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Big Data and Quantum Computing

Instructions for offloading to RAC resources

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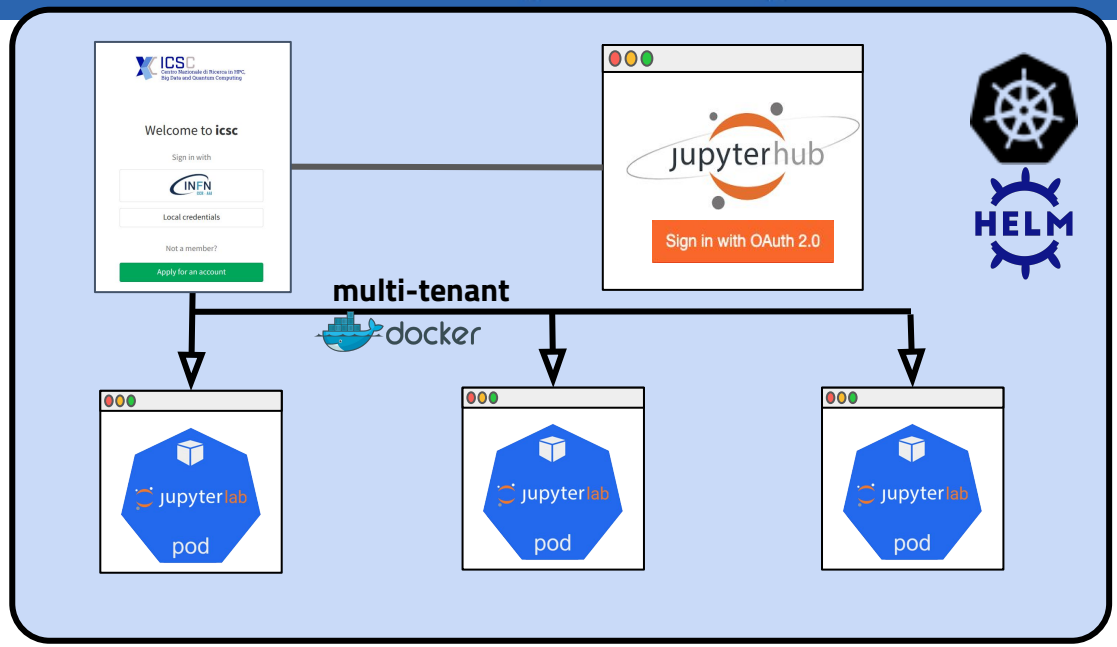
WP2 UC2.2.2 Meeting - 17 July 2025 - ZOOM

The high-rate analysis hub

A jupyterhub is deployed on a k8s cluster (**128 vCPUs and 258 GB**) via the official Spoke2 JHub Helm repo

- endpoint is here and Indigo-IAM is used for authentication

Users choose JupyterLab image to deploy and after deployment completion, they get access to a full IDE (persistent storage, terminal, notebooks, editors)



How we used to scale

A jupyterhub is deployed on a k8s cluster (**128 vCPUs and 258 GB**) via the official Spoke2 JHub Helm repo

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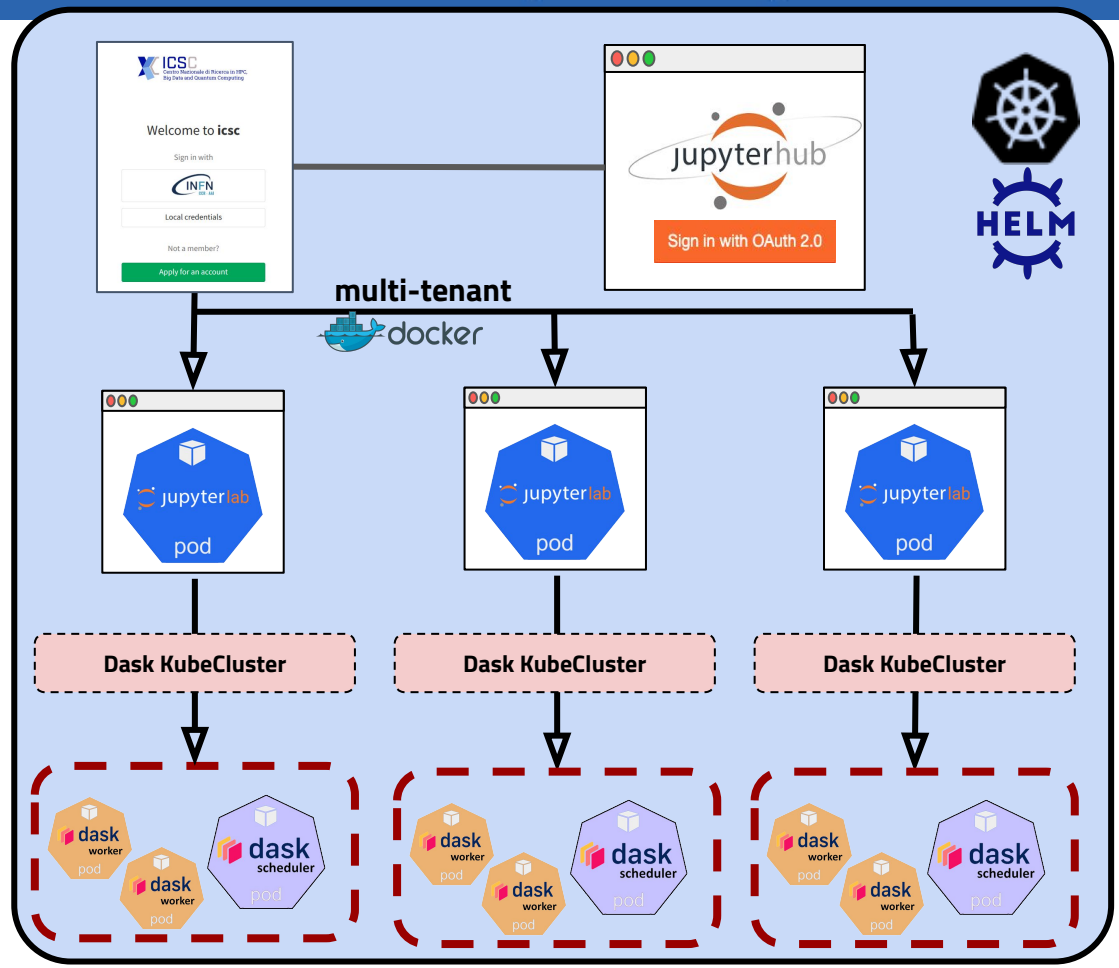
Users used to scale up their python-based computation, using Dask library, within the Kubernetes cluster



Where we are now

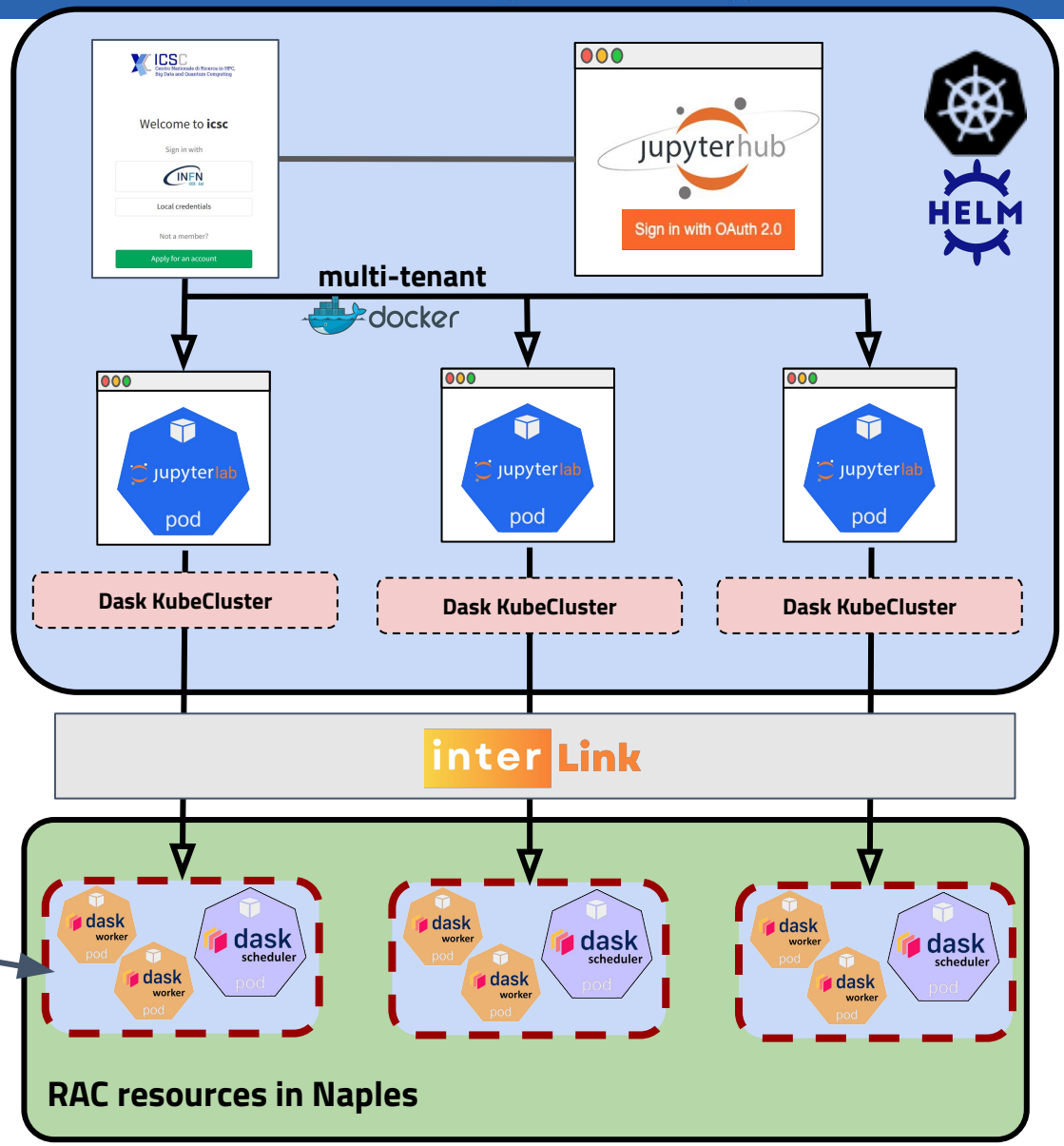
A jupyterhub is deployed on a k8s cluster (**128 vCPUs and 258 GB**) via the official Spoke2 JHub Helm repo

- endpoint is here and Indigo-IAM is used for authentication

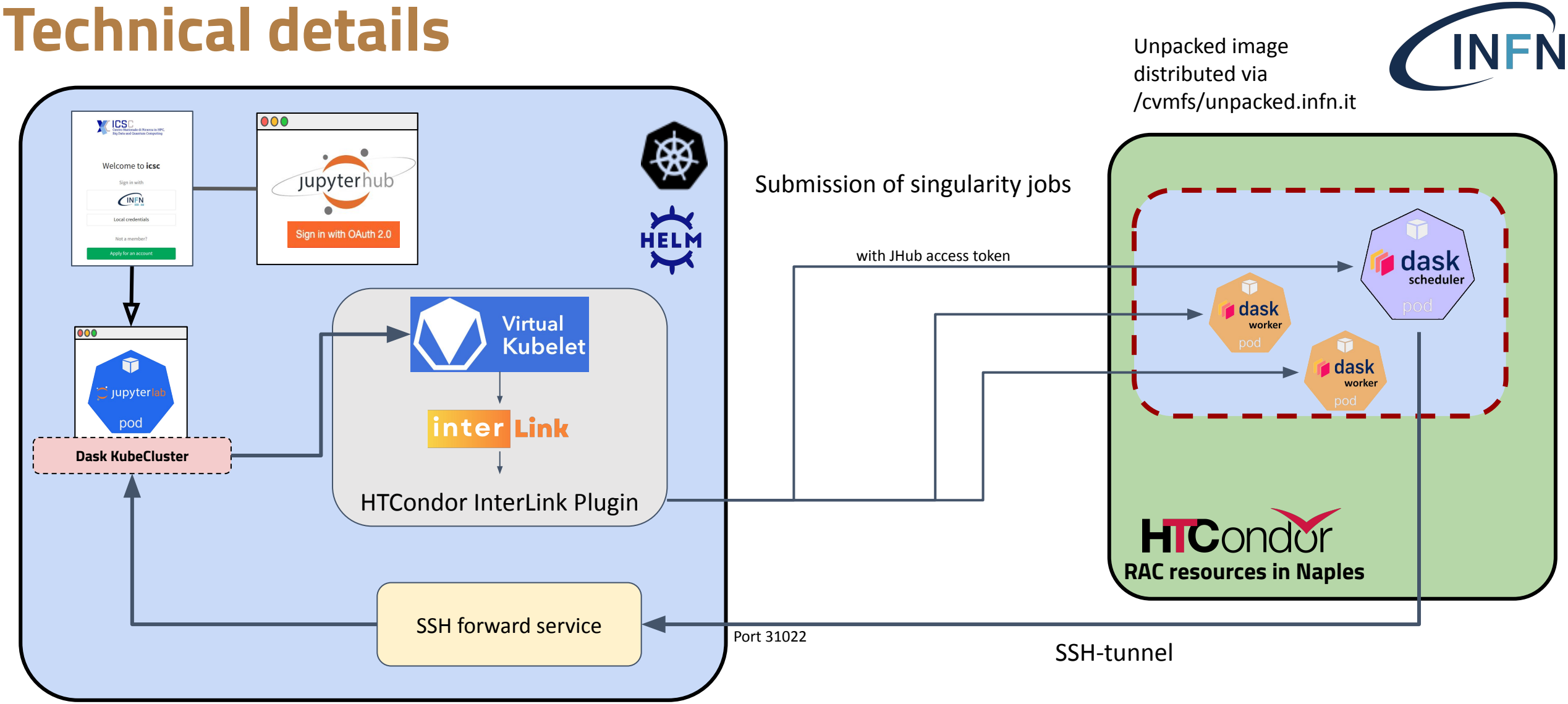
Users choose JupyterLab image to deploy and after deployment completion, they get access to a full IDE (persistent storage, terminal, notebooks, editors)

Users can now scale up their python-based computation, using Dask library, offloading to external RAC resources hosted in Naples:

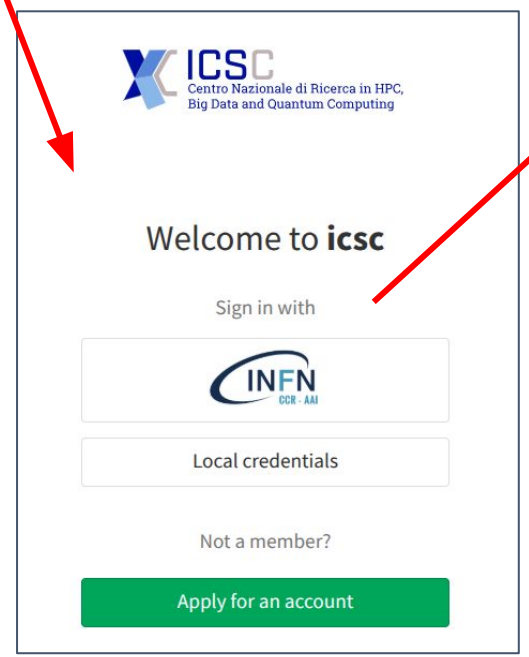
- 70 nodes (96 cores each)
- accessible via an HTCondor-CE

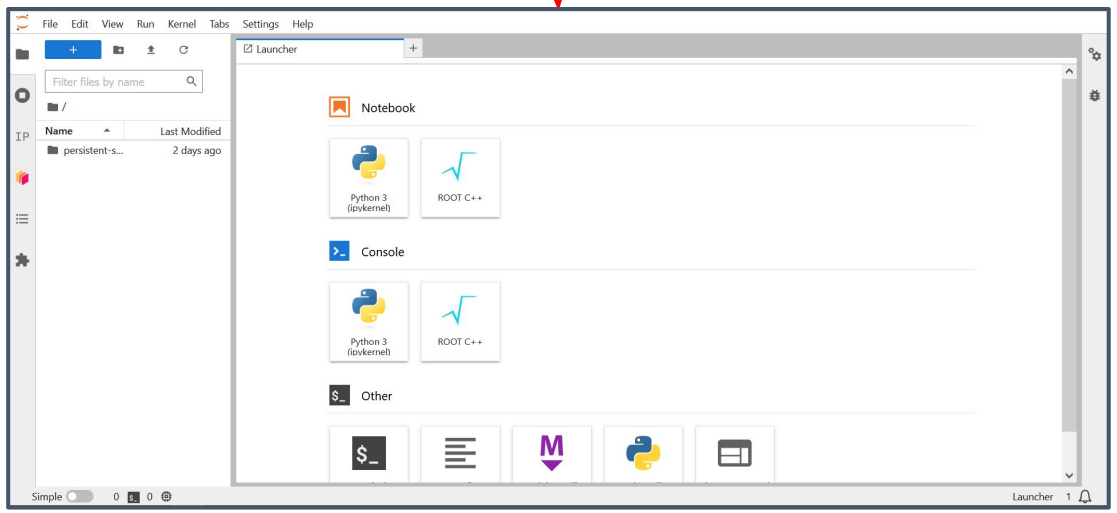


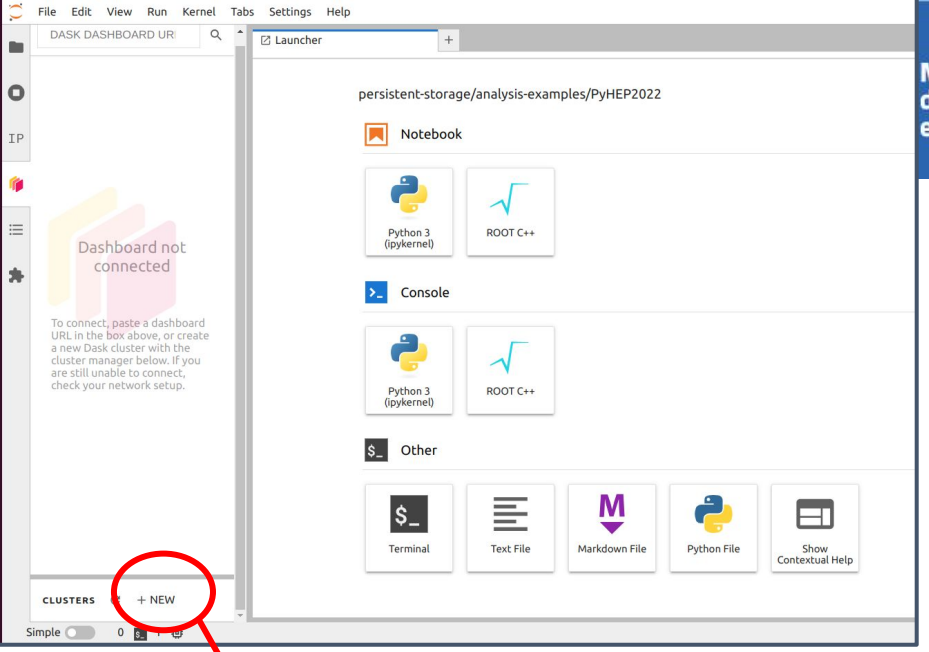
Technical details

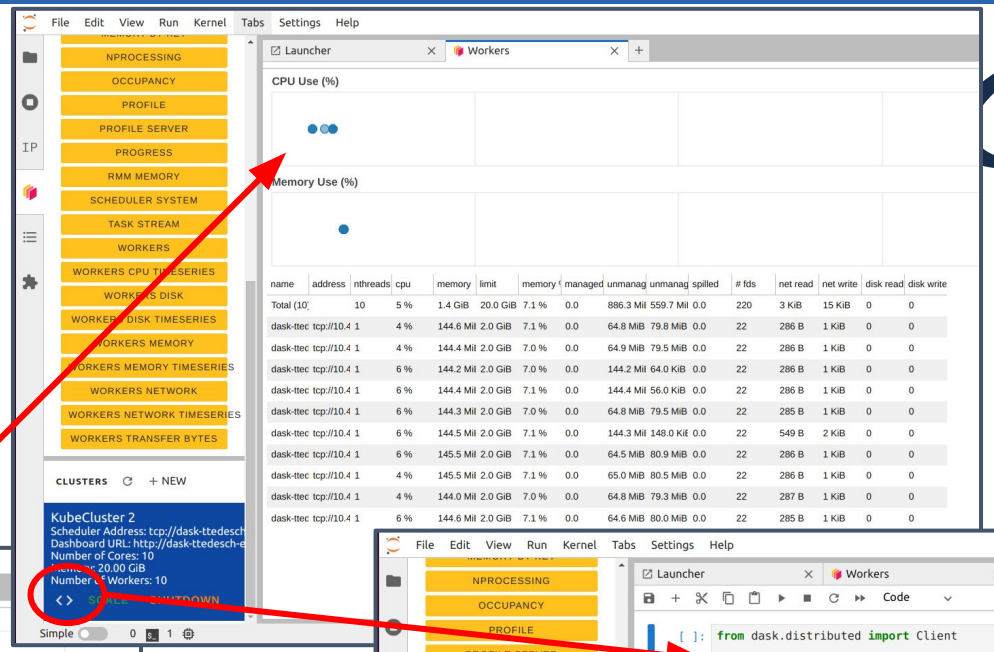


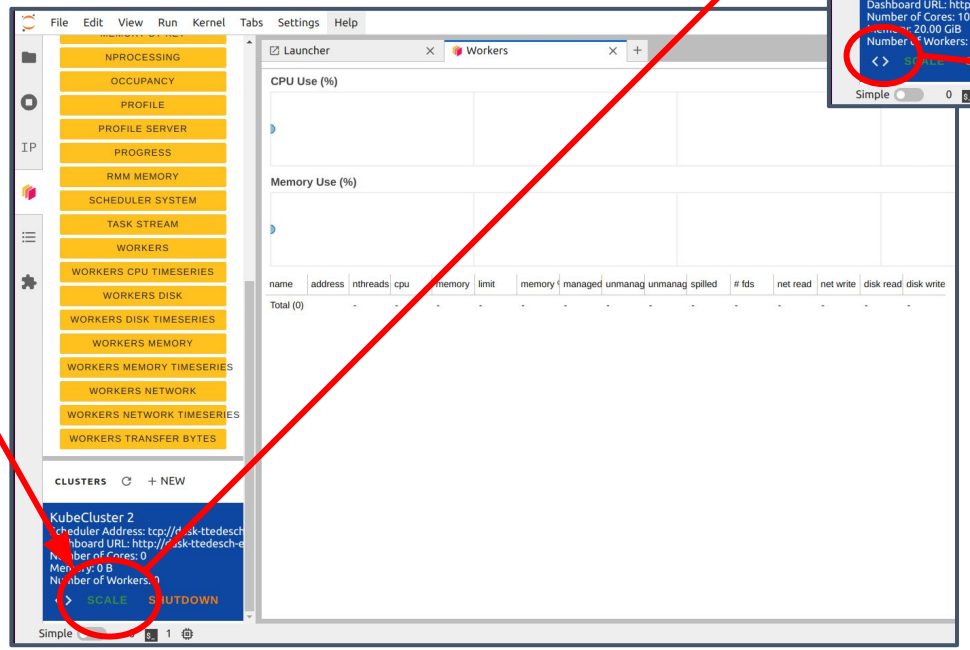
Access steps

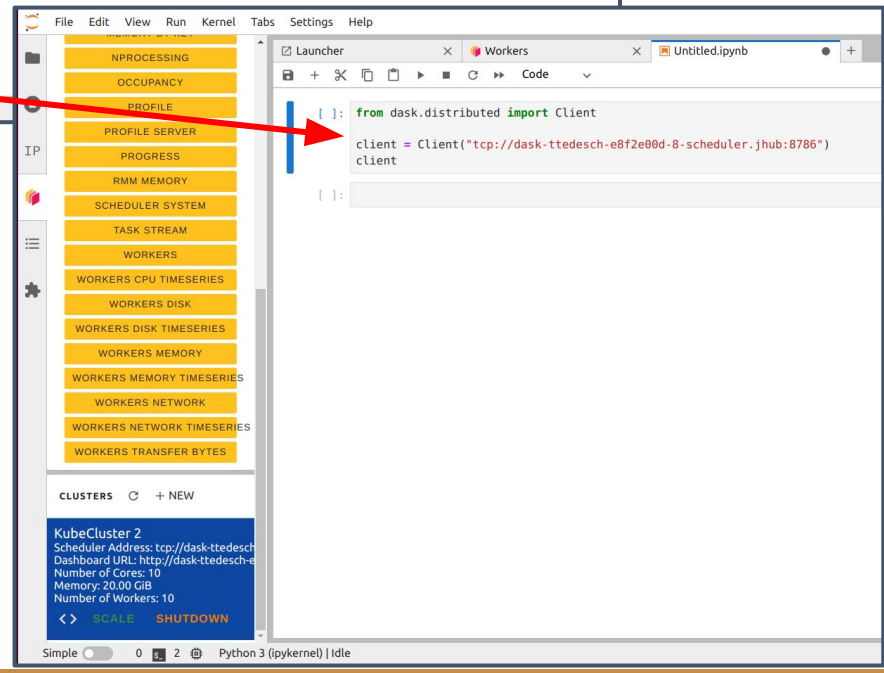












IMPORTANT:
some delay may occur due to the job queueing system. Once connected, please wait ~10s before scaling the cluster

Some additional info

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- cvmfs is mounted both in jlab session and in the nodes (unpacked, sft, cms, grid for now)
- Repo where images are developed: https://github.com/ICSC-Spoke2-repo/wp5-custom-images/tree/highrate-offloading
- As before, **each user is assigned 10 GB of persistent storage**:
  - Anything that is stored outside the `persistent-storage` will be lost when the JLab session ends
  - No redundancy nor any production backup is in place for persistent storage: **BACKUP EVERYTHING ELSEWHERE!** since data will be lost in case of a node failure

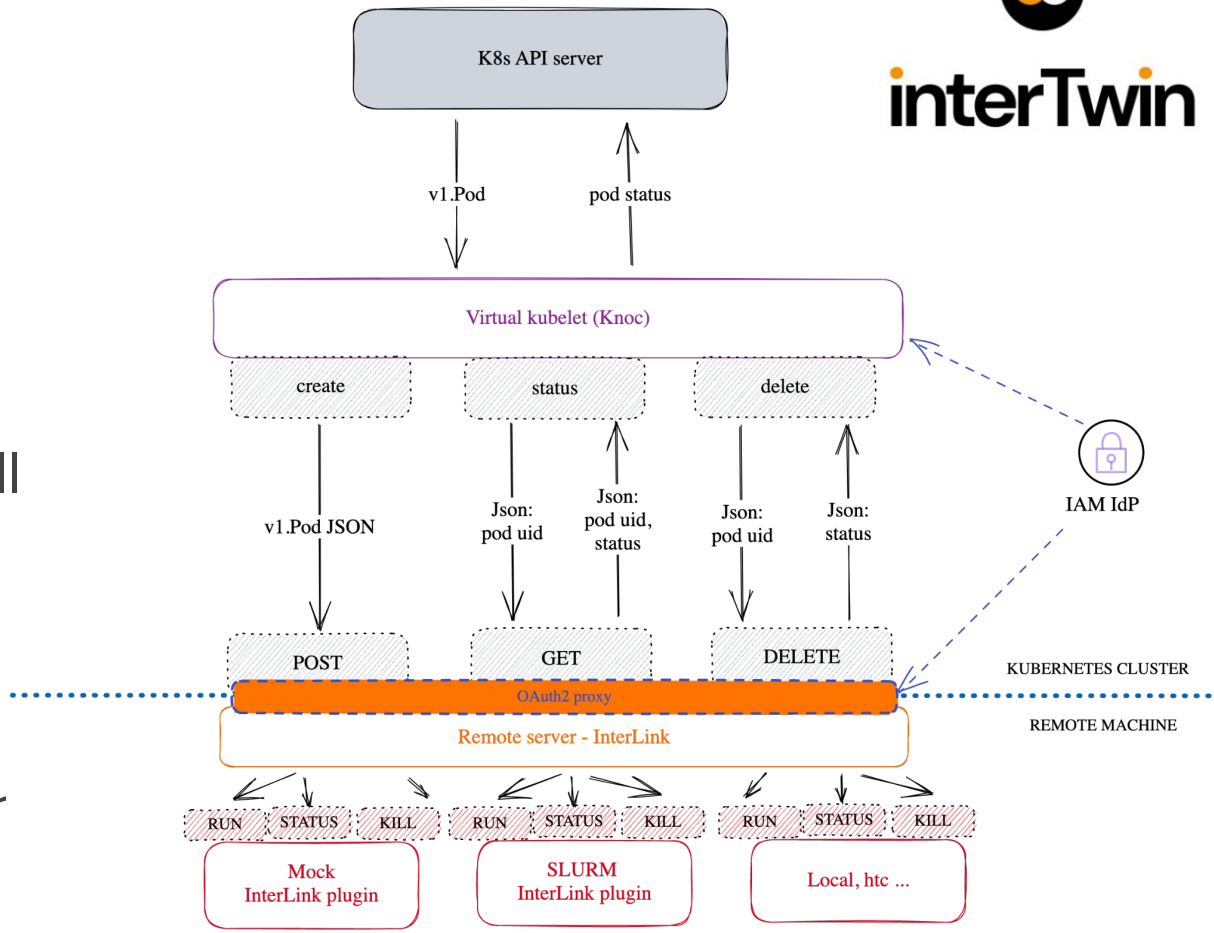
Backup

The technical solution: InterLink

InterLink aims to provide an abstraction for the execution of a Kubernetes pod on any remote resource capable of managing a container execution lifecycle.

The project consists of two main components:

- **A Kubernetes Virtual Node**: based on the VirtualKubelet technology. Translating request for a kubernetes pod execution into a remote call to the interLink API server.
- **The interLink API server**: a modular and pluggable REST server where you can create your own container manager plugin (called sidecar), or use the existing ones: remote docker execution on a remote host, singularity Container on a remote SLURM or **HTCondor batch system**, etc...

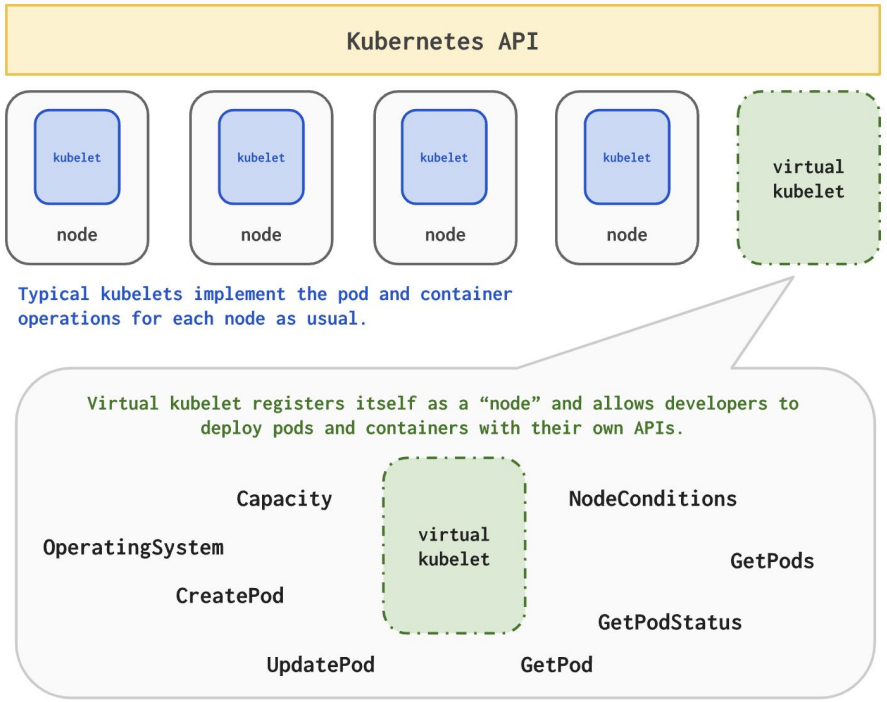


https://github.com/interTwin-eu/interLink

Components: VK

https://virtual-kubelet.io/

- **Virtual kubelet (VK)**:
  - "Open-source Kubernetes kubelet implementation that masquerades as a kubelet. This allows Kubernetes nodes to be backed by Virtual Kubelet providers"
- Can be imagined as a translation layer:
  - "I take your pod and run your container wherever I want"
- Registers virtual node and pulls work to run
- The pod lifecycle is managed via interlink rest calls
- Oauth2 via service token kept "refreshed"



Components: Interlink + Oauth2 proxy

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- Oauth2 proxy: authN with IAM and authZ configurable on aud and groups
- "Digests" and manipulates calls from VK to the sidecar
- Self contained binary, distributable on all OS without dependencies