

**installation  
administration  
and monitoring  
of beowulf clusters  
using open source  
tools**

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i n v e n t

## **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?**

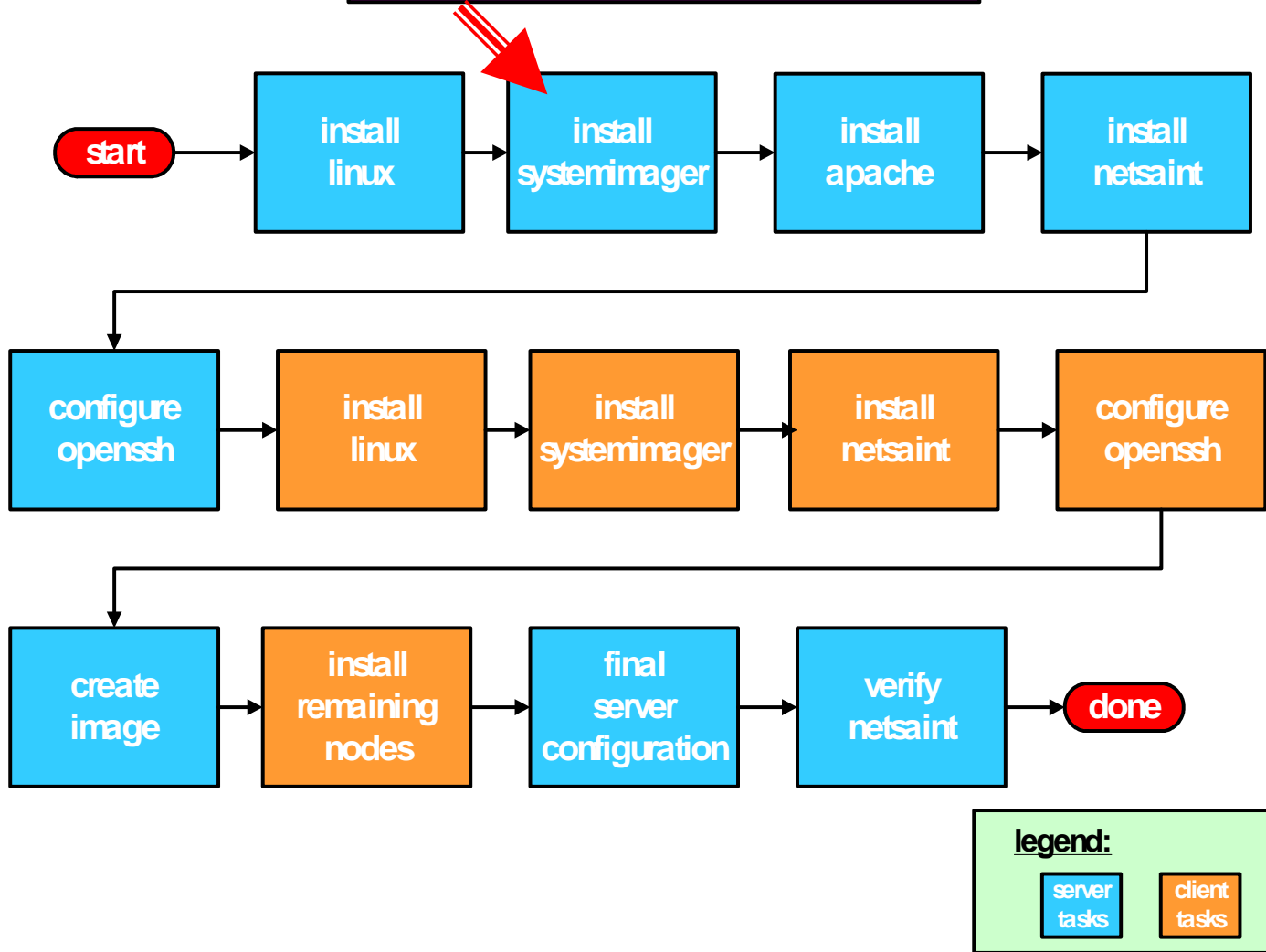
**A kind of high performance, massively parallel computer, interconnected by a private, high-speed network. It consists of a cluster of PCs or workstations dedicated to running high-performance computing tasks. The nodes in the cluster don't sit on people's desks; they are dedicated to running cluster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

# **cluster administration philosophy**

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

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

# cluster installation flow diagram



# 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:  
computer1

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

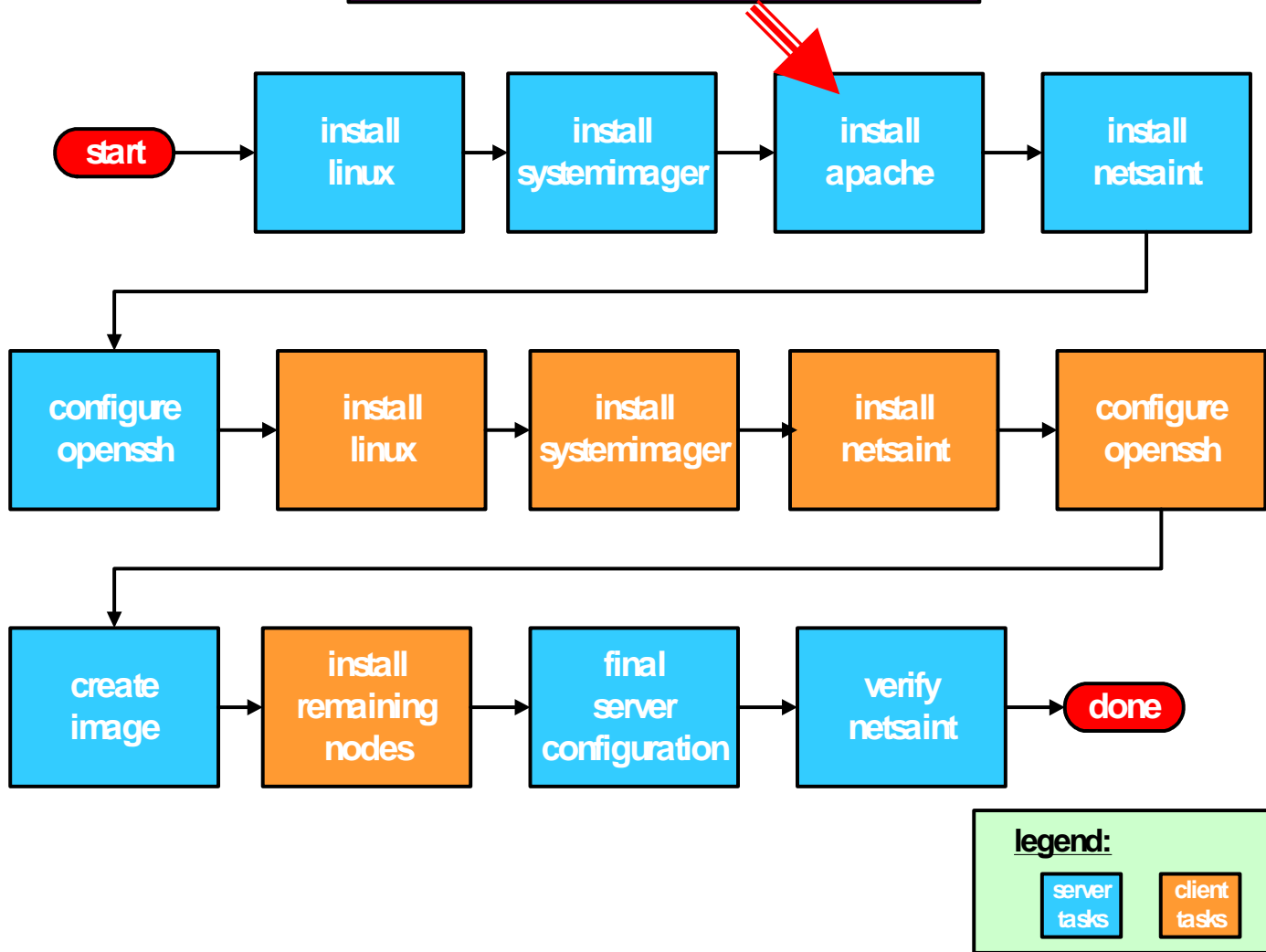
note: when answering questions be sure to  
provide the same information as used in  
the addclients script

edit clusterenv.sh

- sipath, admin node name, golden  
image name

run mkclienttab

# cluster installation flow diagram



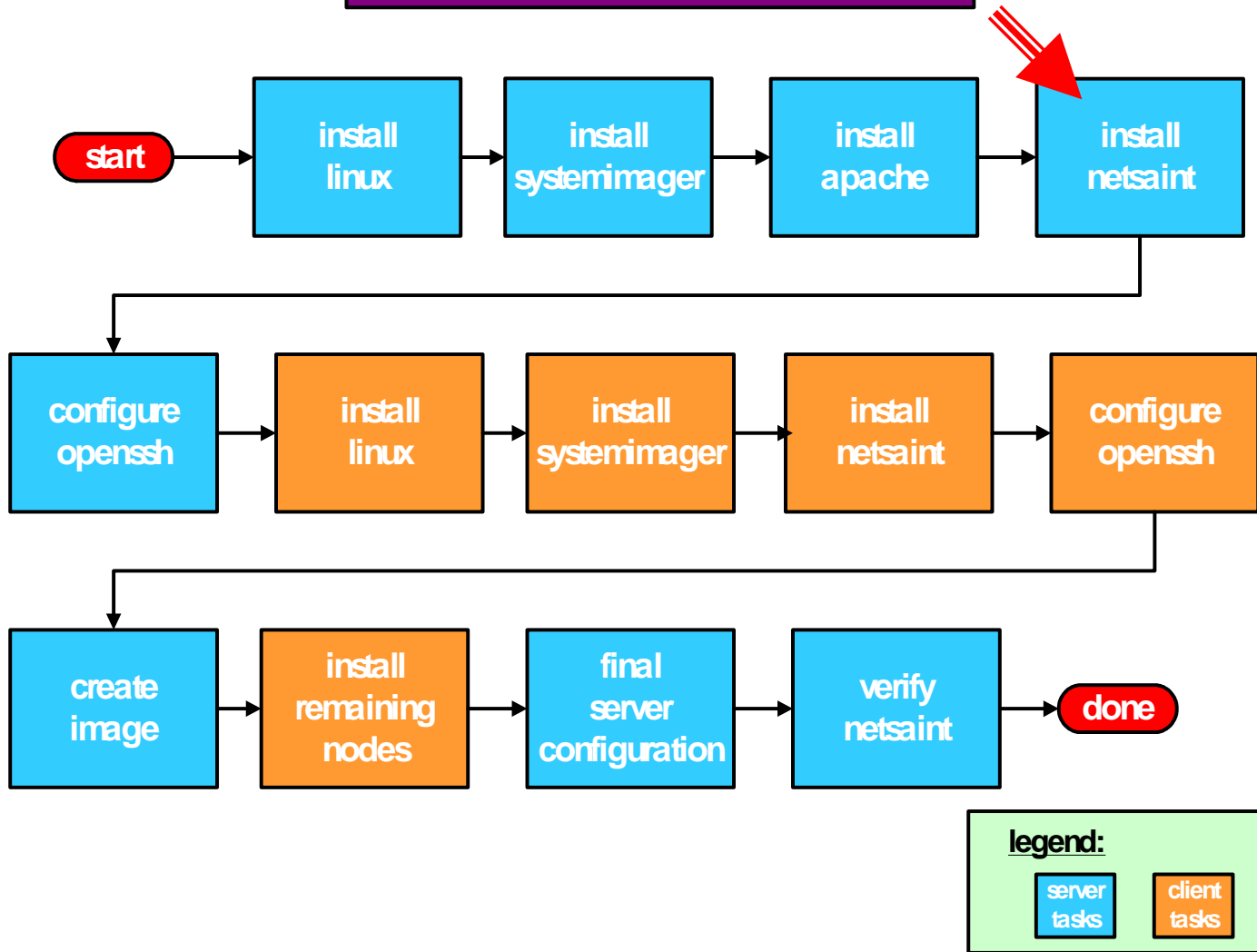
# install and configure apache

- 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

# cluster installation flow diagram



## 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
```

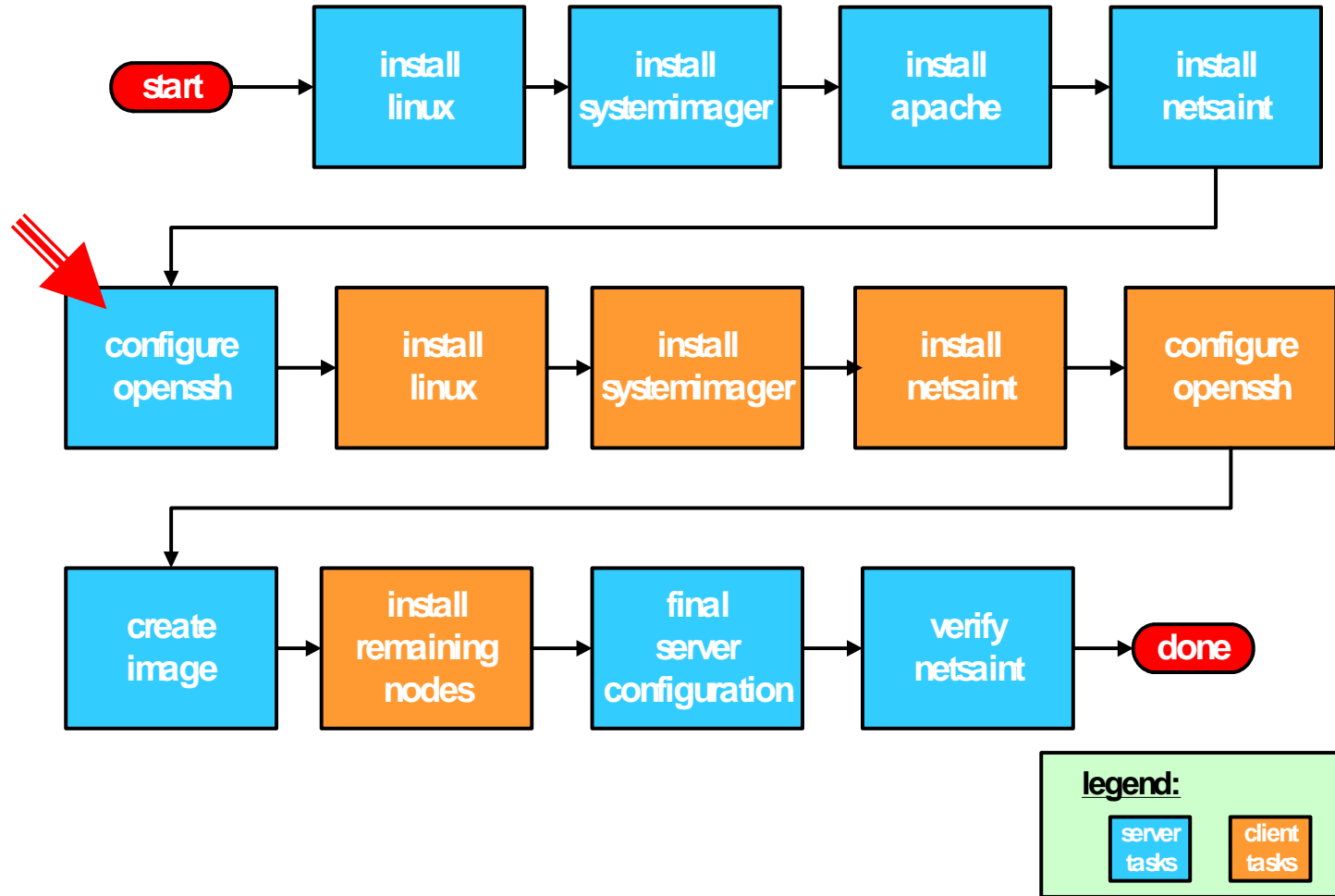
- install netsaint plugins from course CD `RPMS/netsaint` directory onto server

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

- start netsaint daemon process on server

```
# service netsaint start
```

# cluster installation flow diagram

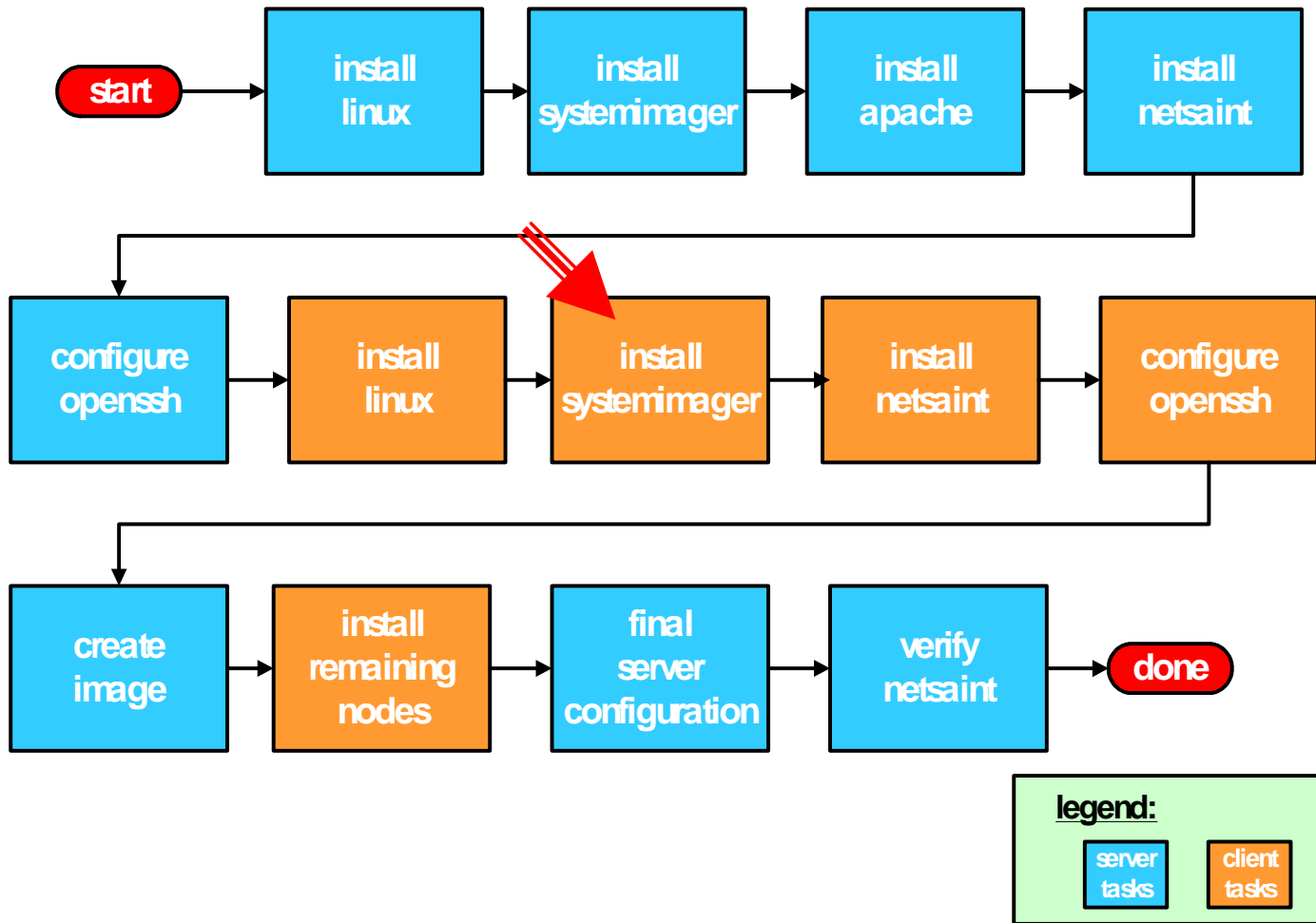


# configure openssh on admin node

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

```
# ssh-keygen -t rsa
```

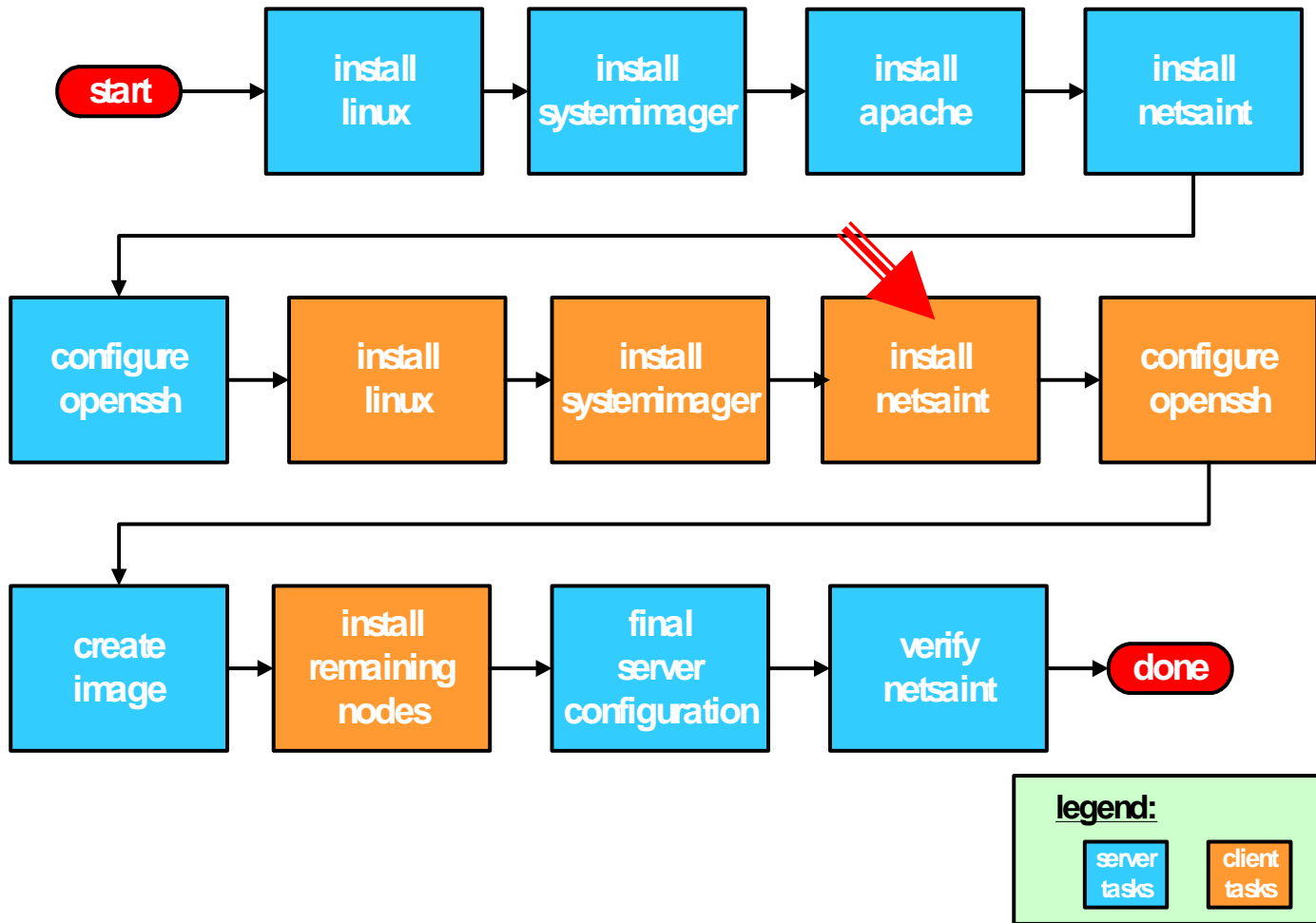
# cluster installation flow diagram



# 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

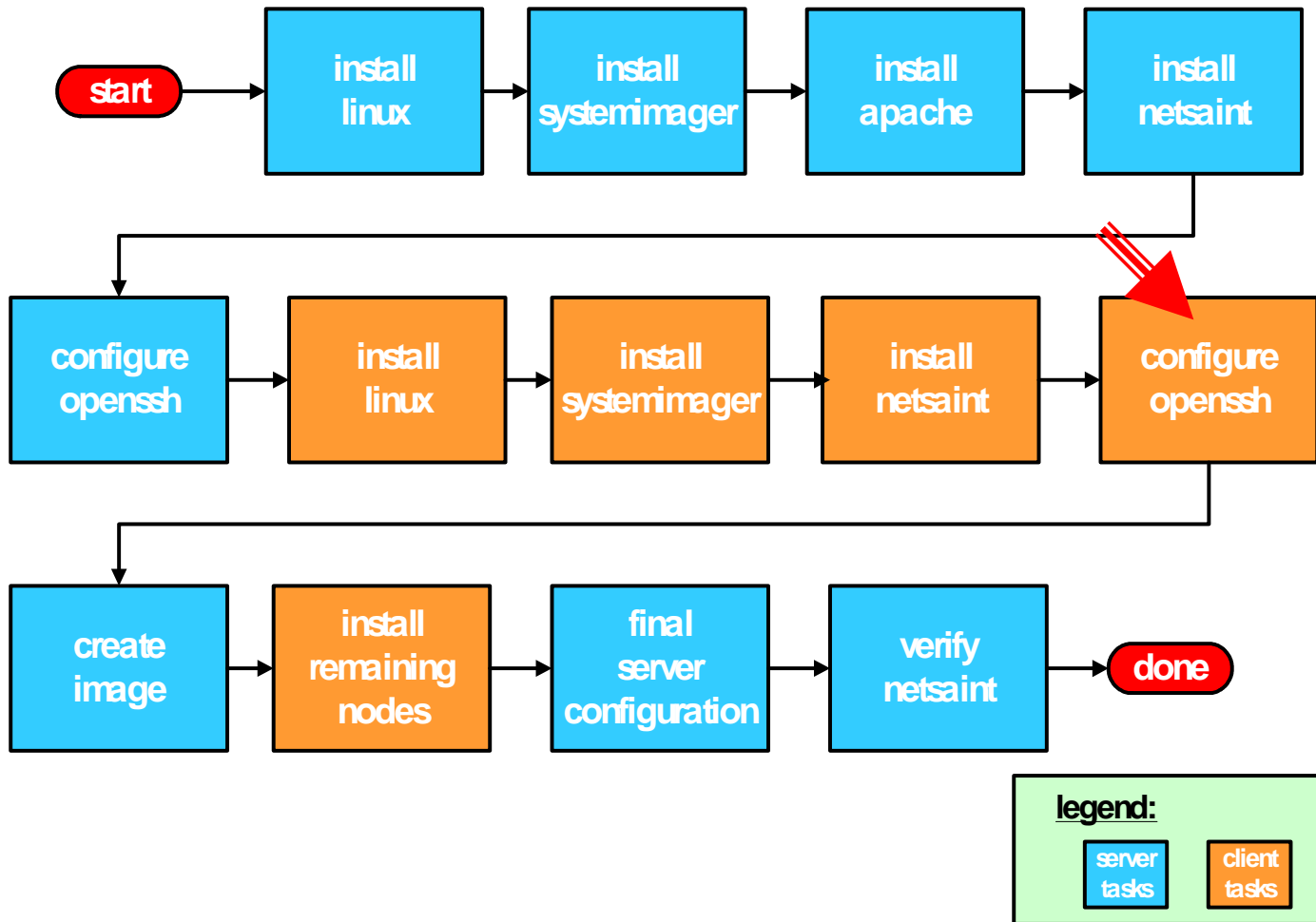


# install and configure netsaint client

- `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

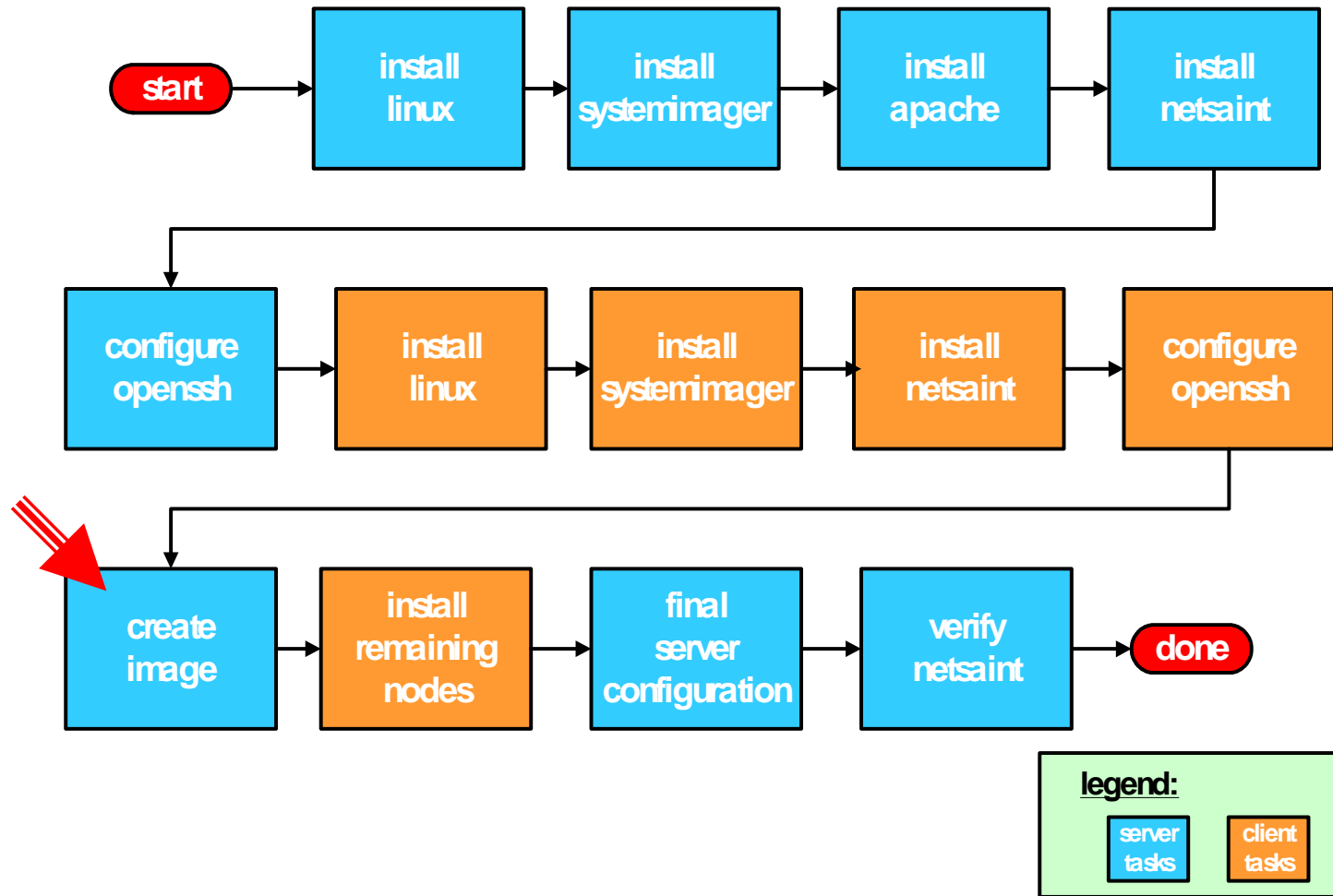
- generate ssh keys for users root and netsaint

```
# 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
```

# cluster installation flow diagram



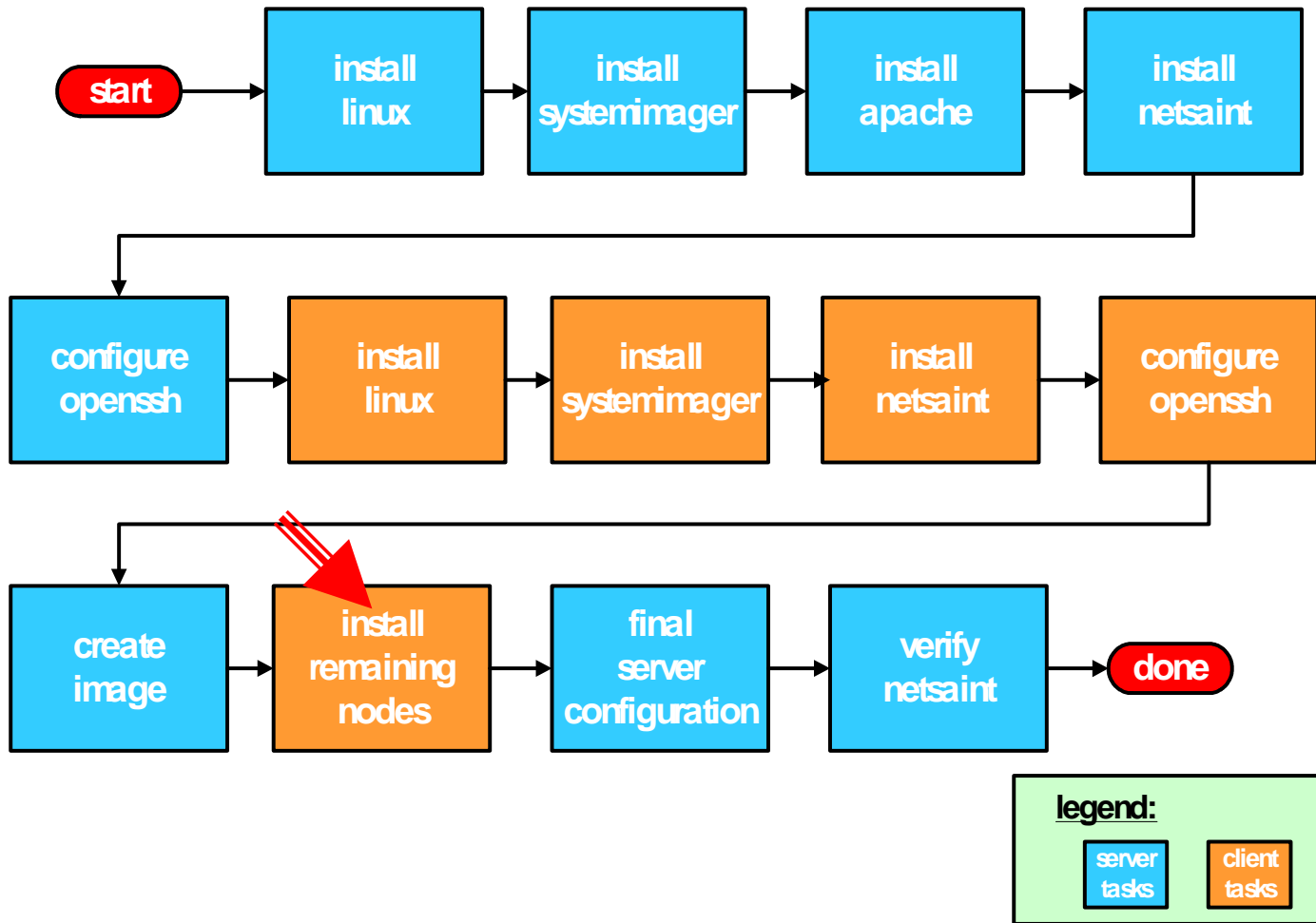
# image creation process

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`)

# cluster installation flow diagram



# image distribution process

install remaining compute nodes:

**Option1: linux not currently installed  
on disk**

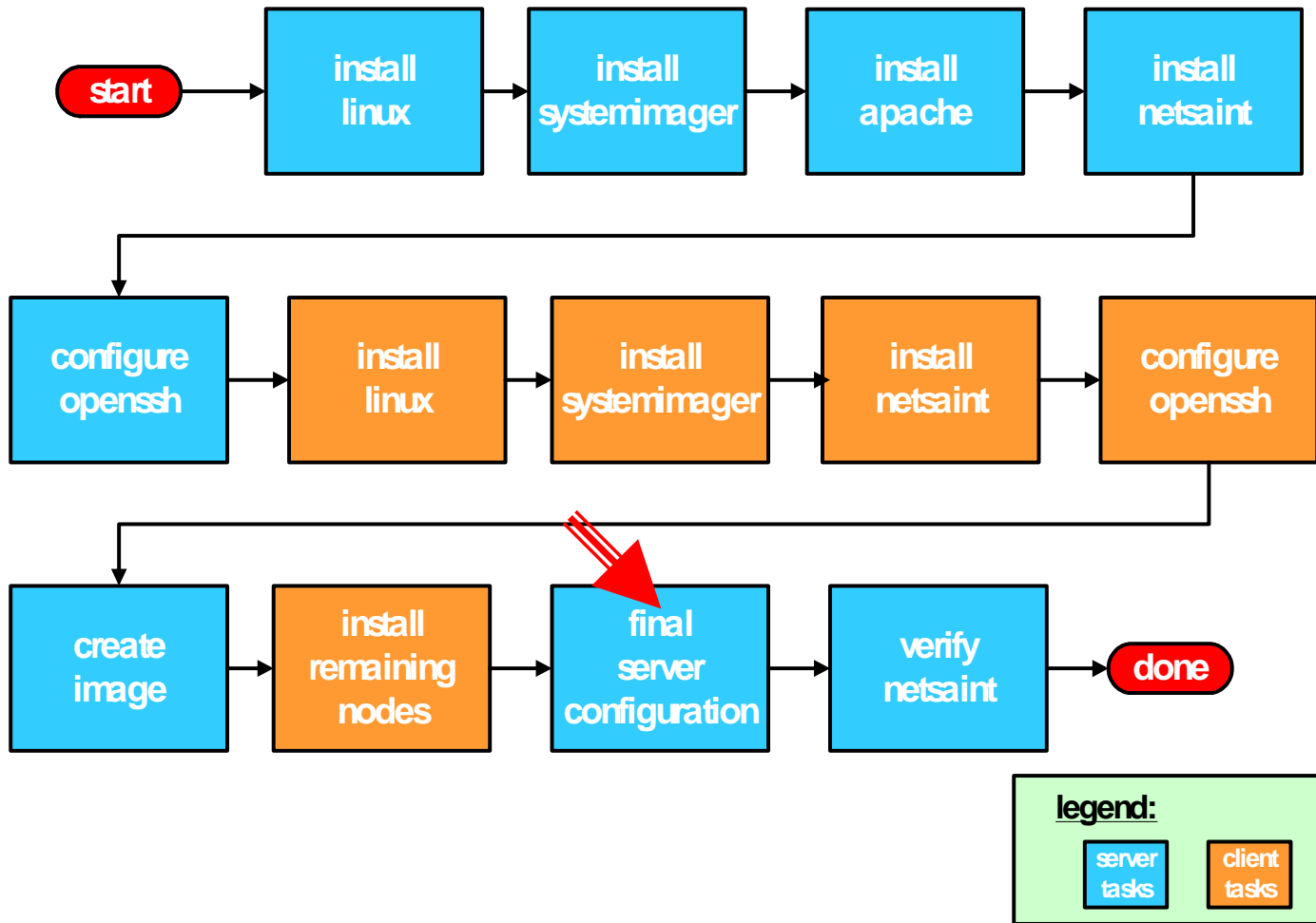
**Run `mkautoinstalldiskette` or  
`mkautoinstallcd` on the  
systemimager server and boot  
each node off the resulting media**

**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

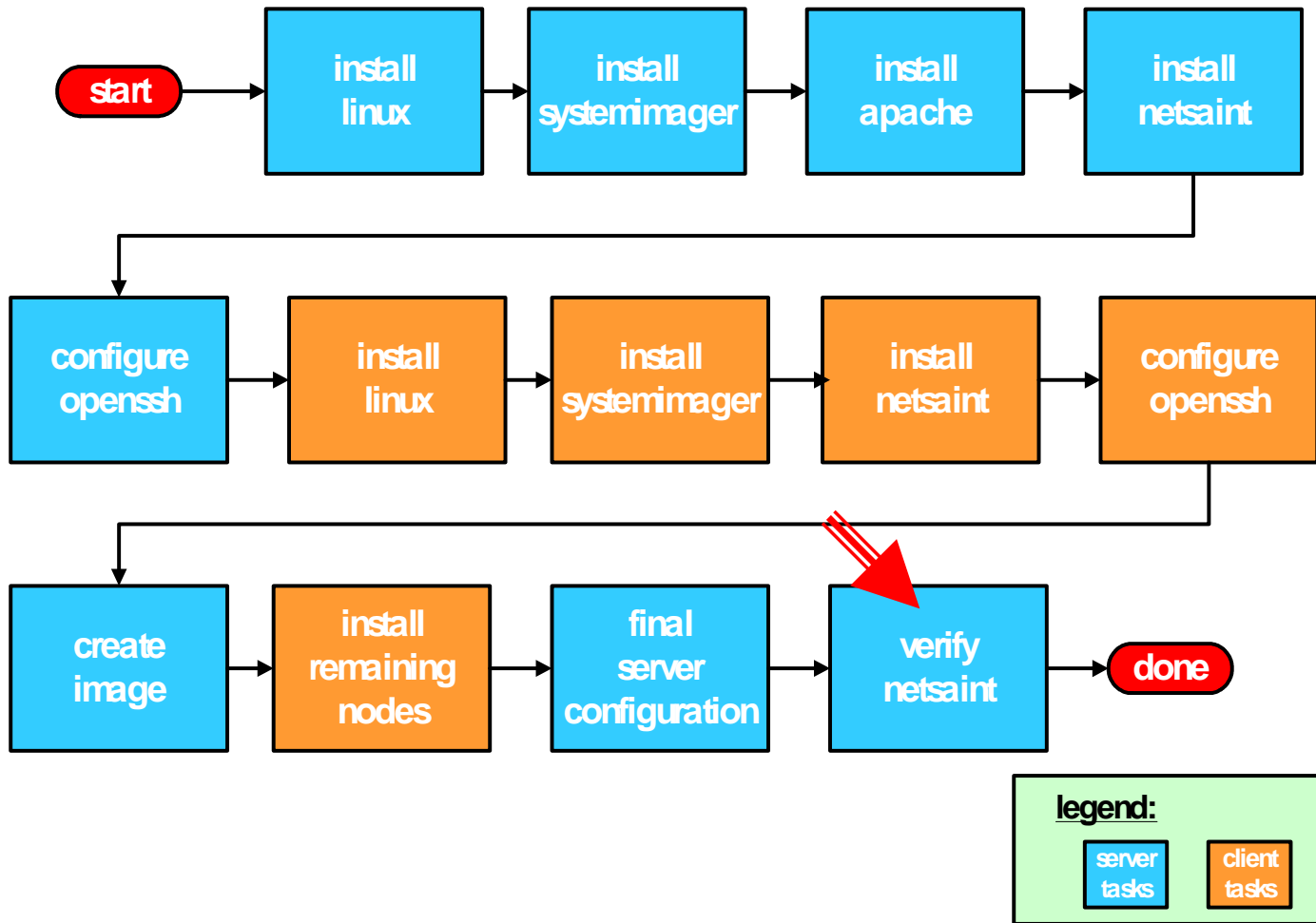


# final server configuration

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



# cluster installation flow diagram





**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 11:35:40 MDT 2002  
 Updated every 30 seconds  
 NetSaint Network Monitor - [www.netsaint.org](http://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 |
| 9  | 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 Modes (admin-nodes)**

| Host   | Status | Services | Actions |
|--------|--------|----------|---------|
| tcd013 | UP     | 5 OK     |         |

**Cluster Modes (cluster-nodes)**

| Host      | Status | Services | Actions |
|-----------|--------|----------|---------|
| computer1 | UP     | 5 OK     |         |
| computer2 | UP     | 5 OK     |         |
| computer3 | UP     | 5 OK     |         |
| computer4 | UP     | 5 OK     |         |
| computer5 | UP     | 5 OK     |         |
| computer6 | UP     | 5 OK     |         |
| computer7 | UP     | 5 OK     |         |



- General
- Home
- Documentation

- Monitoring
- Status Detail
- Status Overview
- Status Summary
- Service Problems
- Network Outages

- Status Map
- 3-D Status Map
- Network Health

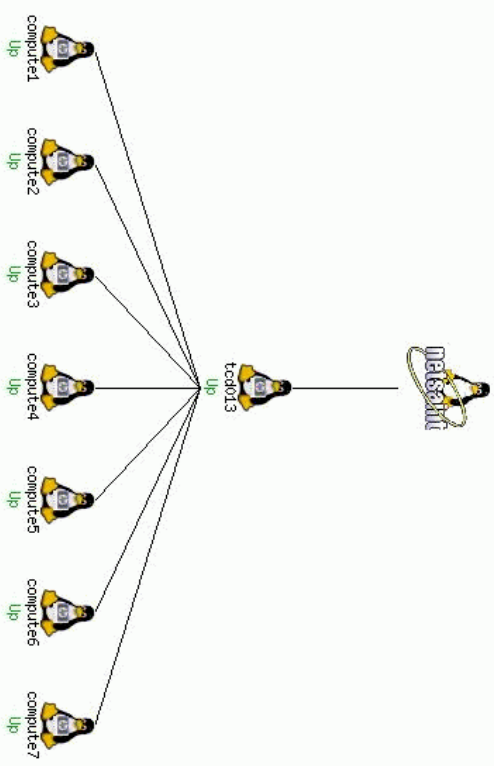
- Trends
- Alert History
- Notifications
- Log File
- Process Info

- Configuration
- Hosts
- Host Groups
- Contacts
- Contact Groups
- Commands
- Services
- Time Periods

**Network Map For All Hosts**  
 Last Updated: Tue Jun 4 11:57:04 MDT 2002  
 Updated every 30 seconds  
 NetSaint Network Monitor - www.netsaint.org  
 Logged in as netsaintadmin  
 - NetSaint process is running (active mode)  
 - 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](#)

(Raw Image Size: 320x128 pixels, Scaled Image Size: 320x128 pixels)



Horizontal node spacing:  Max image width:

Vertical node spacing:  Max image height:

## 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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