## Hands-on activities – Day 2

Virtual HPC cluster Setup

Introduction

Computer clusters

The aim of the following exercises is to familiarize the user with the steps involved in creating and installing a 3 node HPC cluster based on the ROCKS - Open Source Toolkit for Real and Virtual Clusters (http://www.rocksclusters.org/)

The physical infrastructure of the cluster is 3 computers and a network switch is created using the virtualbox virtualization software, which is available for any operating system. As shown in Figure 1 below.
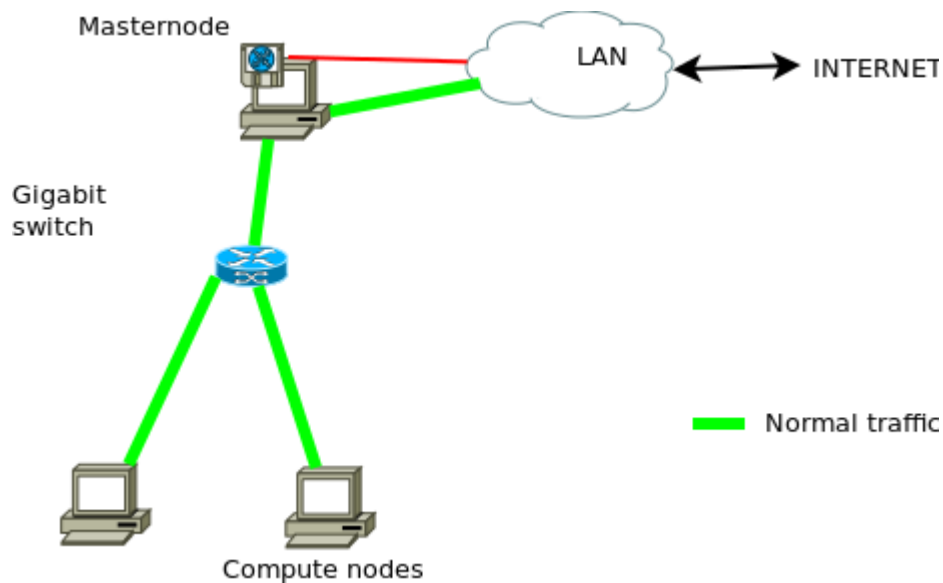
<p align="center">__Activity 1__</p>

<p align="center">__Familiarization with virtualbox__</p>

Requirements:

- VirtualBox manual in PDF format for consultation

Familiarization steps

- Locate the StartMenu or Desktop entry for the VirtualBox application.
- Start the virtualbox application
- Understand the following components/concepts of the interface :
  - Virtual Machine list
  - File/Preference Menu
  - Snapshots
  - Networking mode
  - Creating new machines and VDE networking

<p align="center">__Activity 2__</p>

<p align="center">__Creating a Front-end/cluster Master node__</p>

Requirements

- Working installation of VirtualBox
- ROCKS dvd iso image (For Version 6.2)

Steps

- Create a new virtualbox VM with the following characteristics
  - 1GB Ram, 1 CPU, 2 Ethernet devices, 30GB hard-disk
  - **IMPORTANT-Notes**:
    - **BEFORE INSTALL open Settings → Network and configure the following:**
      - Adapter 1 (eth0) as follows
        - Attached to: Internal Network
        - Name: *cluster-switch*
      - Adapter 2 (eth1)
        - Enabled
        - Attached to: NAT

- In Settings → Storage
  - Attach the CD device to the local ROCKS iso image (Click triangle symbol at end of line to open a file browser)
  - Close the Settings Window
- Boot the machine start the installation from the Rocks DVD
- Press a key quickly at the boot screen to get the boot: prompt
- Type **"build"**
- Click the button titled "CD/DVD-based Roll"
- Select all listed rolls and click submit
- Click Next after verifying that the selected Rolls are listed on the left had side of the screen
- Fill-in the various entries on the screen and use a hostname such as master.hpc and use a two-letter code for the country.
- IMPORTANT: **DO NOT INSTALL WebUI for perSONAR**
- Configure the public interface (eth1) with DHCP or with the following static IP address 10.0.3.10/255.255.255.0 and click Next
- For the private internal network (eth0), it should propose the 10.1.1.0/16 network with master as 10.1.1.1, Click Next
- You may need to fill-in the gateway and DNS entries as follows:
  - Gateway: 10.0.3.2
  - DNS: 10.0.3.3
- Set a suitable root password
- Select the right time zone
- Use automatic repartitioning (note all existing data on the disks will be lost)
- The installation begins..
- After the server reboots, login as root
- Click System --> Administration --> Users and Groups to create a new user
- Open a Terminal Window and run the command
  - rocks sync users
- Logout as root and login as the user.
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Activity 3

Installing the cluster worker/compute nodes

Requirements

- Working installation of VirtualBox
- ROCKS dvd iso image
- Virtualbox machine running master/front-end

Steps

- o Create 2 new virtualbox VM with the following characteristics
  - o 768MB Ram, 1 CPU, 1 Ethernet devices, 30GB hard-disk
  - o IMPORTANT Notes:
    - **BEFORE INSTALL open Settings → Network and configure the following:**
      - Adapter 1 (eth0) as follows
        - o Attached to: Internal Network
        - o Name: *cluster-switch*
      - In Settings → System
        - o Boot order: Enable Network
    - Close the Settings
- o On the master node, As user root
  - o Open a Terminal window and run the command
    - insert-ethers
      - From the new menu select "Compute" entry by highlighting it and pressing the Enter key.
- o Now power on the first compute node
- o The node should be captured and wait until it reports kickstart. The installation should start accordingly.. You can monitor this using the rocks-console command tool
- o Repeat the above for the other node

Day 2- Exercises

1. *Identify various numerical algorithms that you have applied to solving physical or natural problems.*
2. *Compare High Performance Computing, High Throughput Computing*
3. *Identify the key hardware components of a computer.*
4. *Identify various computer types & operating systems and relate by names to the , e.g shells, editors, etc.*
5. *Identify common every-day software that shows the increasing complexity of software.*
6. *Explains Moore's Law*
7. *Determine the maximum integer value that can be stored by a computer in 8,16 32, 64 and 128 bits in binary, octal, hexadecimal & decimal formats.*
8. *Review the following computer terms, Boolean, byte, char, short, integer, long, float, double, endian.*
9. *Explain with suitable examples the following sentence: Converting computer binary numbers to decimal could lead to a loss of precision when the number is not a power of 2.*
10. *Explain the classifications of computers into mainframe, mini, supercomputing & personal computing, single processor, multi-processor, SMP, multi-core.*
11. *Explain the terms networking speed, throughput & latency and why are they important for HPC network.*