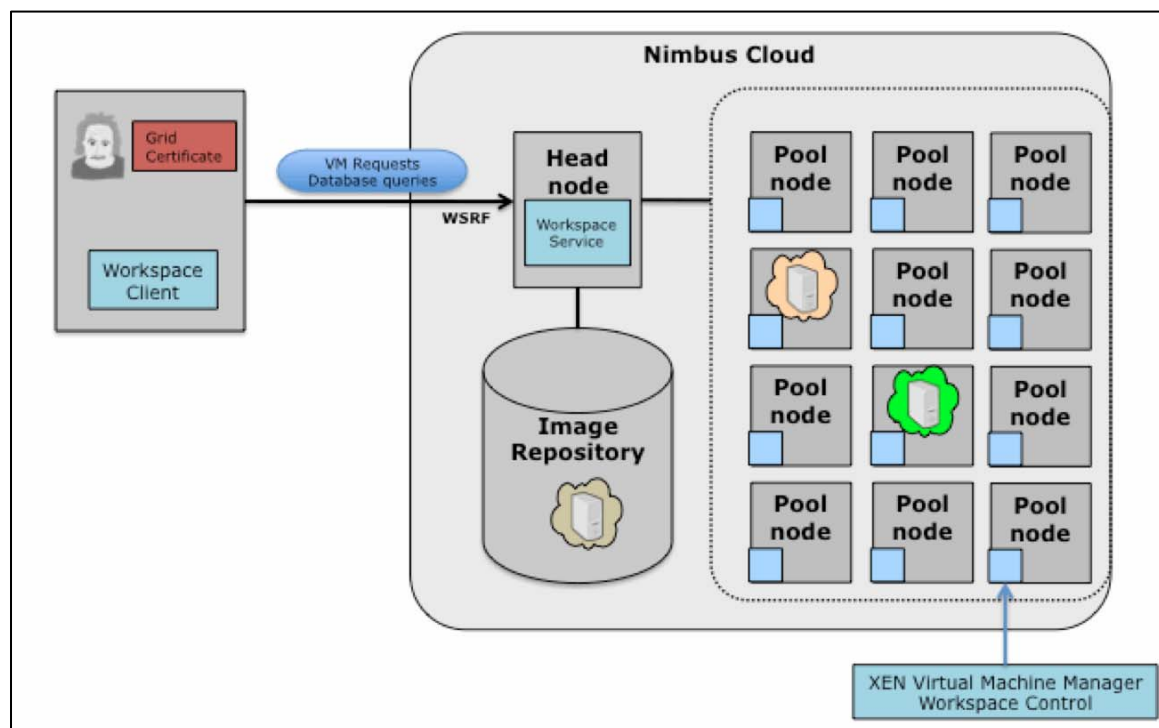




***Cloud Computing:
A solution for Green IT***

Randall Sobie
Institute for Particle Physics
University of Victoria

One view of Cloud Computing



IaaS Model

Infrastructure as a Service

Users lease resources by deploying virtual machines (VMs)

Examples:

Amazon EC2

Nimbus (Globus)

Our group is focusing on Nimbus (but we are also evaluating Amazon EC2)
Collaborating with the Nimbus team and contributing to its development
Establishing a Nimbus Cloud at the University of Victoria

Is Cloud Computing the solution for Green IT?



Cloud Computing offers a solution to “on-demand computing”

Clients can select which Clouds to run their applications

*Fastest, cheapest, safest, **greenest**.*

A row of wind turbines silhouetted against a sunset sky. The turbines are arranged in a line, receding into the distance. The sky is a mix of orange, yellow, and light blue, with some clouds. The overall mood is serene and clean.

Follow the Wind

Clouds are the solution for Green IT

Computing on demand

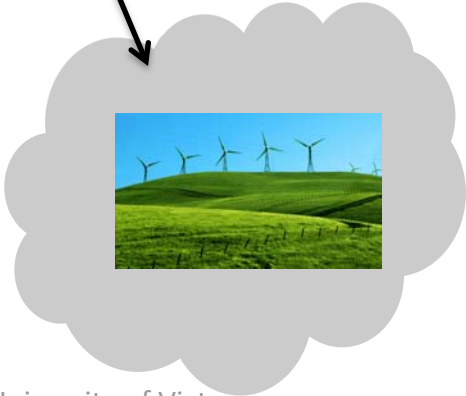
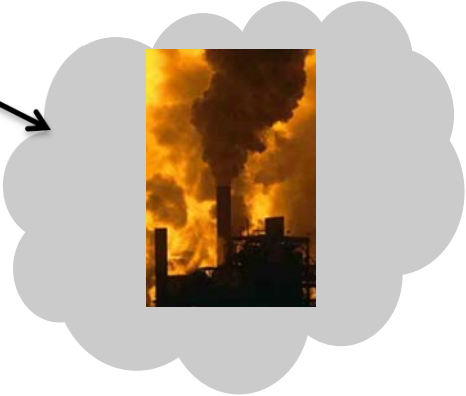
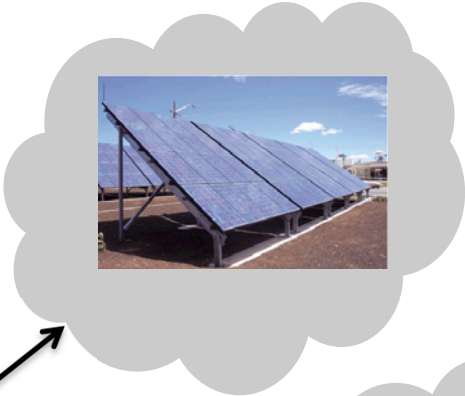
Virtualization of applications and operating system

Clouds and Green IT



I want to minimize my CO2 footprint

Which site is available?
What is the CO2 footprint?
Do I have access?
How much will it cost?



We need a "Grid of Clouds"



Forecast : *Wind Warning*

Facebook's Users Ask Who Owns Information



Cloud Issues

Data ownership

Security

Reliability

Grid of Clouds

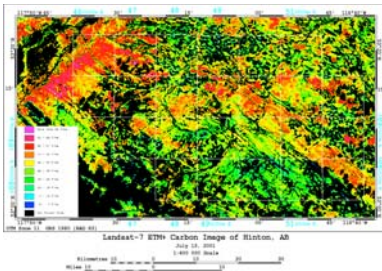
Users must manually search for a Green Cloud site

No database or registry service tracking information such as CO2 footprint of Clouds or whether a Solar Cloud is operational

No metascheduling to route clients to Green sites

An opportunity !

Research applications for the Grid of Clouds



**First Workshop on Data Preservation
and Long Term Analysis in HEP**

DESY, Hamburg, Germany
Mon 26th - Wed 28th January 2009



SAFORAH Forestry Data Grid

Provides forestry researchers with access to earth observation data
CANARIE NEP02 project to extend SAFORAH with grid computing
BC NRAS proposal to enable SAFORAH to use green computing clouds

Herzberg Institute for Astrophysics

CANARIE NEP39 (CANFAR) project
Our groups collaborating on aspects of virtualization and cloud computing

BaBar particle physics experiment at SLAC

How do we preserve data and software for future study?
Solution will likely involve virtualization and cloud computing

ATLAS particle physics experiment at CERN

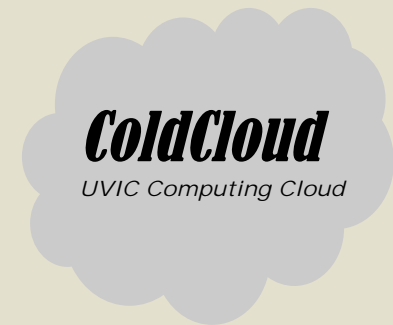
Software is tightly controlled by WLCG/CERN

Challenges

- No incentive for researchers to use Green facilities
 - Universities are obligated to provide power to research projects
 - Significant benefit to researchers by having resources local
- Funding model (CFI) is for hardware and includes a provincial component
- Software used in academic research is nearly always Open Source
 - Linux, Globus (Nimbus), Gnu, ...
 - Software licensing in a cloud?
- Industry Cloud Computing is expensive
 - Amazon EC2 (\$2.50 per core per day) + storage + file transfers

Proposal for the CANARIE Pilot

- Recommend funding several initiatives
 - This is a very new field and the direction is unclear
 - We should pursue many avenues and build up a wide range of expertise
 - Results of the project should be open
- Our focus is to build a Cloud for Research Computing
 - We will have a Cloud at UVIC using Nimbus
 - Pilot project could focus on NEP Projects
 - A “Grid of Clouds” would be a key element of the Pilot project
- UVIC will have new Green (90% carbon free) Data Centre
 - Willing to host a Cloud



Business case for Green IT in Universities

- Research computing
 - Competing against Compute Canada (expect 50K new cores this year)
 - Incentives work: offer existing and new NEP projects a bonus to use Clouds
- Academic or administrative computing
 - Suggest a project to meet with selected CIOs to discuss these issues
 - More complicated than research computing
 - Lots of commercial (licensed) software with sensitive data that may not be allowed to cross national boundaries
 - Does one provide space in a Green Centre where institutes purchase or rent hardware or does one provide access to a Cloud-type resource?

Summary

We believe the CANARIE Pilot project is a unique opportunity to make Canada a leader in environmental computing issues

We recommend funding a number of initiatives that will explore the political, financial and technical aspects. These initiatives could be organized independently but meet together on a periodic basis.

The focus of the Pilot Project is on University Computing which is two-thirds research and on-third administrative. Any pilot project needs to have involvement of the research community and the CIOs of the universities.

It is important that the outcome of the Pilot Project demonstrate a technical model or prototype system that will enable us to achieve the political goals.