CPA – Parallel Computing

Degree in Computer Science

Cluster for the Laboratory: KAHAN

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Section 1

Laboratory Cluster: KAHAN

- Cluster for the Laboratory
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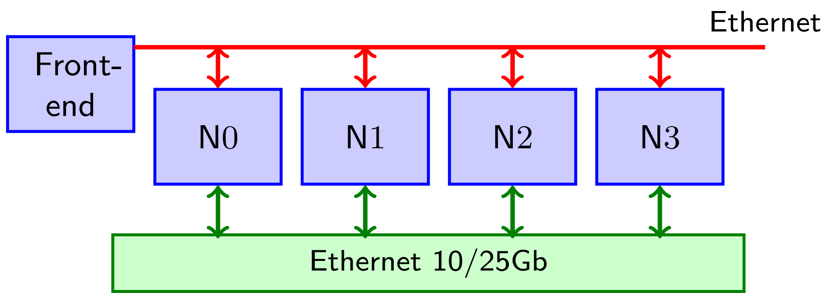
Cluster for the Laboratory

Hardware configuration: 4 nodes



Each node:

- 1 AMD EPYC 7551P 32 Cores (64 virtuals)
- 64GB RAM memory
- Disc SSD 240GB
- Ethernet 10/25Gb 2-port 622FLR -SFP28

In total: 4 processors, 128 cores (256 virtuals), 256 GB

Lab Cluster: Front-End

The front-end enables users to interact with the cluster

Accessing the front-end:

```
$ ssh -Y -l login@alumno.upv.es kahan.dsic.upv.es
```

For routine tasks (do not run costly executions)

- Editing and compiling programs
- Short test runs

Useful commands:

- Files/directories: `cd`, `pwd`, `ls`, `cp`, `mkdir`, `rm`, `mv`, `scp`, `less`, `cat`, `chmod`, `find`
- Processes: `w`, `kill`, `ps`, `top`
- Editors and other: `vim`, `emacs`, `pico`, `man`

Lab Cluster: Network

Gigabit Ethernet

- Auxiliary network, only for the O.S. traffic (`ssh`, NFS)

Ethernet 10/25Gb

- High-bandwidth low-latency network, perfect for clusters
- Ethernet card 10/25Gb 2-port 622FLR -SFP28
- Supports RDMA, RoCE, iWarp
- Can operate at 25 Gbps

Running Parallel Programs

OpenMP: executables can be run directly

Usually the number of threads should be indicated

```
$ OMP_NUM_THREADS=4 ./prgomp
```

Another option is to export the variables

```
$ OMP_NUM_THREADS=4; OMP_SCHEDULE=dynamic
$ export OMP_NUM_THREADS OMP_SCHEDULE
$ ./prgomp
```

MPI: use the command `mpiexec` (or `mpirun`)

Options: choose hosts, architecture

```
$ mpiexec -n 4 prgmpi <args>
$ mpiexec -n 6 -host node1,node2,node5 prgmpi
```

Queue System

The queue system (or job scheduler or resource manager) is a software that enables sharing a cluster among different users

- The user can lauch “jobs” usually in *batch* mode (non interactive) using one or several nodes
- A job is a particular execution with a set of attributes (nodes, maximum execution time, etc.)
- Job scheduling policies are defined
- The system accounts the resources used (hours)
- Objective: maximize usage and minimize waiting time

Working procedure:

1. A job is defined and then submitted to a queue, which returns an identifier
2. Depending on the workload, after a waiting time the job is run
3. The output is obtained when the job finishes

Lab Cluster: Queues (1)

We will use the SLURM queue system

Example of a job file `jobopenmp.sh`

```
#!/bin/bash
#SBATCH --nodes=1
#SBATCH --time=5:00
#SBATCH --partition=cpa
OMP_NUM_THREADS=3 ./pintegral 1
```

- `--nodes`: number of requested nodes
- `--time`: requested execution time
- `--partition`: partition to be used in the queue system

For MPI, use `mpiexec` (no need to specify `-n`)

Lab Cluster: Queues (2)

For the submission of a job:

```
$ sbatch jobopenmp.sh
Submitted batch job 728
```

At the end, one file is created in the current directory:
`slurm-728.out`

To check the status of the job:

```
$ squeue
JOBID PARTITION NAME         USER ST TIME NODES NODELIST
728   cpa       jobopenmp.sh ramos R 0:01  1    kahan01
```

Possible status: queued (`PD`), running (`R`), completing (`CD`)

Job cancelling: `scancel`