

# Calypso architecture

## Physical Infrastructure

It is currently composed of the following machines :

- 1 DELL R740XD (Master)
- 15 DELL R630 (11 currently active)
- 3 DELL R630 (spares)

## Network

Calypso is located in an isolated separate network inside the school. It can be accessed via a [Wireguard VPN](#) (ask Rémi for access).

Inside this network you have a simple setup :

```
192.168.88.0/24 : Network appliances subnet
192.168.89.0/24 : VPN subnet
192.168.90.0/24 : Server's IDRACs subnet
192.168.91.0/24 : Servers subnet
```

Currently there are 11 servers running in the cluster that are accessible to students for their labs :

```
calypso0 : 192.168.91.10
calypso1 : 192.168.91.11
calypso2 : 192.168.91.12
calypso3 : 192.168.91.13
calypso4 : 192.168.91.14
calypso5 : 192.168.91.15
calypso6 : 192.168.91.16
calypso7 : 192.168.91.17
calypso8 : 192.168.91.18
calypso9 : 192.168.91.19
calypso10 : 192.168.91.20
```

The Calypsomaster node is not available for connection to students, it contains the Kubernetes control plane :

```
calypsomaster : 192.168.88.248
calypsomaster IDRAC : 192.168.88.249
```

To work on it, see with your teacher which one are allocated to you, or if you need to run jobs on all nodes (via SLURM) you can pick any of them to run.

## NAS NFS share

On the Calypso infrastructure, there is a shared storage mainly for SLURM needs : it gives students a shared storage between all Calypso nodes to run jobs on any node and have a common filesystem to run jobs / get results on

```
nas (NAS appliance) : 192.168.88.250
```

The filesystem is mounted from **nas:/volume1/calypso\_homes/homes/firstname.lastname** , to each student's shared directory **/exports/firstname.lastname/**

On each student's home, there is a symlink to it : **~/nas\_home**

## DNS server / Gateway

In this isolated network, the Sinf provides us only their gateway as the only DNS server :

```
DNS / Gateway : 172.30.7.1
```

## Software Architecture

### User accounts

User access is SSH based for now, managed by Rémi.

### Container Runtimes

To run containers on Calypso, you can use :

- [Apptainer](#)
- [Docker](#)
- [Containerd](#) (in [Kubernetes](#))

### SLURM Cluster

There is a [SLURM](#) cluster on all Calypso worker nodes :

```
calypsomaster : no SLURM  
calypso0 : SLURM controller + accounting DB  
calypso[0-10] : SLURM workers
```

## Configuration

TODO

## Kubernetes Cluster

The Kubernetes control plane is on calypsomaster, you don't have access to it, and this node can't run pods, it's just administrative for the operation of the cluster. The rest are all capable of running pods.

```
# kubectl get nodes
NAME                STATUS    ROLES    AGE   VERSION
calypso0            Ready    <none>   324d  v1.31.12
calypso1            Ready    <none>   324d  v1.31.12
calypso10           Ready    <none>   19d   v1.31.12
calypso2            Ready    <none>   323d  v1.31.12
calypso3            Ready    <none>   323d  v1.31.12
calypso4            Ready    <none>   323d  v1.31.12
calypso5            Ready    <none>   323d  v1.31.12
calypso6            Ready    <none>   120d  v1.31.12
calypso7            Ready    <none>   19d   v1.31.12
calypso8            Ready    <none>   19d   v1.31.12
calypso9            Ready    <none>   19d   v1.31.12
calypsomaster       Ready    control-plane 324d  v1.31.12
```

There are 2 usable namespaces as of now : the default one where teachers can do tests, and the isc3 namespace for students, the others are administrative.

```
kubectl get namespaces
NAME                STATUS
default             Active
isc3                 Active
kube-flannel        Active
kube-node-lease     Active
kube-public         Active
kube-system         Active
```

The K8s cluster was created with containerd as the main container engine: there is also a docker-engine + docker-compose that are installed on the servers for testing.

## Users

Teacher users are administrators, they have some clusterroles permissions (cluster-admin-role), and large roles permissions on default and isc3 namespaces (default-admin-role, isc-admin-role).

Students have only a role permission, named student-role to do all needed operations on pods, services, deployments etc...

## Storage

The PersistentVolumes (PV) have already been created locally to reflect the local storage capacity, which is NVMe SSD storage: the trade-off is that the PersistentVolumeClaims (PVC) being only assignable 1:1 to a PV, you can't create additional PVCs, it will never be bound to a PV since they are already taken statically: this is due to the local volume type which requires the binding to use the WaitForFirstConsumer policy.

```
kubectl get storageclasses
NAME                                PROVISIONER                                RECLAIMPOLICY
VOLUMEBINDINGMODE                  ALLOWVOLUMEEXPANSION
local-node-storage                 kubernetes.io/no-provisioner              Delete
WaitForFirstConsumer              false

kubectl get pv
NAME                                CAPACITY  ACCESS MODES  RECLAIM POLICY
STATUS  CLAIM                                STORAGECLASS  VOLUMEATTRIBUTESCLASS
local-node-volume                 300G       RW0,RWX       Retain
Bound  default/claim300g                   local-node-storage  <unset>
```

The PVCs were created with Access Mode ReadWriteOnce and ReadWriteMany: which allows pods created by several people to be able to reuse the same PV in a concurrent way.

```
kubectl get pvc
NAME                                STATUS  VOLUME                                CAPACITY  ACCESS MODES
STORAGECLASS                        VOLUMEATTRIBUTESCLASS
claim300g                            Bound   local-node-volume                   300G      RW0,RWX
local-node-storage                   <unset>
```

Rules for persistent storage:

- On all the nodes have up to 300G of disk space allocated to K8s. So to create a pod requiring for example a non-ephemeral database, you need to specify the PersistentVolumeClaim **claim300g** in the deployment yml, and it will be dispatched to a corresponding node.
- The pods will automatically launch on the node that has the right PV/PVC pair.

```
kubectl get pods -n isc3 -o=custom-
columns=NAME:.metadata.name,STATUS:.status.phase,NODE:.spec.nodeName
NAME      STATUS  NODE
www       Running calypso0
www       Running calypso4
www2      Running calypso3
```

## Ressources GPU

Each node in the cluster has Nvidia Container Toolkit installed, which allows you to use their Nvidia GPUs from the containers :

Calypso[0-9] are equipped with Nvidia A2 GPUs

Calypso[10-14] are equipped with Nvidia Tesla T4 GPUs

## Registry Docker

To avoid saturating the network link with the builds there is a local registry that can be used on calypsomaster: you already have in your configuration daemon.json of each node a local insecure registry of settings: "insecure-registries": ["192.168.88.248:5000"]

TODO : Recreate the registry with a certificate from local PKI, distribute CA certificates / registry certificate to every node to trust the local authority.

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