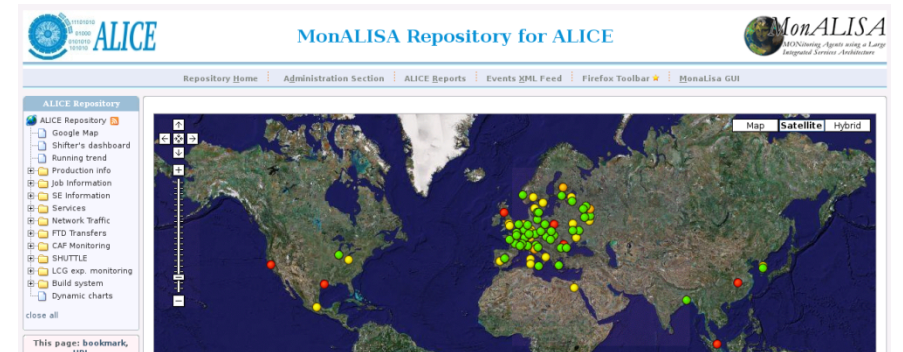
- Many users are not skilled in appliance development yet require the control
- The emergence of community appliance management and maintenance
 - Clovr, BarBar and Canfar @ UVIC, CernVM, and others
- A new role/job description
- Forward looking applications: data preservation

Elasticity, Reliability and Failure

Elasticity and reliability are different sides of the same coin.

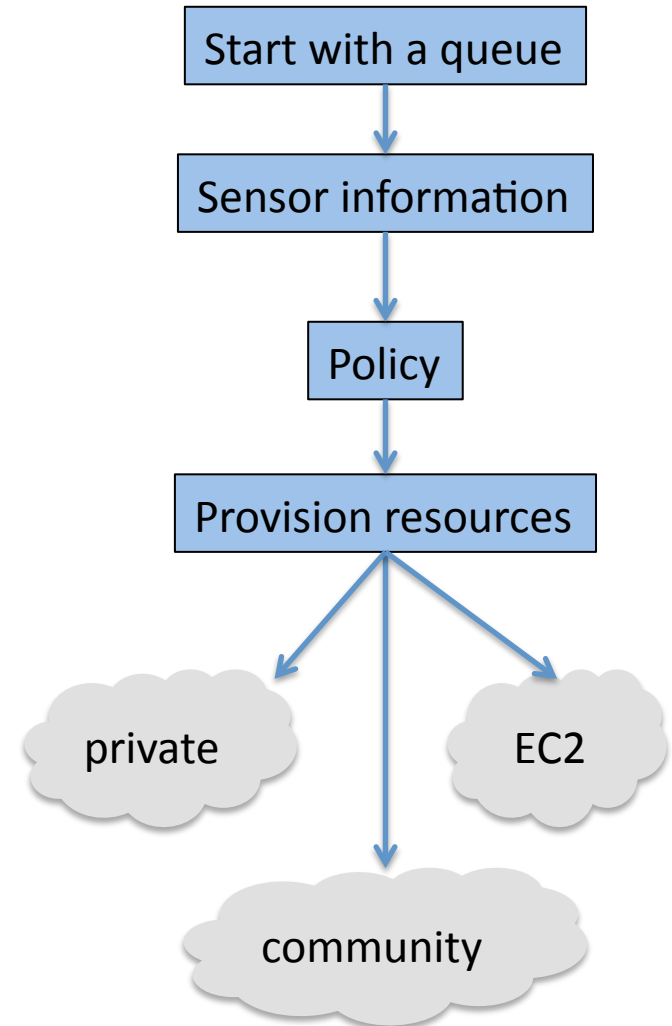
- 2008: The ALICE proof-of-concept
- 2009: ElasticSite prototype
- 2009: OOI pilot

Need for generic, HA, elastic service model



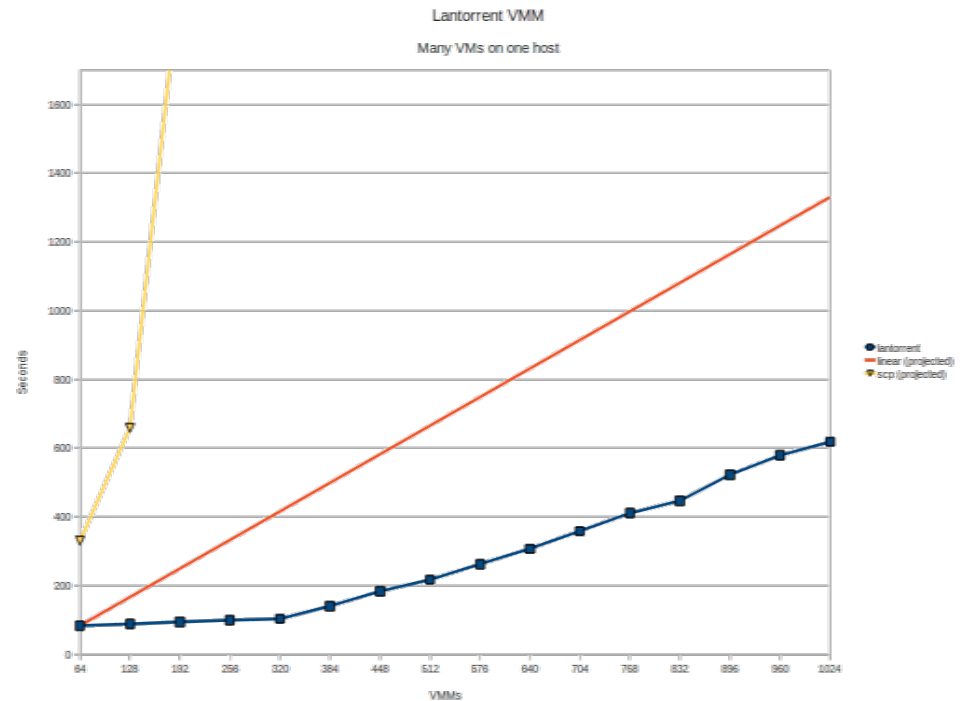
Elasticity, Reliability and Failure

- Assumption: a workload queue
 - ALiEn, PBS, AMQP,...
- React to sensor information
 - Queue properties a sensor
- Scale to demand
 - Across different cloud providers
 - Use contextualization to integrate machines across hybrid clouds
 - Highly Available
 - Scalable: latest tests scale to 100s of nodes on EC2, target is thousands
- Release in early 2011
 - Customizable to input, policy, provider, etc.



Deployment Performance

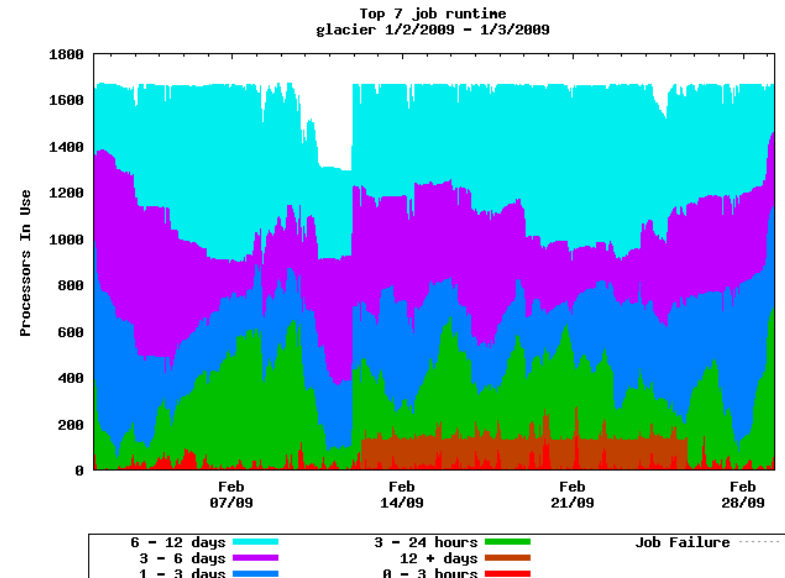
- Moving images is the main component of VM deployment
- LANTorrent: the BitTorrent principle on a LAN
- Streaming
- Minimizes congestion at the switch
- Detecting and eliminating duplicate transfers
- Benefit: a thousand VMs in 10 minutes
- Nimbus release 2.6



Data obtained using the Magellan resource
At Argonne National Laboratory

Cost, Utilization, and Price

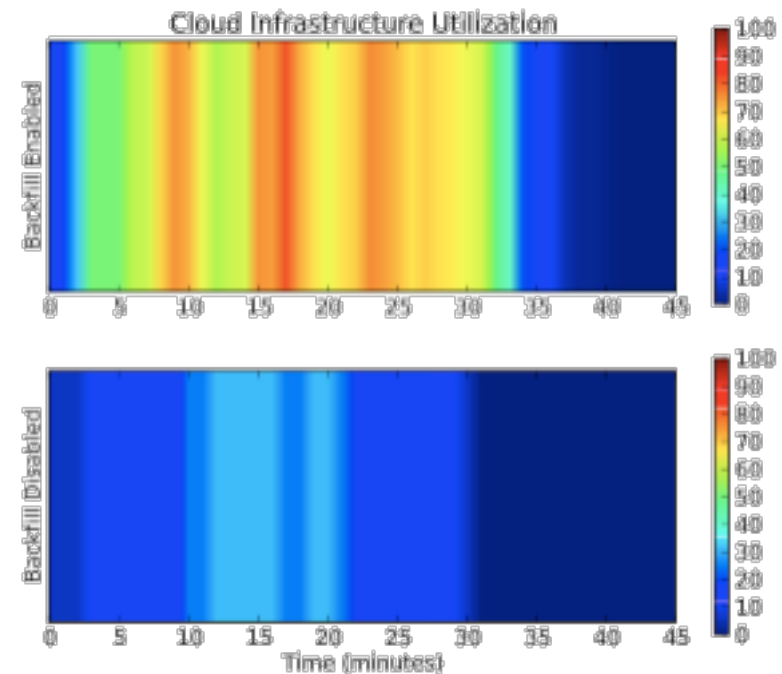
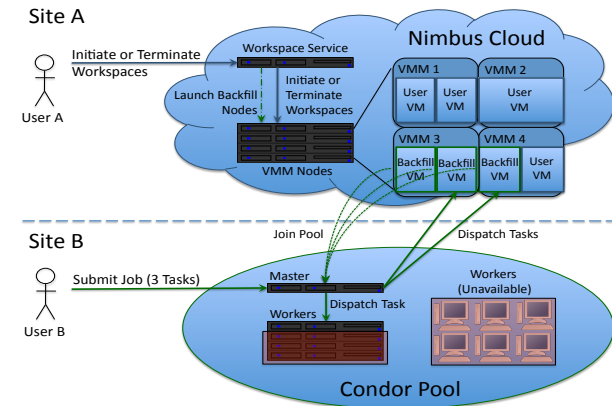
- Most science today is done in batch
 - Not very responsive...
 - ... but very efficient!
- On-demand catch-22 for providers:
 - You can overprovision (Expensive!)
 - Or you can reject requests (Not really on-demand)
- Utilization -> Cost -> Price



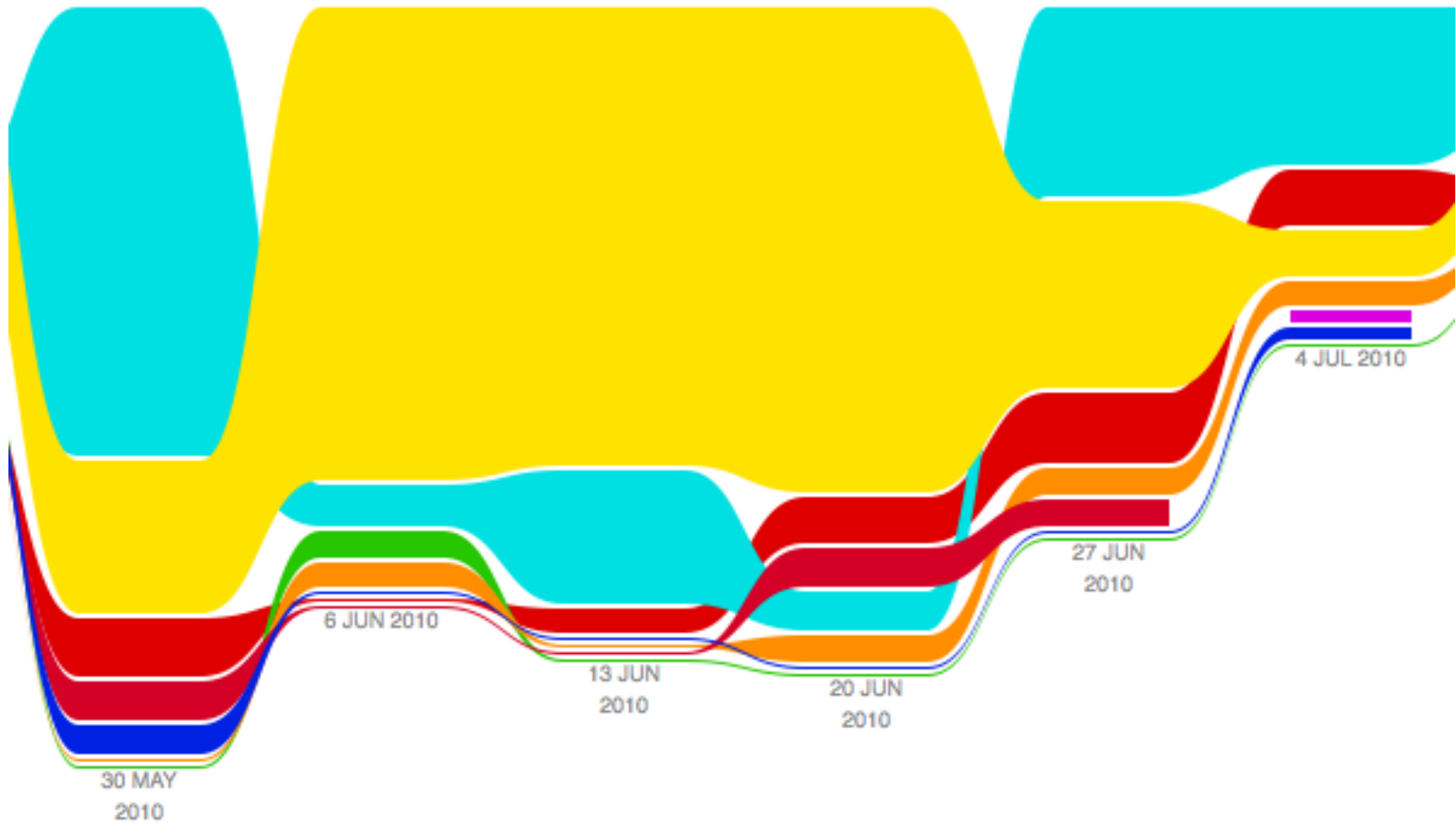
*courtesy of Rob Simmonds,
example of WestGrid utilization*

Cost, Utilization, and Price

- Solution 1:
 - Backfill with volunteer VMs
- Benefits:
 - Up to 100% utilization!
 - Significantly lower cost
- Solution 2:
 - Spot pricing
 - Support for auctions
- Open Source community contribution
- Preparing for running of production workloads on FG @ U Chicago
- Extension to Nimbus Workspace Service RM to be available in Nimbus release 2.7



The Nimbus Team



The Nimbus Team

- Project lead: Kate Keahey, ANL&UC
- Comitters:
 - Tim Freeman - University of Chicago
 - Ian Gable - University of Victoria
 - David LaBissoniere - University of Chicago
 - John Bresnahan - Argonne National Laboratory
 - Patrick Armstrong - University of Victoria
 - Pierre Riteau - University of Rennes 1, IRISA
- Github Contributors:
 - *Tim Freeman, David LaBissoniere, John Bresnahan, Pierre Riteau, Alex Clemesha, Paulo Gomez, Patrick Armstrong, Matt Vliet, Ian Gable, Paul Marshall, Adam Bishop*
- *And many others*
 - See <http://www.nimbusproject.org/about/people/>

Parting Thoughts

- Cloud computing is here to stay
- We showed that it is important to a set of applications – how can we make that set larger?
- A change of paradigm -> a change of pattern
 - New exciting modes of usage
 - New exciting opportunities and needs
- Open source rocks!