Cluster Management

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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
- 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
- Maui Scheduler
- c3
- LAM/MPI
- MPICH
- OpenMPI
- OPIUM (OSCAR User Management software)
- pFilter (Packet filtering)
- PVM
- System Imager Suite (SIS)
- Switcher Environment Switcher

OSCAR Supported Linux Distributions

- RedHat Enterprise Linux 4
- RedHat Enterprise Linux 5
- 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 / !
- Create repositories for SystemInstaller
  ```
  # mkdir /tftpboot
  # mkdir /tftpboot/oscar
  # mkdir /tftpboot/distro
  # mkdir /tftpboot/distro/OS-version-arch
  ```
- 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
- 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
  ```

[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

OSCAR Server Node Network Configuration

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

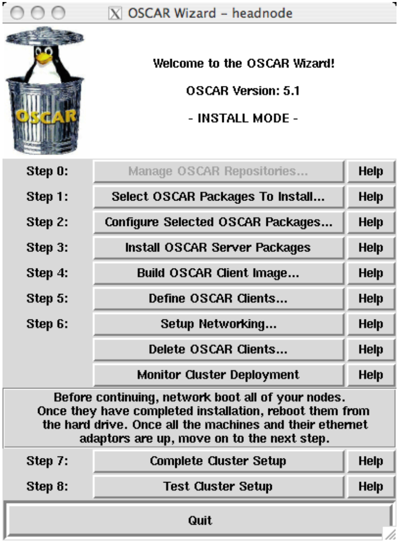
This will:

- 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.

The OSCAR Installation Wizard:

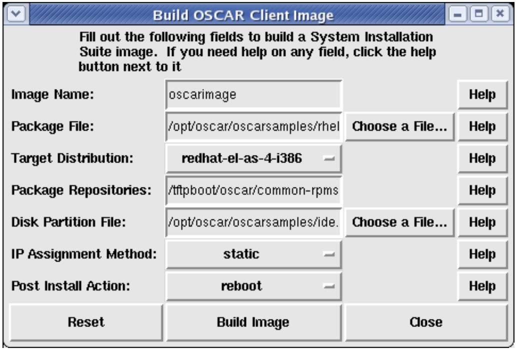
- Select your packages
- Configure the packages
- Install the Server packages
- Build an image for the compute nodes
- Define the compute nodes
- Configure networking
- Complete the setup
- Test the cluster!


OSCAR Wizard – headnode
OSCAR
Welcome to the OSCAR Wizard!
OSCAR Version: 5.1
- INSTALL MODE -
Step 0: Manage OSCAR Repositories... Help
Step 1: Select OSCAR Packages To Install... Help
Step 2: Configure Selected OSCAR Packages... Help
Step 3: Install OSCAR Server Packages Help
Step 4: Build OSCAR Client Image... Help
Step 5: Define OSCAR Clients... Help
Step 6: Setup Networking... Help
Delete OSCAR Clients... Help
Monitor Cluster Deployment Help
Step 7: Complete Cluster Setup Help
Step 8: Test Cluster Setup Help
Quit

Before continuing, network boot all of your nodes. Once they have completed installation, reboot them from the hard drive. Once all the machines and their ethernet adaptors are up, move on to the next step.

Build Client Image

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



Fill out the following fields to build a System Installation Suite image. If you need help on any field, click the help button next to it

Image Name:	oscarimage		Help
Package File:	/opt/oscar/oscarsamples/rhel	Choose a File...	Help
Target Distribution:	redhat-el-as-4-i386		Help
Package Repositories:	/tftpboot/oscar/common-rpms		Help
Disk Partition File:	/opt/oscar/oscarsamples/ide.	Choose a File...	Help
IP Assignment Method:	static		Help
Post Install Action:	reboot		Help

Define OSCAR Clients (Compute Nodes)

- Pick the image to install
- Specify the domain name
- Specify the base hostname
- Specify the number of hosts
- Specify first number to append to the base hostname
- Specify the "padding"
- Specify the starting IP
- Specify the subnet mask
- Specify the default gateway

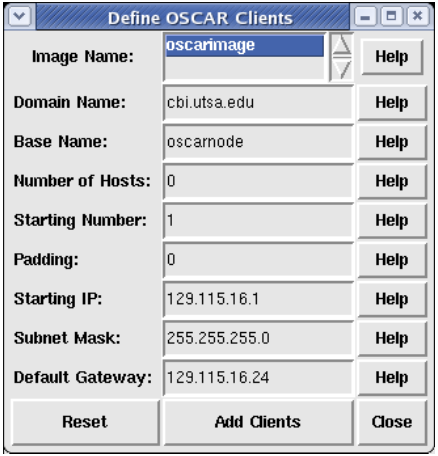
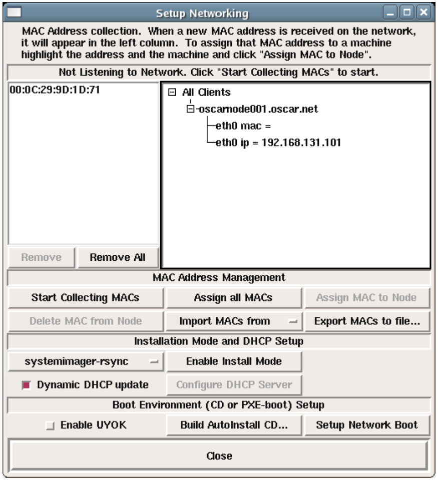


Image Name:	oscarimage
Domain Name:	cbi.utsa.edu
Base Name:	oscarnode
Number of Hosts:	0
Starting Number:	1
Padding:	0
Starting IP:	129.115.16.1
Subnet Mask:	255.255.255.0
Default Gateway:	129.115.16.24

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

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)



Setup Networking

MAC Address collection. When a new MAC address is received on the network, it will appear in the left column. To assign that MAC address to a machine highlight the address and the machine and click "Assign MAC to Node".

Not Listening to Network. Click "Start Collecting MACs" to start.

00:0C:29:9D:1D:71

All Clients
oscarnode001.oscar.net
eth0 mac =
eth0 ip = 192.168.131.101

Finishing Up!

- Go to “Monitor Cluster Deployment” to monitor the progress of the installation.
- Reboot the compute nodes.
- Go to “Complete Cluster Setup”
- Run the OSCAR Test suite (unless you’re feeling brave!)
- Enjoy your new cluster!

Really, Its *that* simple!

- OSCAR comes with quite a few “standard” cluster packages.
- OSCAR uses SystemImager
- SystemImager is Good ^{TM}
- 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/`

ROCKS cluster distribution features:

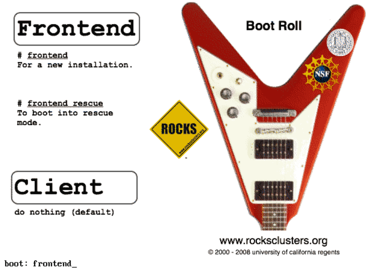
- Supports X86, X86_64 processors
- Supports Ethernet networks
- Supports Specialized networks and components (Myrinet, Infiniband, nVidia GPU)

Beginning the ROCKS Installation

For the Installation, you will need:

- Kernel/Boot Roll CD
- Base Roll CD
- Web Server Roll CD
- OS Roll CD - Disk 1
- OS Roll CD - Disk 2 OR
- ALL Red Hat Enterprise Linux 5 update CDs
- ALL CentOS 5 update 1 CDs
- ALL Scientific Linux 5 update 1 CDs

- Boot the "Kernel/Boot Roll CD" on the server
- You should see:



```
Frontend
# frontend
For a new installation.

# frontend rescue
To boot into rescue
mode.

Client
do nothing (default)

boot: frontend_
```

- 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!

What is “Change Control”?

- 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?

- 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
- 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!

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

PDSH Node Specification

- 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
- 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" "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
- 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)

- 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
  ```
- 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.
- */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
- 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"
- 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}}'
- 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.
- "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"
- 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"
- Meta-characters:
- {}[]()^$.|*+?\

Regular Expression Meta-characters

- . matches any single character
- * match the previous thing 0 or more times
- + match the previous thing 1 or more times
- ? match the previous thing 1 or 0 times
- ^ 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
- {n,} match the previous thing at least “n” times
- {n,m} match the previous thing at least “n” times, but not more than “m” times
- () 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
- 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
- Resource thieves
- Hackers there for various reasons
- Curies script kiddies
- Malicious script kiddies

Attack Vectors

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

Security Strategies

. . . besides cutting the wire

- Secure Communication
- 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?
- Identify sensitive information
  Passwords, Data, etc.
- Identify protective mechanisms
  TCPwrappers, iptables, firewall, etc.

Limiting Weaknesses

- Local weaknesses:
- Limit use of installed privledged binaries
- Removed setuid/setgid bits
- If you don't use it, get rid of it!
- Remote weaknesses:
- Close unused ports
- Limit access to ports
- If you don't use it, get rid of it!

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

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.
- 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)
- 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
- 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
- Have you ever forwarded something else?
- Run administration tools from "inside" the firewall, but still at home
- Forward arbitrary ports – Encrypted!
- ssh -v -L local-port:remote-machine:remote-port local-machine -l root
- ssh -v -L 1178:service1:1178 pq-admin.alliance.unm.edu -l root

Network Topologies and Packet Filtering

- Public Network Topology
  VS.
- Private Network Toplogy

Public Network Topology

The *easy* way. . .

- Simpler to set up
- Allows direct access to compute nodes
- Worse overall cluster security
- *ALL* nodes need packet filtering, security tweaks
- All nodes are potential targets
- Better network throughput

Private Network Topology

Might be worth the extra headache

- Better security for entire cluster
- Relaxed security on compute nodes
- Only login/admin nodes on public network
- Compute/storage nodes access outside network via NAT
- Difficult to allow outside access to compute nodes

Packet Filtering

- Stateless:
  Each packet is handled individually
  ipchains — (OLD!!! *NOBODY uses this anymore!*)
- Stateful:
  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

Stateful Packet Filtering

- Keeps track of active connections
- Examines each packet based on their context
- Can provide a more useable system
- Controlled by iptables on Linux

Protecting a single machine with IPtables
We're *not* doing NAT

- `iptables -A INPUT -m state ESTABLISHED,RELATED -j ACCEPT`
- `iptables -A INPUT -p tcp --destination-port ssh -j ACCEPT`
- `iptables -A INPUT -j REJECT`

Protecting a network with IPtables

Hiding your cluster behind a NAT

- `iptables -A INPUT -p tcp --destination-port ssh -j ACCEPT`
- `iptables -A INPUT -m state --state ESTABLISHED,RELATED -j ACCEPT`
- `iptables -A INPUT -i INTERNAL_INTERFACE -m state --state NEW -j ACCEPT`
- `iptables -A INPUT -j REJECT`
- `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
  echo 1 > /proc/sys/net/ipv4/conf/*/log_martians
  ```
- Disable ICMP redirects
  ```
  echo 0 > /proc/sys/net/ipv4/conf/*/accept_redirects
  ```
- Turn off bootp packet relaying
  ```
  echo 0 > /proc/sys/net/ipv4/conf/*/bootp_relay
  ```
- Ignore ICMP bad error responses
  ```
  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

- System backdoors:
  - cron
  - at
- One user per node guarantee
- Passwordless authentication

One user per node

...or the right number of users per node

- Compute nodes should be wholly allocated to the user(s) that the scheduler has given them to
- Only the scheduler knows who owns the nodes
- Strategies:
  - Modify NIS maps
  - Modify /etc/passwd
  - PAM modules
    We (UNM HPC) use pam_pbssimpleauth distributed with TORQUE for most of our systems.

Passwordless Authentication

- 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
- Nessus — vulnerability scanner
- 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
  The up-and-coming info in the security world

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

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

[4] Jim learned this the hard way!

You're mostly on your own :P

... but its just some shell scripts...

- You can use tools like Cfengine to automate some of your regression testing
- Your regression tests should be easy to run
- Your regression tests should produce a summary of successes and failures — a report at the end.
- Consider a suite of shell scripts
- Should the scripts attempt to repair any errors they find? (season to taste!)

System/Node/Software Change Management Logs

- Change management logs *will* save your backside!
- System administrators can be sloppy! :P :)
  Where did I put that??!
- Choose a tool that works well for the administrator(s) for the system in question.

Where to keep Change Management Logs?

Somewhere that you will actually keep them!

- A Wiki of some kind
- Emacs outline mode is nice!
- Really, whatever works for you and your staff!
- I've seen sites alias editor commands in root's environment to require the admin to make a change management log when s/he edits a config file.
- I won't tell if you're using a plain ASCII text file :)
- ...but if you do, please consider keeping it under some sort of version control :)

How to know when to upgrade, trade–offs

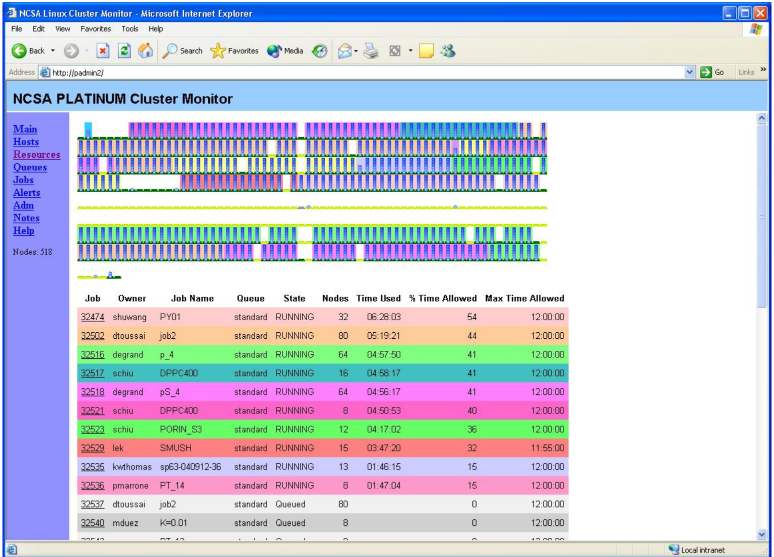
The Great Balancing Act!

- Security upgrades
  VITAL: if you have security concerns!
  VITAL: if you have ****A NETWORK CONNECTION!*****
- Required features
  - Things needed to enhance the useability/stability of the system
  - Software required by the users
- Tracking OS development
  - You don't want to fall *too* far behind
  - 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
Local intranet

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

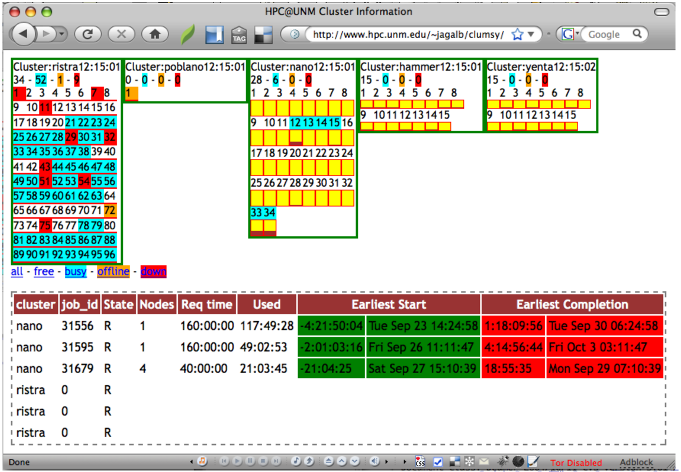
cLUMSy Information:

Vital Statistics:	
Version:	0.0.0
Distribution Formats:	UNRELEASED Bug Jim

cLUMSy

The Lightweight Universal Monitoring System

… a work in progress …


HPC@UNM Cluster Information
http://www.hpc.unm.edu/~jagalb/clumsy/
Google
Done
Tor Disabled
Adblock

Cluster:ristra12:15:01
34 - 52 - 1 - 9
1 2 3 4 5 6 7 8
9 10 11 12 13 14 15 16
17 18 19 20 21 22 23 24
25 26 27 28 29 30 31 32
33 34 35 36 37 38 39 40
41 42 43 44 45 46 47 48
49 50 51 52 53 54 55 56
57 58 59 60 61 62 63 64
65 66 67 68 69 70 71 72
73 74 75 76 77 78 79 80
81 82 83 84 85 86 87 88
89 90 91 92 93 94 95 96

Cluster:poblano12:15:01
0 - 0 - 0 - 0
1

Cluster:nano12:15:01
28 - 6 - 0 - 0
1 2 3 4 5 6 7 8
9 10 11 12 13 14 15 16
17 18 19 20 21 22 23 24
25 26 27 28 29 30 31 32
33 34

Cluster:hammer12:15:01
15 - 0 - 0 - 0
1 2 3 4 5 6 7 8
9 10 11 12 13 14 15

Cluster:yenta12:15:02
15 - 0 - 0 - 0
1 2 3 4 5 6 7 8
9 10 11 12 13 14 15

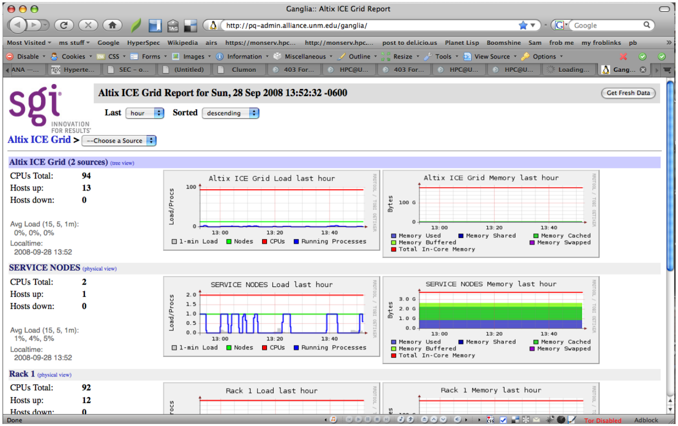
all - free - busy - offline - down

cluster	job_id	State	Nodes	Req time	Used	Earliest Start		Earliest Completion	
nano	31556	R	1	160:00:00	117:49:28	-4:21:50:04	Tue Sep 23 14:24:58	1:18:09:56	Tue Sep 30 06:24:58
nano	31595	R	1	160:00:00	49:02:53	-2:01:03:16	Fri Sep 26 11:11:47	4:14:56:44	Fri Oct 3 03:11:47
nano	31679	R	4	40:00:00	21:03:45	-21:04:25	Sat Sep 27 15:10:39	18:55:35	Mon Sep 29 07:10:39
ristra	0	R							
ristra	0	R							
ristra	0	R							

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

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

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

Rack 1 (physical view)

CPUs Total:	92
Hosts up:	12
Hosts down:	0

Get Fresh Data
INNOVATION FOR RESULTS
Altix ICE Grid Load last hour
Altix ICE Grid Memory last hour
SERVICE NODES Load last hour
SERVICE NODES Memory last hour
Rack 1 Load last hour
Rack 1 Memory last hour
Load/Procs
Bytes
13:00
13:20
13:40
□ 1-min Load 🟩 Nodes 🟥 CPUs 🟦 Running Processes
🟦 Memory Used 🟦 Memory Shared 🟩 Memory Cached
🟩 Memory Buffered 🟪 Memory Swapped
🟥 Total In-Core Memory
Done
Tor Disabled
Adblock