

Creating an HPC (High-Performance Computing) cluster involves setting up multiple computers (nodes) to work together as a single cohesive system to perform computationally intensive tasks. Below is an explanation of the architecture, an example configuration, and a simple diagram.

HPC Cluster Architecture Master Node

An HPC cluster typically consists of the following components:

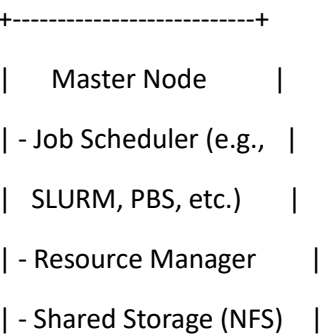
- 1. **Master Node (Head Node):**
 - Manages the cluster, scheduling, and resource allocation.
 - Runs job scheduling software (e.g., Slurm, PBS, Torque).
 - Stores the centralized file system (NFS).
- 2. **Compute Nodes:**
 - Perform the actual computations.
 - Connected to the master node via high-speed interconnects (e.g., InfiniBand, Ethernet).
- 3. **Shared Storage:**
 - Centralized storage accessible by all nodes (e.g., NFS, Lustre, BeeGFS).
- 4. **Interconnect Network:**
 - High-speed network for communication between nodes.
 - Examples: Ethernet (1/10/40/100 Gbps) or InfiniBand.
- 5. **Scheduler/Resource Manager:**
 - Allocates jobs to nodes and ensures efficient use of resources.

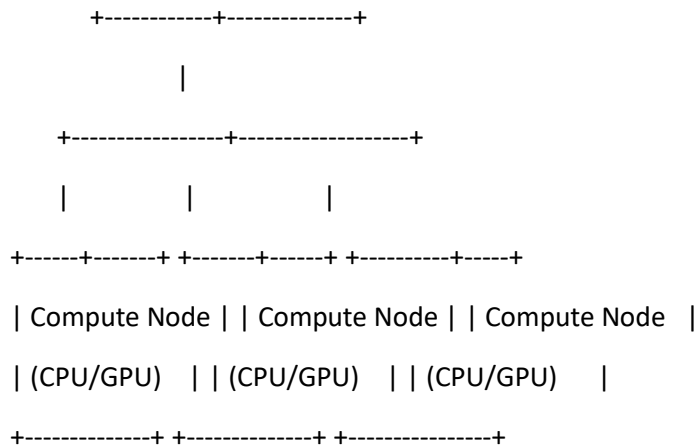
Diagram

Let's create a visual description:

plaintext

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Example Configuration

For a small cluster with a master node and two compute nodes:

Master Node Setup

1. Install essential packages:

```
bash
```

```
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```

```
sudo apt update
```

```
sudo apt install -y slurm-wlm nfs-kernel-server openssh-server
```

2. Configure NFS (shared storage):

- Add /shared to /etc/exports:

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```

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```
/shared *(rw,sync,no_subtree_check)
```

- Restart NFS:

```
bash
```

```
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```
sudo systemctl restart nfs-kernel-server
```

3. Configure SLURM:

- Edit /etc/slurm/slurm.conf with:

```
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```

```
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```

```
ControlMachine=master-node
```

NodeName=node[01-02] CPUs=4 State=UNKNOWN

PartitionName=debug Nodes=node[01-02] Default=YES MaxTime=INFINITE State=UP

4. Start SLURM:

bash

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```
sudo systemctl start slurmctld
```

Compute Node Setup

1. Install required packages:

bash

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```
sudo apt update
```

```
sudo apt install -y slurm-wlm openssh-server nfs-common
```

2. Mount shared storage:

- Add to /etc/fstab:

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```
master-node:/shared /shared nfs defaults 0 0
```

- Mount the shared directory:

bash

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```
sudo mount -a
```

3. Start SLURM daemons:

bash

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```
sudo systemctl start slurmd
```

Testing the Cluster

Submit a test job from the master node:

1. Create a sample job script test_job.sh:

bash

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```
#!/bin/bash
```

```
#SBATCH --job-name=test_job
```

```
#SBATCH --output=output.txt
```

```
#SBATCH --ntasks=1
```

```
#SBATCH --time=00:01:00
```

```
#SBATCH --partition=debug
```

```
echo "Hello from $(hostname)"
```

2. Submit the job:

```
bash
```

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```
sbatch test_job.sh
```

3. Check the job status:

```
bash
```

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```
squeue
```

Would you like me to generate a detailed diagram image or provide further information on scaling this cluster?