CERN

Towards a self automated CERN Cloud

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CERN Cloud Infrastructure

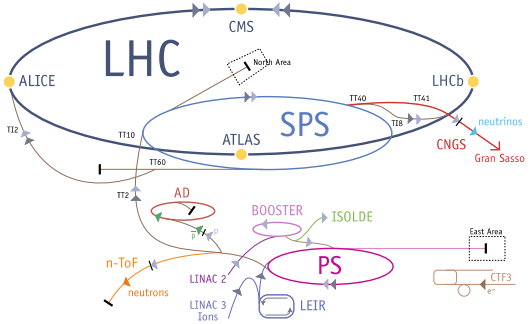
CERN Cloud Team

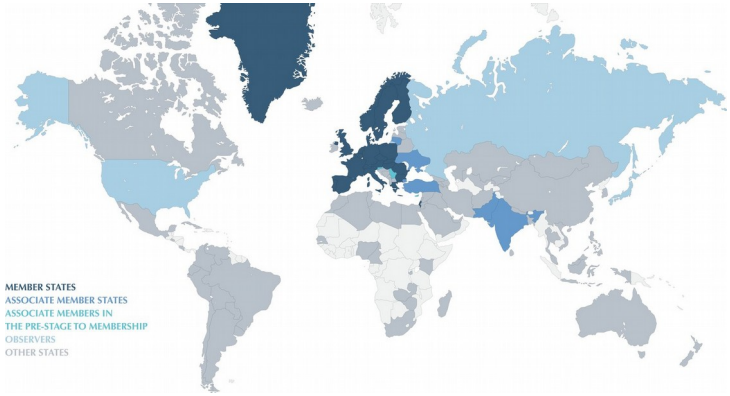
Outlines

- Introduction
- CERN Cloud service
- Automation status
- Upcoming challenges
- Improvement plan
- Source code

European Organization for Nuclear Research

- World largest particle physics laboratory
- Founded in 1954
- 22 member states
- Fundamental research in physics





CERN Cloud Service

- Infrastructure as a Service
- Production since July 2013
- CentOS 7 based
- Geneva and Wigner Computer centres
- Highly scalable architecture > 70 nova cells
- Currently running Rocky release

Cloud resources

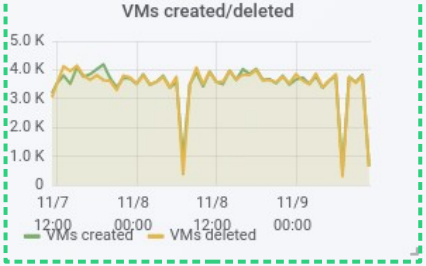
Used	Available	Used	Available	Used	Available
307.4 K cores	300.0 K cores	858.7 TiB RAM	937.5 TiB RAM	10.3 PiB disk	15.6 PiB disk

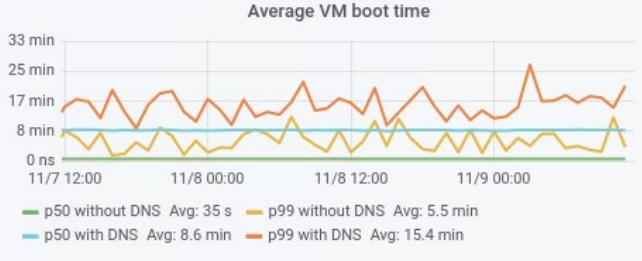
Openstack services stats

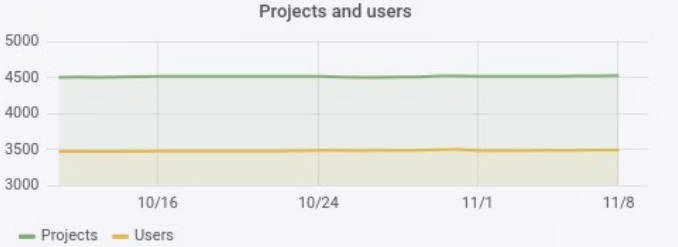
Users	Projects	VMs	Magnum clusters	Hypervisors	Images	Baremetal nodes
3492	4526	36203	420	9212	3179	1294

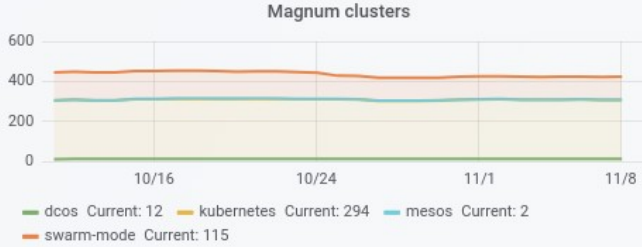
Volumes	Volume size	Fileshares	Fileshares size
6093	1.90 PiB	248	215 TiB

Resource overview by time



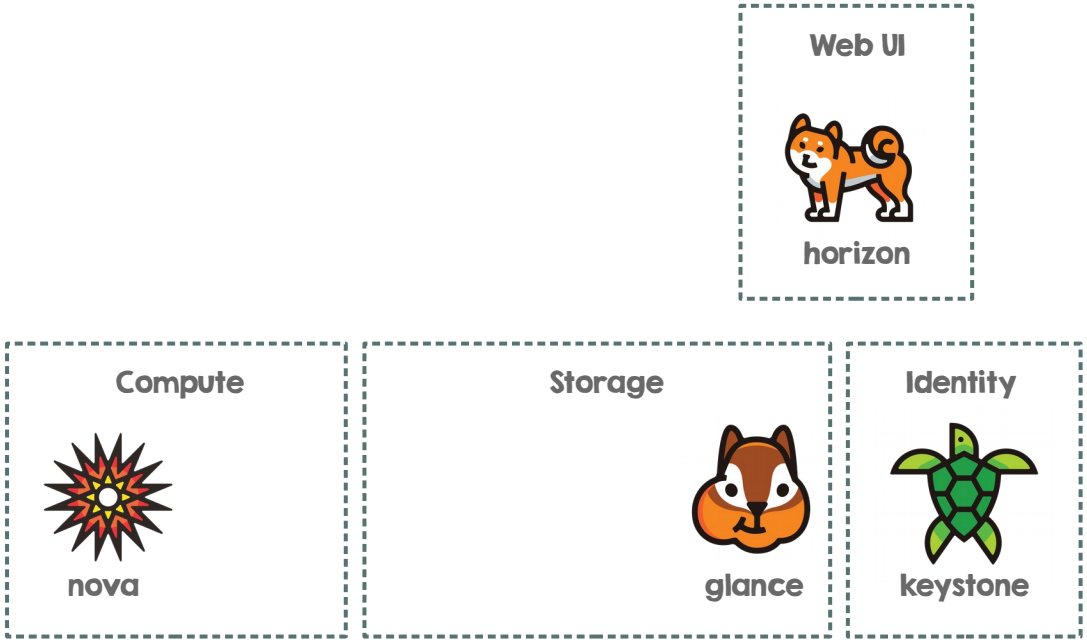






CERN Cloud Infrastructure - initial offering

IaaS



CERN Cloud Infrastructure - now

IaaS+

Orchestration

heat

Container Orchestration

magnum

Automation

mistral

Web UI

horizon

IaaS

Network

neutron

Compute

nova

ironic

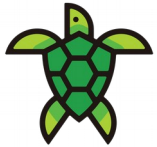
Storage

cinder

manila

glance

Identity

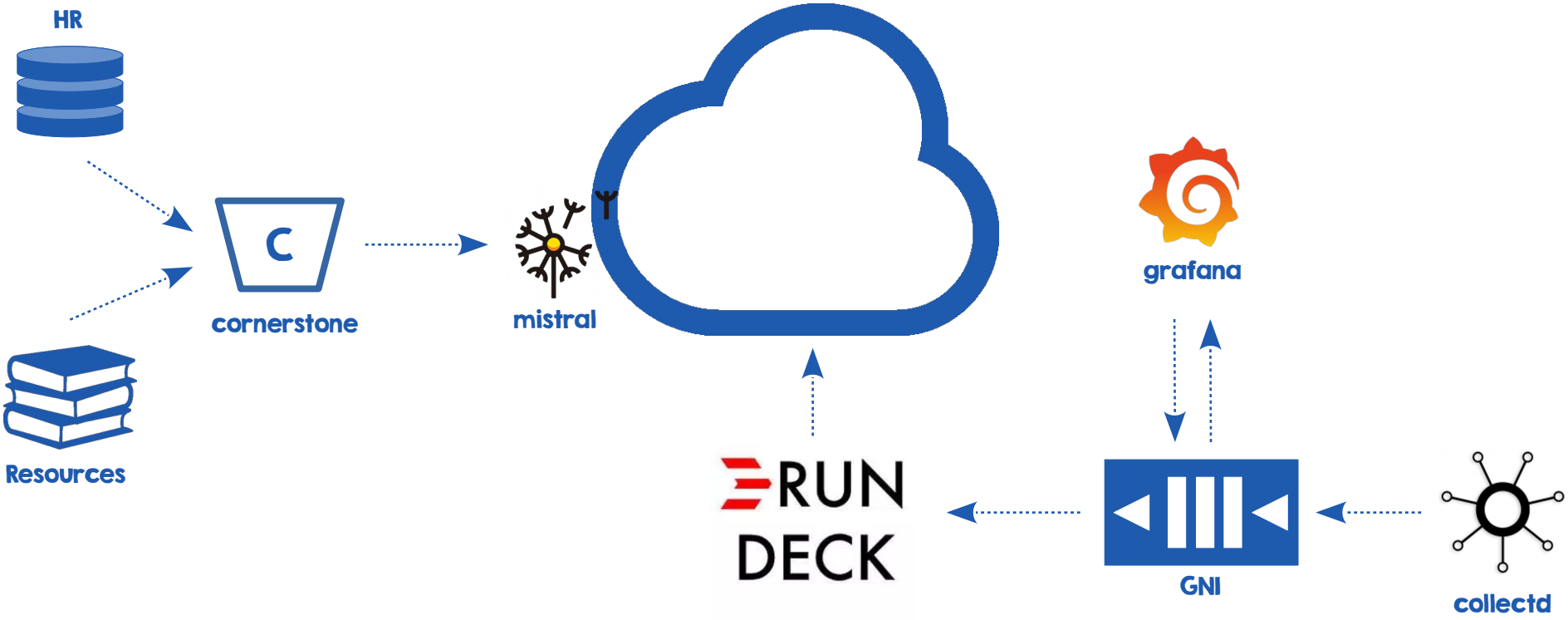


keystone

Key manager

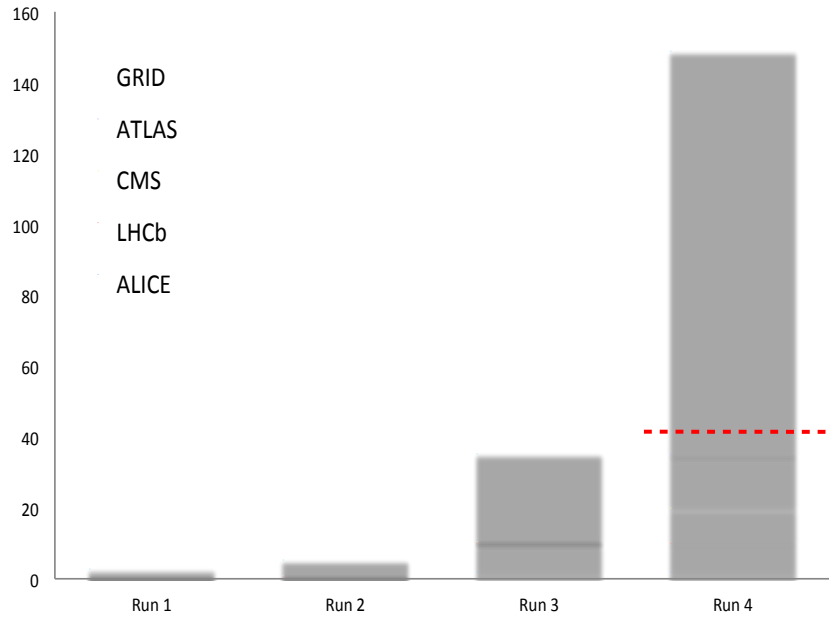
barbican

Automation in the CERN Cloud



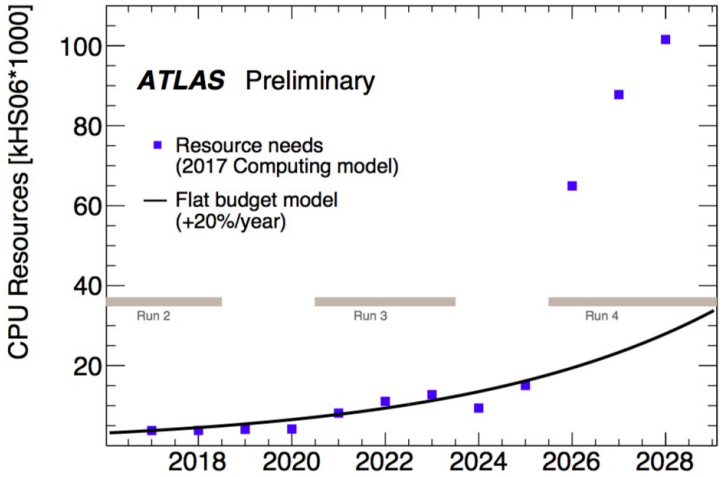
Back in 2012

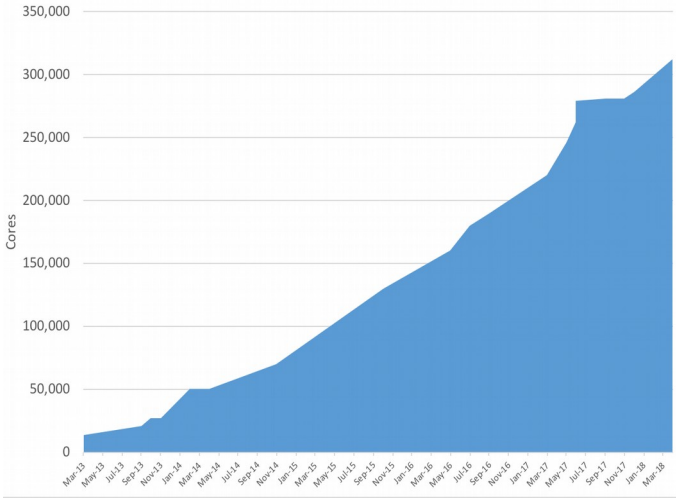
- LHC Computing and Data requirements where increasing
- Constant team size
- Improve manageability and efficiency
- Automation
  - Considered early on
  - Exercise it as much as possible



Situation now

- 300k core cloud and increasing
  - Addition of new services
  - Continuous improvements on existing ones
- No change in number of staff
- Automation is key
  - Keep service knowledge
  - Offload common tasks
  - Simplify management





Automation in the CERN Cloud @today

Host and Service monitoring

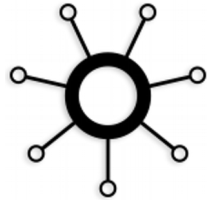
Resource Lifecycle management

Optimize resource availability

Improve VM availability and Performance

Host and Service Monitoring

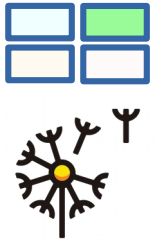
- Monitor HW events with Collectd
- Collect service logs through Flume
- General Notification Infrastructure
  - Support tickets for repairs
- Service alarms in Grafana
- Rundeck jobs
  - Time-scheduled jobs to fix common issues
  - Offload ticket handling
  - Schedule interventions



RunDeck: Task delegation

- Rely on Rundeck for offloading tasks to different teams
  - Procurement
  - Repair Team
  - Resource Coordinator
  - Cloud Service operations
- Example: disk replacement

Resource Lifecycle Management



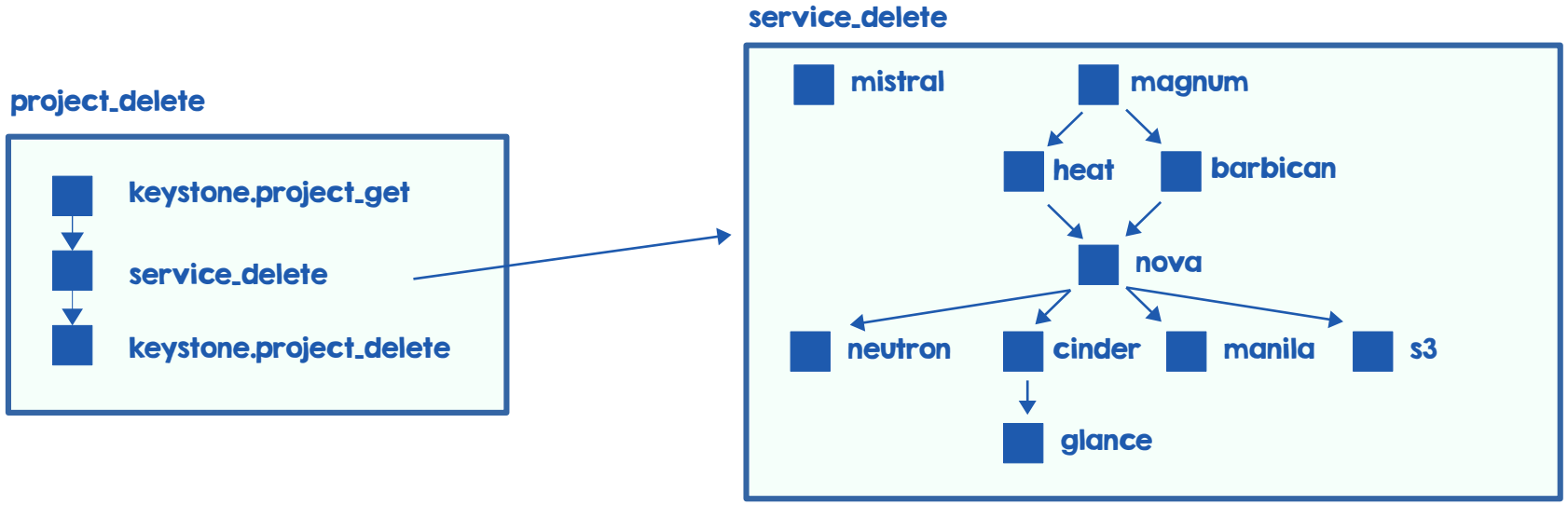
- Types of projects

	Affiliation Expired	User Disabled	User Deletion
Shared	Promote	-	-
Personal	-	Stop	Delete

- Provisioning and cleanup in Mistral workflows
  - Service inter-dependencies

Resource Lifecycle Management in detail

- Set of workbooks interconnected to manage
  - Projects
  - Services



Resource Lifecycle Management for end user

REQUEST NEW PROJECT

Request new project

General

Experiment or department

Name of the project

Description

Owner (primary account)

E-group(s) of project members

Compute

Number of instances 25

Number of cores 25

RAM 50

Volumes

Volume type description

Name: standard
Usage: default
Max IOPS: 100
Max Throughput: 80 MB/s

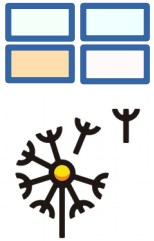
	Number	Space	
standard	0	0	GB
cp1	0	0	GB
cpio1	0	0	GB
crypt	0	0	GB
io1	0	0	GB
wig-cp1	0	0	GB

servicenow

RUN DECK

mistral

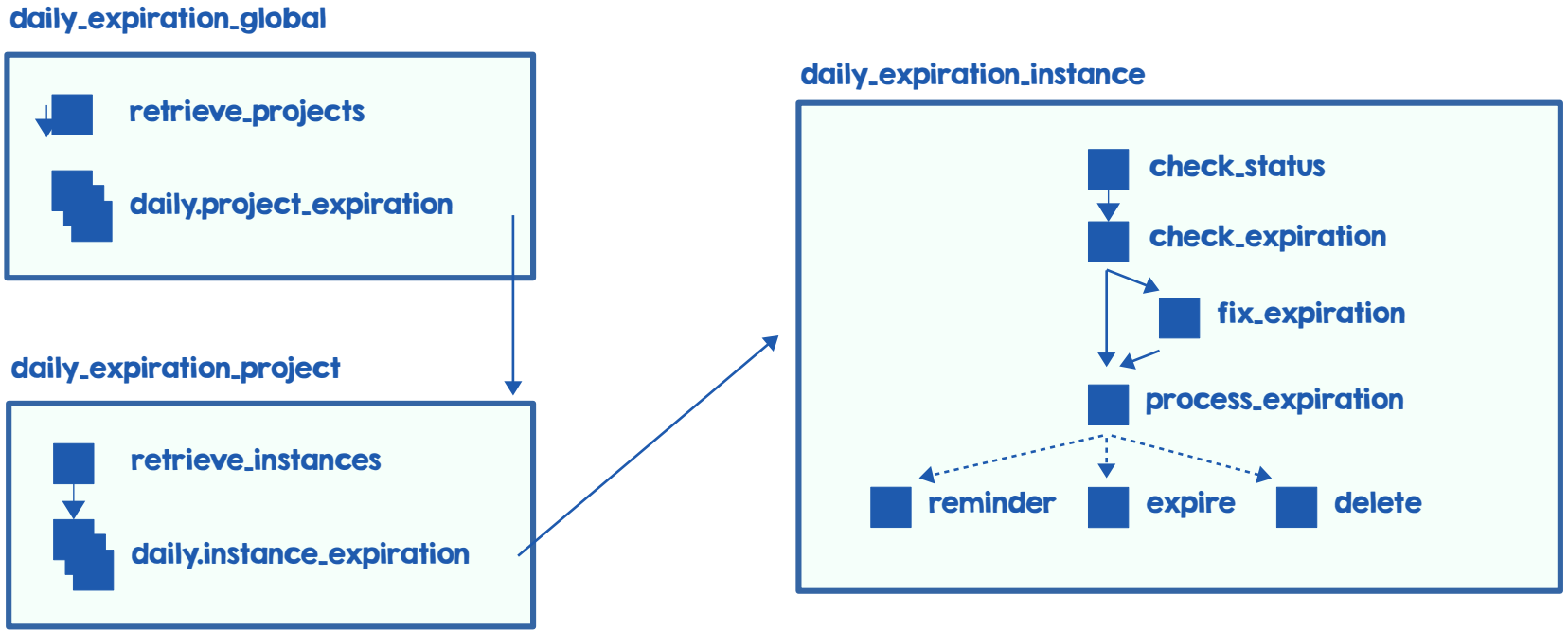
Optimize resource availability - Expiration



- Each VM in a personal project has an expiration date
- Set shortly after creation and evaluated daily
- Configured to 180 days and renewable
- Reminder mails starting 30 days before expiration
- Implemented on a Workbook in Mistral

Expiration of Personal Instances

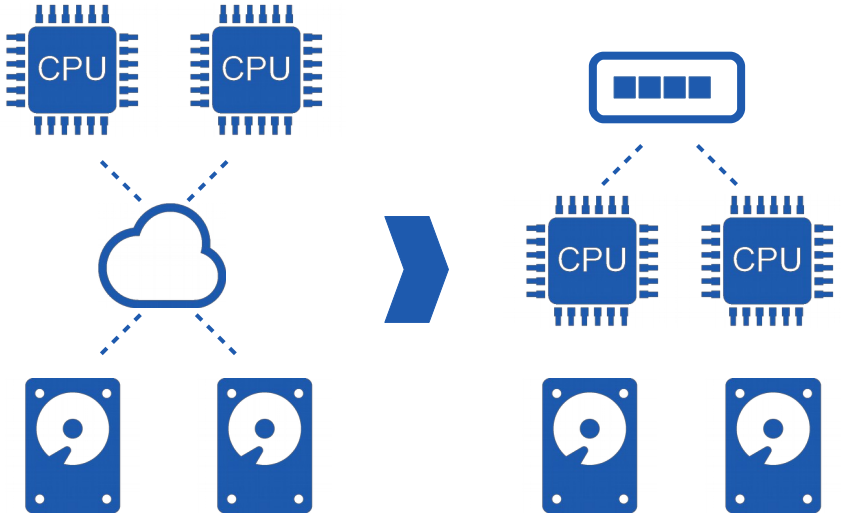
Expiration workbook in detail



- Based on project expiration tag and expire_at instance attribute

Improve VM availability and performance

- Hyperconverged servers
  - Compute + Storage Nodes
  - Local Ceph pool
    - Instances
    - Volumes
  - Ease management
  - Small IO latency
  - Increased Disk capacity
  - Use cases:
    - DB and Storage services



Automation in the CERN Cloud @next

Add new services

Root Cause Analysis

Kubernetes Jobs

Improve further more availability and performance

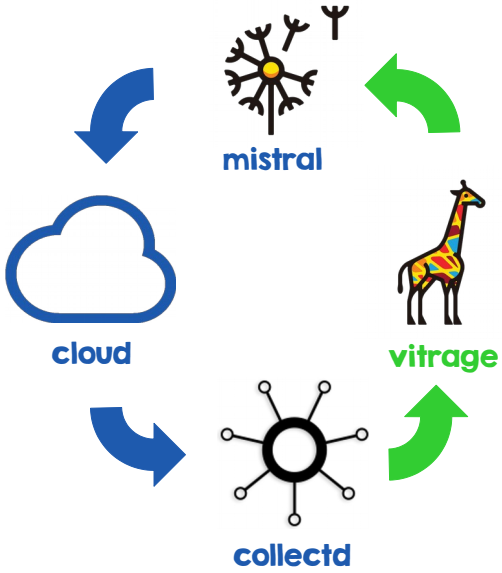
Continuous addition of new services

- Project management workbooks are prepared to be extended
- Latest addition is the S3 service through RadosGW
- Uses AdminOps API for quota operations
  - python-radosgw-admin
  - python-mistral-radosgw-actions
- Modify workflows accordingly

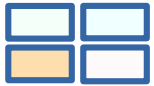
```
disable_user:
  join: all
    action: radosgw.user_update
    input:
      uid: <% $.id %>
      suspended: true
      secret_key: <% $.access_key %>
      access_key: <% $.secret_key %>
```

Root Cause Analysis

- Find root cause of issues
  - Degradation of response of an application
    - CPU issue? kernel degradation?
- Improve alarms with scope
  - Automatically list impacted services
- Find hidden service dependencies
- Trigger automatic resolutions
  - Run healing workflows



Kubernetes jobs



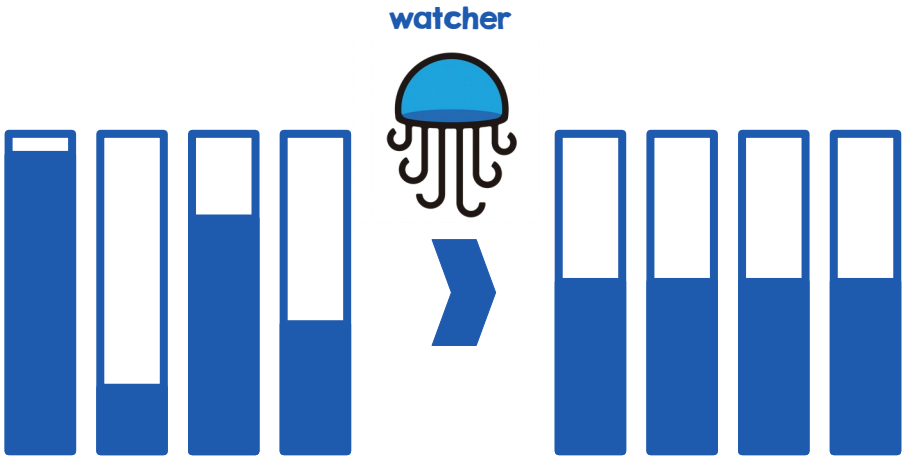
- Moving towards running control plane in kubernetes
  - Based on Helm charts
  - Healing operations added as jobs
- All automated tasks in rundeck can be “dockerized”
- Rundeck now interfaces with Kubernetes
- Start moving tasks into jobs

RUN DECK

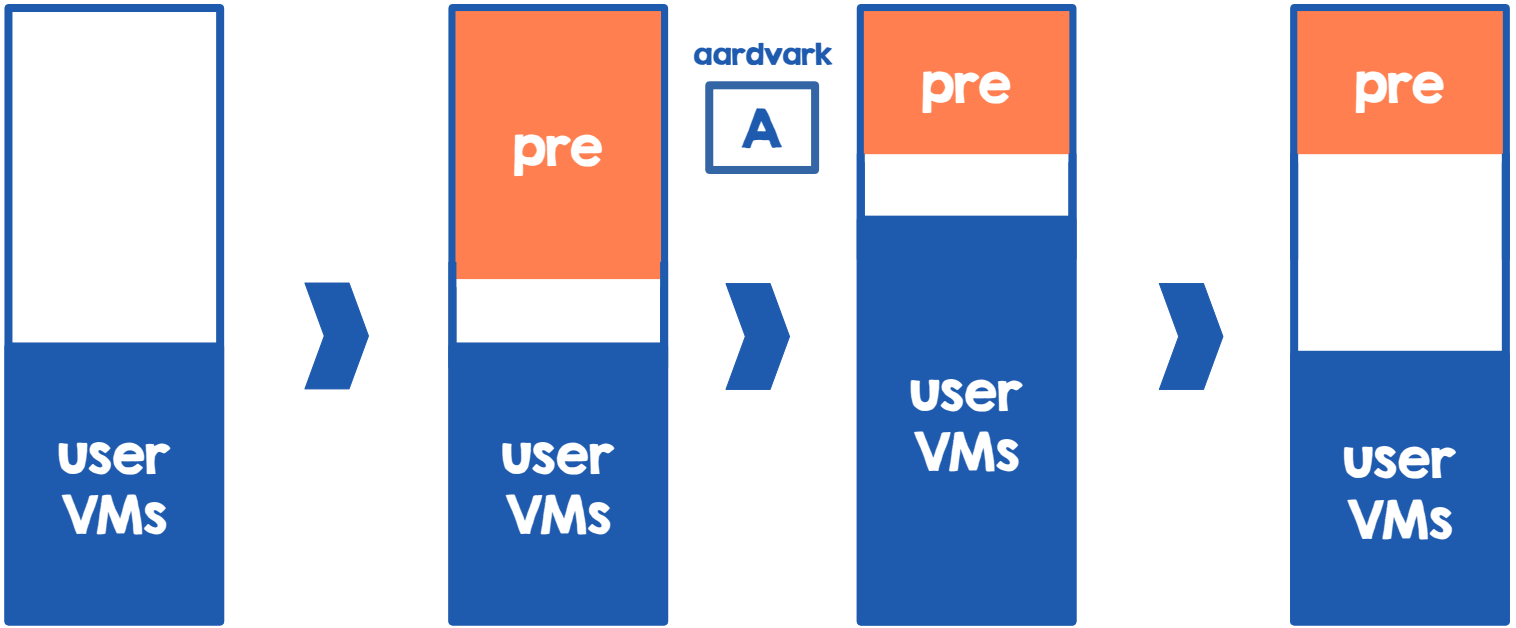
Get even more performance

- Hyperconverged servers
  - Fixed CPU allocation for protecting IO operations

- Dynamically adjust CPU usage in the setup
  - Keeping free resources for IO
  - Avoid impact on compute
  - Automatic live-migration



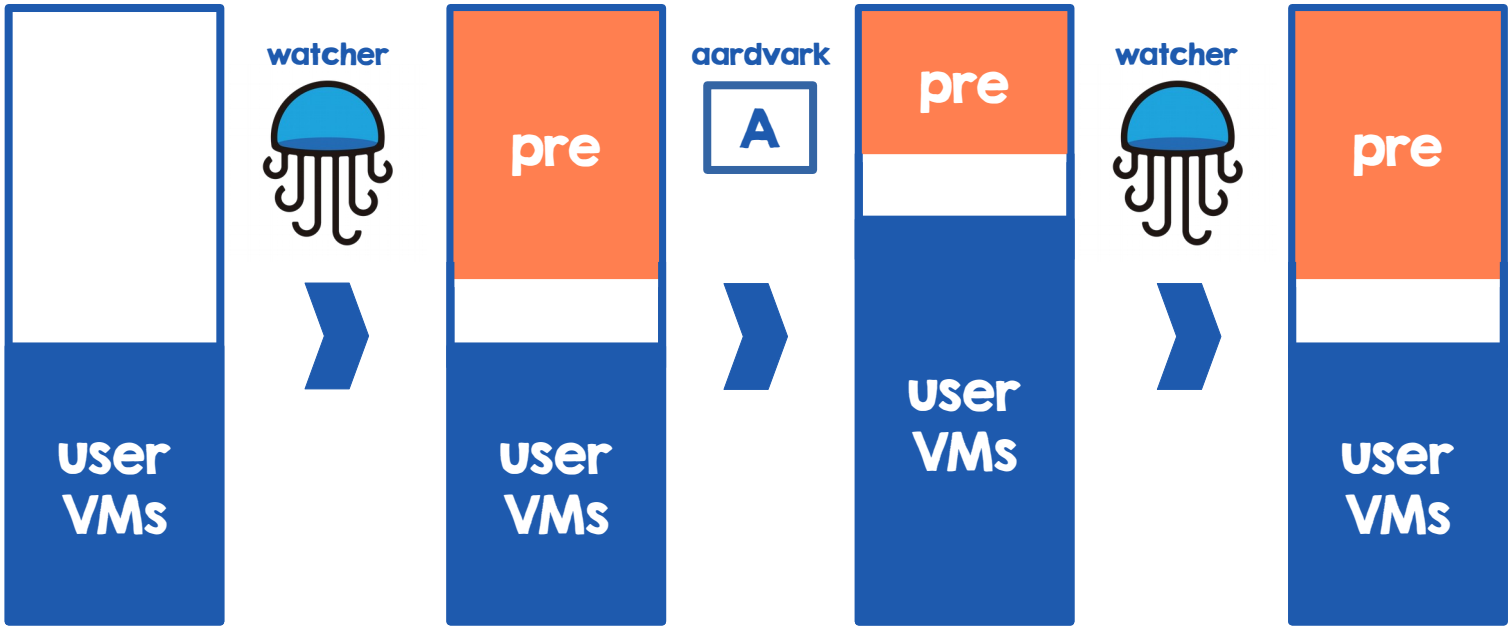
Improve Cloud utilization



- Interested in preemptibles: Preemptible Instances at CERN on Thursday Nov 15th 1:40pm Hall A3

Improve Cloud utilization

- Dynamic allocation of preemptible instances



#talk is cheap
show me the code

Here are the links

- https://gitlab.cern.ch/cloud-infrastructure/
  - cinder, horizon, ironic, keystone, mistral, neutron and nova
  - mistral-workflows
  - mistral-radosgw-actions (python-radosgw-admin)
  - hzrequestspanel
  - cci-scripts
  - cci-tools

Thank you

gitlab.cern.ch/cloud-infrastructure

openstack-in-production.blogspot.ch

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BACKUP SLIDES