# Cluster Management

James E. Prewett

October 8, 2008

# OSCAR Information

| **Vital Statistics:** | |
|---|---|
| Version: | 5.1 |
| Date: | June 23, 2008 |
| Distribution Formats: | tar.gz |
| URL: | http://oscar.openclustergroup.org/ |

# OSCAR cluster distribution features:

- Supports X86, X86_64 processors

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- Supports X86, X86_64 processors
- Supports Ethernet networks
- Supports Infiniband networks
- Graphical Installation and Management tools
  ... if you like that sort of thing

# OSCAR (key) Cluster Packages

## Whats in the box?

- Torque Resource Manager

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# OSCAR Supported Linux Distributions

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- RedHat Enterprise Linux 4
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- Fedora Core 7
- Fedora Core 8
- Yellow Dog Linux 5.0
- OpenSUSE Linux 10.2 (x86_64 Only!)
- "Clones of supported distributions, especially open source rebuilds of Red Hat Enterprise Linux such as CentOS and Scientific Linux, should work but are not officially tested."

# OSCAR Installation

- Install a supported Linux on the erver Node
  Leave at least 4GB free in each of / and /var!
  The easy way is to make 1 big partition for / !

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- Unpack the oscar-repo-common-rpms and the oscar-repo-DISTRO-VER-ARCH tarballs into /tftpboot/oscar/
- Copy your RPMs into the /tftpboot/distro/OS-version-arch directory

# OSCAR Installation (cont.)

- Install yum unless your OS already has it

[1]This is not in the documentation, but I found that the packages were not signed causing yume to barf unless you passed it the --nogpgcheck option. YMMV

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  # yum install createrepo
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- Install yum unless your OS already has it
- Install yume:
  # yum install createrepo
  /tftpboot/oscar/common-rpms/yume*.rpm
- Install oscar-base RPM:
  # yume --nogpgcheck[1] --repo /tftpboot/oscar/common-rpms
  install oscar-base

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# OSCAR Server Node Network Configuration

- Give your host a hostname! The default of “localhost” or “localhost.localdomain” will *not* work.

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- Configure the “Public” network interface as per the requirements of your local network. This is the network that will connect to the Internet (or the lab network), so configure it appropriately.
- Configure the “Private” network interface using a “Private” IP address.
  The IANA has reserved the following three blocks for private internets:
  - 10.0.0.0 – 10.255.255.255 (10/8 CIDR block)
  - 172.16.0.0 – 172.31.255.255 (172.16/12 CIDR block)
  - 192.168.0.0 – 192.168.255.255 (192.168/16 CIDR block)

# OSCAR Cluster Installation

Once the Server is installed and configured, start the installer!
# cd /opt/oscar
# ./install_cluster <device>
This will:

- Install all required RPMs
- update the /etc/hosts file with OSCAR aliases
- update the /etc/exports file
- update system initialization scripts (/etc/rc.d/init.d/)
- restart any affected services

Then the installer GUI will be launched.

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- Select your packages

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- Select your packages
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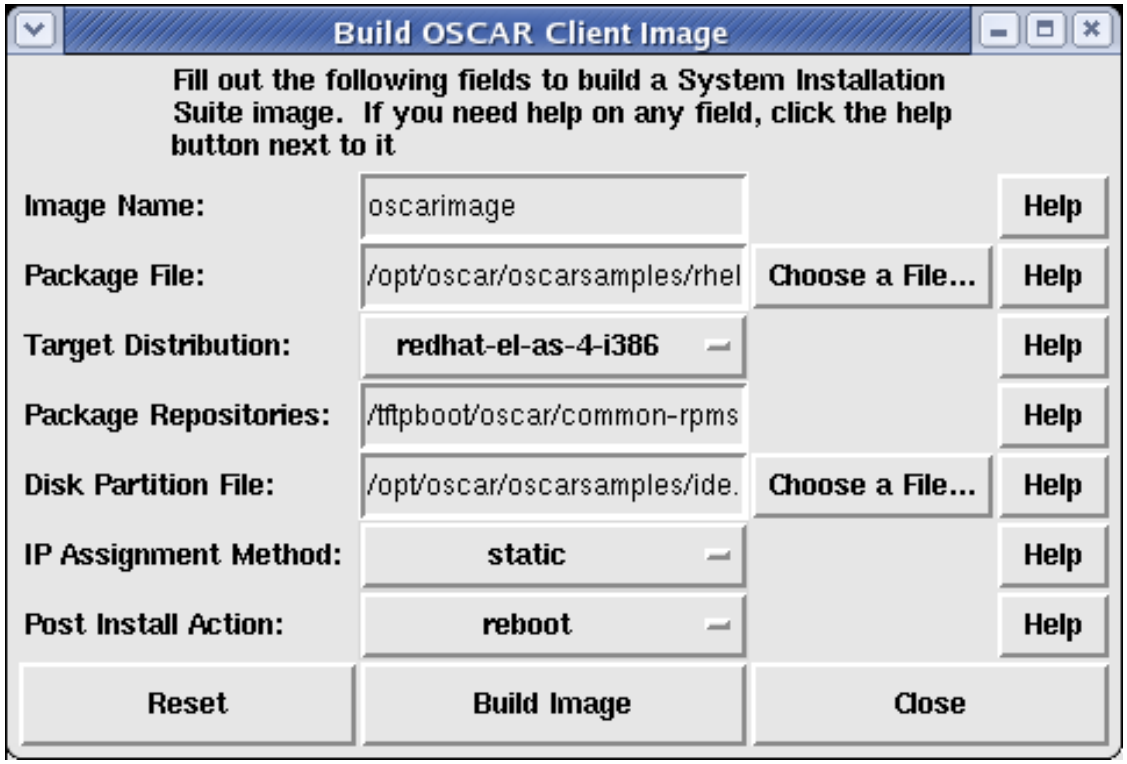
- Install the Server packages
- Build an image for the compute nodes
- Define the compute nodes
- Configure networking
- Complete the setup
- Test the cluster!

# Build Client Image

- Choose an image name



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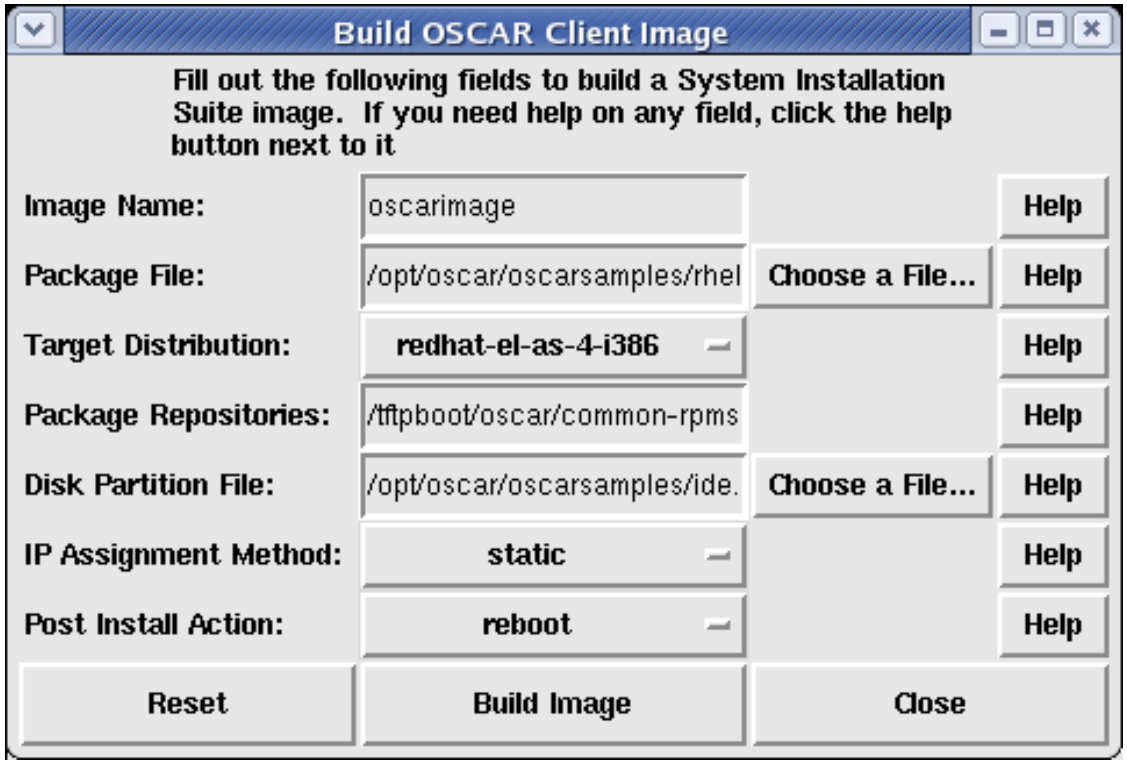

# Build Client Image

- Choose an image name
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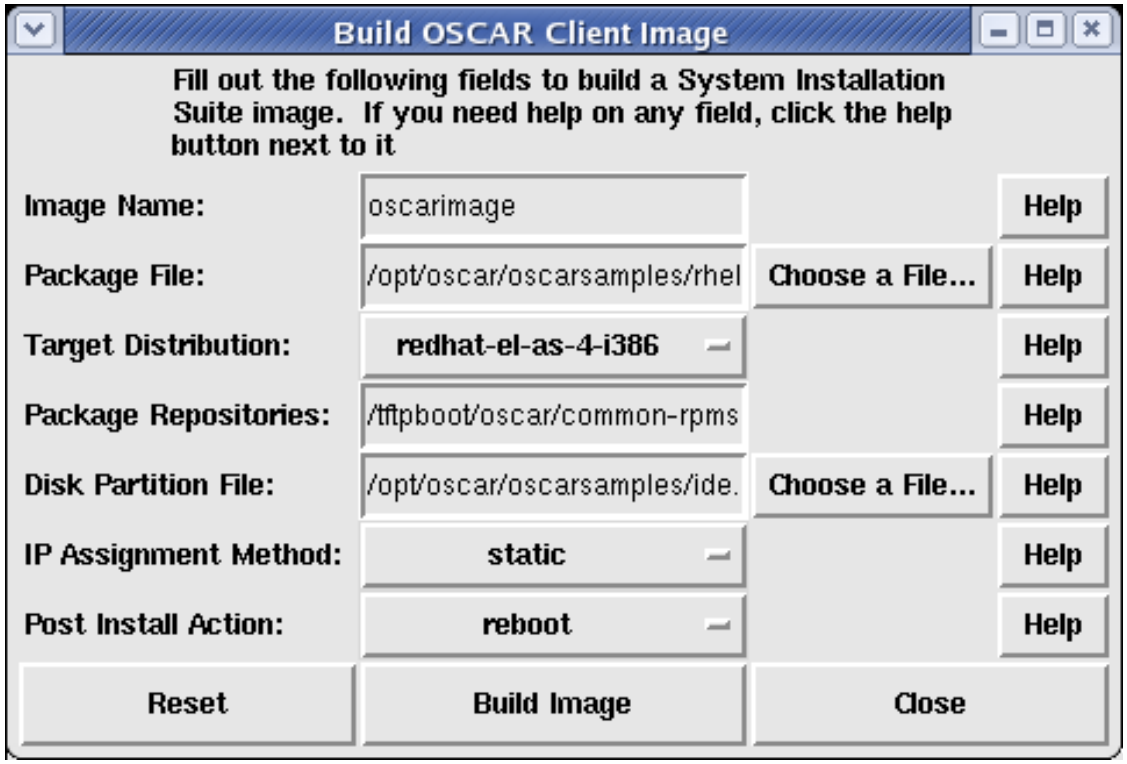
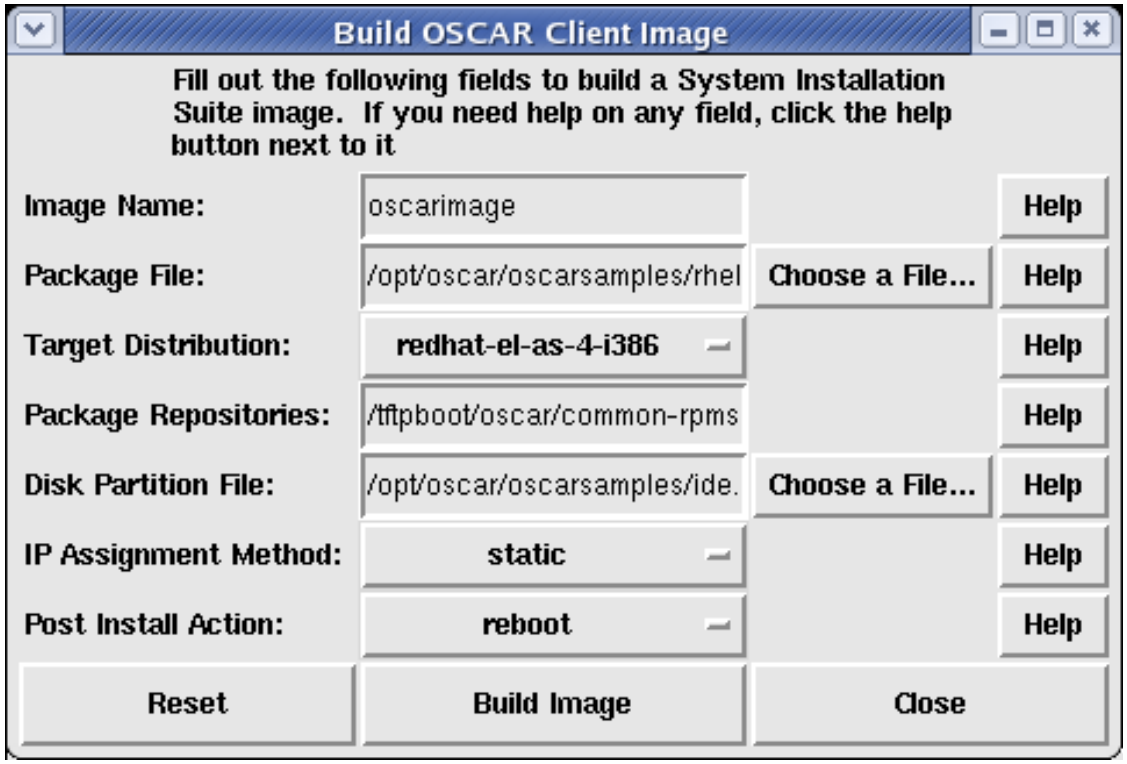
- Chose a Target Distribution



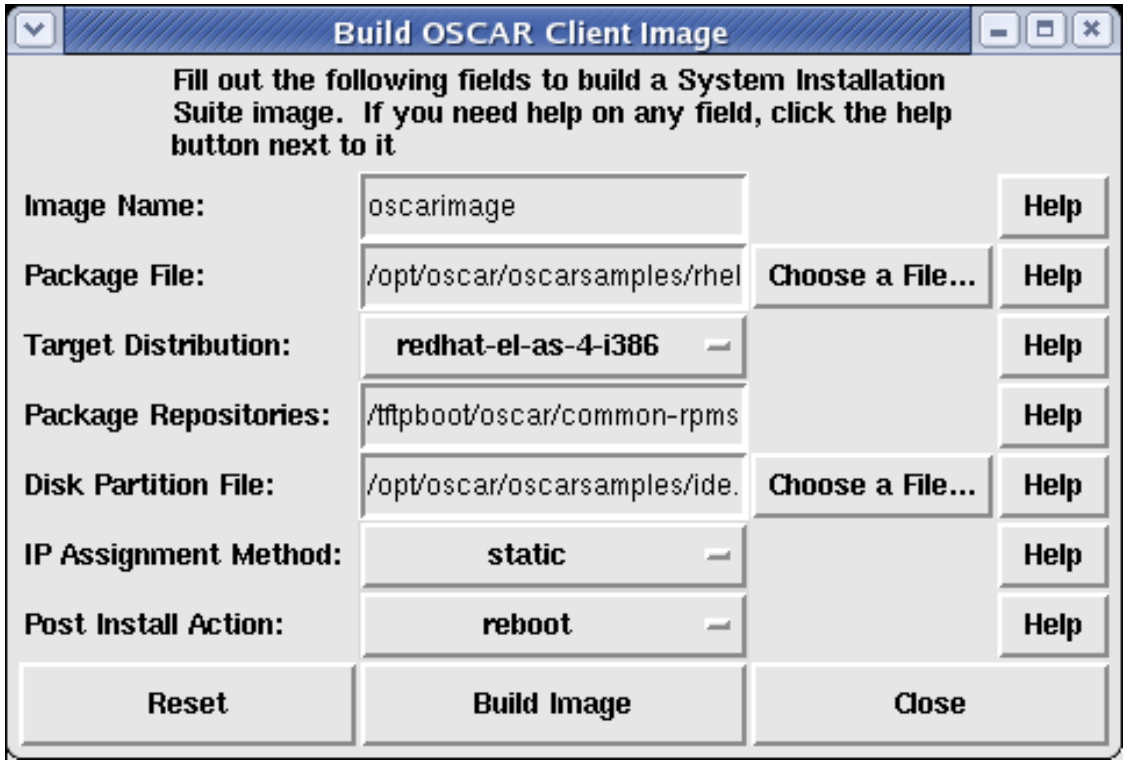
# Build Client Image

- Choose an image name
- Chose a package file
- Chose a Target Distribution
- Specify package repositories



# Build Client Image

- Choose an image name
- Chose a package file
- Chose a Target Distribution
- Specify package repositories
- Specify Disk Partition file



# Build Client Image

- Choose an image name
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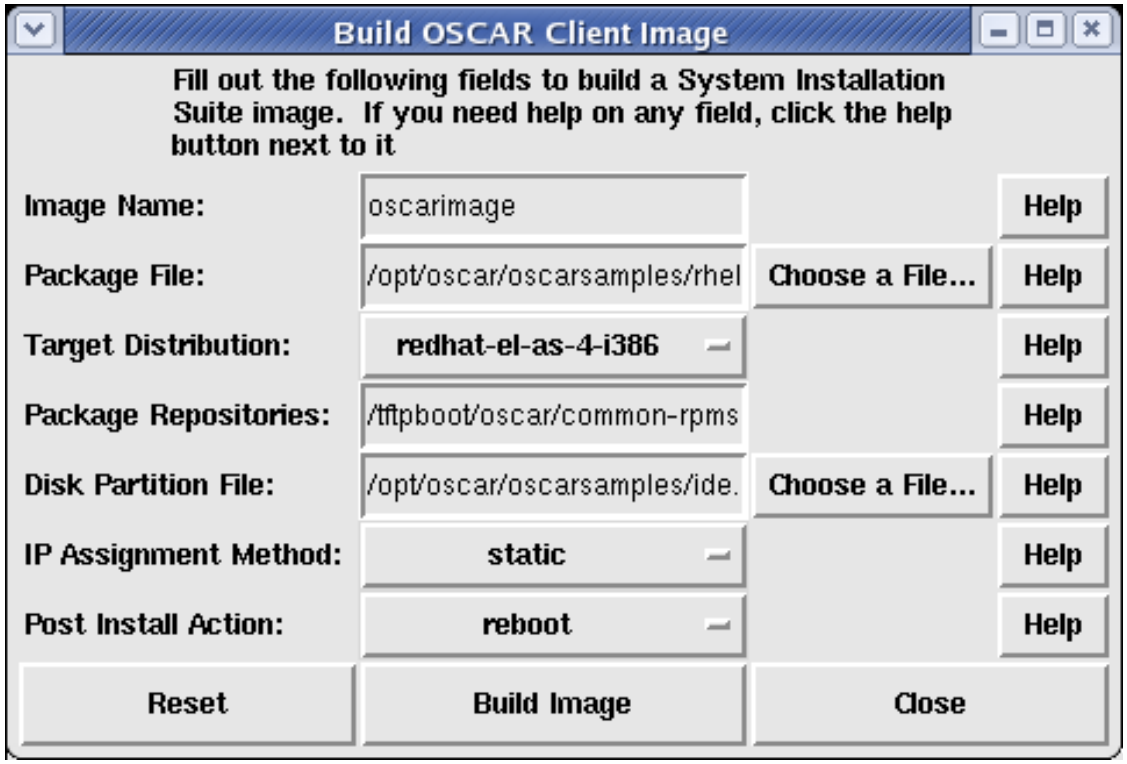
- Chose a Target Distribution
- Specify package repositories
- Specify Disk Partition file
- Pick IP assignment method



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- Specify package repositories
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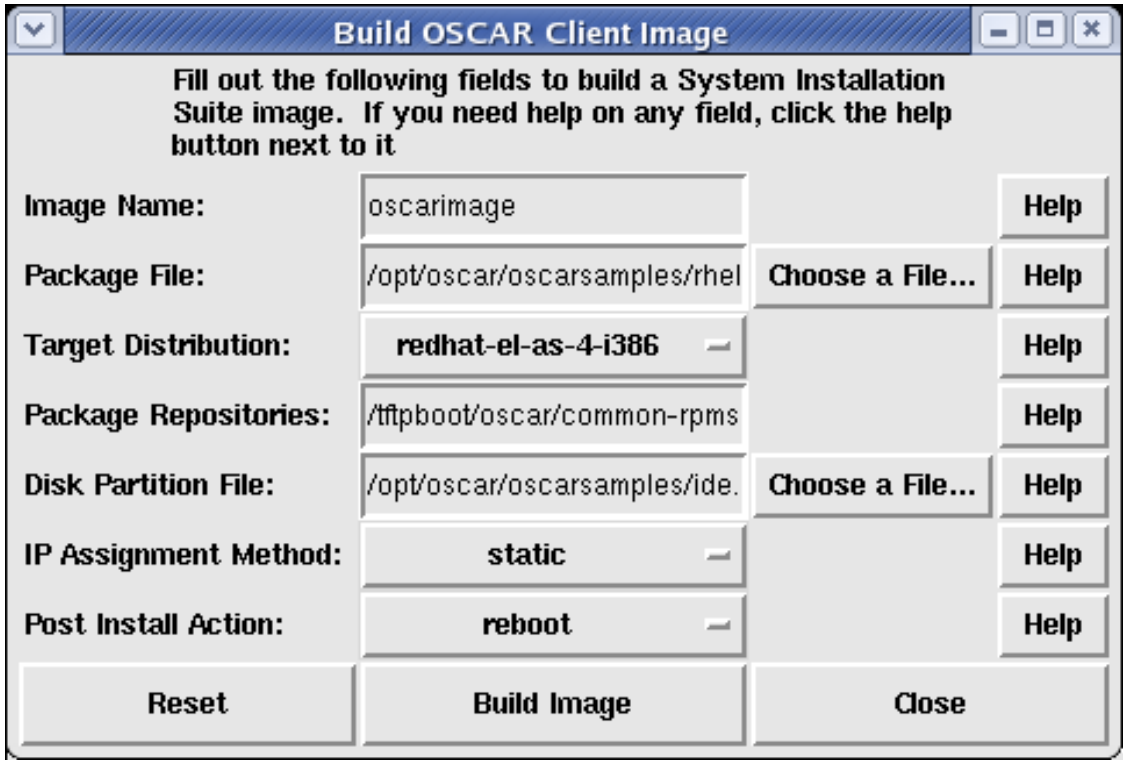
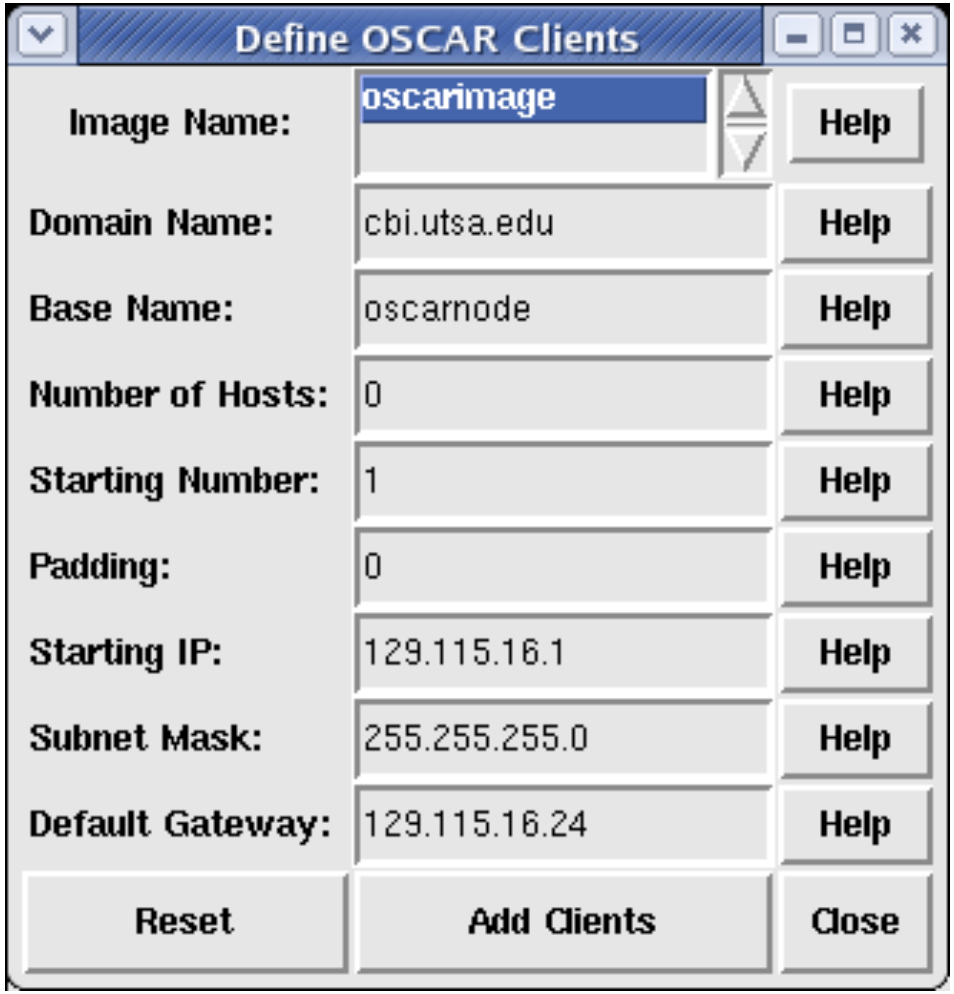
- Pick IP assignment method
- Pick Post Install action



# Define OSCAR Clients (Compute Nodes)

- Pick the image to install




NOTE: You may only define 254 clients at a time!

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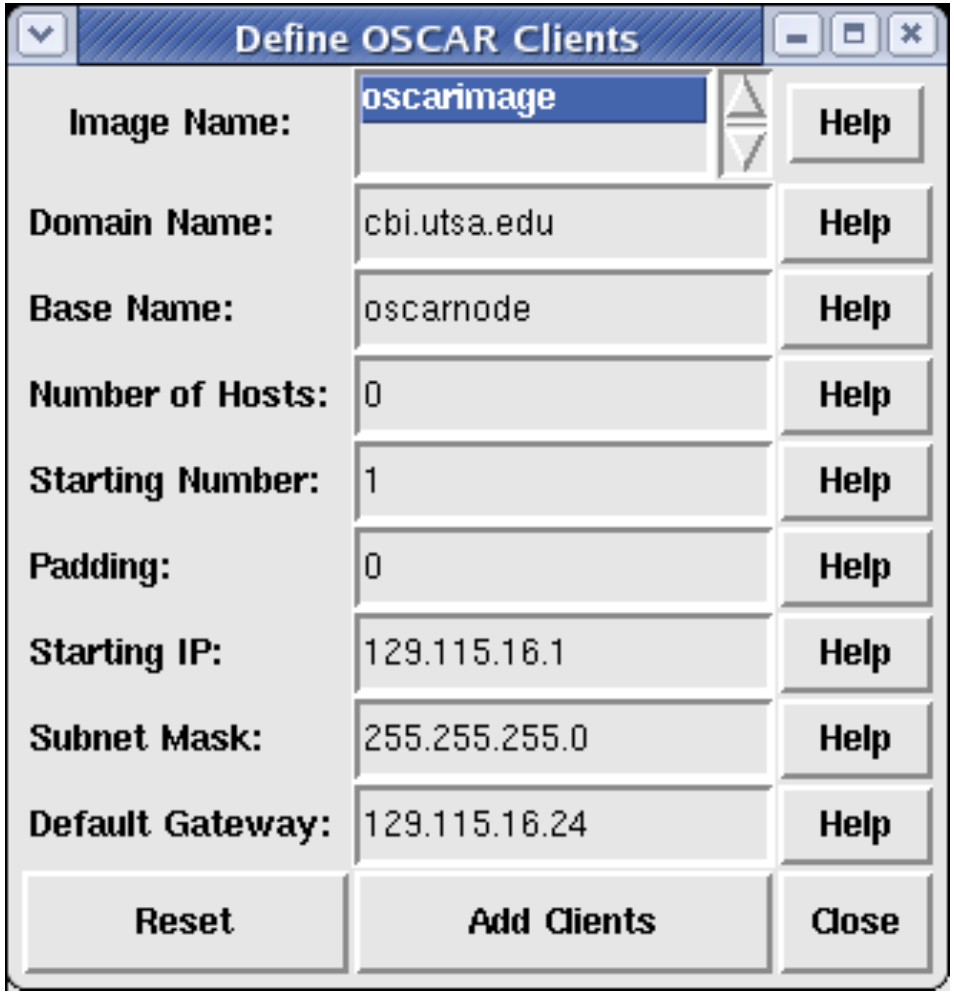


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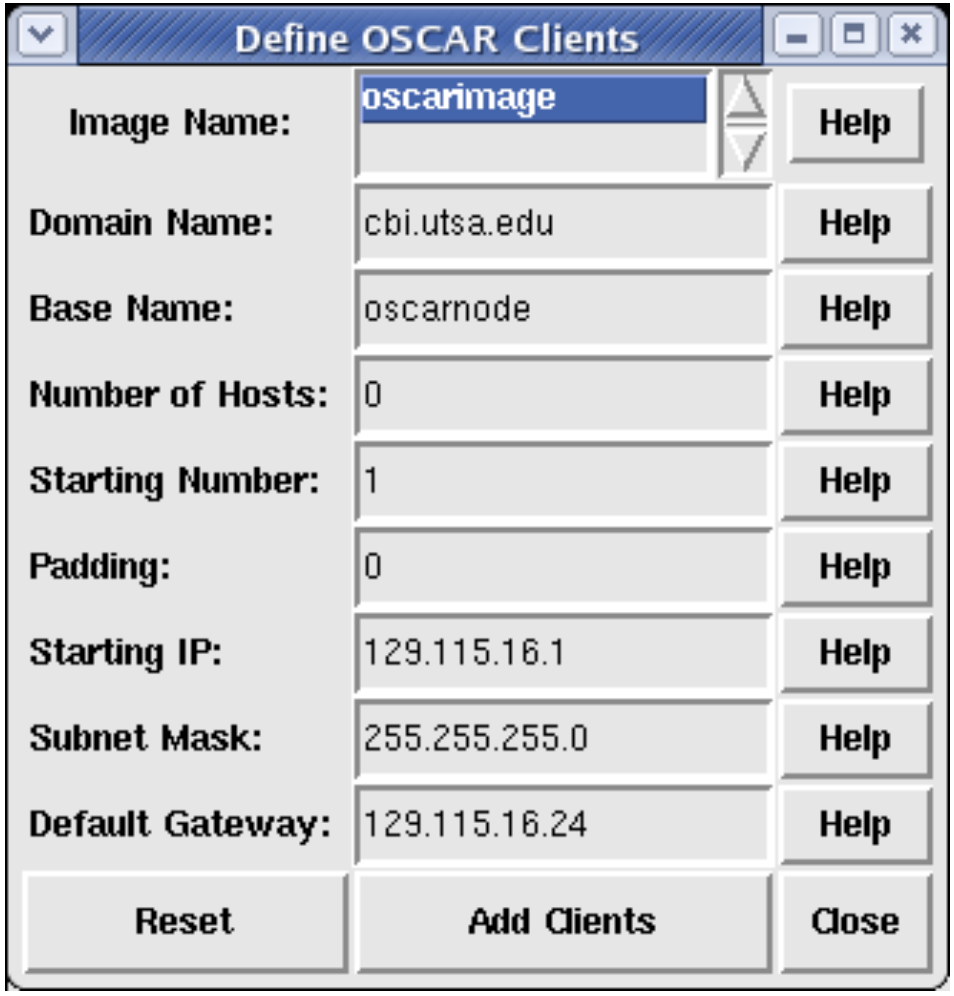


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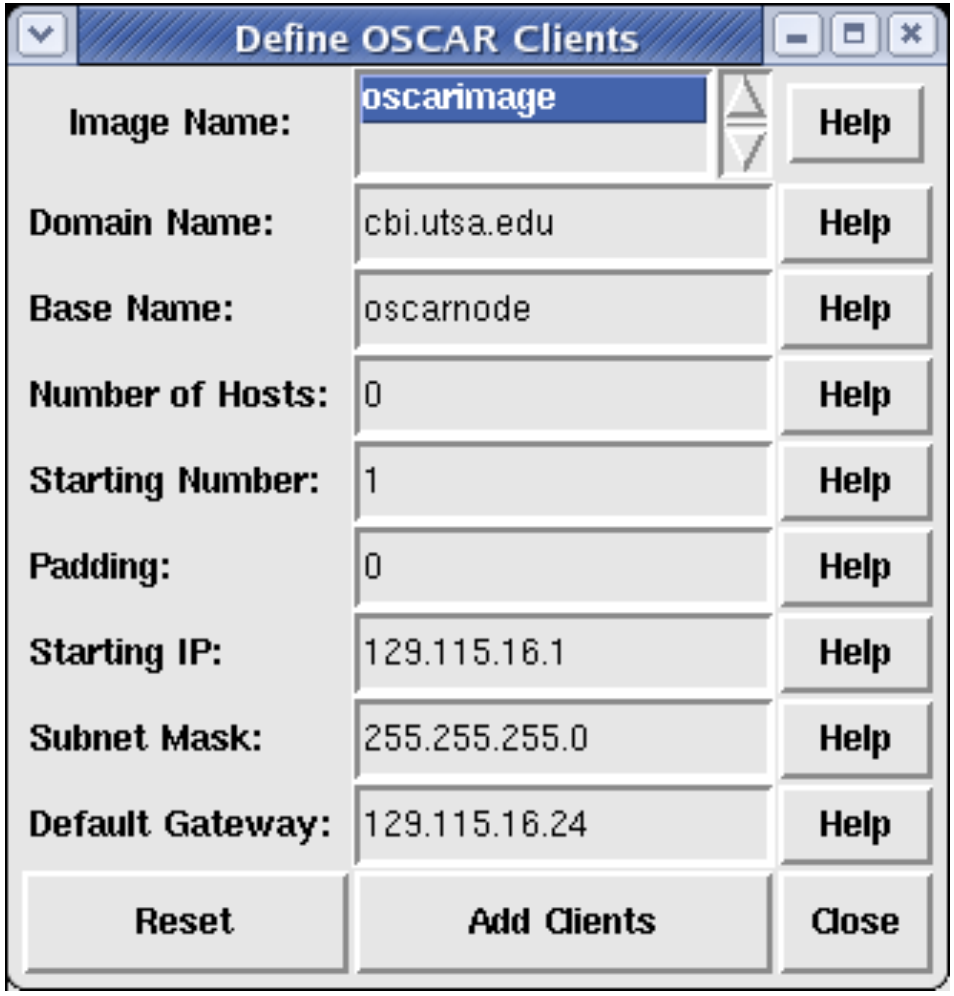


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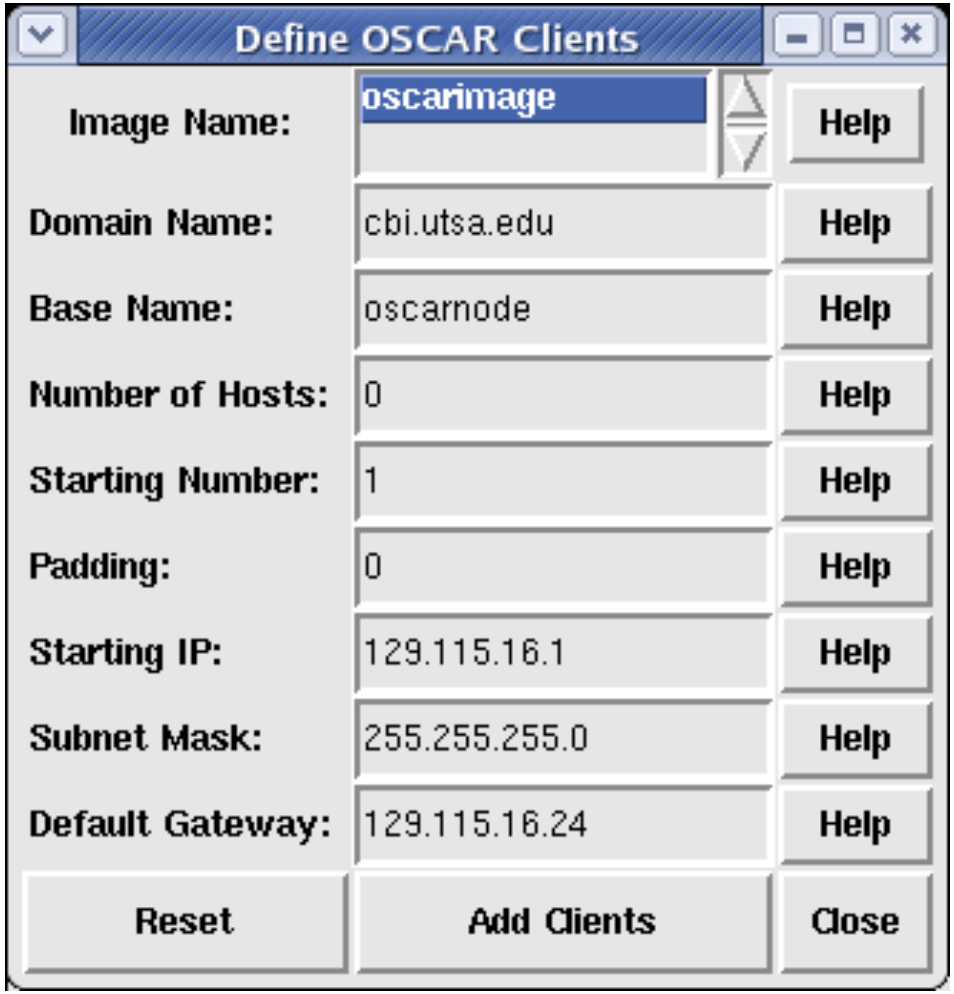


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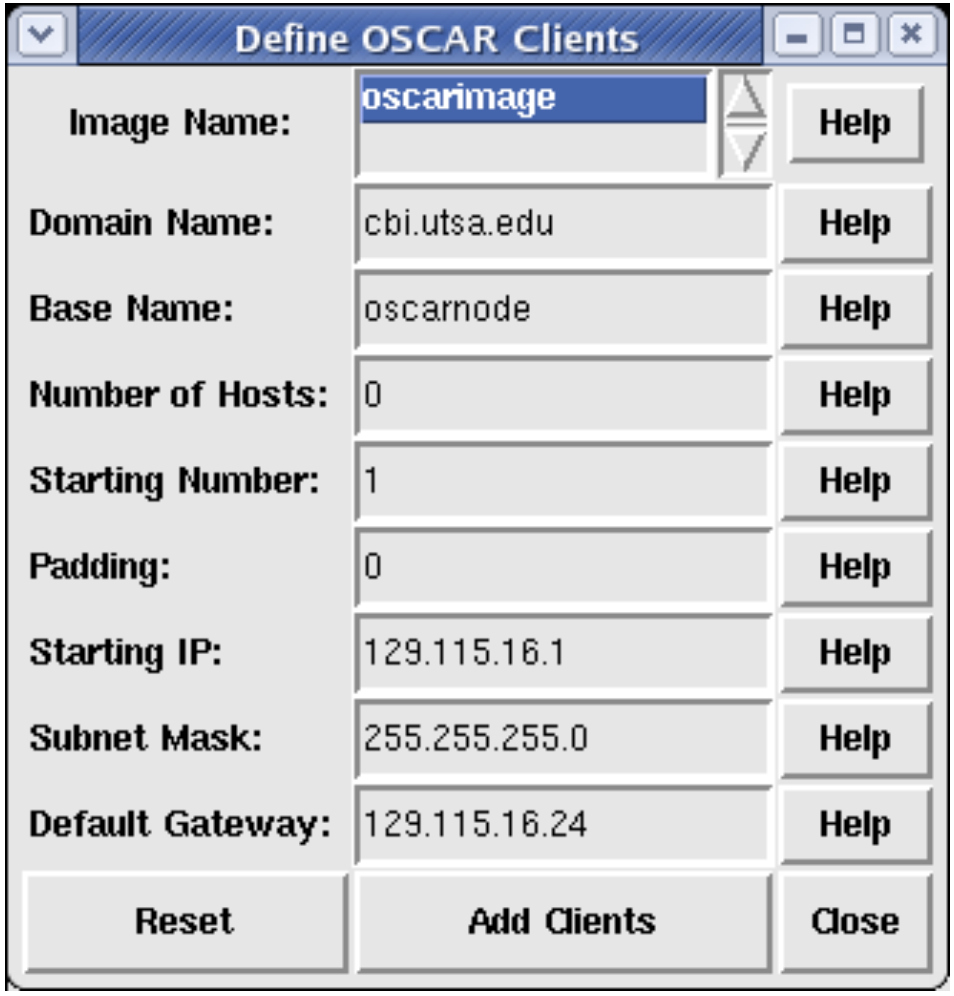


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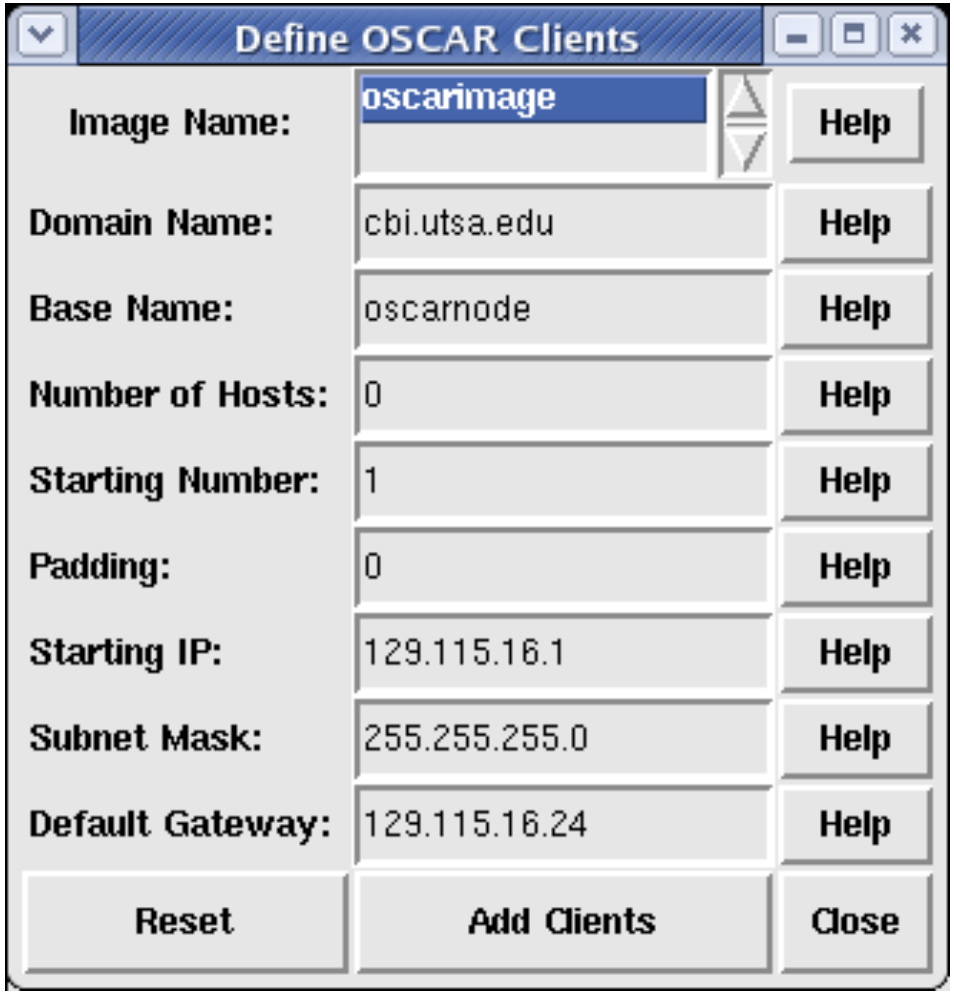


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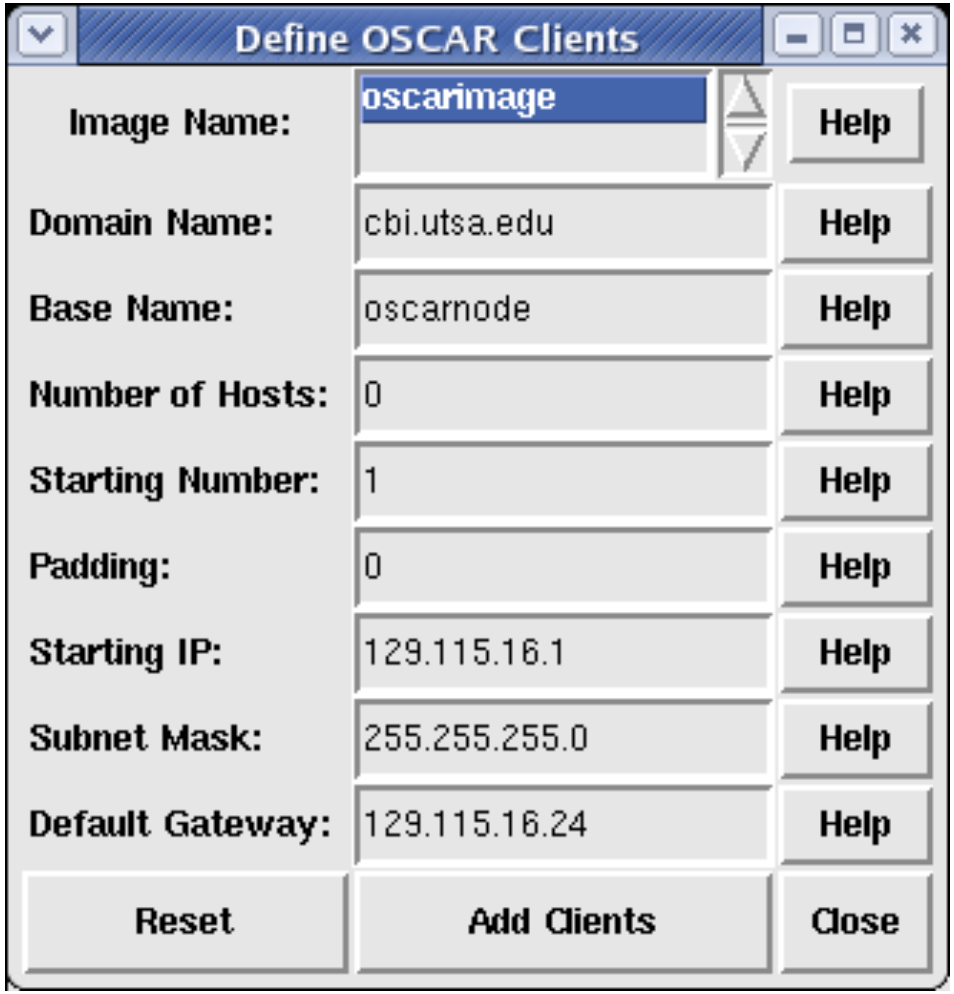


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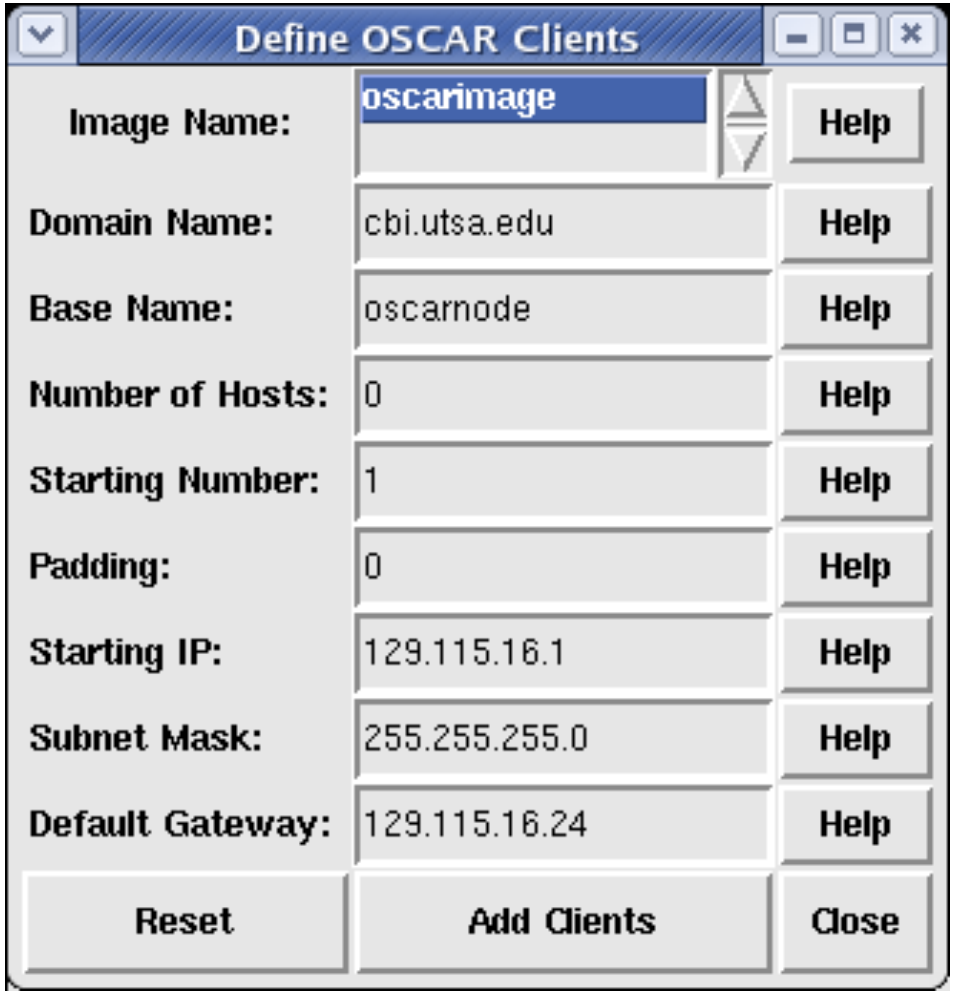
- Specify the subnet mask
- Specify the default gateway

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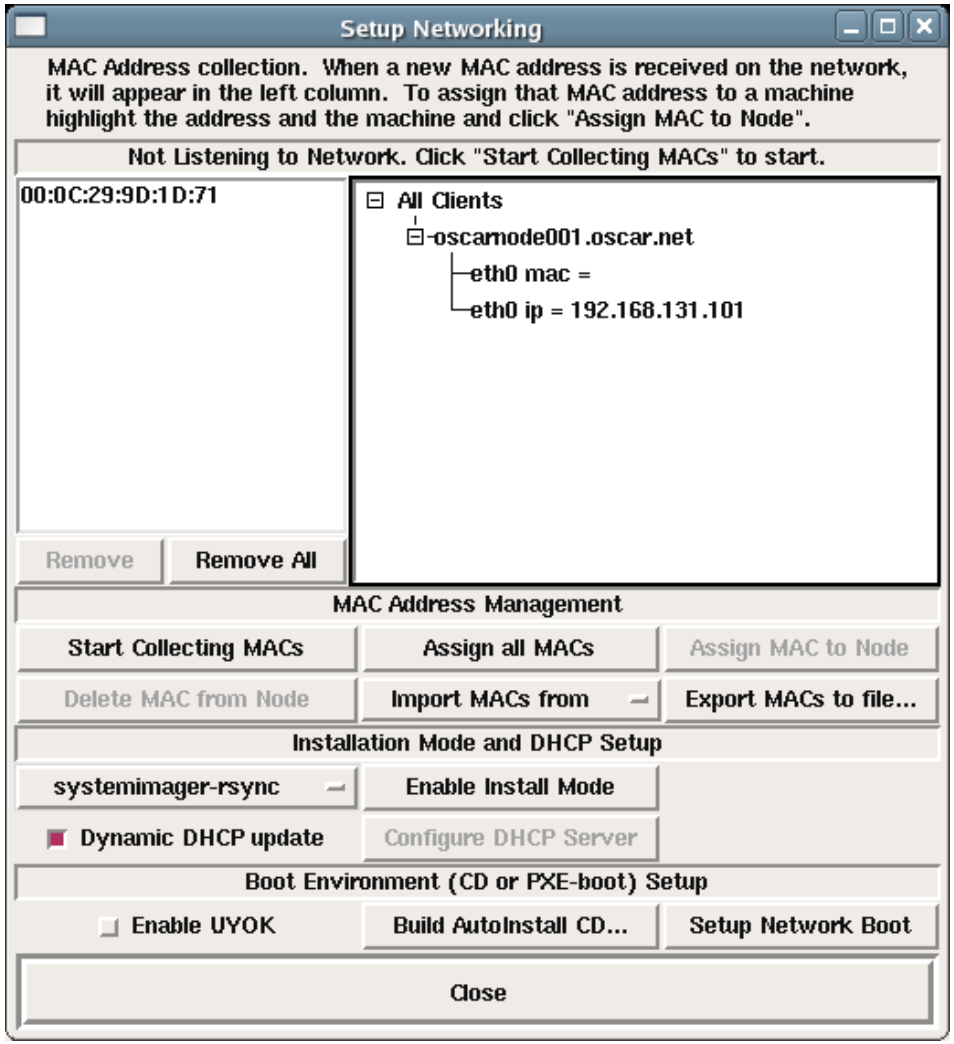
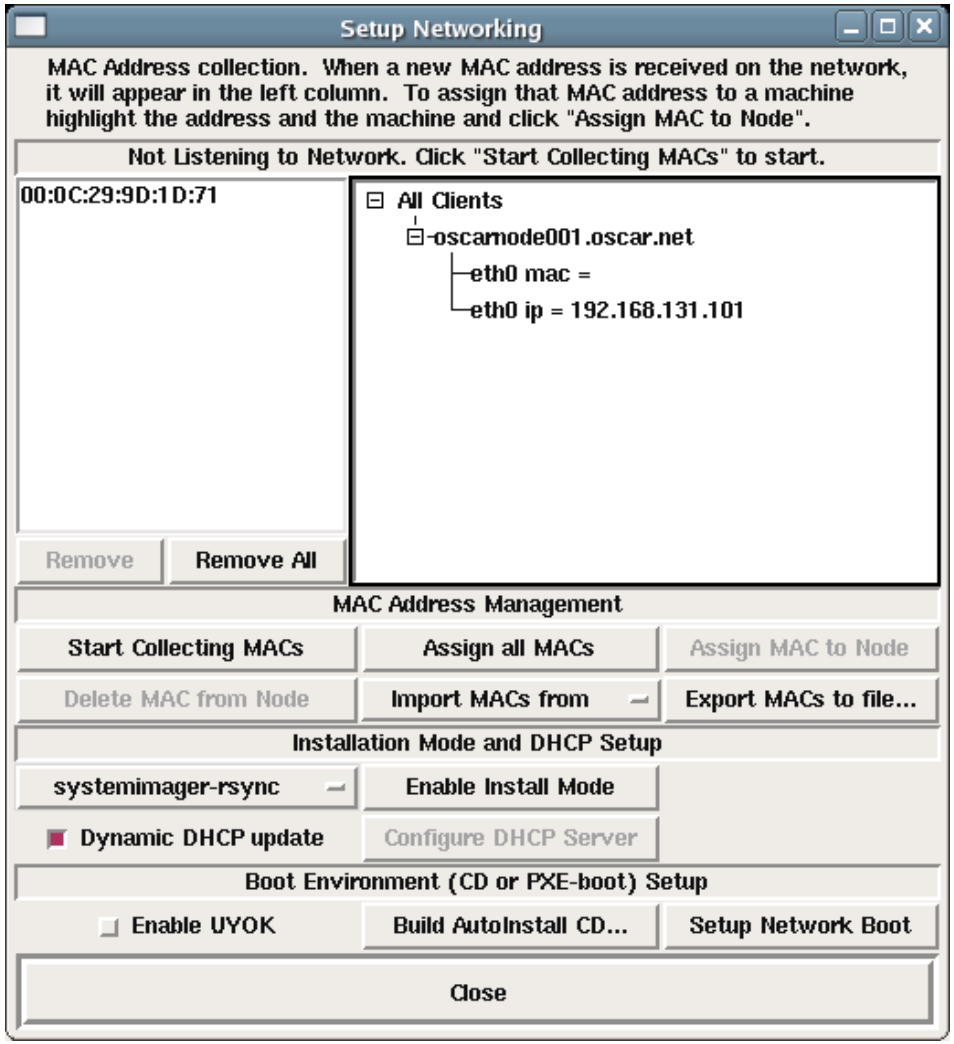


# Setup OSCAR Networking

- Collect MAC Addresses
- Optionally tweak SI installation mode



# Setup OSCAR Networking

- Collect MAC Addresses
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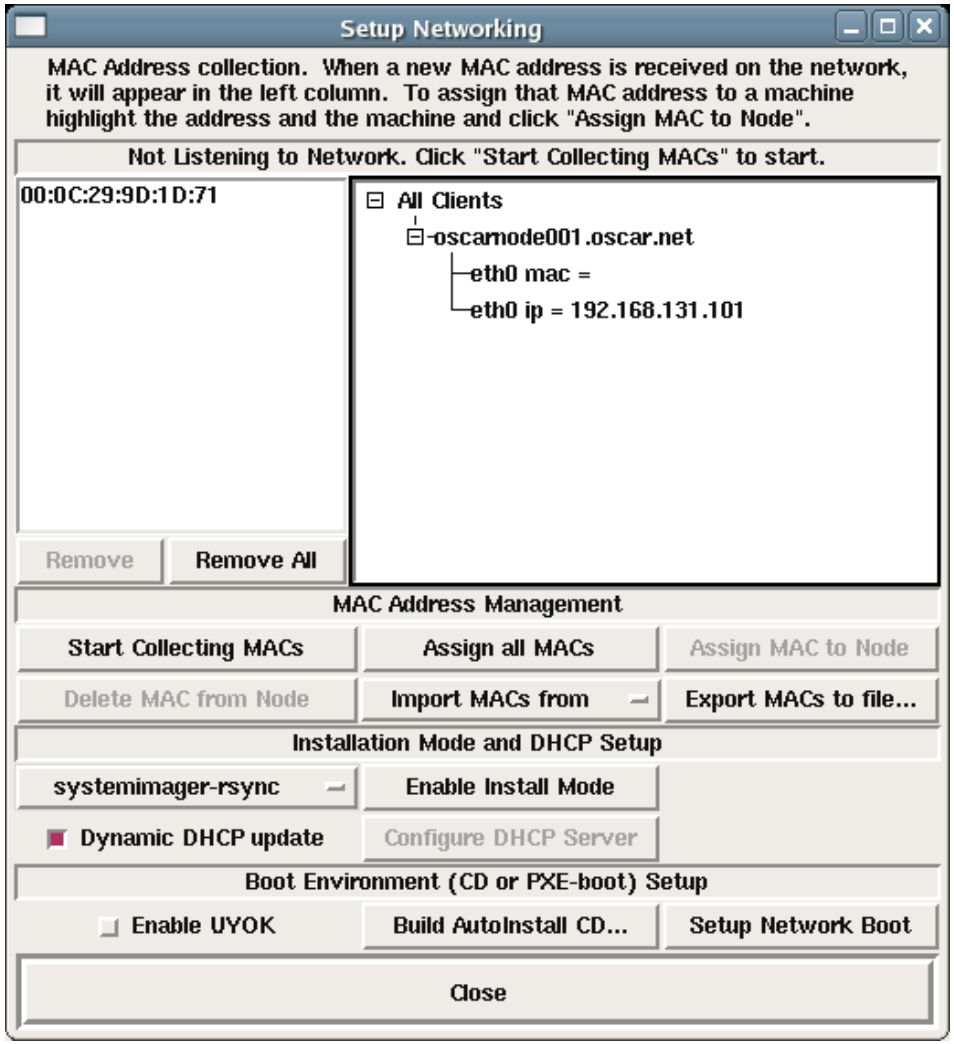
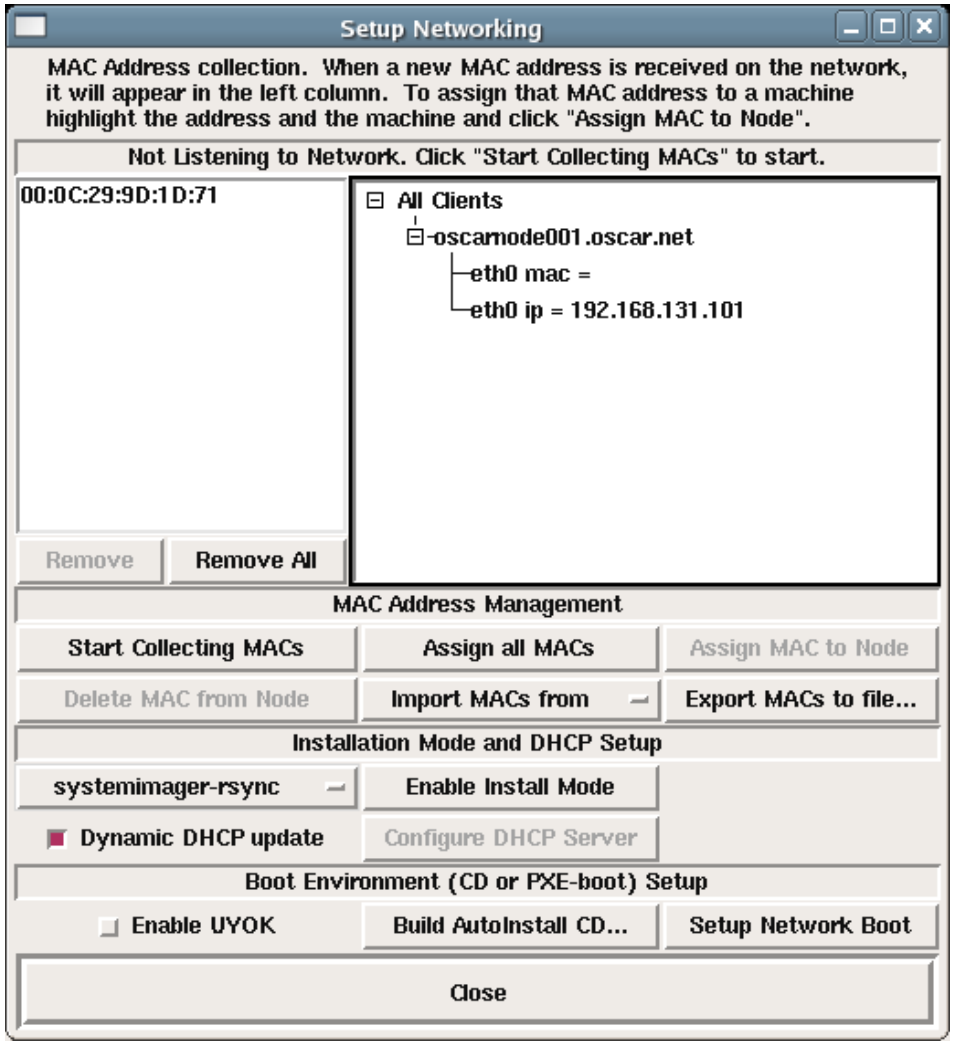
- Build Boot CD
  OR
- Setup Network Boot



# Setup OSCAR Networking

- Collect MAC Addresses
- Optionally tweak SI installation mode
- Build Boot CD
  OR
- Setup Network Boot
- Optionally choose to Use Your Own Kernel (UYOK)



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- Enjoy your new cluster!

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- RPM packages may be added by placing them in the appropriate directory, rebuilding the image, and rebooting the nodes.

# ROCKS Information

| Vital Statistics: | |
|---|---|
| Version: | 5.0 |
| Date: | November 12, 2006 |
| New development: | September 2008 |
| Distribution Formats: | tar.gz |
| URL: | http://oscar.openclustergroup.org/ |

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- Supports Ethernet networks
- Supports Specialized networks and components (Myrinet, Infiniband, nVidia GPU)

# Beginning the ROCKS Installation

For the Installation, you will need:

- Kernel/Boot Roll CD
- Base Roll CD
- Web Server Roll CD

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- ALL Red Hat Enterprise Linux 5 update CDs
- ALL CentOS 5 update 1 CDs
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- ALL CentOS 5 update 1 CDs
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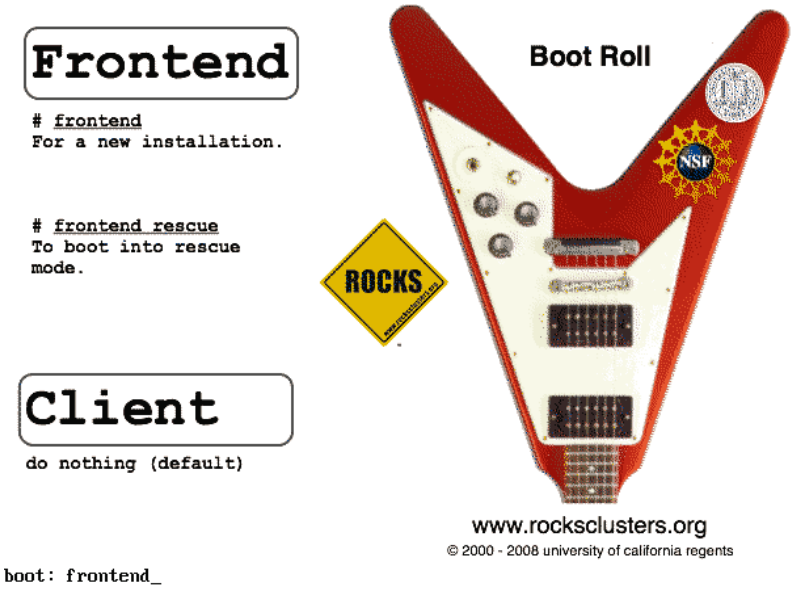
- Boot the "Kernel/Boot Roll CD" on the server
- You should see:



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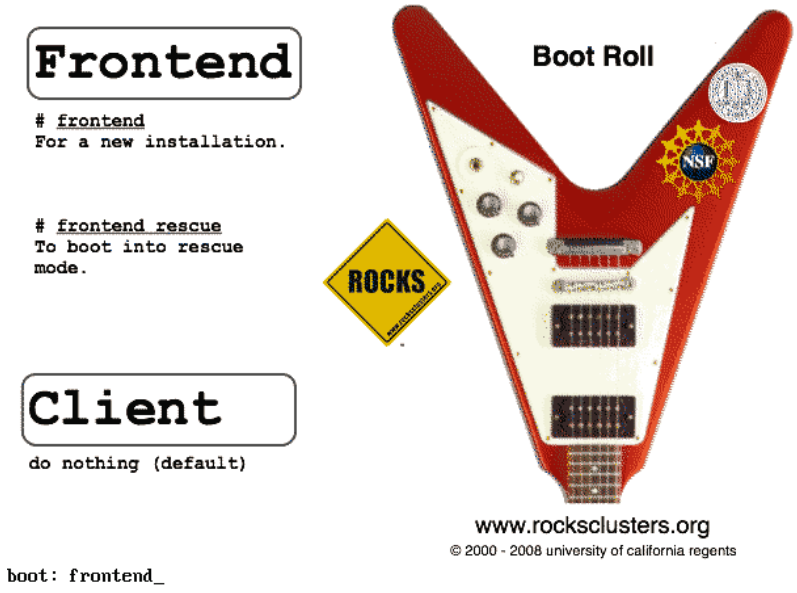


- Type "front-end" to begin the installation

# Other Popular Cluster Management tools

- Xcat
- openMosix (RIP March 1, 2008)
- LinuxPMI Continuation of 2.6 branch of openMosix (*NOT* Single System Image)
- OpenSSI
- Scyld
- IBM's CSM
- Also notable: Sandia's CIT[2]

[2] It may not be the most popular, but it is well designed and pretty darn cool!

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- Automatically manage configuration files
- Take care of maintenance tasks like running backups
- Manage things like "cron jobs" in a centralized place.

... Automate and reduce the headache of administration!

# Cfengine Information

| Vital Statistics: | |
|---|---|
| Version: | 2.2.8 |
| Date: | August 5, 2008 |
| Distribution Formats: | tar.gz |
| URL: | http://www.cfengine.org/ |

# What is Cfengine good for?

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- Standardize properties (netmask, domain name, etc.) of hosts

# What is Cfengine good for?

- Ensure proper versions of software are installed
- Template-based creation of configuration files
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# What is Cfengine good for?

- Ensure proper versions of software are installed
- Template-based creation of configuration files
- Verify permissions & ownership of files and directories
- Standardize properties (netmask, domain name, etc.) of hosts
- Ensure checksums of files
- Check disk capacity

# Installing Cfengine

- tar zxf cfengine-2.2.8.tar.gz
- cd cfengine-2.2.8
- ./configure
- make
- make install
- test: /usr/local/sbin/cfagent -v

# Getting Started with Cfengine

In order to get started with Cfengine, we will need 3 things:

- A crontab entry to run cfexecd periodically[3]
  0 * * * * /usr/local/sbin/cfexecd -F

[3] Cfengine can also be run as a daemon.

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In order to get started with Cfengine, we will need 3 things:

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  0 * * * * /usr/local/sbin/cfexecd -F
- An update.conf file
- A cfagent.conf file

[3] Cfengine can also be run as a daemon.

# update.conf — control section

```
#########################################
#
# Distribute the configuration files
#
#########################################

control:
  # distribute the files, then clean up our mess
  workdir = ( /var/cfengine )
  actionsequence = ( copy tidy )
  policyhost = ( cfengine.hpc.unm.edu ) # master host
  domain = ( hpc.unm.edu )
  master_cfinput = ( /cfengine/inputs )
  sysadmin = root@hpc.unm.edu
```

# cfagent.conf — control section

```
control:
  domain = ( hpc.unm.edu )
  netmask  = ( 255.255.252.0 )
  sysadm = ( root@hpc.unm.edu )
  timezone = ( MST )
  actionsequence = (
    mountall        # mount filesystems in /etc/fstab
    netconfig       # check the network interface
    resolve         # check the DNS resolver
    tidy            # ‘‘tidy’’ Cfengine logfiles
    files           # check file permissions
    directories     # ensure directories exist
    processes )     # check processes
```

# cfagent.conf — files and directories section

```
# check important files
files:
  /etc/passwd                    mode=644 owner=root action=fixall
  /etc/shadow                    mode=600 owner=root action=fixall
  /var/spool/torque/pbs_environment mode=644 owner=root action=fixall
  /var/spool/torque/server_name mode=644 owner=root action=fixall
#check that TORQUE directories exist
directories:
   /var/spool/torque/            owner=root  mode=755  action=fixall
   /var/spool/torque/aux/        owner=root  mode=755  action=fixall
   /var/spool/torque/mom_logs/   owner=root  mode=755  action=fixall
```

(etc.)

# cfagent.conf — processes section

```
# Here we define processes we want to ensure are running
# We could also define ones we wanted to kill or restart
# Strings are regular expressions used to match the name
# of the process
processes:
  "pbs_server"     matches=1    # ensure PBS is running
  "maui"           matches=1    # ensure Maui is running
```

# Popular Parallel Shells

- PDSH
- Dancer's DSH
- Clusterit
- C3 tools

# PDSH Information

| **Vital Statistics:** | |
|---|---|
| Version: | 2.16 |
| Date: | April 3, 2008 |
| "Parallelism": | "sliding window" parallel algorithm |
| Language: | C |
| Distribution Formats: | RPM, tar.gz |
| URL: | https://computing.llnl.gov/linux/pdsh.html |

# PDSH Remote command modules

These are ways of accessing the remote nodes. Tune as per your security/performance requirements!

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These are ways of accessing the remote nodes. Tune as per your security/performance requirements!

- RSH
- SSH
- Kerberos
- MRSH, QSH, MQSH, XCPU (whatever those are ;)

# PDSH Node Specification

- Specify a list of hosts:
  pdsh -w node01,node05,node17 -- command

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  pdsh -w node01,node05,node17 -- command
- specify a range of hosts:
  pdsh -w node01-node100 -- command

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- Specify a list of hosts:
  pdsh -w node01,node05,node17 -- command
- specify a range of hosts:
  pdsh -w node01-node100 -- command
- Specify a range of hosts, excluding a set in the middle:
  pdsh -w node01-node100 -x node20-node30 -- command

# PDSH Node Specification (cont.)

- Specify a nodes in a netgroup “netgroup”:
  pdsh -g netgroup -- command

# PDSH Node Specification (cont.)

- Specify a nodes in a netgroup “netgroup”:
  pdsh -g netgroup -- command
- Exclude nodes in the netgroup “netgroup”:
  pdsh -X netgroup -- command

# PDSH Node Specification (cont.)

- Specify a nodes in a netgroup “netgroup”:
  pdsh -g netgroup -- command
- Exclude nodes in the netgroup “netgroup”:
  pdsh -X netgroup -- command
- Execute a command on all nodes in a file:
  export WCOLL=/path/to/node-file
  pdsh -- command

# Dancer's DSH Information

| **Vital Statistics:** | |
|---|---|
| Version: | 0.25.9 |
| Date: | August 15, 2007 |
| "Parallelism": | "Hierarchical invocation technique"<br>"4 nodes accessing 4 nodes" ... |
| Language: | C |
| Distribution Formats: | DEB, .tar.gz |
| URL: | http://www.netfort.gr.jp/~dancer/software/dsh.html.en |

# Dancer's DSH Node Specification

- Use the global nodes file, /etc/dsh/machines.list:
  dsh -a -c -- command

# Dancer's DSH Node Specification

- Use the global nodes file, /etc/dsh/machines.list:
  dsh -a -c -- command
- Use the list of nodes for "Rack 1" stored in
  $HOME.dsh/group/rack1
  dsh -g rack1 -c -- command

# Clusterit Information

| **Vital Statistics:** | |
|---|---|
| Version: 2.5 | |
| Date: | August 15, 2007 |
| "Parallelism": | N-way Fanout |
| Language: | C |
| Distribution Formats: | .tar.gz |
| URL: | http://clusterit.sourceforge.net/ |

# Clusterit Node Specification (Groups and Lumps)

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- GROUP:compute
  node01
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- Groups are sets of nodes:
- GROUP:compute
  node01
  node02
- Lumps are sets of groups:
- LUMP:cluster
  compute
  storage
  admin

# Clusterit Node Specification

- Specify a list of hosts:
  dsh -w node01,node04,node23 -- command

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  dsh -w node01,node04,node23 -- command
- Exclude a list of hosts:
  dsh -x node03,node09,node17 -- command

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- Specify a list of hosts:
  dsh -w node01,node04,node23 -- command
- Exclude a list of hosts:
  dsh -x node03,node09,node17 -- command
- Specify a group of hosts:
  export CLUSTER=/path/to/nodefile
  dsh -g compute -- command

# Clusterit Node Specification

- Specify a list of hosts:
  dsh -w node01,node04,node23 -- command
- Exclude a list of hosts:
  dsh -x node03,node09,node17 -- command
- Specify a group of hosts:
  export CLUSTER=/path/to/nodefile
  dsh -g compute -- command
- Specify a lump of hosts:
  export CLUSTER=/path/to/nodefile
  dsh -g cluster -- command

# C3 Information

| **Vital Statistics:** | |
|---|---|
| Version: | 4.0.1 |
| Date: | July 15, 2003 |
| "Parallelism": | "Sub-Cluster Staging" |
| Language: | Python |
| Distribution Formats: | RPM, .tar.gz |
| URL: | http://www.csm.ornl.gov/torc/C3/C3softwarepage.shtml |

# C3 Cluster Node Specification file format *(/etc/c3.conf)*

- Specify a cluster with a head node with an external interface named "external-name" and an internal interface named "node0" and 64 compute nodes named node01-node64.

# C3 Cluster Node Specification file format */etc/c3.conf*

- Specify a cluster with a head node with an external interface named "external-name" and an internal interface named "node0" and 64 compute nodes named node01-node64.
- */etc/c3.conf contents:*

```
cluster my-cluster
{
external-name:node0 #head node
node[1-64] #compute nodes
}
```

# C3 Node Specification

- Specify the default cluster:
  cexec command

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- Specify a subset of nodes in the default cluster:
  cexec :6-53 command
- Specify a list of clusters:
  cexec cluster1: cluster2: command

# Basic Cluster Scripting

## grep is your (best) friend

- Find the CPU count on all of the nodes:
  pdsh "cat /proc/cpuinfo | grep processor | wc -l"

# Basic Cluster Scripting

## grep is your (best) friend

- Find the CPU count on all of the nodes:
  pdsh "cat /proc/cpuinfo | grep processor | wc -l"
- Find nodes with the wrong image version:
  export VER="1.2.3"
  pdsh "cat /etc/image_version | grep \ "^$VER\$\" || hostname"

# More Basic Cluster Scripting

## awk is a pretty good friend too!

- Find nodes where the load is greater than 2:
  pdsh uptime | awk '{if($11 > 2.0){print}}'

# More Basic Cluster Scripting

## awk is a pretty good friend too!

- Find nodes where the load is greater than 2:
  pdsh uptime | awk '{if($11 > 2.0){print}}'
- Find bad GM counts on all nodes:
  pdsh "/opt/mx/bin/mx_counters |
  awk '/bad/ {if (\$2 > 0) {print;}}' "

# Backup anything you can't recreate

## Backup anything you can recreate but can't recreate quickly

- Use backup anytime it would take longer to rebuild and reconfigure than to restore.

Thanks to Roy Heimbach for contributing this slide!

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## Backup anything you can recreate but can't recreate quickly

- Use backup anytime it would take longer to rebuild and reconfigure than to restore.
- "Longer" may be in terms of staff time or elapsed time or both.
- Consider:
  - User directories (not scratch!)
  - Libraries and applications you've built on site
  - Tcl module files in /usr/share/modules/modulefiles/
  - System configuration files DNS, DHCP, NIS, etc. (Should that be everything in /etc/?)
  - Node images

Thanks to Roy Heimbach for contributing this slide!

# Logging/Automated Log Analysis Tools:

- SEC
- Logsurfer+
- splunk

# What can we find in our logfiles?

## What are we happily ignoring?

- Evidence of misconfigurations:
  e.g. “/var/log/lastlog does not exist”

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  e.g. "/var/log/lastlog does not exist"
- Security violations
  e.g. Illegal users
- Hardware/Software errors e.g. Disk failures

# Regular Expression Review

## Is that line noise?

This is a quick review of Perl Regular Expressions.

- Simple 'as-is' text string matching:
- "cat" or "dog"

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This is a quick review of Perl Regular Expressions.

- Simple 'as-is' text string matching:
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- Meta-characters:
- {}[]()^$.|*+?\

# Regular Expression Meta-characters

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- ^ matches the beginning of the line
- $ matches the end of the line
- \'escapes' the next character
- [] specifies a set or range of characters:
  eg. [a-z,A-Z,0-9] would match all alphanumeric characters

# Regular Expression Meta-characters (cont.)

- {n} match the previous thing exactly “n” times

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- {n} match the previous thing exactly "n" times
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- {n,m} match the previous thing at least "n" times, but not more than "m" times

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- () specifies groups of things or things to "save"
  the first group will be saved in $1, the second in $2, etc.

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- () specifies groups of things or things to "save"
  the first group will be saved in $1, the second in $2, etc.
- | specifies "OR" inside of a group
  eg. (cat|dog) would match either "cat" or "dog"

# SEC Information

| **Vital Statistics:** | |
|---|---|
| Version: | 2.4.2 |
| Date: | February 1, 2008 |
| Language: | Perl |
| Distribution Formats: | .tar.gz, DEB, RPM, FreeBSD and OpenBSD ports, Gentoo portage |
| URL: | http://www.estpak.ee/~risto/sec/ |

# *Quick* intro to SEC:

## SEC Components

- Messages
  Single lines of text in a logfile

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  Do something in response to an incoming Message

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- Messages
  Single lines of text in a logfile
- Rules
  Do something in response to an incoming Message
- Contexts
  Passive structures to store Messages

# Default SEC Rule

## Match all messages and print them

```
# Print all messages
type=single
ptype=regexp
pattern=.+
desc=unmatched message: $0 # note $0 is the entire message
action=logonly
```

This, or something like it, should be the last rule in your ruleset

# SEC Filtering Rule

## Ignore messages we're expecting

```
# This machine has 4 processors
# Ignore messages reporting what we expect!
type=single
ptype=RegExp
pattern=kernel: Total of 4 processors activated
desc=correct processors initialized
action=none
```

# SEC Responding to messages

Sound the alert!

```
# This machine has 4 processors
# Report any number other than that!
# report_problem.sh is a script we wrote to report this
# to our admins
type=single
ptype=RegExp
pattern=(\S+) kernel: Total of (\d+) processors activated
desc=incorrect processor count: $2 on host: $1
action=shellcmd report_problem.sh $1 $2
```

# SEC Contexts and Correlation

## Finding, Blocking, and Reporting on "SSH scanners"

```
# Store "Invaid user" messages from this host unless we're blocking it
type=single
continue = TakeNext
desc = invalid login from host $2
ptype=regexp
pattern = ^\S+\s+\S+\s+\S+\s+\S+\s+sshd\[\d+\]: Invalid user (\S+) from (\S+)$
context = (!(block_bad_ssh-$2))
action=add bad_ssh-$2

# Block the host if we've gotten 10 "Invalid user" messages in a day
type=SingleWithThreshold
desc = invalid login from host $2
ptype=regexp
pattern = ^\S+\s+\S+\s+\S+\s+\S+\s+sshd\[\d+\]: Invalid user (\S+) from (\S+)$
thresh=3
action=create block_bad_ssh-$2; \
       shellcmd iptables -A INPUT --source $2 -j REJECT ; \
       report bad_ssh-$2 /usr/adm/bin/report-bad-host.pl $2 ; \
       delete bad_ssh-$2
window=10000000
```

# Logsurfer+ Information:

| **Vital Statistics:** | |
|---|---|
| Version: | 1.7 |
| Date: | December 2006 |
| Language: | C |
| Distribution Formats: | .tar.gz |
| URL: | http://www.crypt.gen.nz/logsurfer/ |

# System and Cluster Security!

## Watch Out!

- Identify the Problem
- Security Strategies
- Dealing with Weaknesses
- Cluster Network Topologies
- Cluster Specific Issues
- Linux Tricks
- Checking Your Work

# Define the Enemy

- Data thieves

# Define the Enemy

- Data thieves
- Resource thieves

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- Hackers there for various reasons

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- Data thieves
- Resource thieves
- Hackers there for various reasons
- Curies script kiddies
- Malicious script kiddies

# Attack Vectors

- Remote Attacks:
  Network Services allow access to the machine

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  Network Services allow access to the machine
- Local Attacks:
  Insecure Priveledged Binaries allow Priveledge escalation

# Security Strategies

## . . . besides cutting the wire

- Secure Communication

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## . . . besides cutting the wire

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- Hunt and kill unneeded services
- Application configuration
- Protective Mechanisms

# Identifying Weaknesses

## The key here is to strike a balance between security and useability

- Identify and categorize running services
  Are they *Really* needed?

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## The key here is to strike a balance between security and useability

- Identify and categorize running services
  Are they *Really* needed?
- Identify sensitive information
  Passwords, Data, etc.
- Identify protective mechanisms
  TCPwrappers, iptables, firewall, etc.

# Limiting Weaknesses

- Local weaknesses:

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- Limit use of installed privledged binaries

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# Finding services

## They *can't* hide!

- inetd(8) and xinetd(8) configuration files

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- lsof(8) -i

# Finding services

## They *can't* hide!

- inetd(8) and xinetd(8) configuration files
- chkconfig(8)
- init(8) scripts
- ps(1)
- lsof(8) -i
- nmap(1)

# Killing Services

- kill(1)

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# Killing Services

- kill(1)
- chkconfig(8)
- init(8) scripts
- inetd(8) and xinetd(8) configuration files
- chmod(1)

# Common Cluster Services

- Login Service(s)

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- Login Service(s)
- File Transfer Service(s)

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- Login Service(s)
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# Common Cluster Services

- Login Service(s)
- File Transfer Service(s)
- File Service(s)
- Time Service

# Common Cluster Services

- Login Service(s)
- File Transfer Service(s)
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# Common Cluster Services

- Login Service(s)
- File Transfer Service(s)
- File Service(s)
- Time Service
- Domain name service (DNS)
- Common Configuration Serices
  - DHCP
  - NIS

    or
  - LDAP
  - etc.

# Login Services

- rlogin, telnet, etc.

# Login Services

- rlogin, telnet, etc.
- SSH
  - Kerberized versions available
  - PKI (GSI) versions available

# SSH Key Setup

```
ssh-keygen -N "" -f /tmp/key
# if you want password-less access
cp --force /tmp/key /root/.ssh/identity
rm --force /tmp/key
cat /tmp/key.pub >>/nfs/shared/authorized_keys
pdsh "cp /nfs/shared/authorized_keys /root/.ssh/"
```

# Secure File Transfer

- scp(1)
  - Encrypted connections
  - Kerberized versions available
  - Uses ssh(1)

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- scp(1)
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  - Kerberized versions available
  - Uses ssh(1)
- sftp(1)
  - "Simular" to ftp(1)
  - Encrypted connections
  - Kerberized versions available
  - Uses ssh(1)
  - Clumsy!

# Secure X11 Connections

- Use ssh to “tunnel” X11 connections safely

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- Use ssh to "tunnel" X11 connections safely
- default ssh configuration files disable this
- To enable "X11 Forwarding":
  - In sshd_config add:
    `X11Forwarding yes`
  - In ssh_config add:
    `ForwardAgent yes`
    `ForwardX11 yes`

# Using my admin tools from home. . .

## SSH tunnels for the win!

- *EVERYONE* has used an X11 tunnel over SSH

# Using my admin tools from home...

## SSH tunnels for the win!

- *EVERYONE* has used an X11 tunnel over SSH
- Have you ever forwarded something else?

# Using my admin tools from home...

## SSH tunnels for the win!

- *EVERYONE* has used an X11 tunnel over SSH
- Have you ever forwarded something else?
- Run administration tools from "inside" the firewall, but still at home

# Using my admin tools from home...

## SSH tunnels for the win!

- *EVERYONE* has used an X11 tunnel over SSH
- Have you ever forwarded something else?
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# Network Topologies and Packet Filtering

- Public Network Topology
  VS.
- Private Network Toplogy

# Public Network Topology

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- Allows direct access to compute nodes
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- *ALL* nodes need packet filtering, security tweaks
- All nodes are potential targets
- Better network throughput

# Private Network Topology

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- Only login/admin nodes on public network
- Compute/storage nodes access outside network via NAT
- Difficult to allow outside access to compute nodes

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  Each packet is viewed as a part of a session
  iptables — Modern, *probably* in your kernel.
- You can filter based on:
  - Network interface
  - Protocol type
  - Source address and port
  - Destination address and port
  - Other parameters depending upon the protocol

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- Controlled by iptables on Linux

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- `iptables -A FORWARD -j REJECT`

# /proc Protections

## Turning on network stack security features

- Prevent address spoofing:

```
echo 0 > /proc/sys/net/ipv4/conf/*/accept_source_route
echo 1 > /proc/sys/net/ipv4/conf/*/rp_filter
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- Turn off bootp packet relaying
  ```
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  ```
- Ignore ICMP bad error responses
  ```
  echo 1 >
  /proc/sys/net/ipv4/icmp_ignore_bogus_error_responses
  ```

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  echo 1 >
  /proc/sys/net/ipv4/icmp_ignore_bogus_error_responses
  ```
- Enable syncookie protection
  ```
  echo 1 > /proc/sys/net/ipv4/tcp_syncookies
  ```

# Cluster-specific issues

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- Strategies:
  - Modify NIS maps
  - Modify /etc/passwd
  - PAM modules
    We (UNM HPC) use pam_pbssimpleauth distributed with TORQUE for most of our systems.

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- Job launch can't require passwords
- SSH can be used via RSAAuthentication (Public Key)
- Issues:
  - Management of host keys
  - Management of user keys

# RSA vs. DSA (the low–down)

"In DSA, signature generation is faster than signature verification, whereas with the RSA algorithm, signature verification is very much faster than signature generation. . . ."
(http://www.rsasecurity.com/rsalabs/faq/3-4-1.html)
In a nutshell:
RSA can be used for both encryption and digital signatures.
DSA is strictly a digital signature

# Checking Your Work

- nmap — port scanner

- Bugtraq — for the seriously hardcore
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- nmap — port scanner
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- Securityfocus.com
  - Search for your distribution & version
  - Compare vulnerabilties to services you run
  - Compare vulnerabilities to setuid/setgid binaries on your system
- Bugtraq — for the seriously hardcore
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# Finding listening services with lsof:

lsof shows which network files are open:

```
% lsof -i | awk '/LISTEN/ print $1,$(NF-2),$(NF-1)' | sort
| uniq
condor_ma TCP service0.nano.alliance.unm.edu:1026
identd TCP *:auth
inetd TCP *:ftp
inetd TCP *:globus-gatekeeper
inetd TCP *:gsiftp
inetd TCP *:klogin
inetd TCP *:kshell
inetd TCP *:login
inetd TCP *:netsaint_remote
```

# Finiding init.d started services:

To find the services that will be started by default at the current runlevel using /etc/rc.d/init.d scripts:

```
# chkconfig --list | grep `grep :initdefault:
/etc/inittab | awk -F: 'print $2'':on | awk 'print $1' |
sort | column
```

| | | |
|---|---|---|
| atd | isdn | random |
| autofs | keytable | reconfig |
| condorg | netfs | sendmail |
| crond | network | sshd |
| globus | nfslock | syslog |
| gm | pbs_mom | verifyd |

# Finding Network visible services

## Nmap is your friend!

To find services visible from the network:

```
other-host# nmap host-to-be-looked-at
Port       State   Service
21/tcp     open    ftp
22/tcp     open    ssh
23/tcp     open    telnet
111/tcp    open    sunrpc
113/tcp    open    auth
513/tcp    open    login
514/tcp    open    shell
1026/tcp   open    nterm
4321/tcp   open    rwhoisw
```

# Regression Testing

## Making sure stuff still works

Your regression tests should:

- Check your basic system components and tools

Jim's Rule:[4]
If the cluster doesn't work for your users, the cluster *doesn't work*!

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- Check your network(s)
- Check your important applications

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- Your regression tests should produce a summary of successes and failures — a report at the end.
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- Should the scripts attempt to repair any errors they find? (season to taste!)

# System/Node/Software Change Management Logs

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  *Where did I put that??!*
- Choose a tool that works well for the administrator(s) for the system in question.

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- ...but if you do, please consider keeping it under some sort of version control :)

# How to know when to upgrade, trade–offs

## The Great Balancing Act!

- Security upgrades
  VITAL: if you have security concerns!
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- Tracking OS development
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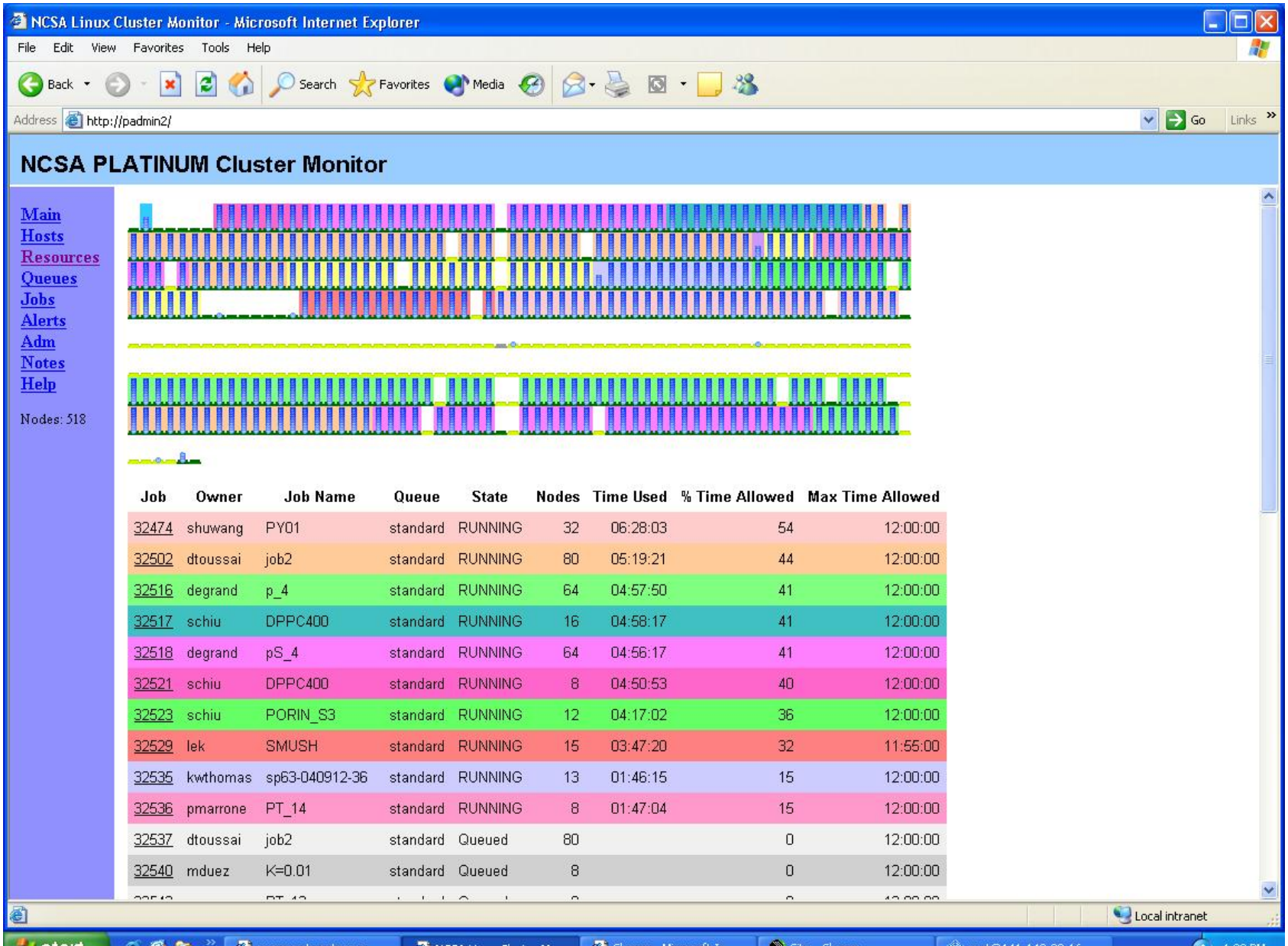
  - Upgrading several major versions is very painful!
  - Keep your upgrades *relatively* small
- Latest development may *not* be what you want!

# Clumon Information:

| **Vital Statistics:** | |
|---|---|
| Version: | 2.0 Alpha |
| Distribution Formats: | RPM,.tar.gz |
| URL: | http://clumon.ncsa.uiuc.edu/ |

# Clumon


NCSA Linux Cluster Monitor - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites Media
Address http://padmin2/
Go Links
NCSA PLATINUM Cluster Monitor
Main
Hosts
Resources
Queues
Jobs
Alerts
Adm
Notes
Help
Nodes: 518
Job Owner Job Name Queue State Nodes Time Used % Time Allowed Max Time Allowed
32474 shuwang PY01 standard RUNNING 32 06:28:03 54 12:00:00
32502 dtoussai job2 standard RUNNING 80 05:19:21 44 12:00:00
32516 degrand p_4 standard RUNNING 64 04:57:50 41 12:00:00
32517 schiu DPPC400 standard RUNNING 16 04:58:17 41 12:00:00
32518 degrand pS_4 standard RUNNING 64 04:56:17 41 12:00:00
32521 schiu DPPC400 standard RUNNING 8 04:50:53 40 12:00:00
32523 schiu PORIN_S3 standard RUNNING 12 04:17:02 36 12:00:00
32529 lek SMUSH standard RUNNING 15 03:47:20 32 11:55:00
32535 kwthomas sp63-040912-36 standard RUNNING 13 01:46:15 15 12:00:00
32536 pmarrone PT_14 standard RUNNING 8 01:47:04 15 12:00:00
32537 dtoussai job2 standard Queued 80 0 12:00:00
32540 mduez K=0.01 standard Queued 8 0 12:00:00
Local intranet

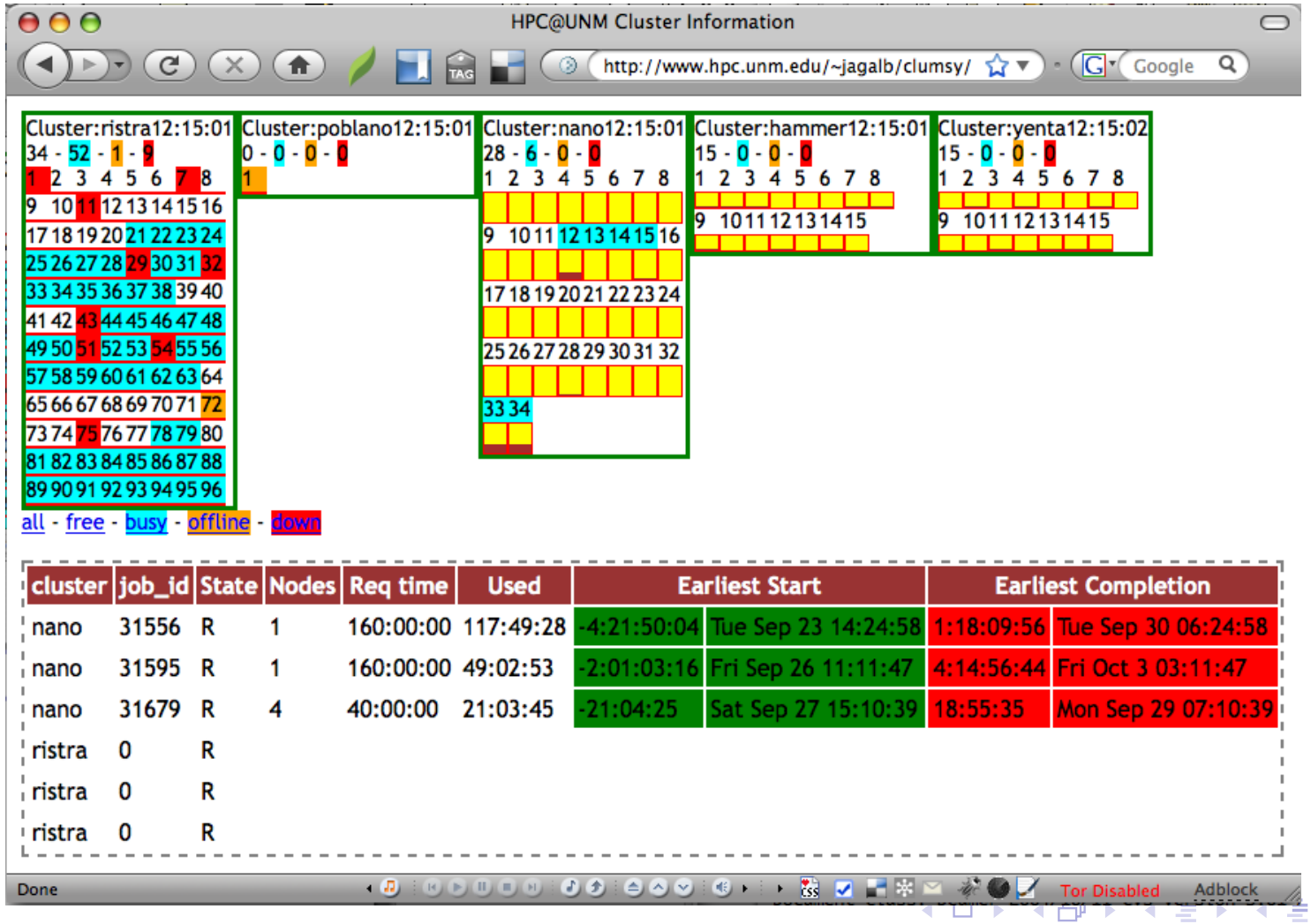
# cLUMSy Information:

| **Vital Statistics:** | |
|---|---|
| Version: | 0.0.0 |
| Distribution Formats: | UNRELEASED Bug Jim |

# cLUMSy

## The Lightweight Universal Monitoring System

... a work in progress ...



# Ganglia Information:

| **Vital Statistics:** | |
|---|---|
| Version: | 3.1.1 |
| Distribution Formats: | RPM,.tar.gz |
| URL: | http://ganglia.info/ |

# Ganglia


Ganglia:: Altix ICE Grid Report
http://pq-admin.alliance.unm.edu/ganglia/
Altix ICE Grid Report for Sun, 28 Sep 2008 13:52:32 -0600
Get Fresh Data
Last hour
Sorted descending
Altix ICE Grid > --Choose a Source
Altix ICE Grid (2 sources) (tree view)
CPUs Total: 94
Hosts up: 13
Hosts down: 0
Avg Load (15, 5, 1m): 0%, 0%, 0%
Localtime: 2008-09-28 13:52
Altix ICE Grid Load last hour
Load/Procs
1-min Load Nodes CPUs Running Processes
Altix ICE Grid Memory last hour
Bytes
Memory Used Memory Shared Memory Cached
Memory Buffered Memory Swapped
Total In-Core Memory
SERVICE NODES (physical view)
CPUs Total: 2
Hosts up: 1
Hosts down: 0
Avg Load (15, 5, 1m): 1%, 4%, 5%
Localtime: 2008-09-28 13:52
SERVICE NODES Load last hour
SERVICE NODES Memory last hour
Rack 1 (physical view)
CPUs Total: 92
Hosts up: 12
Rack 1 Load last hour
Rack 1 Memory last hour
Done
Tor Disabled
Adblock