Cloud bursting experiment at CNES

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peps.cnes.fr

The french access to the Sentinel products

Redistributes Sentinel 1,2,3 satellites products from Copernicus, the European Union's Earth Observation Program.

Sentinels are multi-sensors satellites (radar, optical, etc.) with high revisit frequency (time series).
Almost 20 other satellites planned before 2030.

2 PB of data in 30 years for SPOT satellites
9 PB of data in 4 years for Sentinel products
Currently 10 millions of products & 15 TB/day

opernicus
Europe's eyes on Earth

esa

Processing on demand on PEPS platform

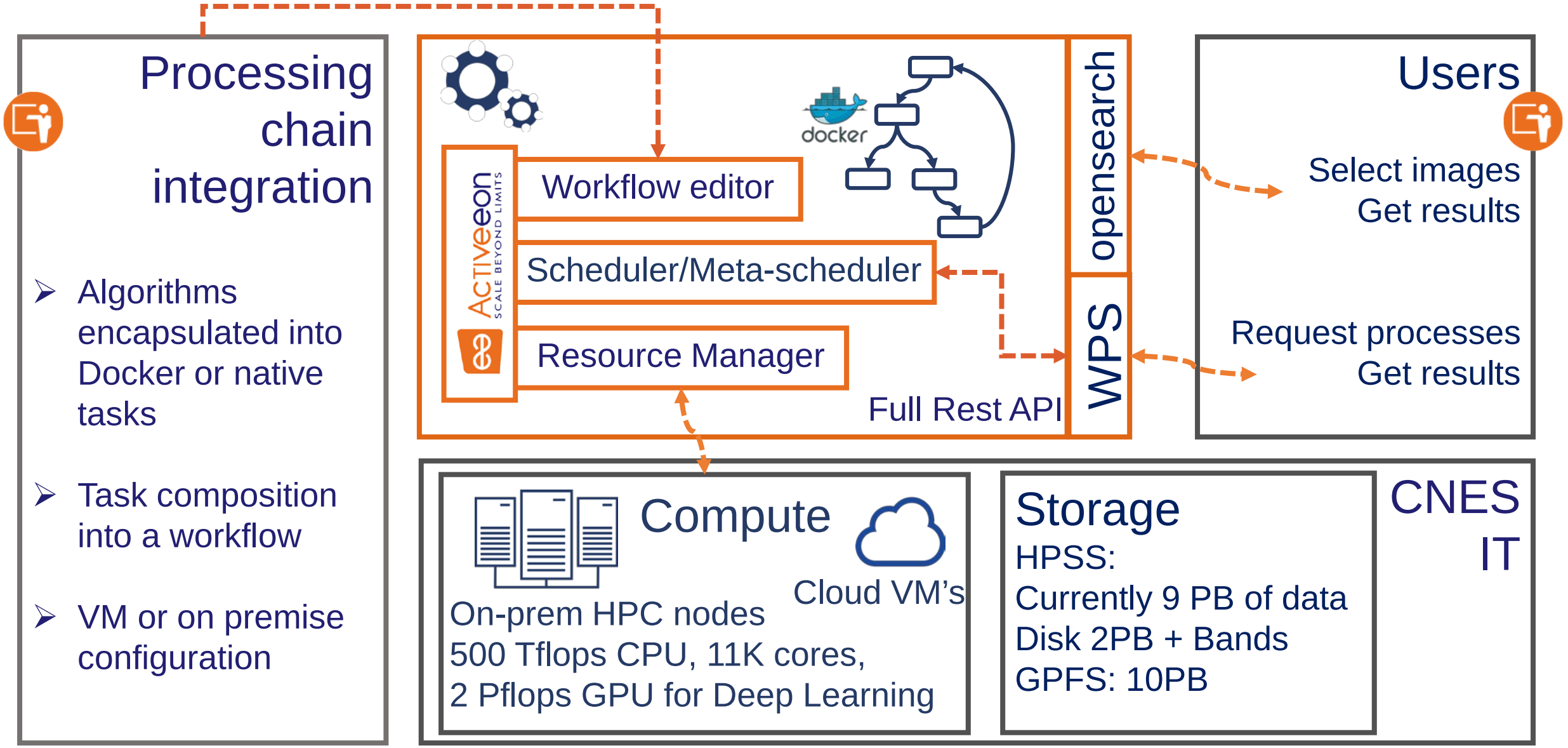
- Sentinel-2 false or true color composition, computation of radiometric indices (NDVI, LAI, etc.)
- Sentinel-2 atmospheric correction and cloud detection using MAJA processing chain from CESBIO laboratory
- Sentinel-1 ortho-rectification from CESBIO laboratory to produce ortho-rectified tiles at 10 meters of resolution using MGRS grid to be able to superpose Sentinel-1 and Sentinel-2 pixels
- In the roadmap: Soil moisture computation using both Sentinel-1 and Sentinel-2 products, evolution of Sentinel-1 ortho-rectification with multi-temporal filtering of the speckle noise

Processing on PEPS platform

- In the roadmap:
- LEGOS laboratory: First Global Atlas of Littoral Bathymetry using Sentinel2 data and possibly later PLEIADES data for hotspots areas
- IFREMER and CLS: Extraction of hurricane characteristics at a very high resolution from space using Sentinel-1 images over tropical cyclones

Information such as the ocean surface wind field provided at 1 km resolution could trigger perspectives for improving hurricane forecast information

Processing on demand on PEPS platform : How?



Cloud bursting experiment at CNES : Why?

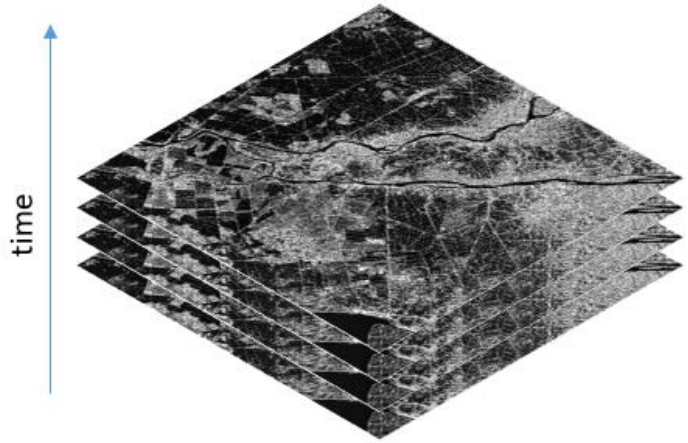
A first POC done in 2018, a second one this year.

Objectives:

- Transparent hybrid cloud bursting
- Performances comparison with on premise nodes
- Is it possible to scale? Dynamically?
- Costs comparison with on premise resources

Cloud bursting experiment: What?

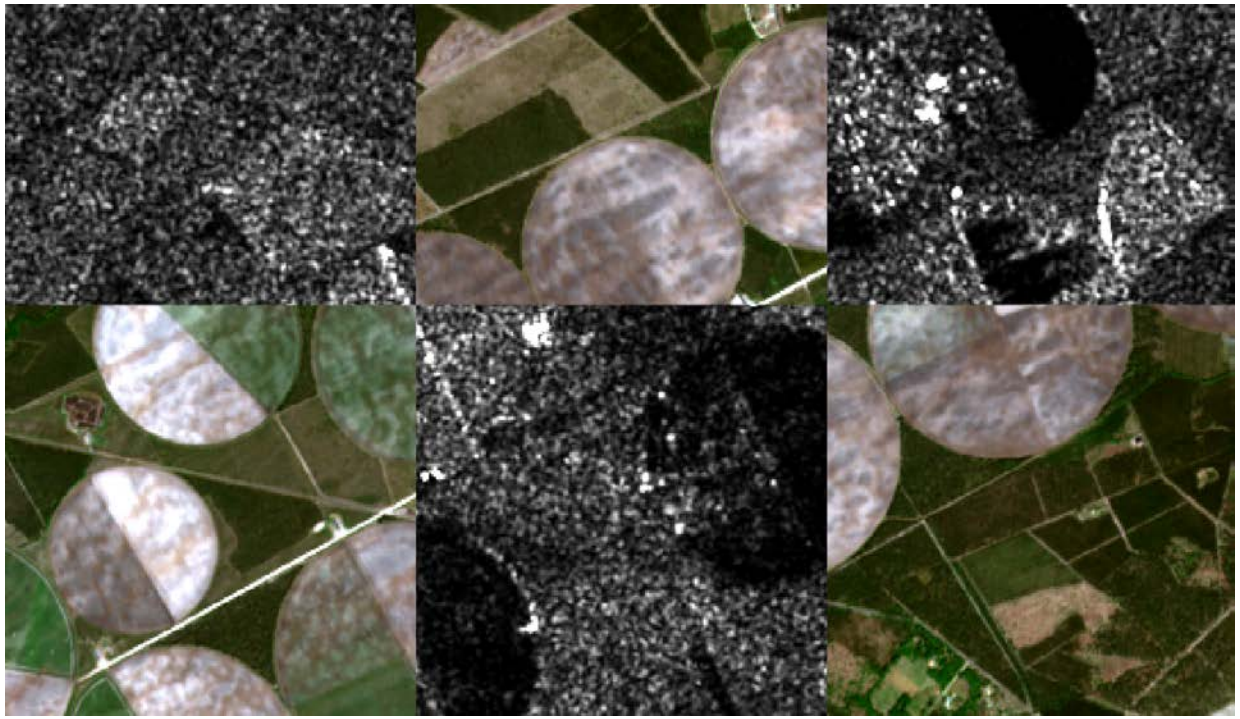
- Sentinel-1: The only system to provide SAR images regularly on all lands on the planet. Access to these time series of images opens an extraordinary range of applications



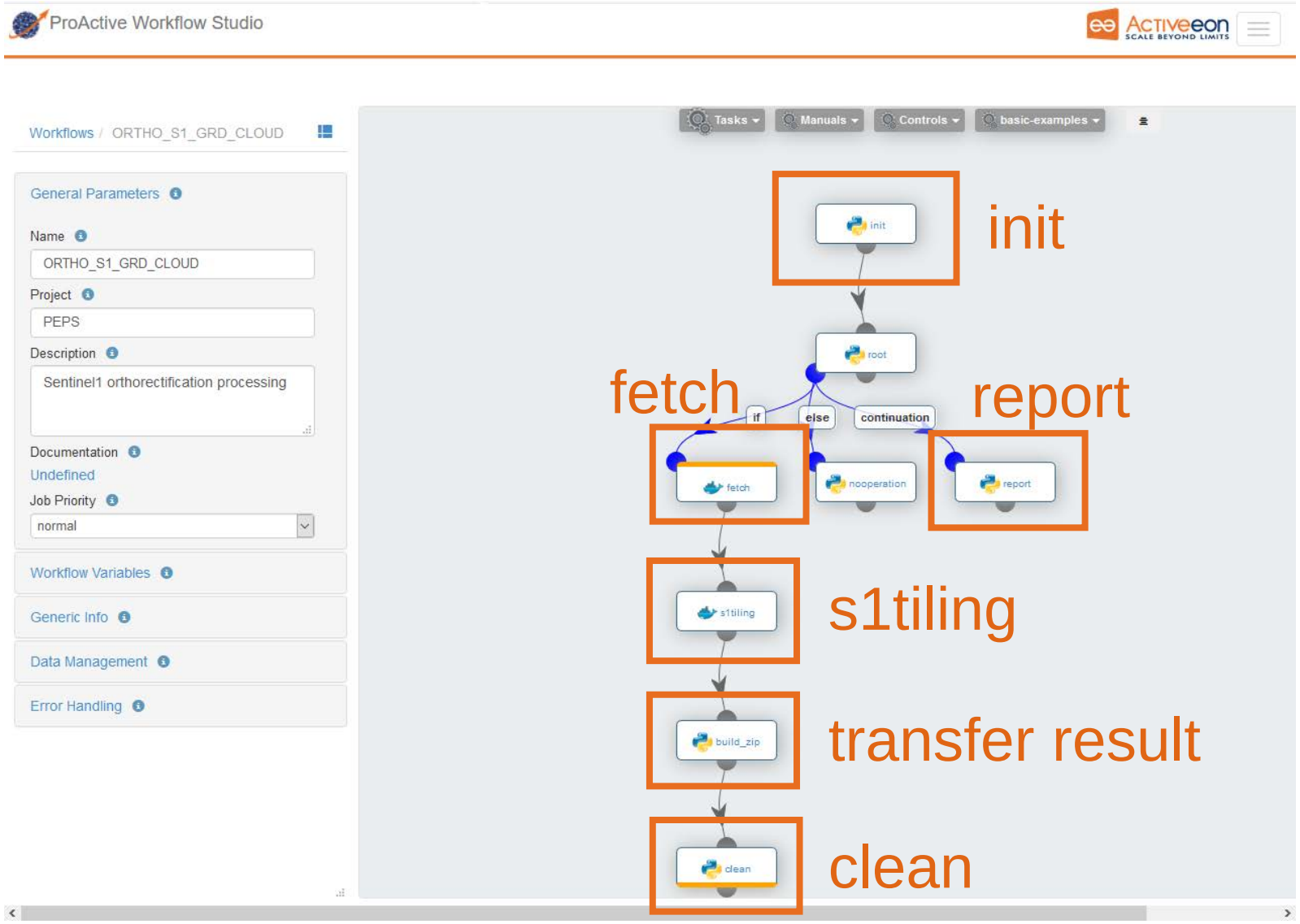
- Sentinel-1 ortho-rectification processing chain uses S1tiling algorithm developed to provide "Analysis Ready" time series for a very large number of applications
- Developed within the CNES radar service, in collaboration with CESBIO laboratory

Cloud bursting experiment: What?

- The tool benefits from the opensource Orfeo Tool Box developed by CNES
- Resulting images are registered to Sentinel-2 optical images, using the same MGRS geographic reference. It promotes joint use of both missions



Cloud bursting experiment: How?



init

Initialize workflow folders and variables

fetch Docker task

Fetch image data

s1tiling Docker task

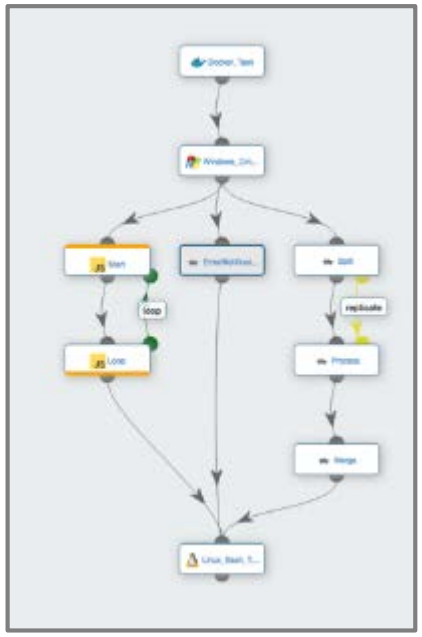
Image processing over 6 CPU cores

Transfer result

Clean

Report

Transparent hybrid cloud bursting?

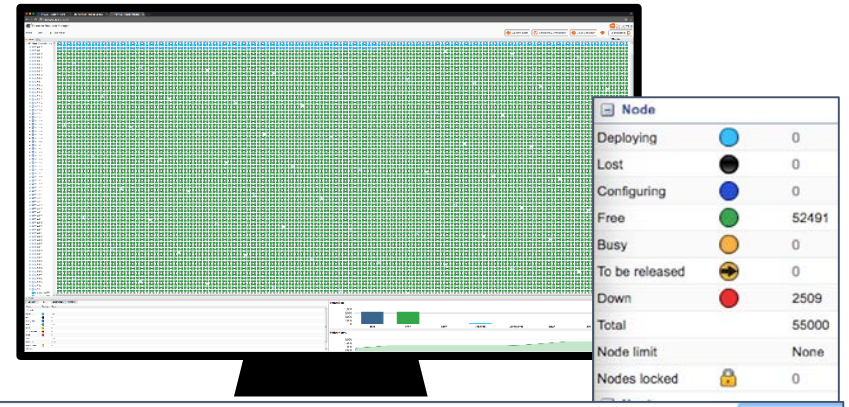


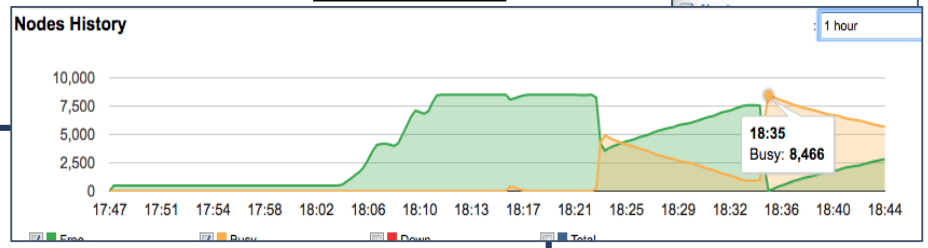
hadoop · kubernetes · docker · Java · Spark · python · sas · GREENPLUM DATABASE · ANACONDA · kafka

ProActive Workflows & Scheduling

Workflow Scheduler

Resource Manager





Azure Node Sources

VM · VM

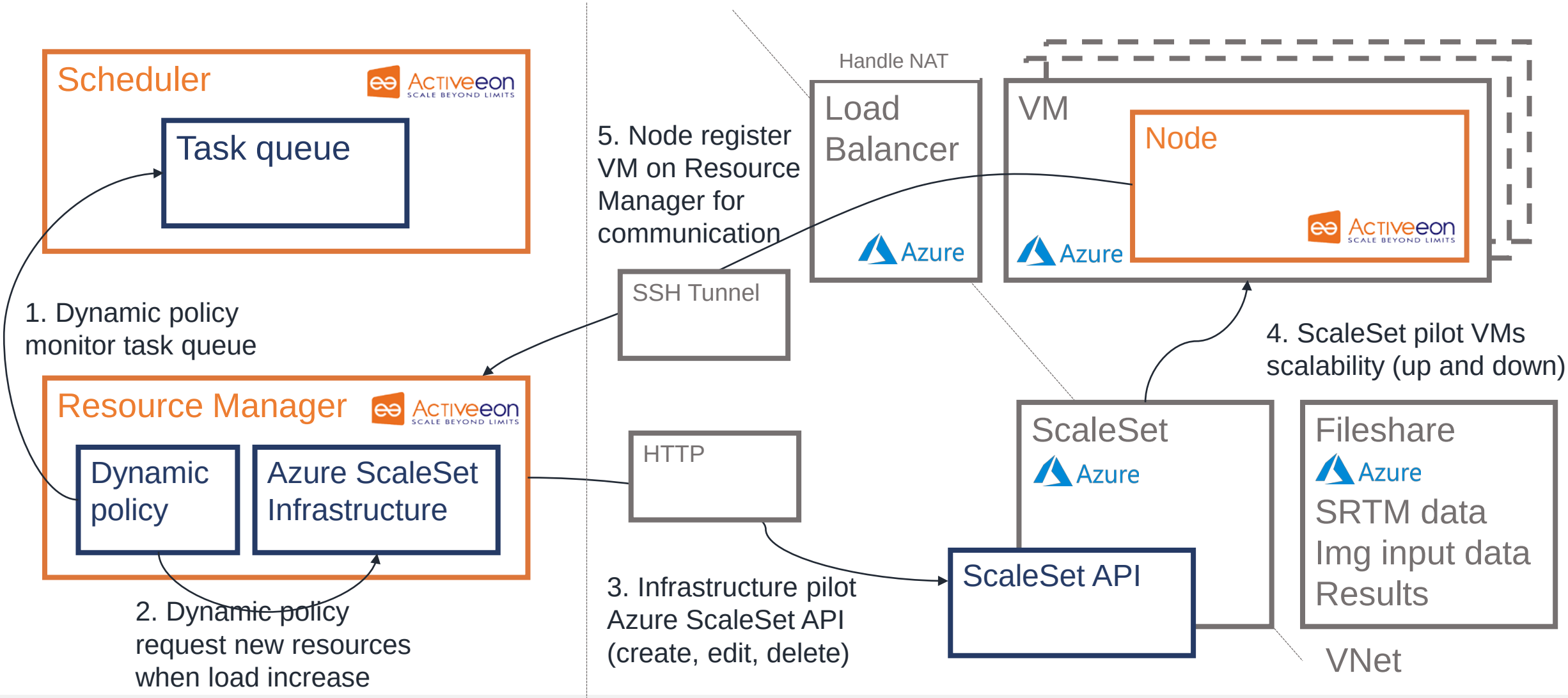
aws AWS Node Sources

Amazon S3 · Autoscale · EC2 · EC2

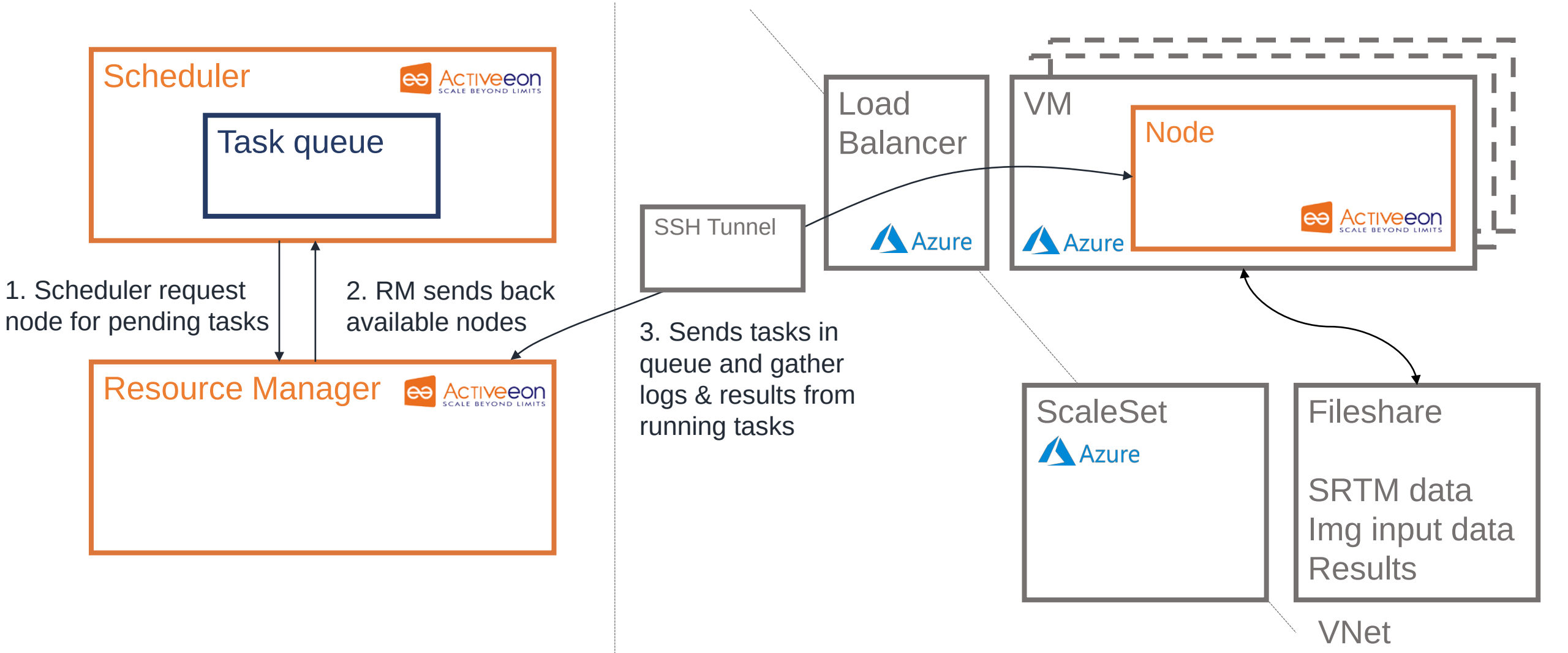
Private Node Sources

openstack · vmware · PBS · slurm · docker · Node · Node

Transparent hybrid cloud bursting: How?



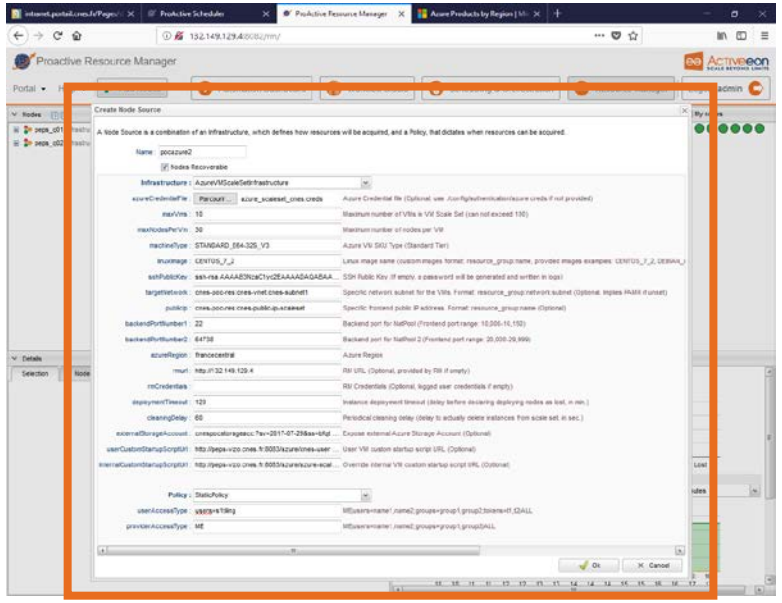
Transparent hybrid cloud bursting: How?

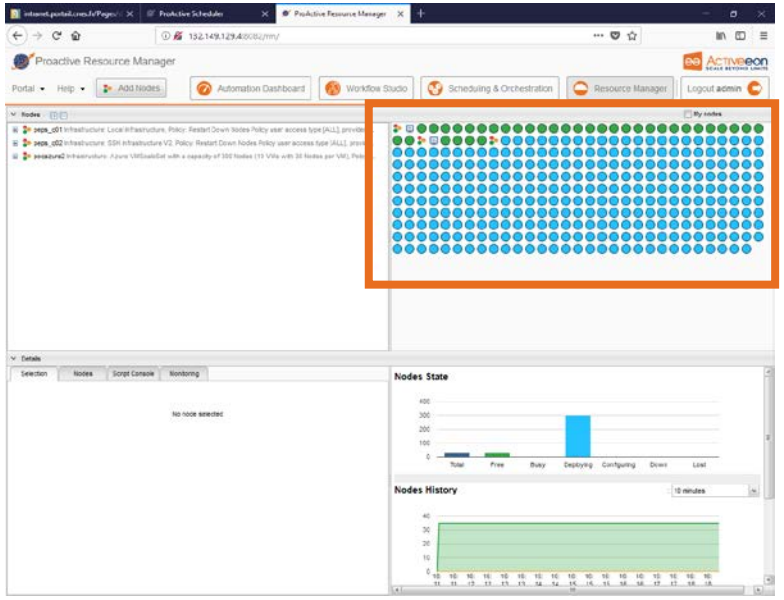


Cloud bursting experiment POC1

1

Resource allocation from Resource Manager



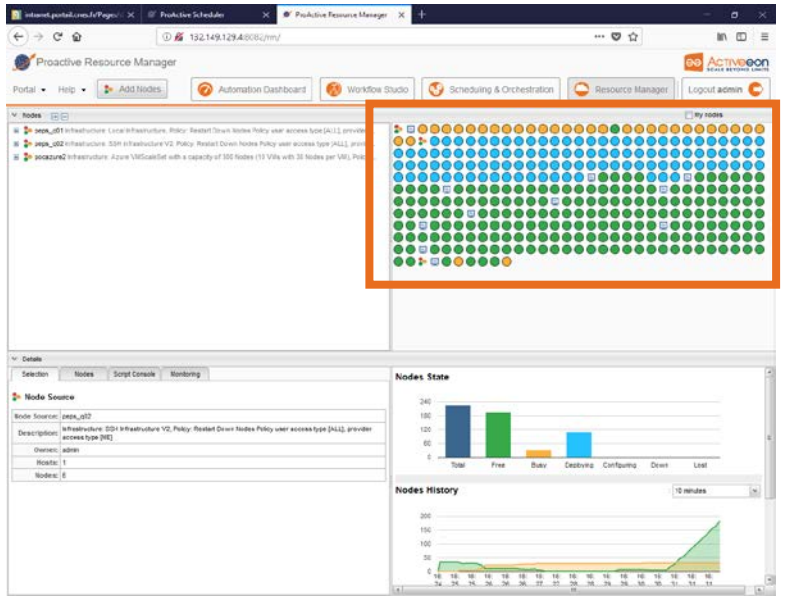


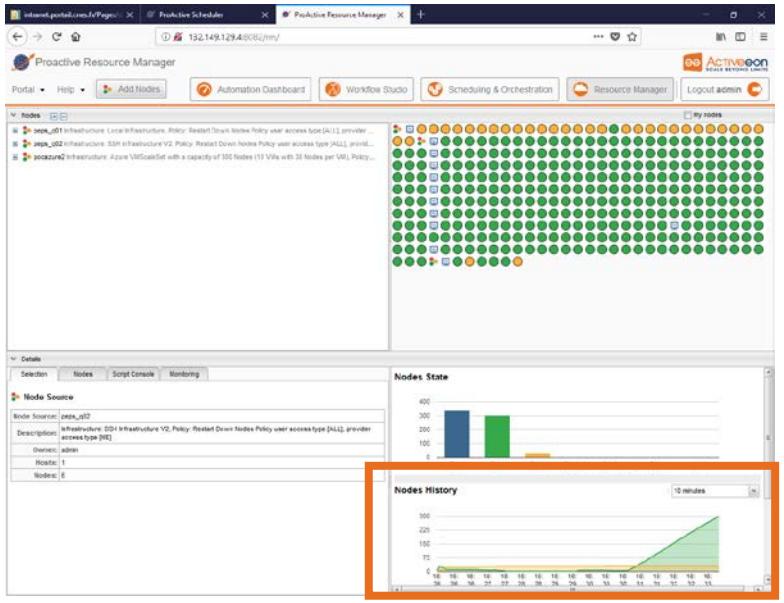
2

Waiting for VMs to start

3

First VMs Connected

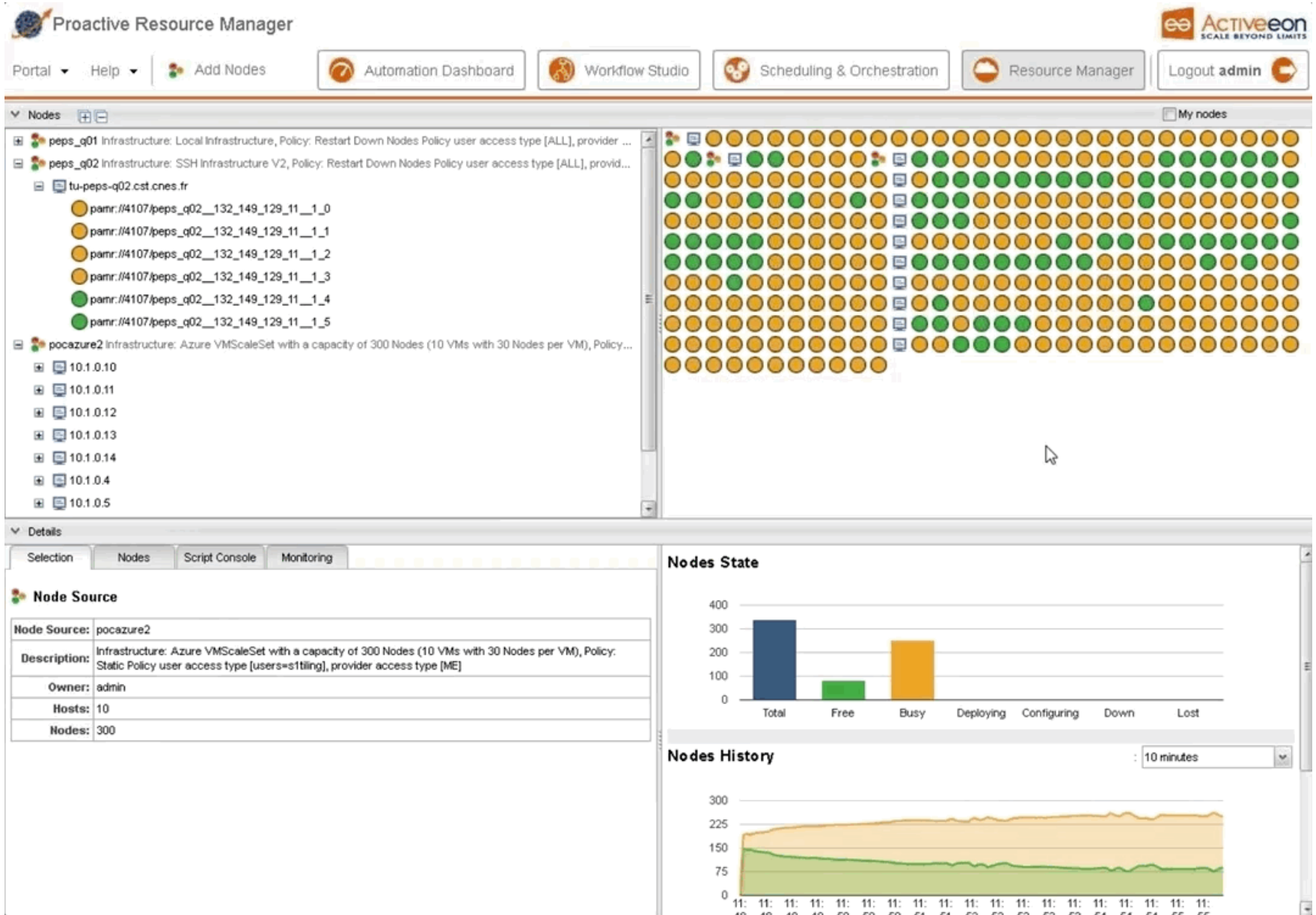




4

Visualize CPU cores available through time

Cloud bursting experiment POC1



> Up to 640 cores

- VM monitoring
- Resource utilization status

Results

Technical results:

- Successful transparent hybrid cloud bursting in 2018 from CNES datacenter into Microsoft Azure public cloud with 640 cores running the ortho-rectification chain

- Comparable performances obtained with:
  STANDARD_E64-32S_V3 Azure VM
  and
  on premise resources (HPC & dedicated Nodes)

- Issues identified related to bandwidth:
  a direct link to the datacenter used is necessary

Results

Costs and cloud benefits:

One of the main element of costs gives:

- 0.061€ CPU/hour for the STANDARD_E64-32S_V3 Azure VM

And

- 0,05€ CPU/hour for a CNES cluster HPC node all included (computation, local storage, full support, electricity consumption, investment)

- Benefits: Data processing architecture comparison, Performance & Cost optimization, Requirement maturity

Perspectives

- Computing distribution has been addressed
- To be done: data interconnection avoiding data duplication

=> Goal: Facilitate data centers cooperation

Thank you for your attention