Deployment Of HPC Cluster Over Bare Metal

- Under the Guidance of Mr. Nikhlesh Safaya

- Project group :3

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INTRODUCTION

- *High-Performance Computing (HPC) clusters play a pivotal role in accelerating complex computations, simulations, and data analysis. Managing these clusters efficiently is a*
- *challenge that the Extreme Cloud Administration Toolkit (xCAT) addresses. In this project,*
- *we will provide an overview of xCAT and explore how it can be integrated with LDAP,*
- *Nagios, and Slurm to optimize HPC cluster management.*
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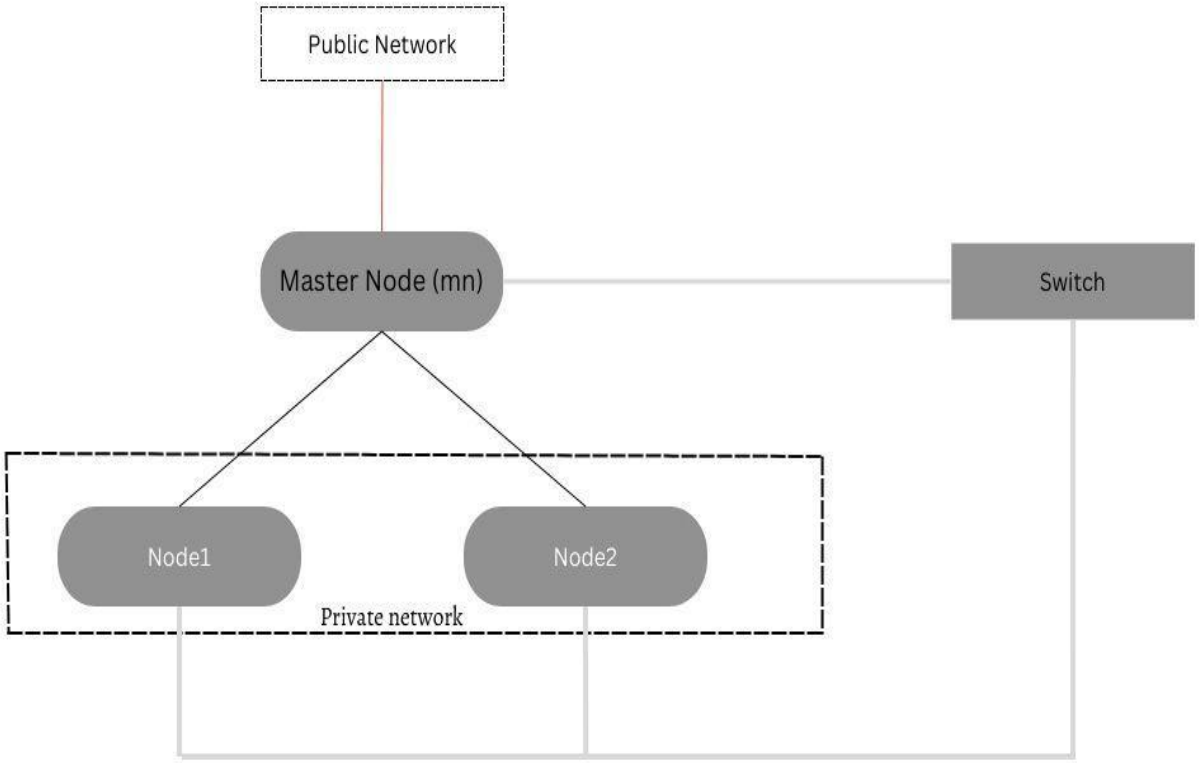
XCAT

xCAT (Extreme Cloud Administration Toolkit)

- What is xCAT ?
  - xCAT (Extreme Cluster/Cloud Administration Toolkit) is an open-source toolset for simplifying the management and provisioning of large-scale computing clusters and cloud infrastructures in High-Performance Computing (HPC) environments.


Public Network
Master Node (mn)
Switch
Node1
Node2
Private network

SYSTEM REQUIREMENTS

Hardware Requirement

- xCAT Management Server
- Master Node

  RAM - 32 GB

  Processor - 4
- Storage
- Worker Node
- Switch

Software Requirement

- Linux – CentOS 8

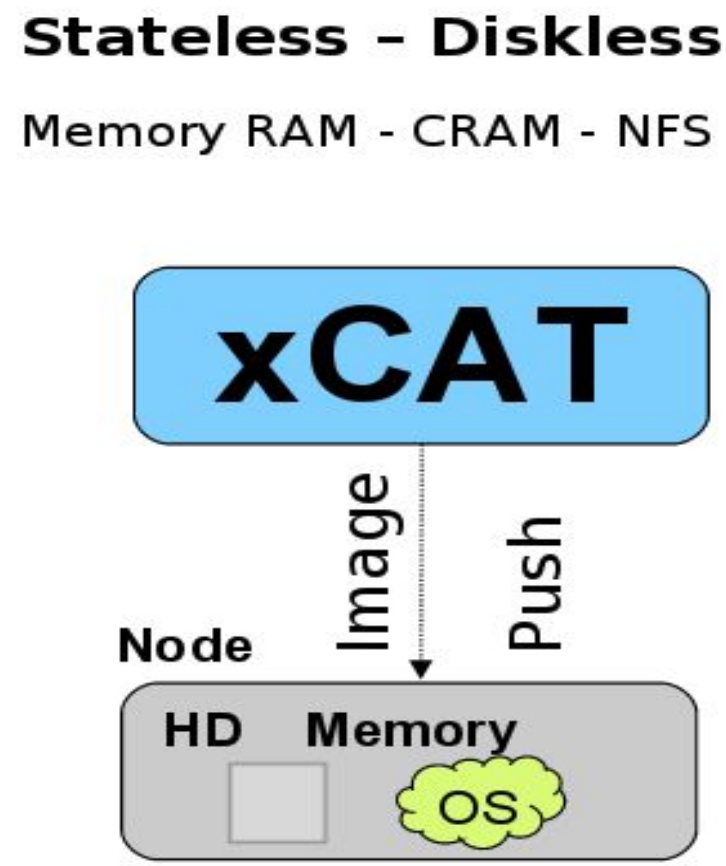
- xCAT
- Slurm
- Nagios
- Ansible

xCAT objective:

- **Automated Deployment**
- **Centralized Management**
- **Consistency and Standardization**
- **Support for Different Operating Systems**
- **Bare Metal Provisioning**
- **Integration with Other Tools**
- **Reduced Administration Complexity**

xCAT Provisioning Methods

1) Stateful-Diskful
2) Stateless-Diskless
3) Statelite



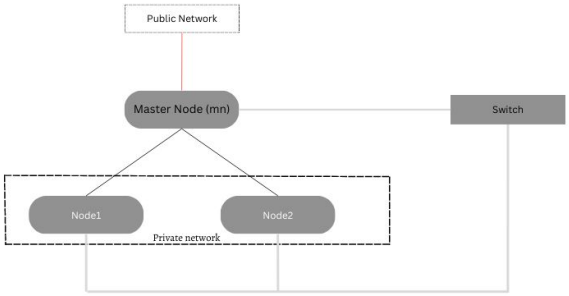
Slurm

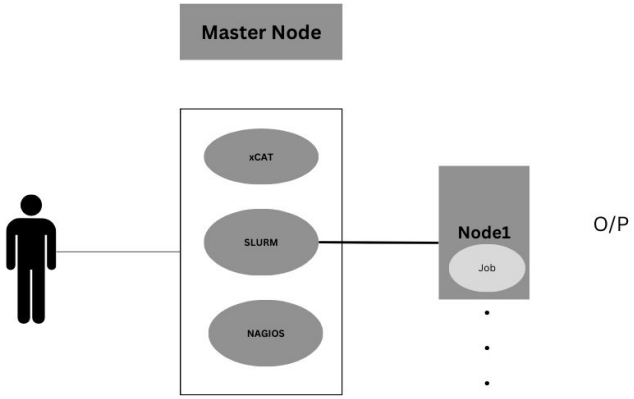
- Simple Linux Utility for Resource Management (SLURM)
- Open source
- fault-tolerant
- Highly Scalable
- job scheduling system for large and small clusters.

Nagios

- Nagios is an open source IT system monitoring tool.
- It was designed to run on the Linux operating system and can monitor devices running Linux, Windows and Unix OSes.
- Nagios software runs periodic checks on critical parameters of application, network and server resources.
- Nagios provides plugins.

Use Case Diagram:





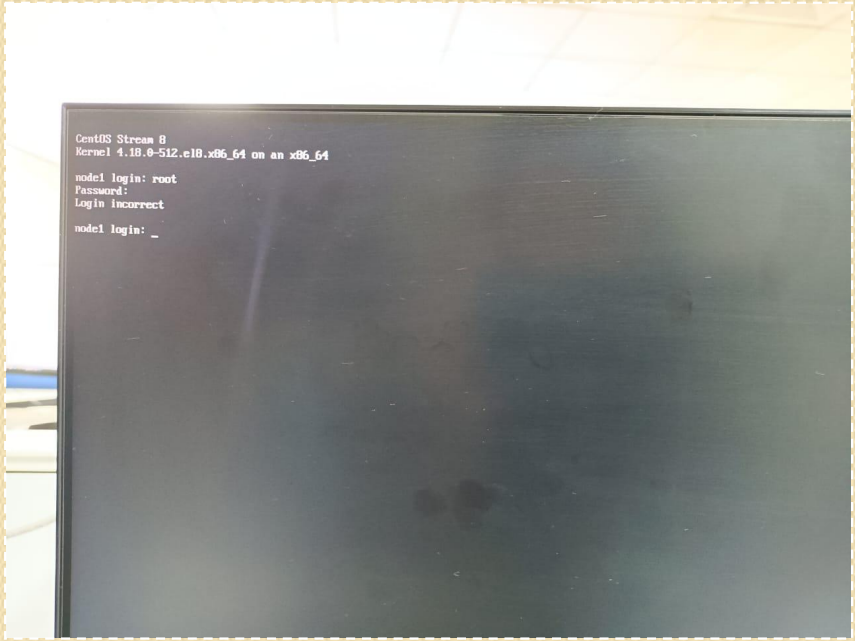
System Application

- Multiprogramming and Multithreading
- Healthcare
- High Performance Computing

master

Node1

```
bash:
: command not found...
[root@hpcsa20 opt]# lsdef node1
Object name: node1
    arch=x86_64
    currstate=netboot centos-stream8-x86_64-compute
    groups=all
    ip=10.10.10.11
    mac=A4:BB:6D:5E:7F:F6
    netboot=xnba
    os=centos-stream8
    postbootscripts=otherpkgs
    postscripts=syslog,remoteshell,syncfiles
    profile=compute
    provmethod=centos-stream8-x86_64-netboot-compute
    status=booted
    statustime=08-29-2023 19:57:14
[root@hpcsa20 opt]# lsdef -t osimage
centos-stream8-x86_64-compute  (osimage)
centos-stream8-x86_64-install-compute  (osimage)
centos-stream8-x86_64-install-service  (osimage)
centos-stream8-x86_64-netboot-compute  (osimage)
centos-stream8-x86_64-statelite-compute  (osimage)
centos7.9-x86_64-install-compute  (osimage)
centos7.9-x86_64-netboot-compute  (osimage)
centos7.9-x86_64-statelite-compute  (osimage)
[root@hpcsa20 opt]# lsdef -t osimage centos-stream8-x86_64-compute
Object name: centos-stream8-x86_64-compute
    imagetype=NIM
    synclists=/install/custom/netboot/compute.synclist
[root@hpcsa20 opt]# ll /install/
centos-stream8/ netboot/        postscripts/    prescripts/     winpostscripts/
[root@hpcsa20 opt]# ll /install/
centos-stream8/ netboot/        postscripts/    prescripts/     winpostscripts/
[root@hpcsa20 opt]# ll /install/netboot/centos
centos7.9/      centos-stream8/
[root@hpcsa20 opt]# ll /install/netboot/centos-stream8/x86_64/compute/
initrd-stateless.gz  initrd-statelite.gz  kernel               rootimg/            rootimg.cpio.gz
```




```
centos7.9/      centos-stream8/
[root@hpcsa20 opt]# ll /install/netboot/centos-stream8/x86_64/compute/
initrd-stateless.gz  initrd-statelite.gz  kernel               rootimg/            rootimg.cpio.gz
[root@hpcsa20 opt]# chdef -t osimage -o centos-stream8-x86_64-compute synclists="/install/netboot/compute.synclist"
1 object definitions have been created or modified.
[root@hpcsa20 opt]# vim /install/
centos-stream8/ netboot/        postscripts/    prescripts/     winpostscripts/
[root@hpcsa20 opt]# vim /install/netboot/centos
centos7.9/      centos-stream8/
[root@hpcsa20 opt]# vim /install/netboot/compute.synclist
[root@hpcsa20 opt]# packimage centos-stream8-x86_64-netboot-compute
Packing contents of /install/netboot/centos-stream8/x86_64/compute/rootimg
archive method:cpio
compress method:pigz

[root@hpcsa20 opt]# nodeset node1 osimage=centos-stream8-x86_64-netboot-compute
node1: netboot centos-stream8-x86_64-compute
[root@hpcsa20 opt]# chtab key=system passwd.username=root passwd.password=root
[root@hpcsa20 opt]# chtab key=system passwd.username=root passwd.password=root
[root@hpcsa20 opt]# packimage centos-stream8-x86_64-netboot-compute
Packing contents of /install/netboot/centos-stream8/x86_64/compute/rootimg
archive method:cpio
compress method:pigz

[root@hpcsa20 opt]# nodeset node1 osimage=centos-stream8-x86_64-netboot-compute
node1: netboot centos-stream8-x86_64-compute
[root@hpcsa20 opt]#
```

o/p

HPC cluster uses:-

- Weather modelling
- Data Mining
- Cosmology
- Physics

Future Sope

- Reduced need for Physical testing
- Colaborate the same project with kubernatess
- Deploy same cluster on cloud
- Develop the REST APIs for the automated sript and operations