Cloud@CNAF Evolution

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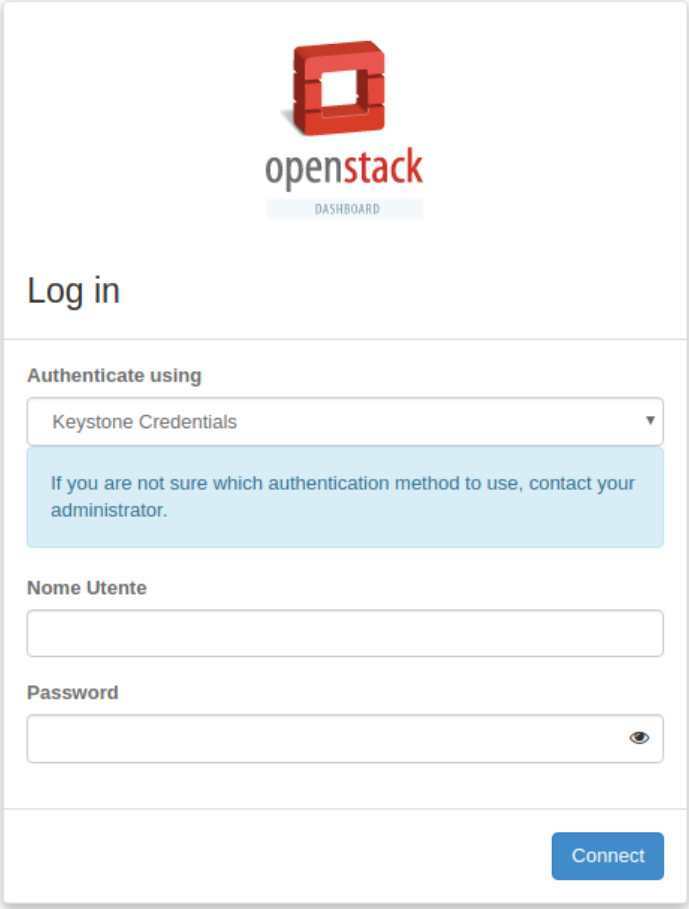
Outline

- Requirements
- Infrastructure
- Authn/Authz
- Problems and solutions
- Next steps
- A Cloud for INFN



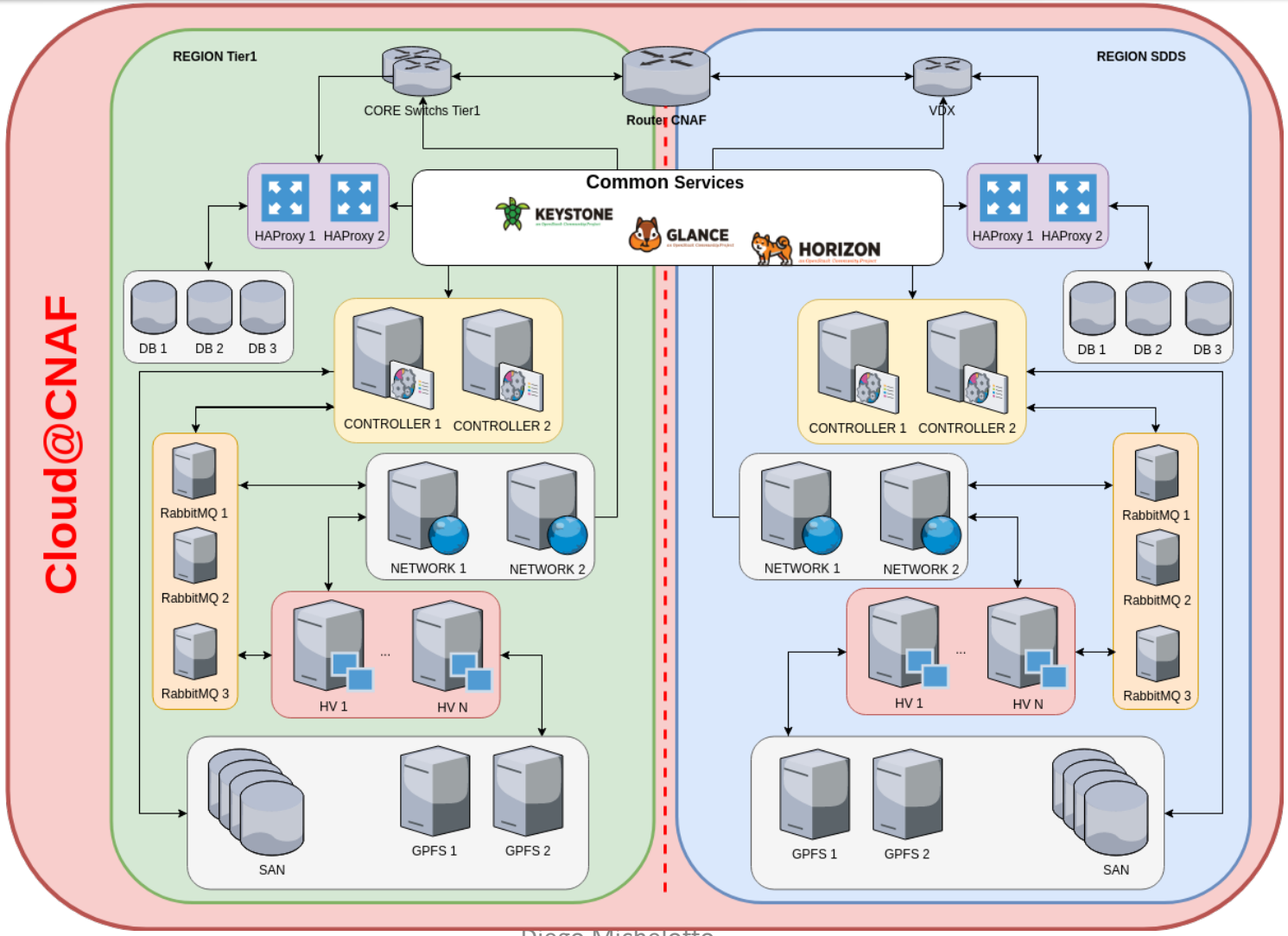
Cloud@CNAF before

- Based on (outdated) OpenStack[1] Mitaka release.
- Only one region managed by SDDS group.
- Used mainly by:
  - INFN experiments,
  - Developers and local users,
  - External, H2020 and regional projects.

Requirements

- Single management domain shared between SDDS and Tier-1 functional units.
- Single infrastructure for all CNAF use-cases:
  - R&D projects,
  - Developers,
  - WLCG and INFN experiments (Pledged experiments).
- Environment separation:
  - Tier-1 and SDDS regions,
  - Tier-1 data access,
  - LHCONE, LHCOPN networks,
  - H2020 Projects.

Infrastructure - Schema



Infrastructure - Services

- **Common core services**
  - Keystone
  - Glance
    - **GPFS backend**
  - Horizon

- **Per region support services**
  - 3 nodes RabbitMQ Cluster
  - 3 nodes Mysql Percona Multi Master Cluster
  - 2 Nodes HAProxy + Keepalived
    - Serve and manage all OpenStack services and DBs

- **Per region services**
  - Cinder
    - GPFS backend
  - Nova
    - GPFS backend as storage, Libvirt backend as virtualizator
  - Neutron
    - Linuxbridge, **VLAN**, External Network (/23)
  - Heat
- **Virtual vs Bare Metal**
  - Only openstack-nova-compute, neutron-linuxbridge, neutron-dhcp, neutron-l3-agent and neutron-metadata are on physical nodes (**Compute nodes and Network nodes**).
  - All other openstack **service are virtualized and replicated on different virtualization systems** (oVirt, VMWare).
  - DBs are on physical nodes on diffent racks with 15k SAS disks.

Infrastructure - Deployments

- **Rocky** (in production):
  - **SDDS region** ~ 1400 cores, 5TB RAM, 16TB Shared FS, 28TB local FS.
  - **Tier1 region** ~ 500 TB-N shared FS, ~5200 cores (to be added soon).

- **Testbed**:
  - 2 smaller production-like setup regions.
  - Necessary to test pre-production of new services, puppet classes and upgrades.
  - ISO 27001 testbed.

- **SGSI** separate instance

Infrastructure - SGSI

- CNAF got **ISO27001** certification to address strictly secure data handling requirements ("Sistema per la Gestione della Sicurezza dell'Informazione").
- A cloud deployment is going to be setup in June to host new experiments:
  - Harmony (genomics),
  - Alleanza Contro il Cancro (biomedic).
- **Separated** and **isolated** infrastructure.
- **Ceph** will be used as storage backend.

Authn/Authz

- Based on **OpenID-connect** provided by INDIGO-IAM[2]
  - Dedicated INDIGO-IAM service https://iam.cnaf.infn.it for CNAF, INFN AAI and EduGAIN users, **permissions managed** through IAM **groups**:
    - **No group** membership means **no cloud access**.
    - Users in **"cloud" group** can access cloud in the **shared project CNAF** with limited resources through **ephemeral user.**
    - Users in **"cloud/user" group** can access cloud in two **project: CNAF** one and **personal** one through **ephemeral user**.
    - Users in **"cloud/local" group** can access cloud through **keystone mapped user and projects**.
  - **Other INDIGO-IAM services** for R&D project like DODAS, eXtreme-DataCloud, DEEP Hybrid Data Cloud, etc. mapped on **ephemeral user with dedicated project.**

Cloud@CNAF ecosystem

- **Provisioning and configuration** managed via The Foreman[3] and Puppet[4].
  - Developed our own puppet classes for all the clusters, services and configurations.

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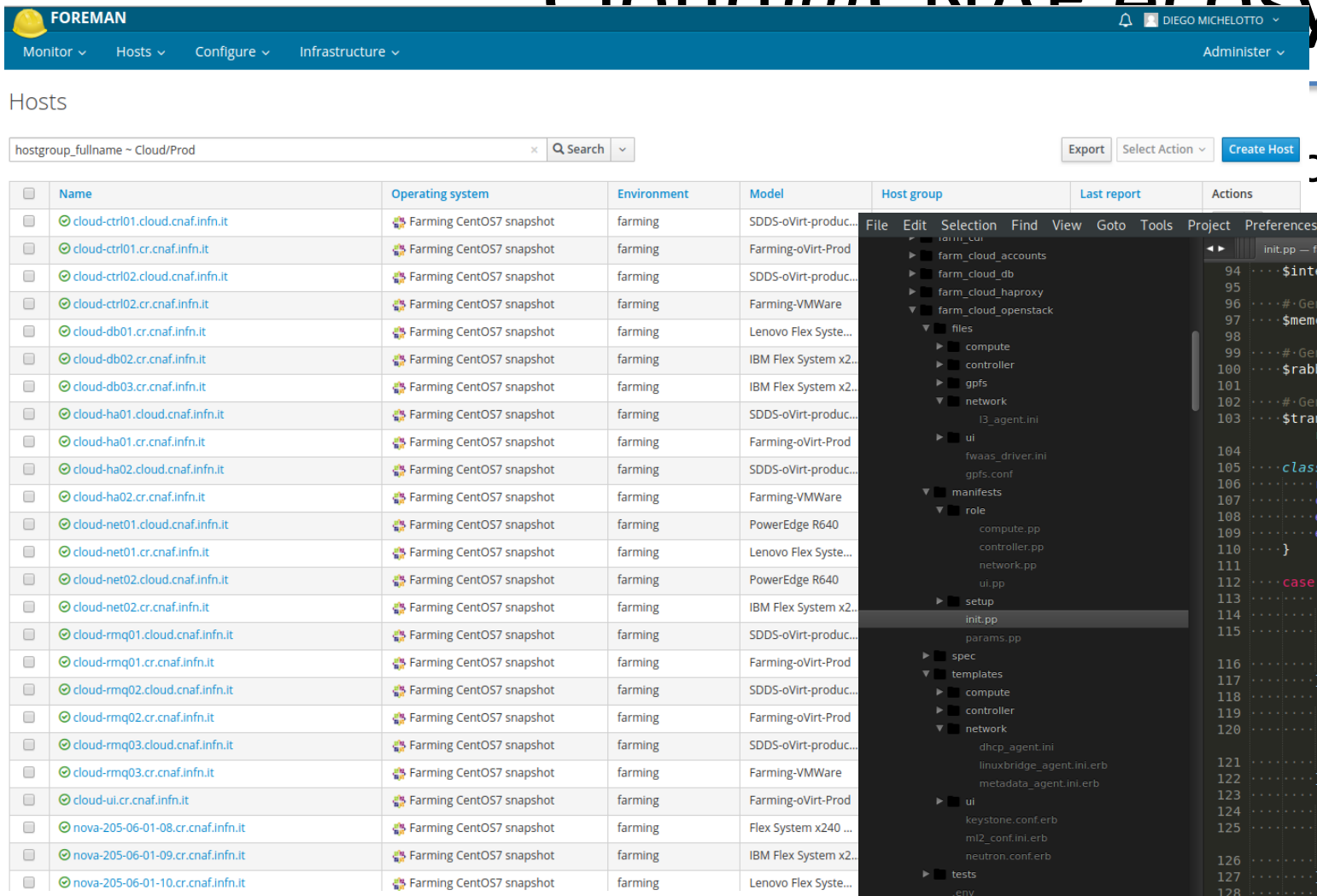

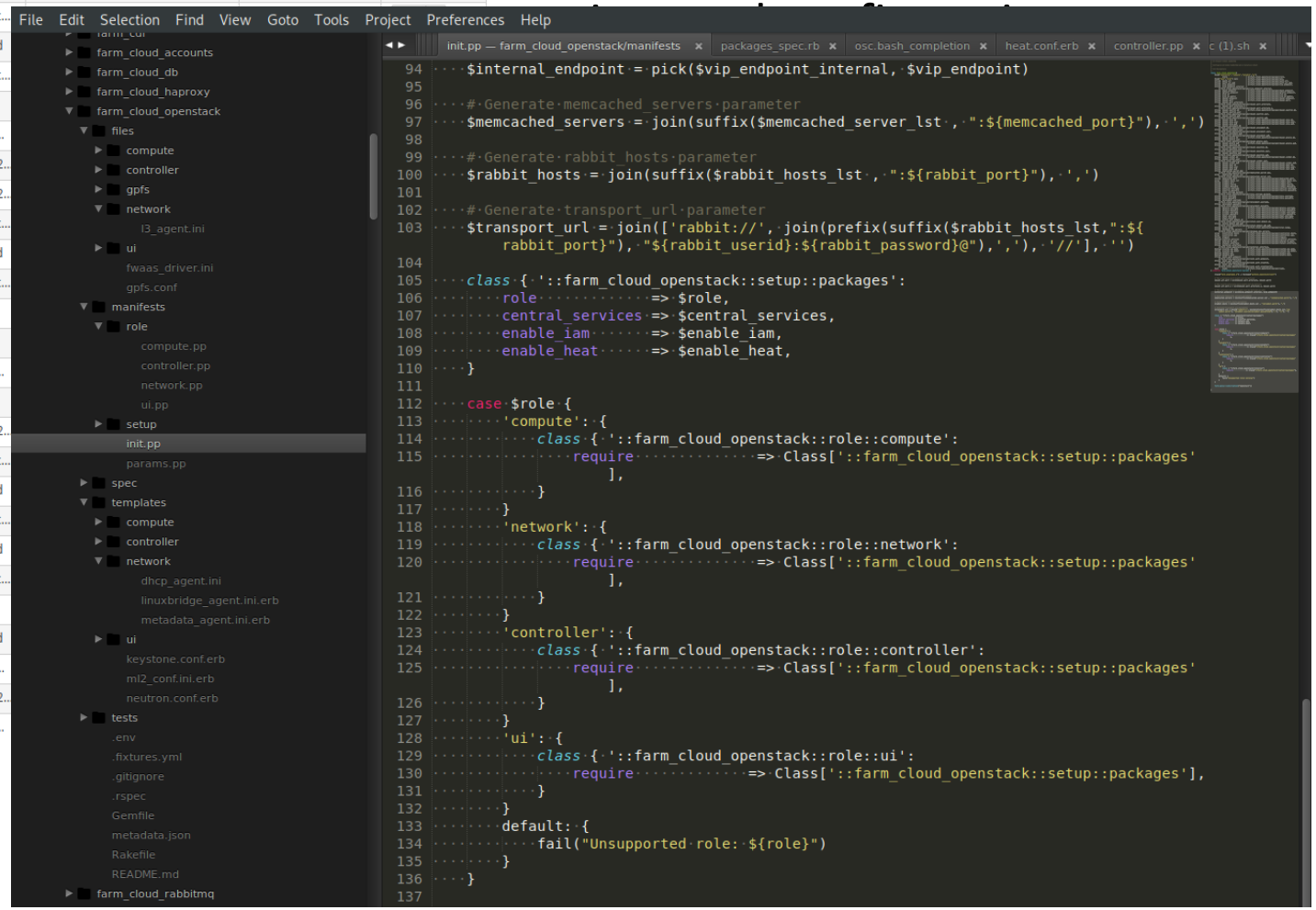

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Rally task results

- Task overview
- Input file
- ► Authenticate
- ► CinderVolumes
- ► GlanceImages
- ► KeystoneBasic
- ► NeutronNetworks
- ► NovaKeypair
- ► NovaServers
- ► Quotas

Task overview

Scenario ▲	Load duration (s)	Full duration (s)	Iterations	Runner	Errors	Hooks	Success (SLA)
Authenticate.keystone	0.482	2.688	1	constant	0	0	✔
CinderVolumes.create_and_attach_volume	24.119	40.619	1	constant	0	0	✔
CinderVolumes.create_and_delete_snapshot	5.990	24.749	1	constant	0	0	✔
CinderVolumes.create_and_delete_volume	6.080	14.943	1	constant	0	0	✔
CinderVolumes.create_and_delete_volume-2	8.156	15.075	1	constant	0	0	✔
CinderVolumes.create_and_delete_volume-3	8.148	16.293	1	constant	0	0	✔
CinderVolumes.create_and_extend_volume	10.512	17.821	1	constant	0	0	✔
CinderVolumes.create_and_list_snapshots	3.869	26.549	1	constant	0	0	✔
CinderVolumes.create_and_list_volume	5.388	15.000	1	constant	0	0	✔
CinderVolumes.create_and_list_volume-2	5.664	16.950	1	constant	0	0	✔
CinderVolumes.create_and_upload_volume_to_image	14.371	24.213	1	constant	0	0	✔
CinderVolumes.create_from_volume_and_delete_volume	10.490	30.689	1	constant	0	0	✔
GlanceImages.create_and_delete_image	2.822	7.266	1	constant	0	0	✔
GlanceImages.create_and_list_image	2.830	9.485	1	constant	0	0	✔
GlanceImages.list_images	0.170	3.525	1	constant	0	0	✔
KeystoneBasic.add_and_remove_user_role	1.347	12.692	1	constant	0	0	✔
KeystoneBasic.create_add_and_list_user_roles	1.296	13.044	1	constant	0	0	✔
KeystoneBasic.create_and_delete_role	0.676	10.338	1	constant	0	0	✔
KeystoneBasic.create_and_delete_service	1.231	10.219	1	constant	0	0	✔
KeystoneBasic.create_and_list_tenants	1.271	13.052	1	constant	0	0	✔
KeystoneBasic.create_update_and_delete_tenant	1.590	11.075	1	constant	0	0	✔
KeystoneBasic.get_entities	1.767	19.408	1	constant	0	0	✔
NeutronNetworks.create_and_delete_networks	2.785	11.706	1	constant	0	0	✔
NeutronNetworks.create_and_delete_ports	3.632	20.078	1	constant	0	0	✔
NeutronNetworks.create_and_delete_routers	10.733	29.603	1	constant	0	0	✔
NeutronNetworks.create_and_delete_subnets	3.899	17.180	1	constant	0	0	✔
NeutronNetworks.create_and_list_networks	1.747	16.396	1	constant	0	0	✔
NeutronNetworks.create_and_list_ports	2.577	18.899	1	constant	0	0	✔
NeutronNetworks.create_and_list_routers	8.257	35.458	1	constant	0	0	✔
NeutronNetworks.create_and_list_subnets	2.413	17.567	1	constant	0	0	✔
NeutronNetworks.create_and_update_networks	1.950	18.473	1	constant	0	0	✔
NeutronNetworks.create_and_update_ports	3.900	23.136	1	constant	0	0	✔
NeutronNetworks.create_and_update_routers	8.870	30.255	1	constant	0	0	✔
NeutronNetworks.create_and_update_subnets	3.682	24.011	1	constant	0	0	✔

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- Use of Rundeck[6] for **operations**.

RUNDECK | ops | Jobs | Nodes | Commands | Activity | dmichelotto | help

Jobs (24) Filter Expand All Collapse All

Job Actions

- Cloud
  - Infra
    - Configure IPMI R2
    - disable-mycls — Disable a Percona cluster member on the ha01/ha02 load balancers.
    - enable-mycls — Enable a Percona cluster member on the ha01/ha02 load balancers.
    - Install Compute 1 Network and Storage
    - Install Compute 1&2 Network, Storage GPFS [NO UPDATE & REBOOT]
    - Install Compute 2 GPFS
    - Install Compute 3 Complete installation
    - Install Compute LSD
  - Maintenance
    - start-compute-nodes — Start OpenStack Nova Compute services on all compute nodes
    - start-controller-nodes
    - start-network-nodes
    - stop-compute-nodes — Shutdown services on all OpenStack compute nodes
    - stop-compute-nodes-fe — Shutdown services on all OpenStack compute nodes in Ferrara
    - stop-controller-nodes
    - stop-controller-nodes-fe — Stop controller-nodes at FE
    - stop-network-nodes
    - Upgrade

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- Use of ELK[7] stack for **log collection, management and analysis** of the infrastructure.

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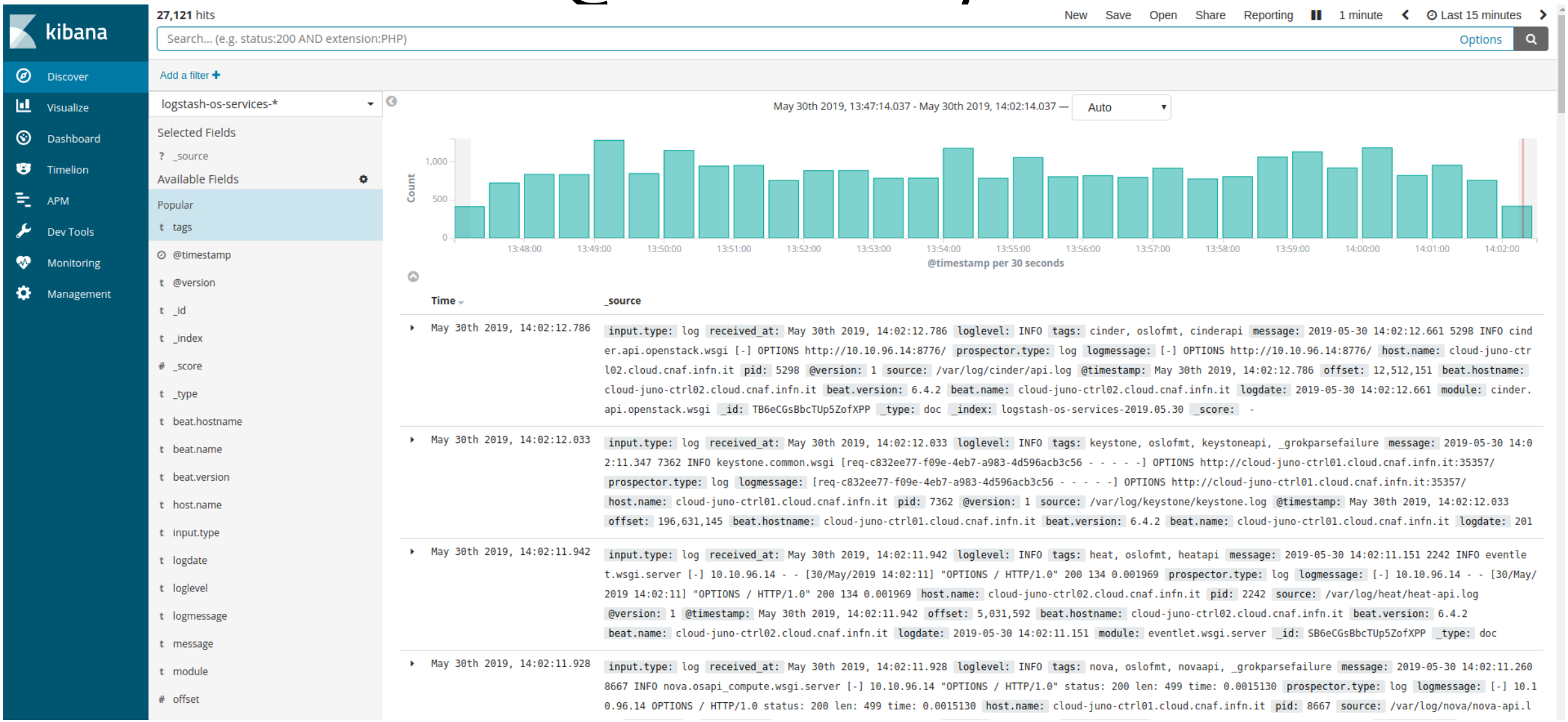

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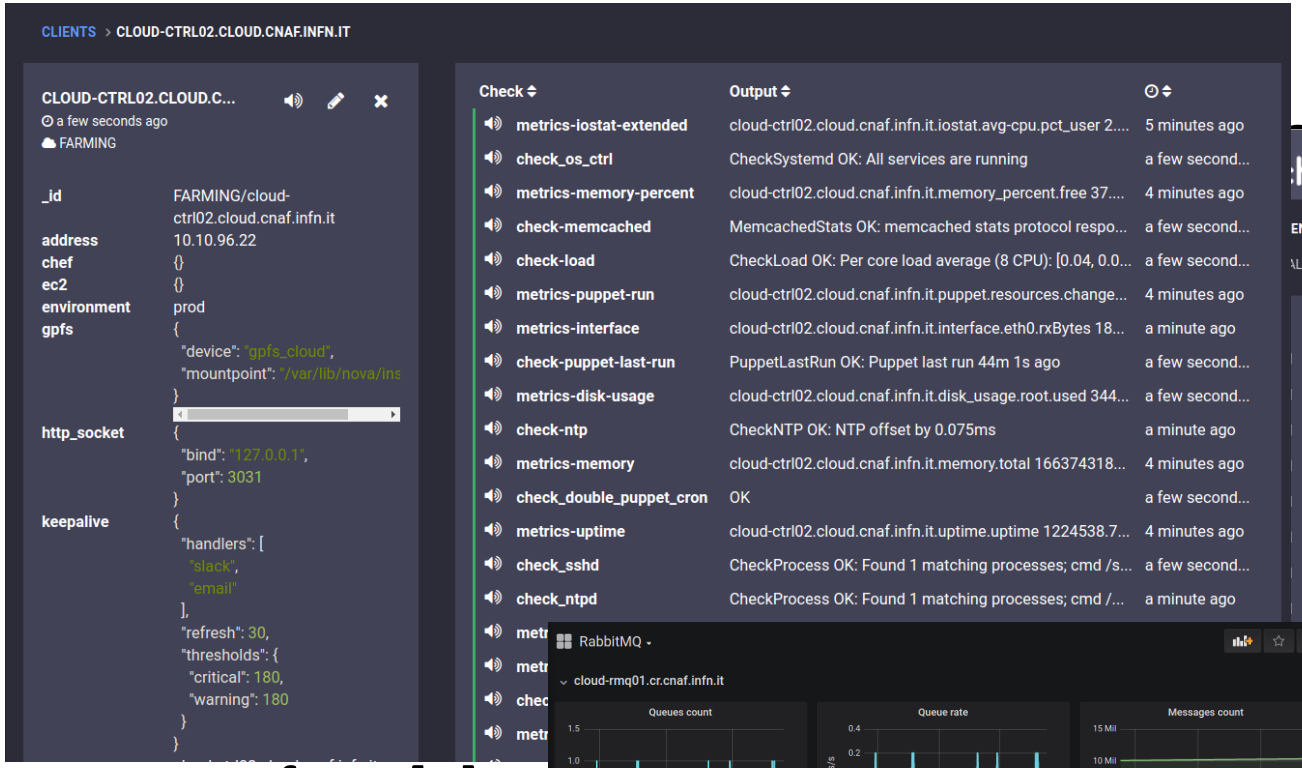
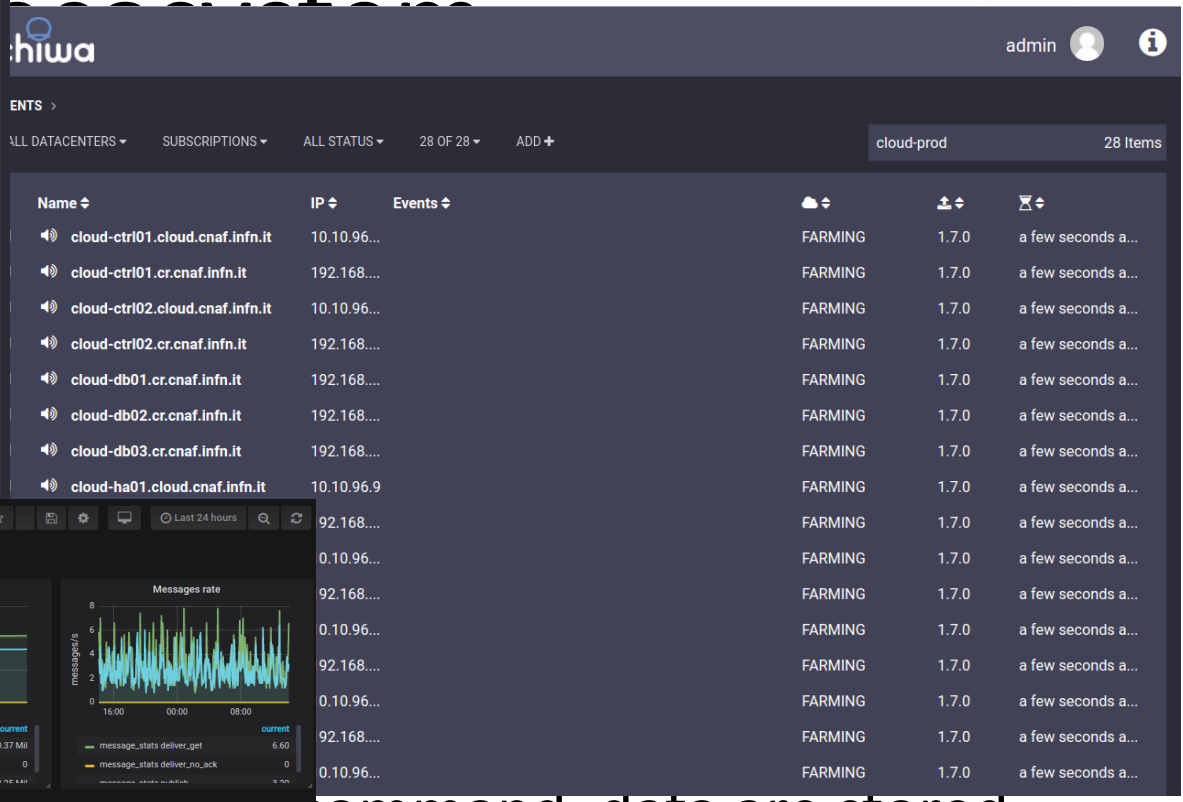
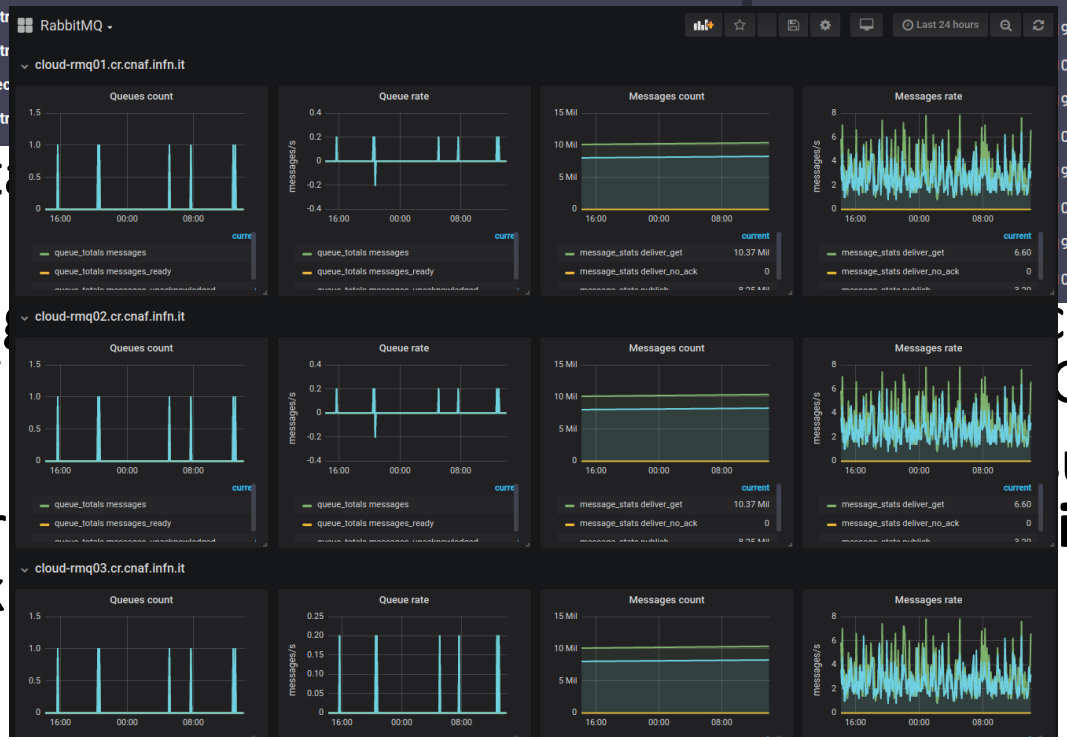
- Basic accounting made using `Openstack usage list` command, data are stored in InfluxDB[8] timeseries database and displayed with Grafana[9].
- All services and performance are **monitored with Sensu**[10], is used InfluxDB and Grafana for data storing and displaying. Alert **notification** generate by Sensu is sent via **Slack**[11] and **e-mail**.







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Cloud@CNAF security

- For the delegation of responsibility we align to what Harmony group will produce.
  - Delegate resp. to user with root access, whether internal or external
- For traceability and security reasons, users can only use images provided by Cloud@CNAF admins:
  - **Customized images** with rsyslog service enabled
  - **Injected ssh key** for root access used only in case of security incident.
- VMs external access through frontier firewall:
  - By default, CNAF outer perimeter **firewall blocks incoming access**.
  - Ports can be **opened upon express request**.

Problems and Solutions (1/2)

- Libvirt doesn't recognize GPFS as distributed file system.
  - Locally patched and tested for libvirt 4.5.
  - Patch submitted and **accepted** upstream for libvirt 5.0. https://bugzilla.redhat.com/show_bug.cgi?id=1679528
    - CentOS has not yet backported the patch but has taken it into consideration.

- Nova APIs fail when receive requests from HAProxy.
  - https://bugs.launchpad.net/nova/+bug/1728732
  - **Patch backported** with puppet ad-hoc class.

Problems and Solutions (2/2)

- CPU capabilities are different and can block live migrations. Two cases:
  - **Different vendor**: solved using **host aggregate**.
    - AMD vs Intel
  - **Same vendor** but different architecture, two sub-cases:
    - High number of nodes for each type, solved using **host aggregate.**
      - e.g. AMD G4 vs. AMD G5 or Intel Broadwell vs. Intel Skylake.
    - Low number of nodes for each type, solved configuring **CPU model** in nova.conf with the CPU baseline between different.

Next steps

- **Elastic partitioning of Farm**
  - Possibility to detach WNs from the production farm and assign them to cloud partition and vice versa.
- Fine tuning of virtual machines monitoring and accounting.
- Implement workflow management to monitor VM lifecycle.
- Improve logs parsing and analysis.
- GPU virtualization.

A Cloud for INFN

- We can now give access to Tier-1 resources both through standard grid approach and Cloud.
- Goal is to federate our infrastructure with other INFN clouds to implement a **unique** INFN cloud.
  - Federation mechanism: INFN-CC or IAM.
- (Possibly) complemented by Data-Lake like infrastructure for data.

Credits

- CNAF Network team:
  - Study, design and setup for Cloud@CNAF networks.
- CNAF Storage team:
  - GPFS setup for Cloud@CNAF.
- CNAF Software Development team:
  - Setup and integrations of IAM and ELK.

Thanks


thank you
danke
謝謝
ngiyabonga
teşekkür ederim
gracias
спасибо
obrigado
merci
bedankt
dziękuję
go raibh maith agat
mochchakkeram
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References

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[3] The Foreman: https://www.theforeman.org/

[4] Puppet: https://puppet.com/

[5] Rally: https://rally.readthedocs.io/en/latest/

[6] Rundeck: https://www.rundeck.com/open-source

[7] ELK: https://www.elastic.co/

[8] InfluxDB: https://www.influxdata.com/

[9] Grafana: https://grafana.com/

[10] Sensu: https://sensu.io/

[11] Slack: https://slack.com