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# EUCALYPTUS: An Open Source Infrastructure for Elastic Computing Research

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# Commercial Cloud Formation



Amazon Elastic Compute Cloud (Amazon EC2) - Beta



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MOSSO the hosting cloud



# How do they work?

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- What can and cannot easily be hosted in a cloud?
- What extensions or modifications are required to support a wider variety of services and applications?
  - Scientific computing
  - Data assimilation
  - Multiplayer gaming
- How can cloud computing be coupled with other distributed software systems and infrastructure?
  - How should clouds and mobile devices (e.g. cell phones) interact?
- Open Source Cloud
  - Simple
  - Extensible
  - Based on widely available and popular technologies
  - Easy to install and maintain

# The Skies are Opening

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- **Nimbus (Freeman and Keahey, University of Chicago)**
  - Client-side cloud-computing interface to Globus-enabled TeraPort cluster at U of C
  - Based on GT4 and the Globus Virtual Workspace Service
    - Lots of cool features
    - Great if local resources are GT4 proficient
    - Tutorials and documentation in “grid space”



- **Enomalism**

- Start-up company distributing open source
- REST APIs
- User “dashboard”
- Multi-virtulization support
- Lost of extended cloud services
- Beta version now available for download from SourceForge



- Elastic Utility Computing Architecture Linking Your Programs To Useful Systems
- Web services based implementation of elastic/utility/cloud computing infrastructure
  - Linux image hosting ala Amazon
- Interface compatible with EC2
  - Works with command-line tools from Amazon w/o modification
  - Enables leverage of emerging EC2 value-added service venues (e.g. Rightscale)
- Functions as a software overlay
  - Existing installation should not be violated (too much)
- “One-button” install using Rocks
  - “System Administrators are people too.”*

# Goals for Eucalyptus

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- Foster research in elastic/cloud/utility computing
  - models of service provisioning, scheduling, SLA formulation, hypervisor portability and feature enhancement, etc.
- Experimentation vehicle prior to buying commercial services
  - “Tech Preview” using local machines with local system administration support
- Provide a debugging and development platform for EC2 (and other clouds)
  - Allow the environment to be set up and tested before it is instantiated in a for-fee environment
- Provide a basic software development platform for the open source community
  - E.g. the “Linux Experience”
- Not a designed as a replacement technology for EC2 or any other cloud service

# Challenges

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- **Extensibility**
  - Simple architecture and open internal APIs
- **Client-side interface**
  - Amazon's EC2 interface and functionality (familiar and testable)
- **Networking**
  - Virtual private network per cloud
  - Must function as an overlay => cannot supplant local networking
- **Security**
  - Must be compatible with local security policies
- **Packaging, installation, maintenance**
  - system administration staff is an important constituency for uptake



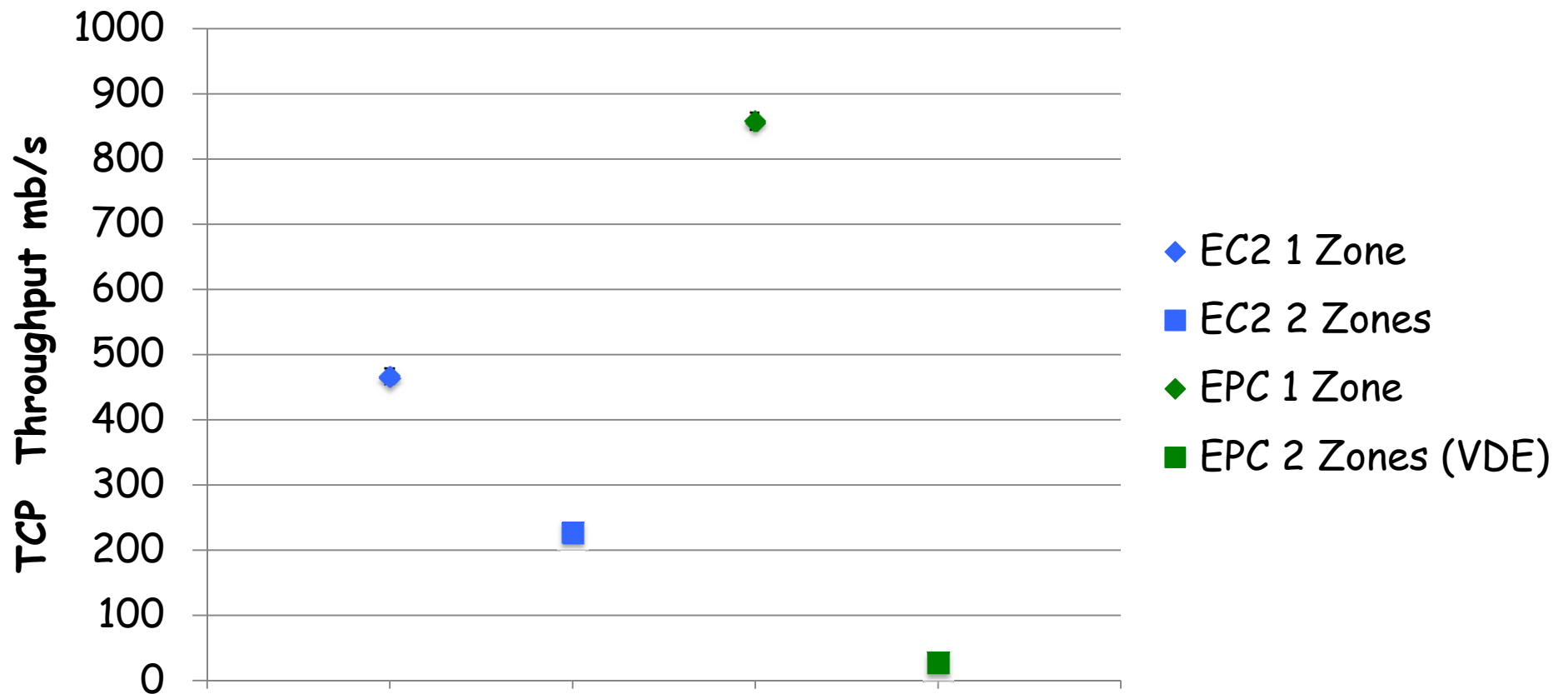
# Eucalyptus Public Cloud

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- Free, time limited access to a **Eucalyptus** installation at UCSB
  - Only installed images can be run (i.e. no image uploading)
  - 4 VM limit
  - 6 hour limit
  - Reverse firewall
- Configuration
  - 8 Pentium Xeon processors (3.2 GHz)
  - 2.5 GB of memory per image
  - 36 GB of disk space
  - 1 Gb enet interconnect
  - Local availability zone only (i.e. no VDE)
  - Debian 4.0, Linux v2.6.18-xen-3.1
  - Xen 3.2

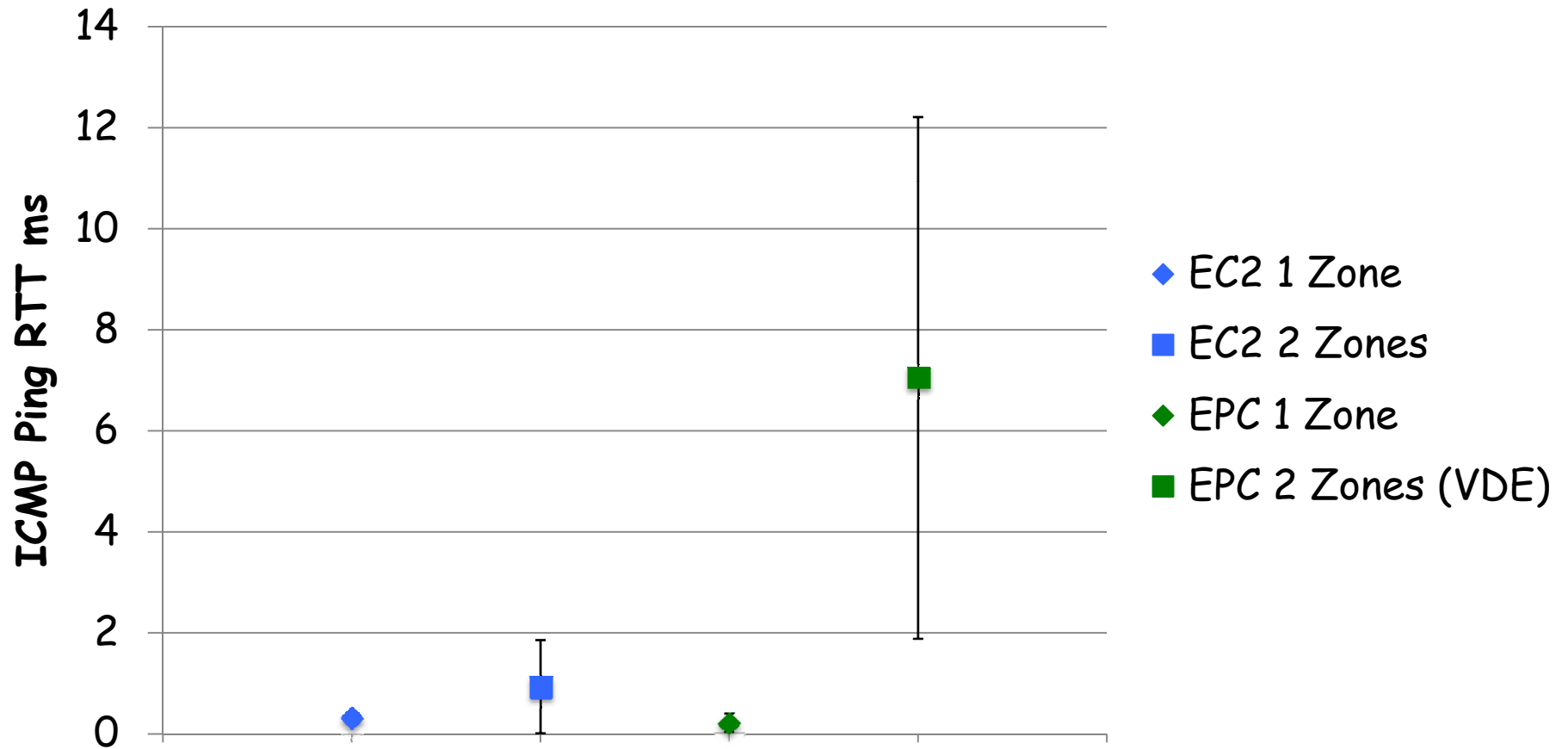
# EC2 and EPC Throughput

## Comparing TCP Performance between EC2 and EPC



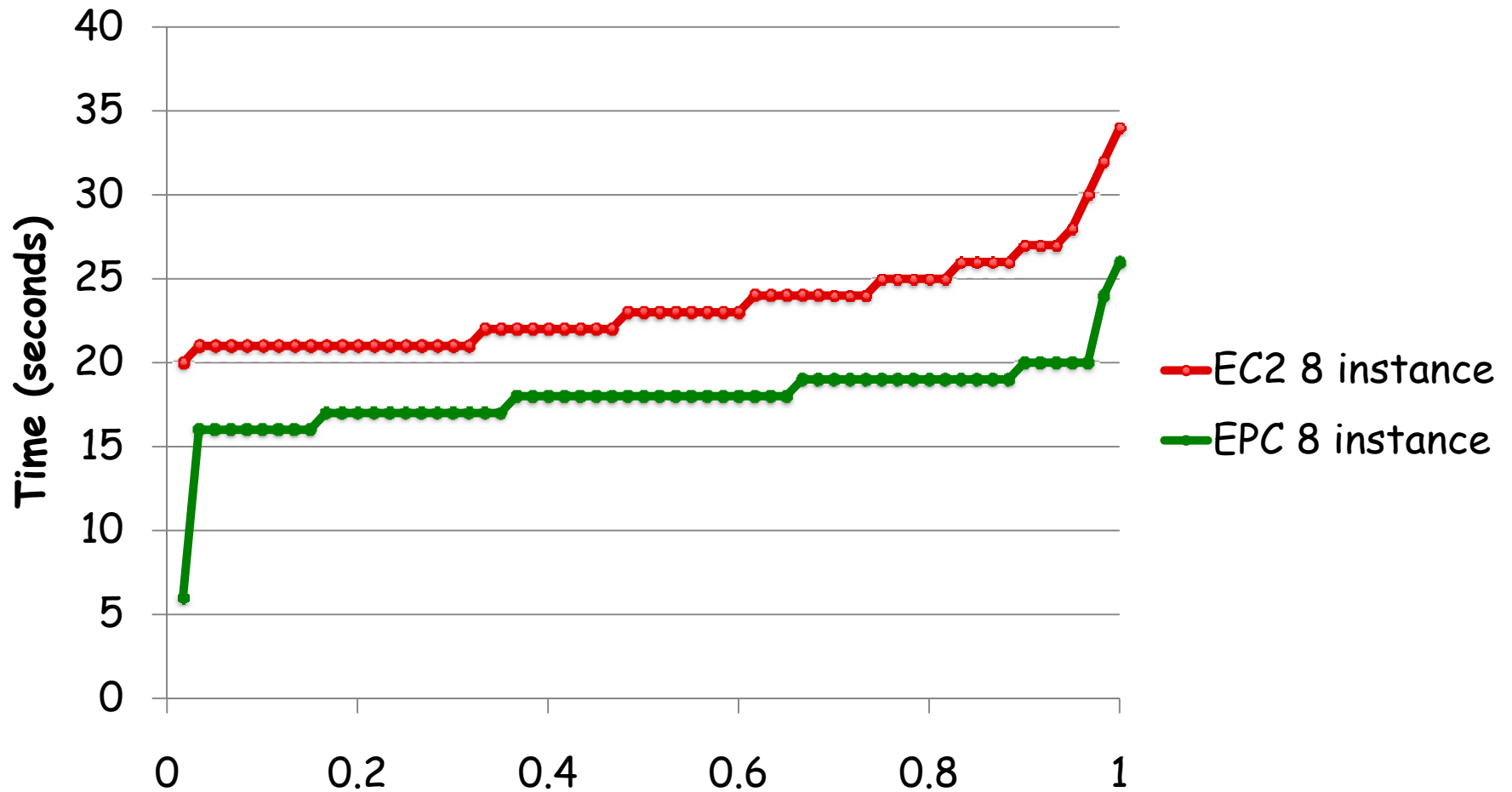
# EC2 and EPC RTT

## Comparing ICMP Ping Performance between EC2 and EPC



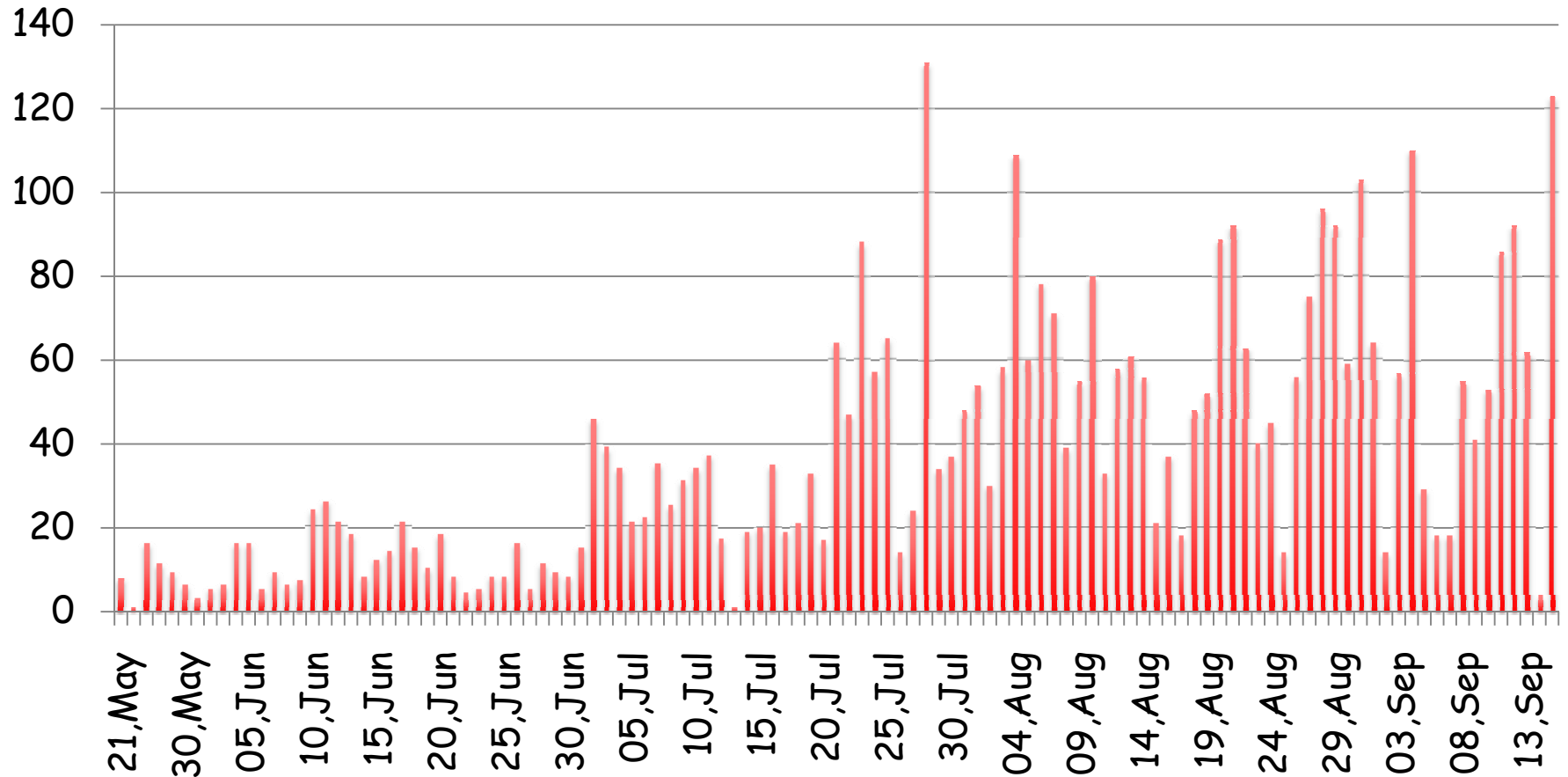
# Eight Instances

## Eight Instance Start-up Time (CDF)



# Uptake

## Downloads



# Ancillary Projects

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- **Google App Engine**

- AppDrop will run App Engine inside EC2
- Port AppDrop to Eucalyptus
- Port App Engine to Hbase and/or Hypertable
- Should provide an interesting research vehicle



- **Rightscale**

- Local enterprise focused on providing Ruby-on-Rails infrastructure for EC2
- “Turing Test” for Eucalyptus
  - Can Rightscale “tell” that it isn’t talking to EC2?
- Requires that the REST interface be solid
- Testing now against the EPC



- **Elastra**

- Announced beta support for Eucalyptus 8/19



# Who Cares?

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- Tech. savvy members of the bloggesphere
  - “How do I run Eucalyptus on my laptop?”
- Campus cloud efforts
  - Interest in leveraging local resources in a way that is compatible with commercial offerings
- Industry
  - Hosting companies
  - Large scale tech companies
  - Web companies
  - Cloud user-experience companies

# Lessons Learned so Far

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- Open source for cloud computing constrains design more than we thought it would
  - More of the technical challenge centers on dealing with local configuration choices
  - Multi-cluster service ensemble really isn't a typical open source tool
    - Do we really need a laptop edition?
- Administrators in the "real world" still build clusters by hand
  - We thought the use of Rocks early on would make us heroes -- it hasn't
  - In HPC space, admin time is \*really\* expensive
- There are few, if any, cloud configuration tools available
  - Red Hat, Debian, CentOS, Ubuntu => linux packaging and deployment
  - Rocks => cluster packaging and deployment
  - ??? => cloud packaging and deployment?



# Thanks, More Information, and Help!

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- National Science Foundation
  - VGrADS Project
- SDSC, CNSI, IU, Rice University
- RightScale.com
- The Eucalyptus Development Team at UCSB is
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