installation administration and monitoring of beowulf clusters using open source tools

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invent

topics to be covered:

- beowulf cluster definition
- cluster administration philosophy
- installation flowchart
  - uniform compute node installation
    - systemimager
  - cluster wide monitoring
    - netsaint

topics not to be covered:

- cluster architecture
- applications
- job scheduling
- other tools

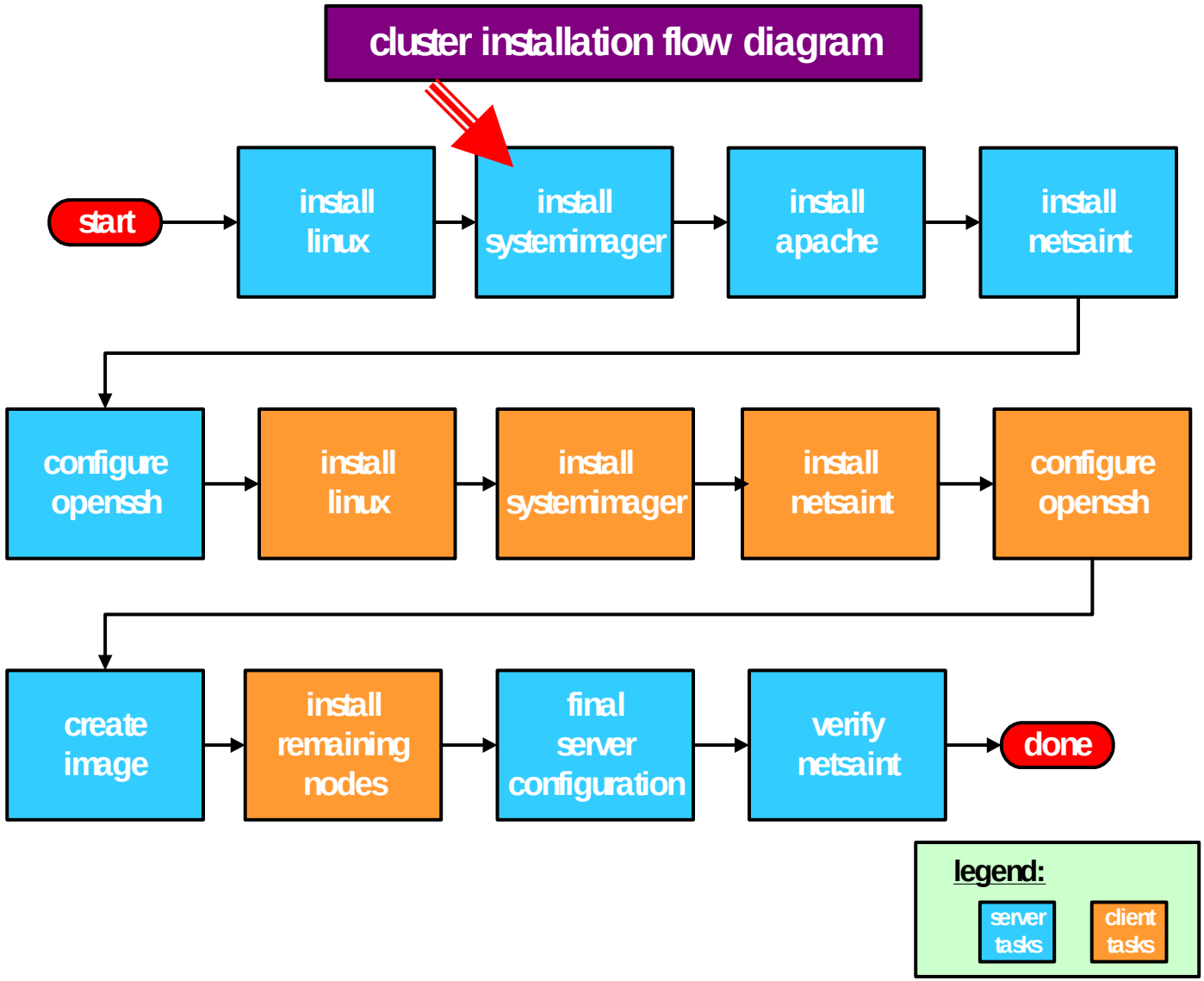
What is a Beowulf Cluster?

A kind of high performance, massively parallel computer, interconnected by a private, high-speed network. It consists of a cluster of PCs or workstations dedicated to running high-performance computing tasks. The nodes in the cluster don't sit on people's desks; they are dedicated to running cluster jobs. It is usually connected to the outside world through only a single node.

maintain a consistent OS image across all nodes in the cluster via a network based OS image distribution utility. Why?

cluster administration philosophy

- **ease of administration**
- **predictable performance**
- **predictable results**
- **application debugging**


cluster installation flow diagram
start
install linux
install systemimager
install apache
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create image
install remaining nodes
final server configuration
verify netsaint
done
legend:
server tasks
client tasks

systemimager for linux

- http://www.systemimager.org
- general purpose golden image distribution utility
- linux distribution independent
- provides unattended, across network installations
- provides unattended across network image update capability
- version 2.0.1 is included on the accompanying CD for the course in `RPMS/si_client` and `RPMS/si_server` directories

systemimager setup steps

- server installation
- master client installation
- image creation process
- image distribution process

A detailed set of installation steps are included in a cluster “how-to” document in the `docs` directory on the course CD

systemimager server installation

download and install the following rpms:

systemimager rpms:

- **systemimager-server**
- **systemimager-common**
- **systemimager-i386**

other required rpms:

- **libappconfig-perl**
- **nasm**
- **rsync**
- **syslinux**
- **systemconfigurator**

systemimager server installation (continued)

additional server preparation:

```
# addclients
```

a series of questions will be used to create a range of hostnames:

```
What is your domain name? []:
    cluster.com
What is the base host name that you
    want me to use? []: compute
What number should I begin with? []: 1
What number should I end with? []: 99
```

the result will be a series of hostnames that looks like this:

```
compute1.cluster.com
compute2.cluster.com
compute3.cluster.com
compute4.cluster.com
```

Answer “yes” to the question about creating links to master script and choose the image to install for these systems

systemimager server installation (continued)

still in `addclients`:

answer “yes” to the question to create entries in `/etc/hosts`

```
The first host in subnet 1 will be:
    compute1
What is the starting IP address for
    subnet 1? []: 192.168.1.1
What is the ending IP address? []:
    192.168.1.99
```

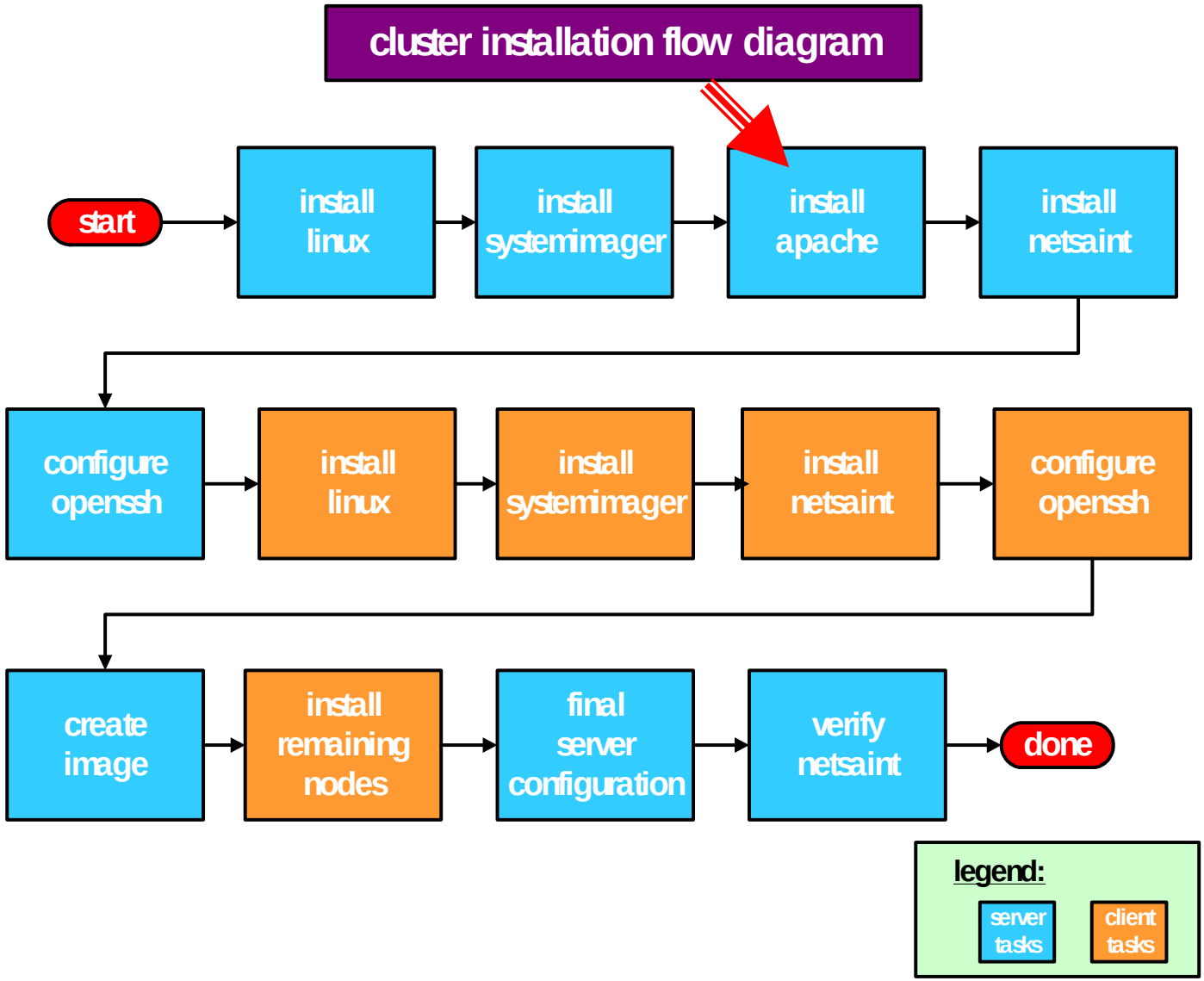
run `mkdhcpserver`

note: when answering questions be sure to provide the same information as used in the `addclients` script

edit `clusterenv.sh`

- sipath, admin node name, golden image name

run `mkclienttab`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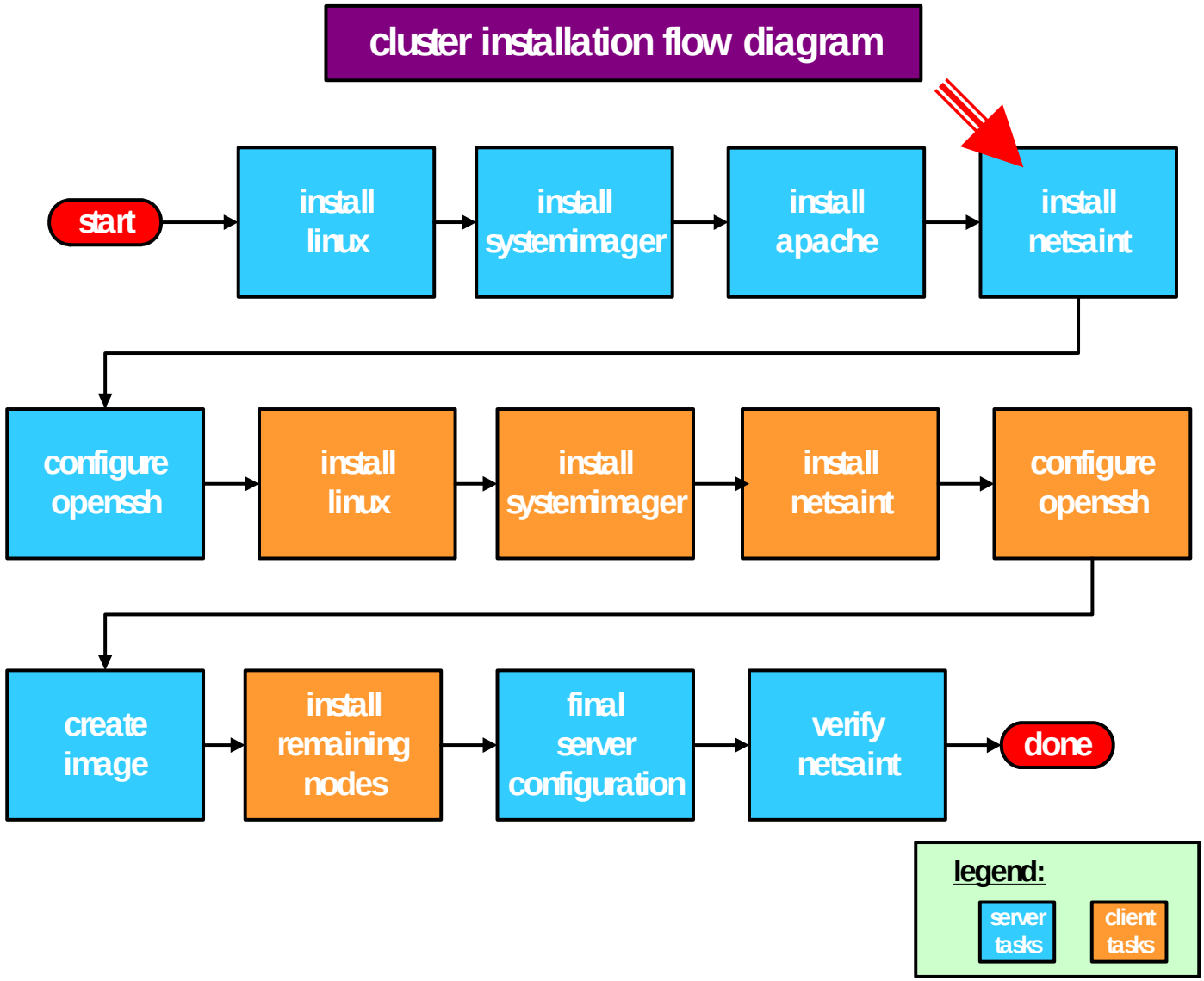
install and configure apache

- assuming you installed the apache rpms when you installed your server machine you only need to turn on the daemon:

```
# chkconfig --level 2345 httpd on
```

- netsaint requires modifications to a number of apache configuration files see the cluster “how-to” document on the course CD in directory `docs` or the netsaint installation guide for details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netsaint for linux

- http://www.netsaint.org
- monitors hosts and services including disk, memory usage, processes, log files, etc
- OS independent
- netsaint can email or page when a problem shows up
- can automatically run scripts when a problem shows up
- version 2.0.1 is included on the accompanying CD for the course in `RPMS/netsaint` directories

netsaint setup steps

- install and configure apache
- install and configure netsaint server
- install and configure netsaint client

install and configure netsaint server

- add a user to administer netsaint

```
# adduser netsaint
```

- download the netsaint tar ball into the `/home/netsaint` directory
- unpack the distribution
- build and install the software

```
# cd netsaint-0.0.6
# ./configure
# make all
# make install
# make install-config
# make install-daemoninit
```

- setup apache authenticated users

```
 # htpasswd –c \
/usr/local/netsaint/etc/htpasswd.users \
netsaintadmin
```

install and configure netsaint server (continued)

- run netsaint configuration script from course CD `tools/` directory

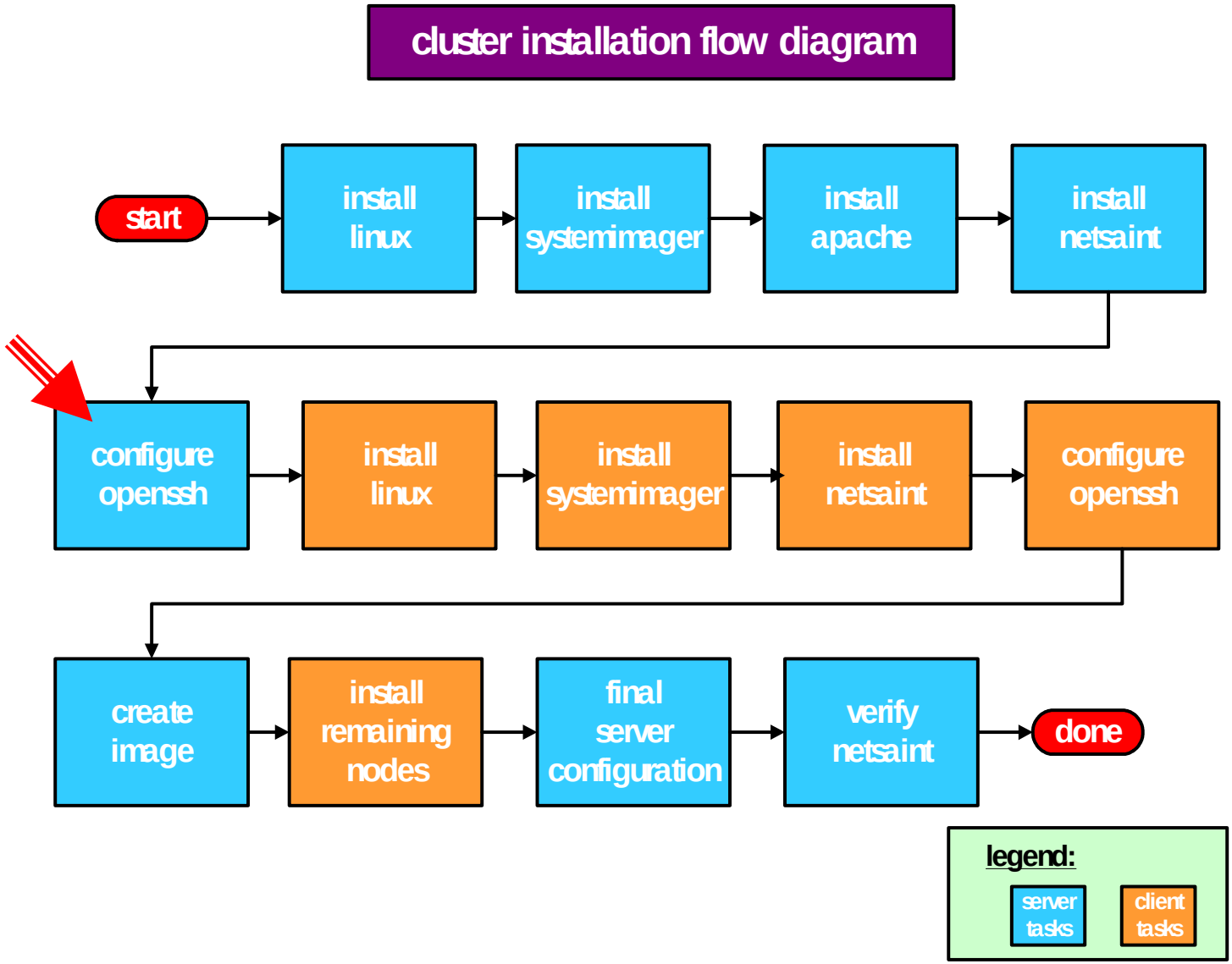
```
# mknetsaint.cfg
```

- install netsaint plugins from course CD `RPMS/netsaint` directory onto server

```
# cd /
# tar xvf netsaint-plugins.tar
```

- start netsaint daemon process on server

```
# service netsaint start
```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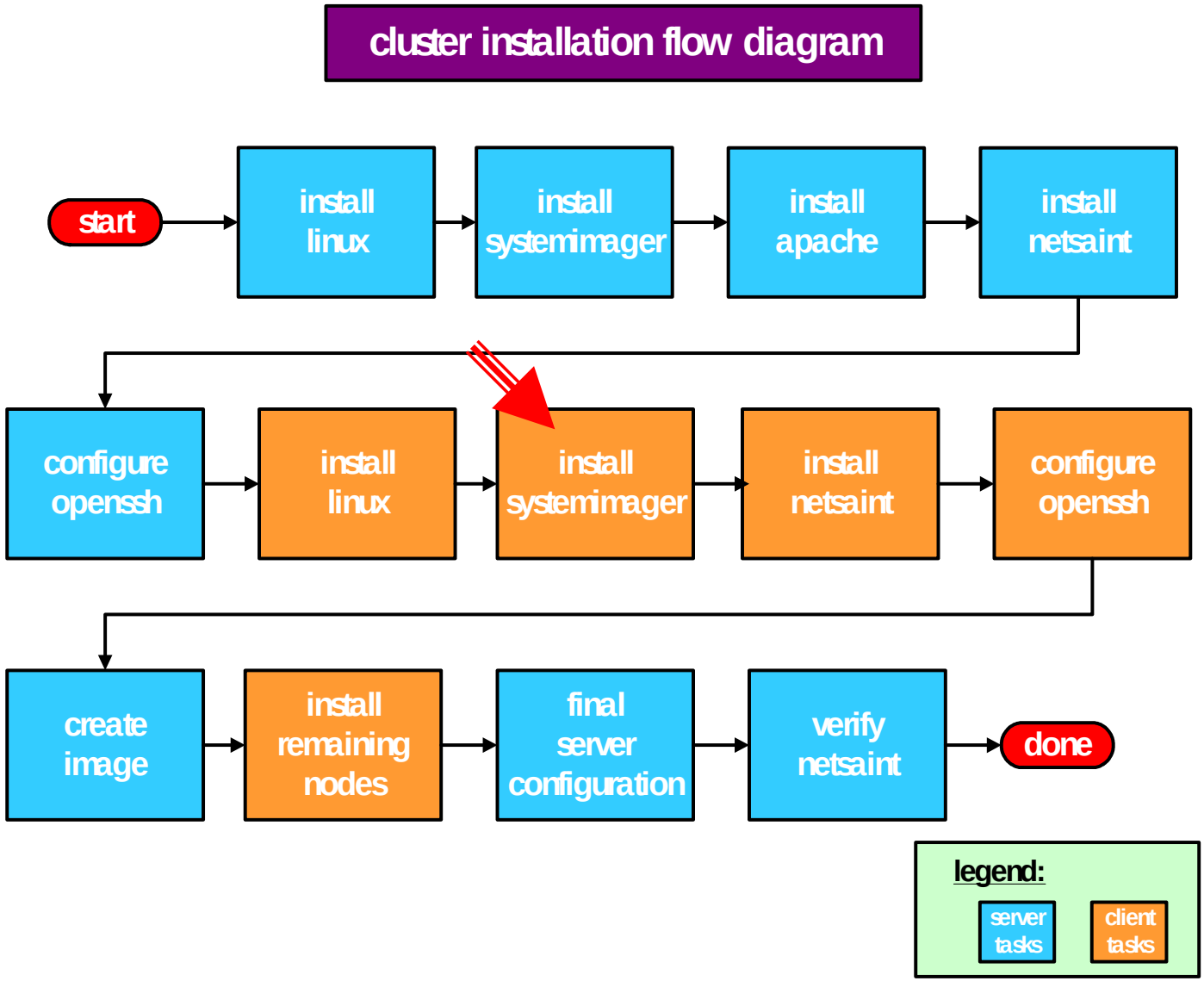
configure openssh on admin node

- verify that sshd daemon is running
- generate ssh keys for users root and netsaint

```
# ssh-keygen –t rsa
```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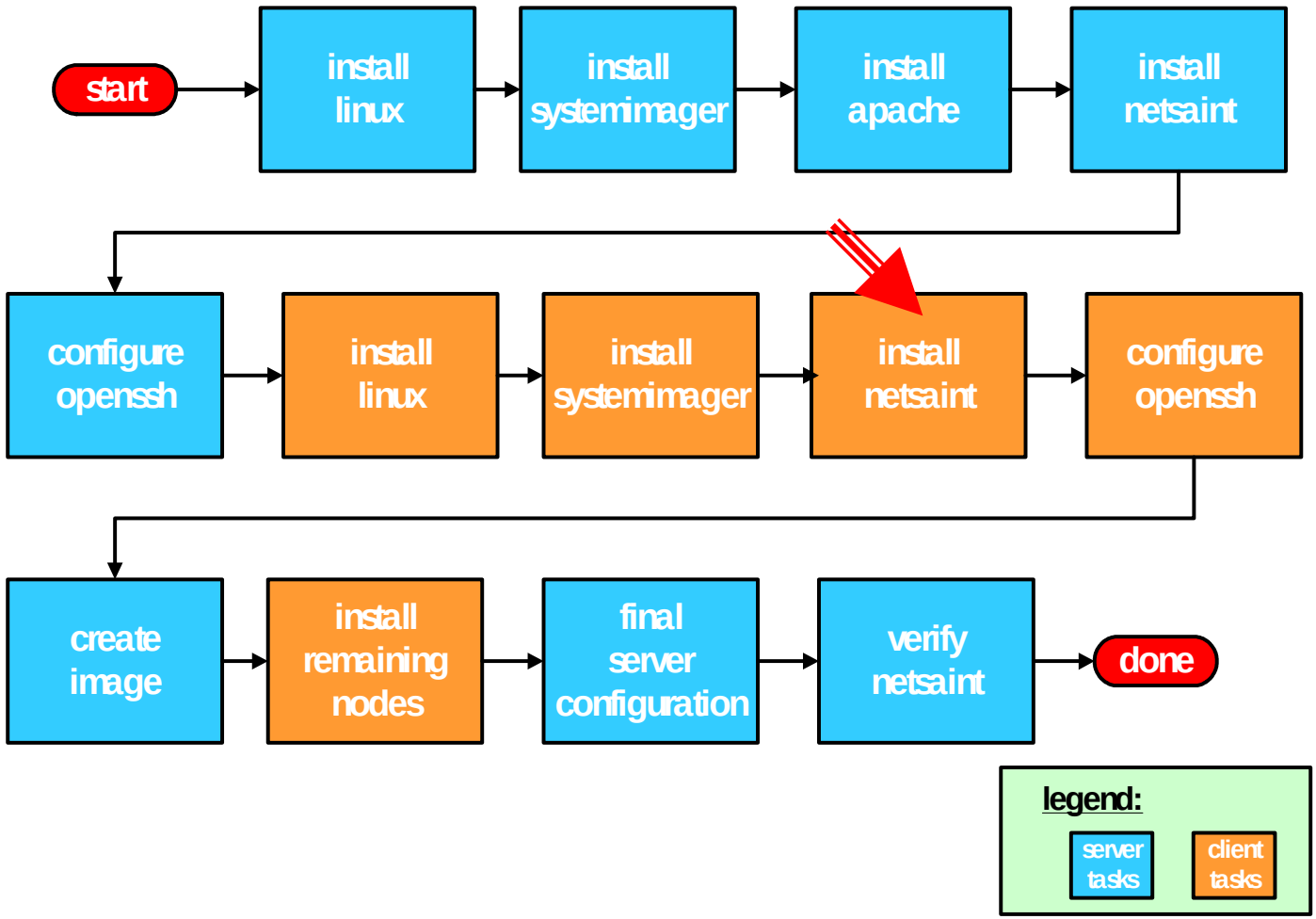
systemimager master client installation

- install the linux of your choice on your master client
- download and install the following rpms:
- systemimager rpms:
  - systemimager-client
  - systemimager-common
- other required rpms:
  - libappconfig-perl
  - nasm
  - rsync
  - syslinux
  - systemconfigurator
- run `prepareclient`

cluster installation flow diagram

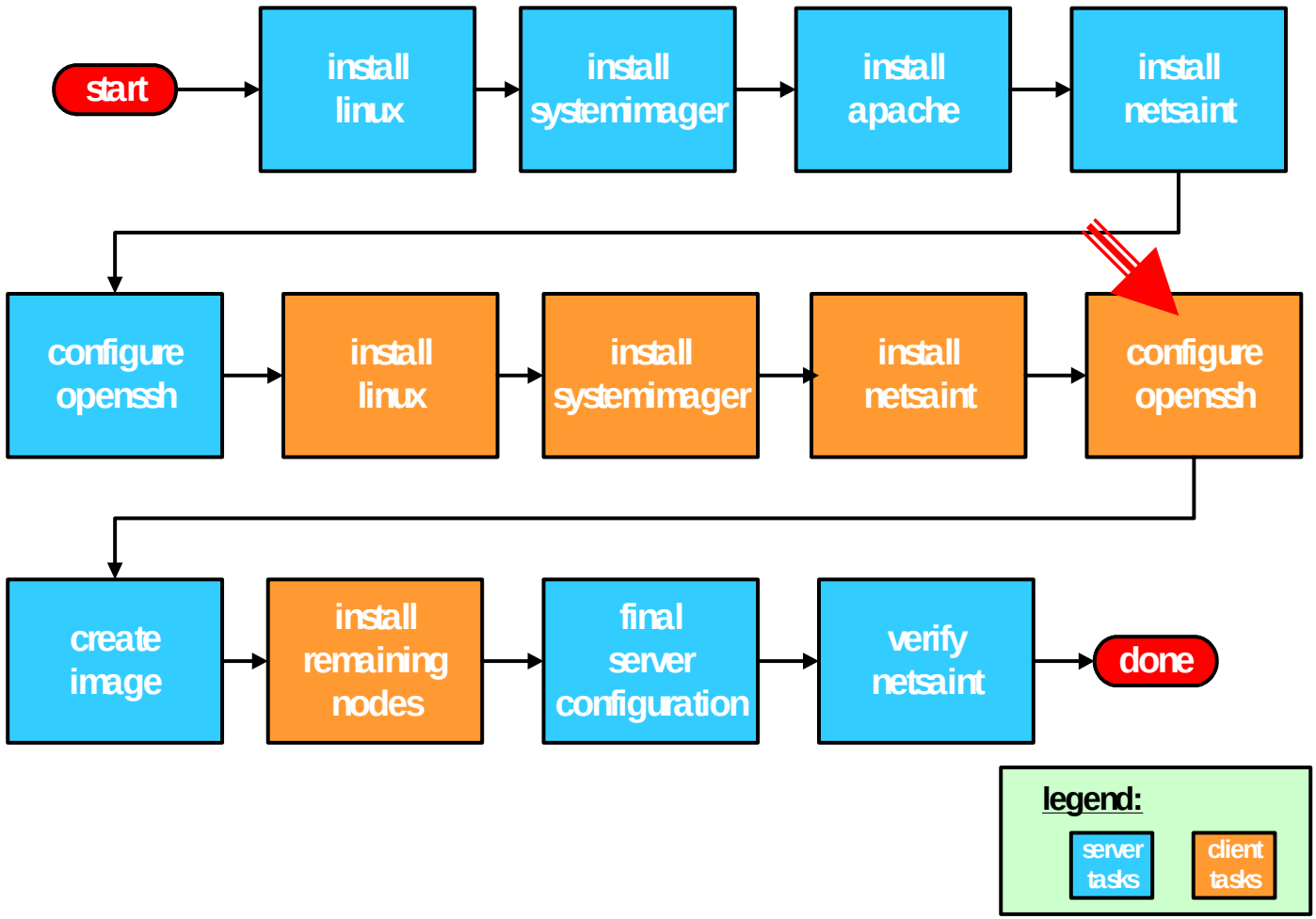


install and configure netsaint client

- `adduser netsaint`
- install netsaint plugins from course CD `RPMS/netsaint` directory onto each client
- restart netsaint daemon process on server

```
# service netsaint restart
```

cluster installation flow diagram



configure openssh on master client

- generate ssh keys for users root and netsaint

```
# ssh-keygen –t rsa
```

- enable password-less access to client node from admin node for users root and netsaint

```
# scp $SERVER:$HOME/.ssh/id_rsa.pub \
 $HOME/.ssh/authorized_keys2
```

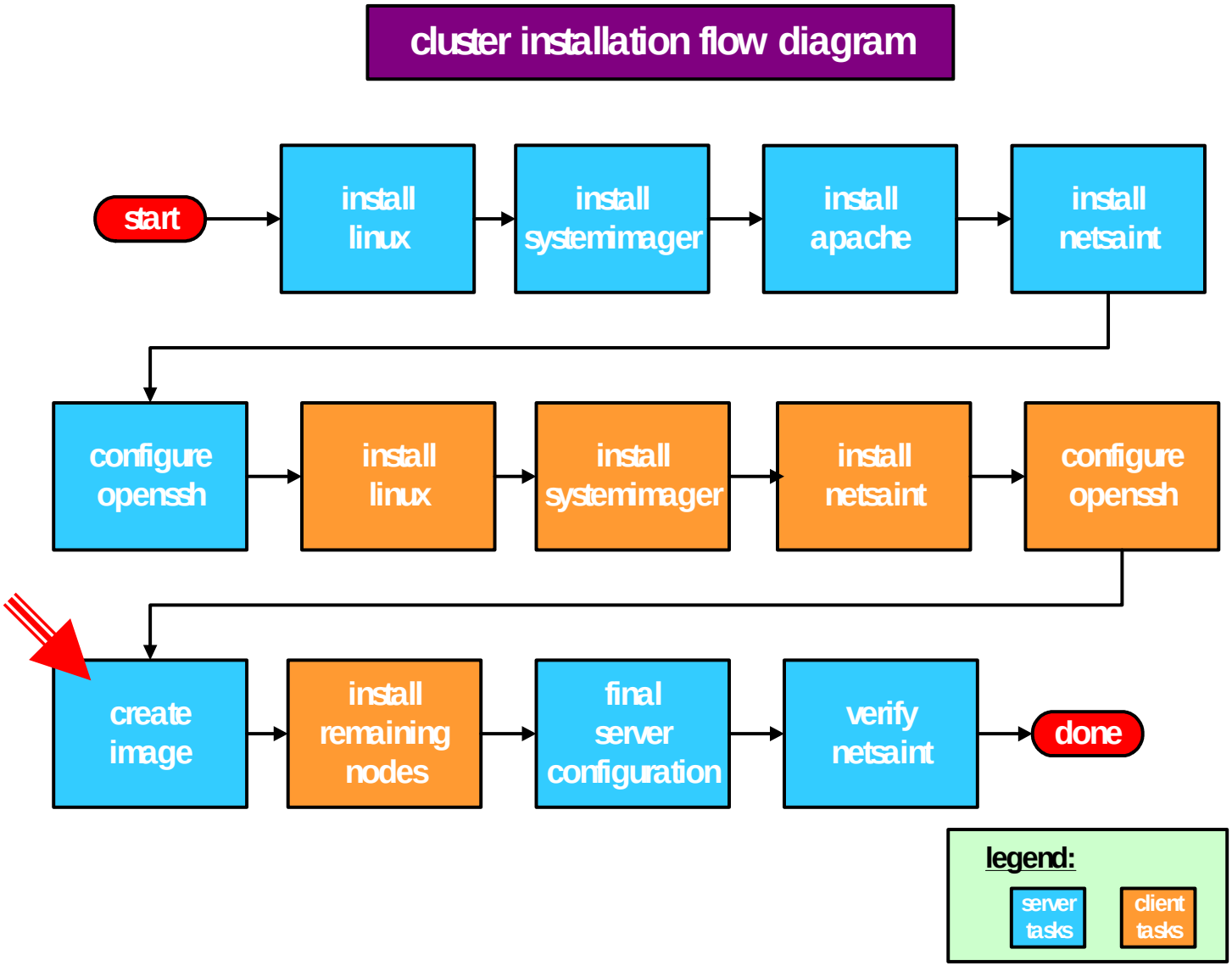

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image creation process

on systemimager server run:

```
# getimage –g $GOLDEN_CLIENT \
  –image $IMAGE_NAME \
  –post reboot
```

at the end of `getimage`, you will be asked for IP address assignment method. select `static_dhcp` (cf. `dynamic_dhcp|static|replicant`)

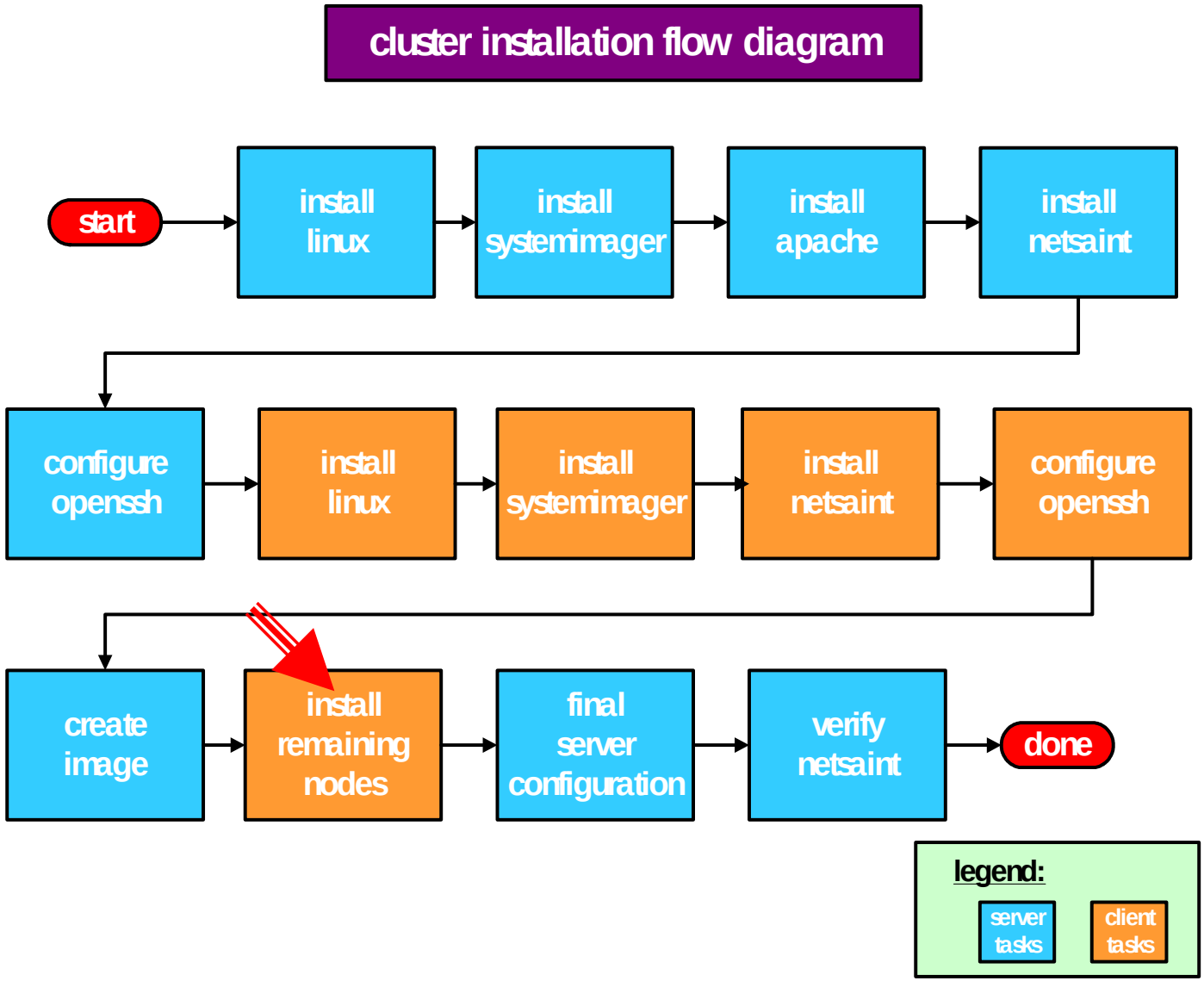
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image distribution process

install remaining compute nodes:

Option1: linux not currently installed on disk

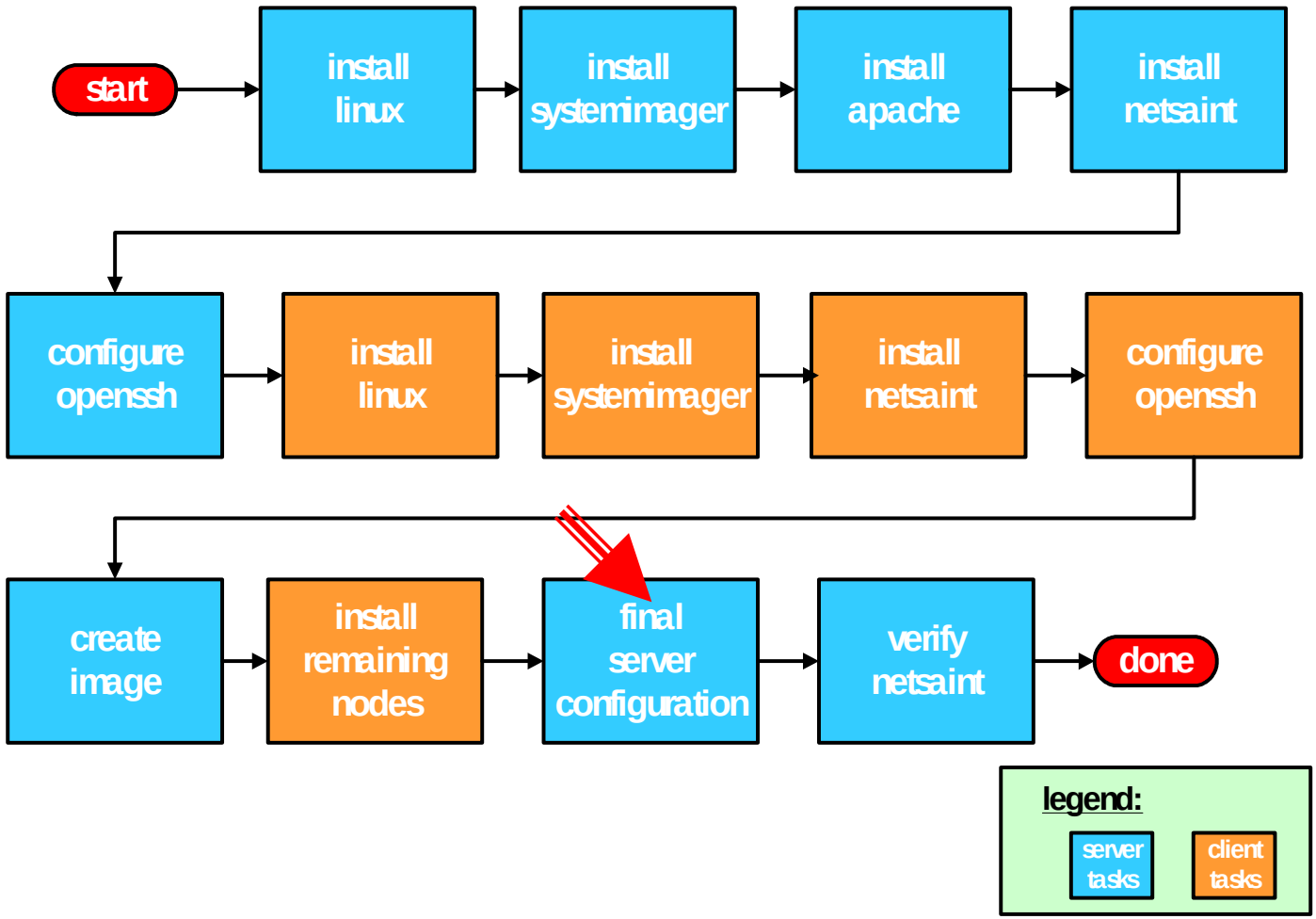
Run `mkautoinstalldiskette` or `mkautoinstallcd` on the systemimager server and boot each node off the resulting media

Option2: linux already installed on disk

Copy over and then run `updateclient` on each node in the cluster

```
# updateclient –autoinstall \
      -server $SERVER_NAME\
      -reboot
```

cluster installation flow diagram

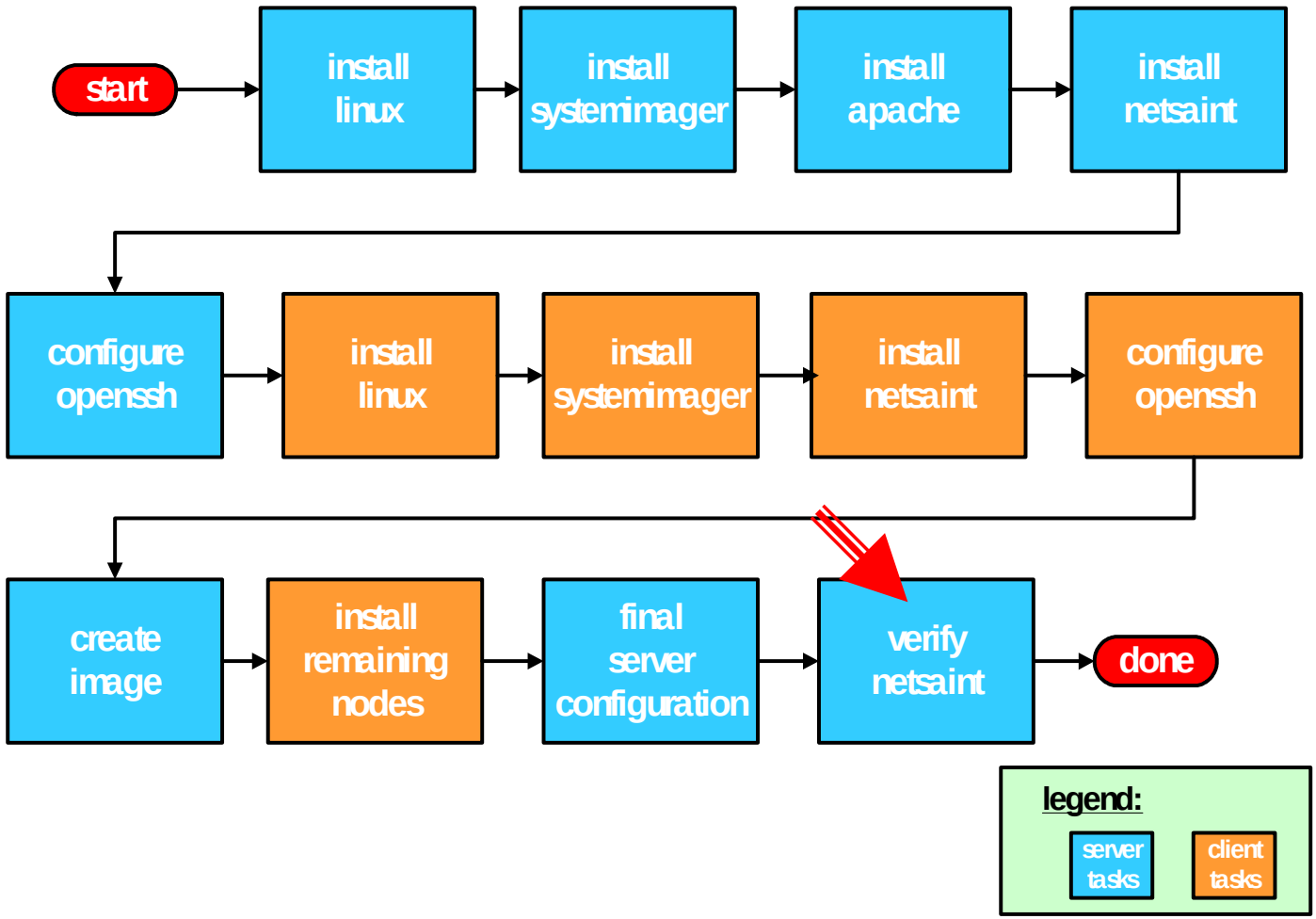


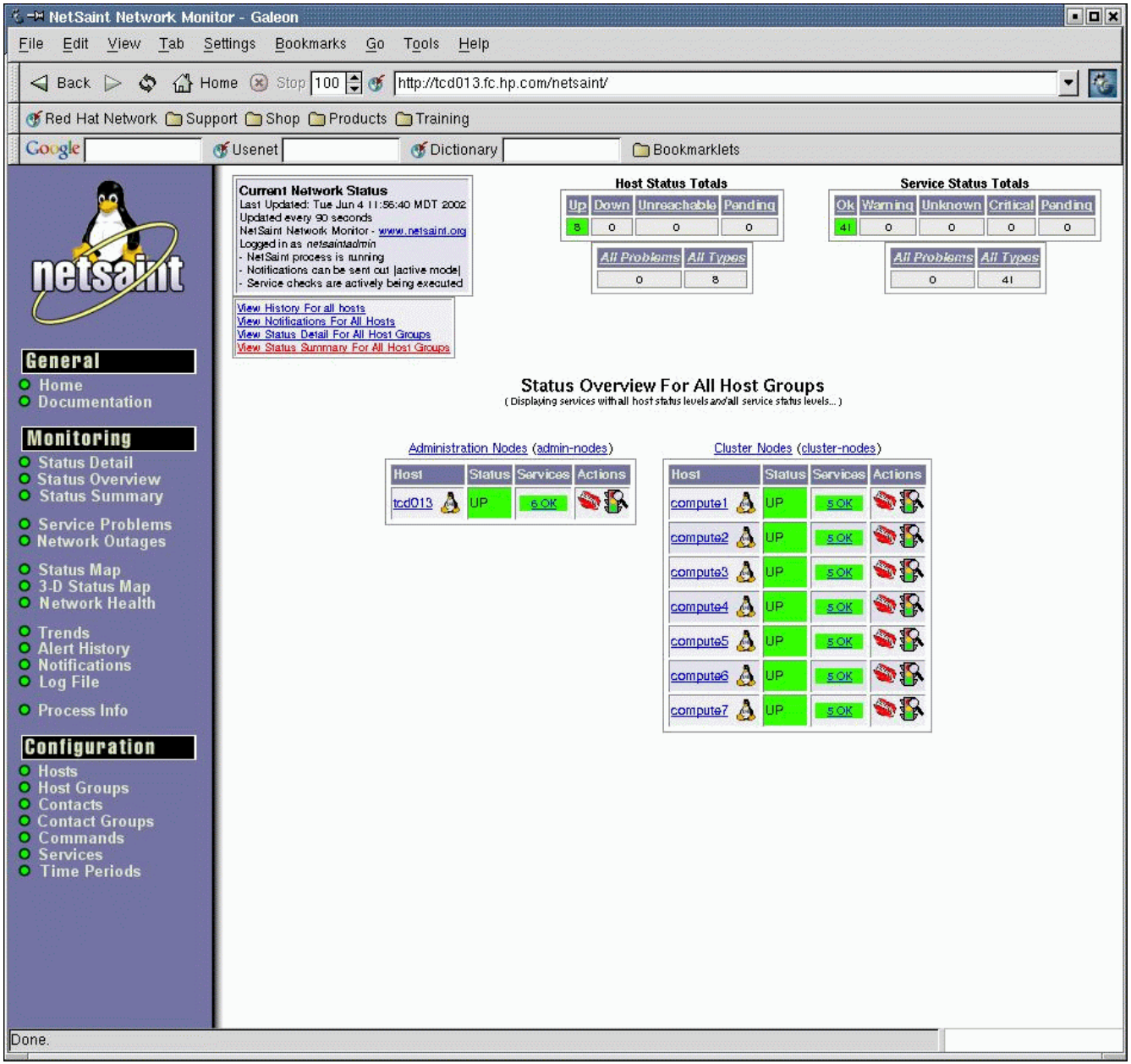
final server configuration

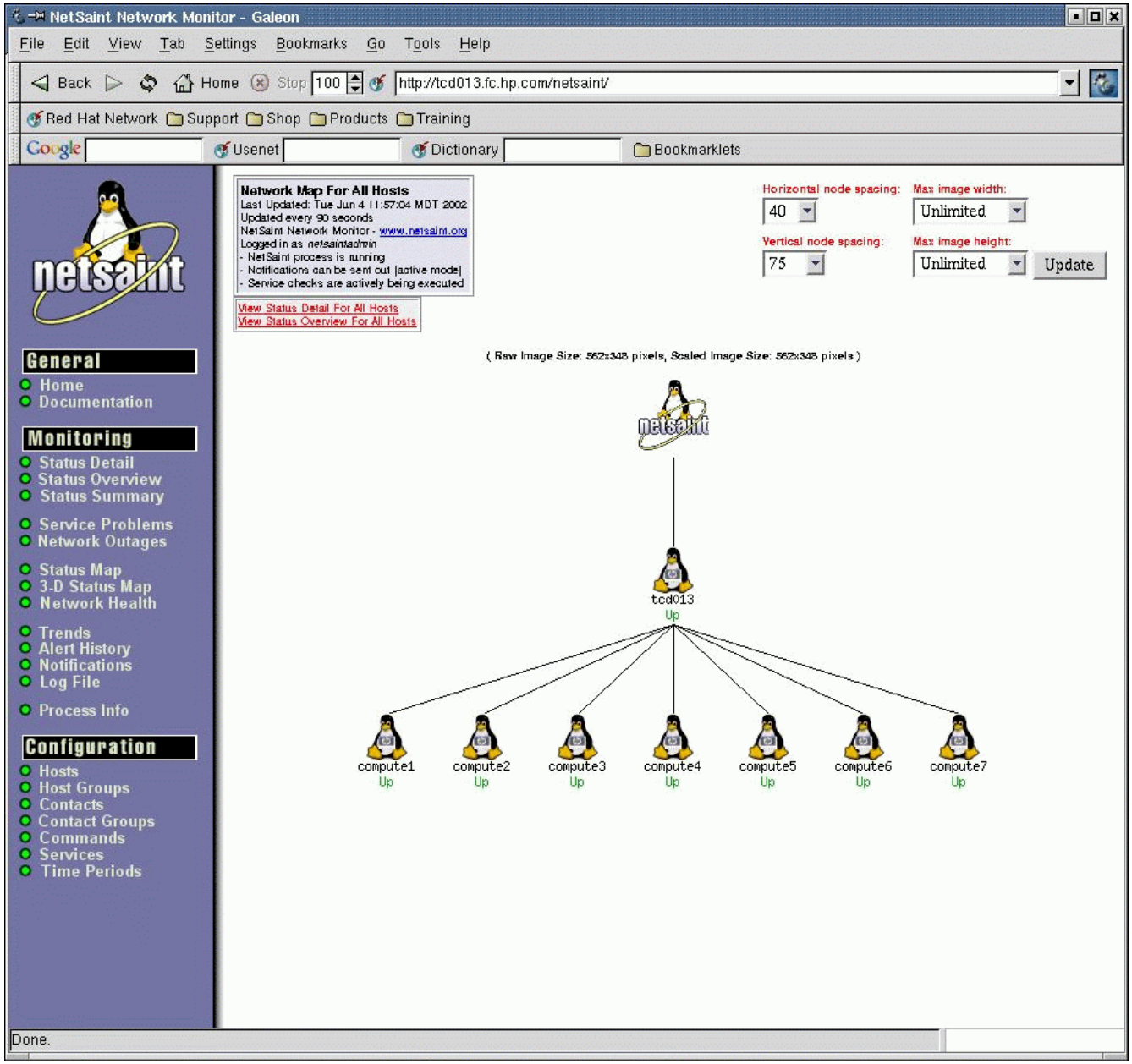
- run `mkdhcpstatic`
- run `mksshclientkeys` from the `tools/` directory on the course CD
- restart netsaint server process

```
# service netsaint restart
```

cluster installation flow diagram




NetSaint Network Monitor - Galeon
File Edit View Tab Settings Bookmarks Go Tools Help
Back Home Stop 100 http://tcd013.fc.hp.com/netsaint/
Red Hat Network Support Shop Products Training
Google Usenet Dictionary Bookmarklets
netsaint
General
Home
Documentation
Monitoring
Status Detail
Status Overview
Status Summary
Service Problems
Network Outages
Status Map
3-D Status Map
Network Health
Trends
Alert History
Notifications
Log File
Process Info
Configuration
Hosts
Host Groups
Contacts
Contact Groups
Commands
Services
Time Periods
Current Network Status
Last Updated: Tue Jun 4 11:56:40 MDT 2002
Updated every 90 seconds
NetSaint Network Monitor - www.netsaint.org
Logged in as netsaintadmin
- NetSaint process is running
- Notifications can be sent out [active mode]
- Service checks are actively being executed
View History For all hosts
View Notifications For All Hosts
View Status Detail For All Host Groups
View Status Summary For All Host Groups
Host Status Totals
Up Down Unreachable Pending
8 0 0 0
All Problems All Types
0 8
Service Status Totals
Ok Warning Unknown Critical Pending
41 0 0 0 0
All Problems All Types
0 41
Status Overview For All Host Groups
(Displaying services with all host status levels and all service status levels...)
Administration Nodes (admin-nodes)
Host Status Services Actions
tcd013 UP 5 OK
Cluster Nodes (cluster-nodes)
Host Status Services Actions
compute1 UP 5 OK
compute2 UP 5 OK
compute3 UP 5 OK
compute4 UP 5 OK
compute5 UP 5 OK
compute6 UP 5 OK
compute7 UP 5 OK
Done.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Network Map For All Hosts
Last Updated: Tue Jun 4 11:57:04 MDT 2002
Updated every 90 seconds
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Logged in as netsaintadmin
- NetSaint process is running
- Notifications can be sent out [active mode]
- Service checks are actively being executed
View Status Detail For All Hosts
View Status Overview For All Hosts
Horizontal node spacing: 40
Max image width: Unlimited
Vertical node spacing: 75
Max image height: Unlimited
Update
(Raw Image Size: 562x348 pixels, Scaled Image Size: 562x348 pixels)
tcd013
Up
compute1
Up
compute2
Up
compute3
Up
compute4
Up
compute5
Up
compute6
Up
compute7
Up
Done.

other tools

- Included on the course CD are several additional tools for the configuration and verification of the cluster. They are all in the tools/ directory
- `mk[gnome|kde]sshmenu`
- `mk[gnome|kde]gkrellmenu`
- `cupdateclient`
- cluster diagnostic scripts
  - `cping`
  - `csshtest`
- Assumptions made by the tools
  - `clusterenv.sh`
  - `mkclienttab`
  - the commands are run on the admin node

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