Cloud@CNAF Management and Evolution

C. Duma[1], A. Costantini[1], D. Michelotto[1] and D. Salomoni[1]

[1]INFN Division CNAF, Bologna, Italy

E-mail: ds@cnaf.infn.it

Abstract.

Cloud@CNAF is the cloud infrastructure hosted at CNAF, based on open source solutions aiming to serve different use cases present here. The infrastructure is the result of the collaboration of a transversal group of people from all CNAF functional units: networking, storage, farming, national services, distributed systems. If 2016 was for the Cloud@CNAF IaaS (Infrastructure as a Service) based on OpenStack, a period of consolidation and improvement, 2017 was an year of consolidation and operation ended with an extreme event - the flooding of the DataCenter, when an aqueduct pipe located in the street nearby CNAF went broke. This event caused down of the entire DataCenter, including the Cloud@CNAF infrastructure.This paper presents the activities carried out throughout 2018 to ensure the functioning of the center cloud infrastructure, that saw the its migration from CNAF to INFN-Ferrara, starting to the re-design of the entire to cope with the limited availability of space and weigth imposed by the new location, to the physical migration of the racks and remote management and operation of infrastructure in order to continue to provide high-quality services for our users and communities.

1. Introduction

The main goal of Cloud@CNAF [1] project is to provide a production quality Cloud Infrastructure for CNAF internal activities as well as national and international projects hosted at CNAF:

- Internal activities
  - Provisioning VM for CNAF departments and staff members
  - Tutorial and courses
- National and international projects
  - Providing VMs for experiments hosted at CNAF, like CMS, ATLAS, EEE and FAZIA
  - testbeds for testing the services developed by projects like the INDIGO-DataCloud, eXtreme-DataCLoud and DEEP-HybridDataCloud

The infrastructure made available is based on OpenStack [2], version Mitaka, with all the services deployed using a High-Availability (HA) setup or in a clustered manner (for ex. for the DBs used). During 2016 the infrastructure has been enhanced, by adding new resources, compute and network, and its operation has been improved and guaranteed by adding the monitoring part, improving the support, automating the maintenance activities.

Thanks to this enhancement, Cloud@CNAF was able to offer high reliable services to the users and communities who rely on such infrastructure.

At the end of 2017, on November 9th early at morning, an aqueduct pipe located in the street nearby CNAF, broke as documented in Ref. [3]. As a result, a river of water and mud flowed

towards the Tier1 data center. The level of the water did not exceeded the threshold of safety of the waterproof doors but, due to the porosity of the external walls and the floor, it could find a way into the data center. Both electric lines failed at about 7.10AM CET. Access to the data center was possible only in the afternoon, after all the water had been pumped out. As a result, the entire Tier1 data center went down, included the Cloud@CNAF infrastructure.

2. The resource migration

Some weeks after the flooding, has been decided to move the Cloud@CNAF core services in a different location in order to recover the services provided for communities and experiments. Thanks to a strong relationship, both University of Parma/INFN-Parma and INFN-Ferrara proposed to host our core machinery and related services. Due to the geographical proximity and the presence of Point of Presence (PoP) GARR, the Cloud@CNAF core machinery was moved to the INFN-Ferrara location.

Unfortunately, we were not able to move all the Cloud@CNAF resources due to a limited power and weight availability in the new location. For the above mentioned reason, the re-design of the new infrastructure has been considered. As a first step, the services and the related machinery to move to the new - temporary - location have been selected in order to fit the maximum power consumption and weight estimated for each of the two rooms devoted to host Cloud@CNAF services (see Table 1 for details).

	Room1			Room2	Tot
	Rack1	Rack2	Tot	Rack3	
Power consumption (kW)	8,88	4,91	13,79 (15)	5,8 (7)	19,59
Weight (Kg)	201	151	352 (400Kg/mq)	92 (400Kg/mq)	444
Occupancy (U)	9	12	21	10	31

Table 1. Power consumption weight and occupancy for each Rack. In brackets, the maximum value admitted for the Room.

3. Re-design the new infrastructure

Due to the limitations described in Table1 only three racks have been used to host Cloud@CNAF core service. Among this three racks, the first hosts the storage resources, the second hosts the Openstack controller, the network services and the GPFS cluster. The third hosts Ovirt and Openstack compute nodes, together with some other ancillary services (see Table 2 for details). Rack1 and Rack2 have been connected by 2x40Gbps through our Brocade VDX switches and Rack1 and Rack3 have been connected by 2x10Gbps through PowerConnect switches.

	Rack1	Rack2	Rack3
Resources and Services	VDX	VDX	PowerConnect x2
	EqualLogic	Cloud controllers	Ovirt nodes
	Powervault	Cloud networks	Compute nodes
		Gridstore	DBs nodes
		Other services	Cloud UI

Table 2. List of resources and services hosted per Rack

Moreover, Rack1 is connected to PoP GARR with 1x1Gbps fiber connection to guarantee external connectivity. A complete overview of the new infrastructure and related resource location is shown in Figure 1. As depicted from the Figure 1 and taking into account the

limitations described in Table 1) the power consumption has been limited up to 13,79kW in respect to Room1 (limit 15kW) and up to 5.8kW (limit 7kW) in respect to Room2.

The whole migration process (from the design to the reconfiguration of the new infrastructure) took just a business week and after that the Cloud@CNAF infrastructure and related services where up and running, able to serve again different projects and communities.

Thanks to the experience and documentation gathered, in June 2018 - after the Tier1 returned in its production status, Cloud@CNAF has been migrated back in less than three business days.

4. Cloud@CNAF evolution

Starting from the activity carried out in 2016 related to the improvements done at the infrastructure level [1], in 2018 (after the return of the core infrastructure services due to the flooding) the increase of the computing resources, in terms of quality and quantity, continued in order to enhance both the services and the performance offered to users.

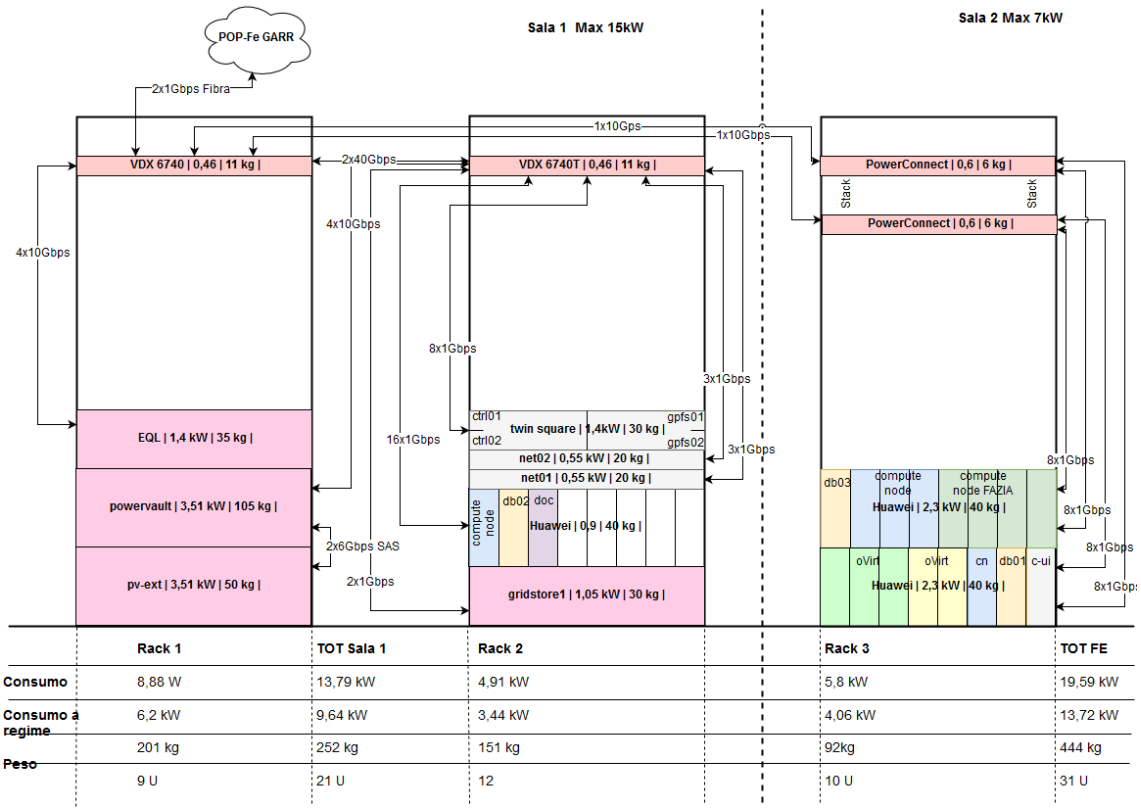
Thanks to such activity, during the last year the Cloud@CNAF saw a growth on the number of users and use cases implemented in the infrastructure, in particular the number of projects increased up to 87 using approximately 1035 virtual CPUS, 1.766TB of RAM, with a total of 267 virtual machines (see Figure 2 for more details).

Among others, some of the projects that used the cloud infrastructure are:

- HARMONY - Proof-of-concept under the TTLab coordination, is a project aimed at finding resourceful medicines offensive against neoplasms in hematology,
- EEE - Extreme Energy Events - Science inside Schools (EEE), is a special research activity about the origin of cosmic rays carried out with the essential contribution of students and teachers of high schools,
- CHNET-DHLab - Cultural heritage network of INFN for the development of virtual laboratories services,
- USER Support - for the development of experiments dashboard and the hosting of the production instance of the dashboard, displayed on the monitor present on the CNAF hallway,
- EOSC-hub DODAS - Temaic service for Elastic Extension of Computing Centre batch resources on external clouds,
- Services devoted to EU projects like DEEP-HDC [4], XDC [5] and EOSC-pilot [6].

5. Conclusions and future work

Due to a damage in the aqueduct pipe located in the street nearby CNAF, a river of water and mud flowed towards the Tier1 data center causing the shutdown of the entire data center. For such reason, the services and related resources hosted by Cloud@CNAF went down. To cope with this problem, the decision to temporary migrate the core resources and services of Clud@CNAF to INFN-Ferrara has been taken and adopted. In order to do this, a complete re-design of the entire infrastructure was needed to tackle the limitations in terms of power consumption and weight imposed by the new location. The joint effort and expertise of all the CNAF people and the INFN-Ferrara colleagues made possible to re-design, migrate and make operational the Cloud@CNAF infrastructure and related hosted services in less than a business week. Thanks to the experience and the documentation gathered, in June 2018 - after the Tier1 returned in its production status, Cloud@CNAF has been migrated back in less than three business days. Even with the above described problems, the Cloud@CNAF infrastructure has been maintained and evolved, giving the possibility to the users to carry on their activities and obtain their desidered results. For the next year new and challenging activities are planned, in particular the migration to the OpenStack Rocky version and the deployment of a new architecture distributed between differnet functional units, Data Center and SDDS.



	Rack 1	TOT Sala 1	Rack 2	Rack 3	TOT FE
Consumo	8,88 W	13,79 kW	4,91 kW	5,8 kW	19,59 kW
Consumo a regime	6,2 kW	9,64 kW	3,44 kW	4,06 kW	13,72 kW
Peso	201 kg	252 kg	151 kg	92kg	444 kg
	9 U	21 U	12	10 U	31 U

Figure 1. The new architecture of the Cloud@CNAF developed to cope the limitations at INFN-Ferrara.

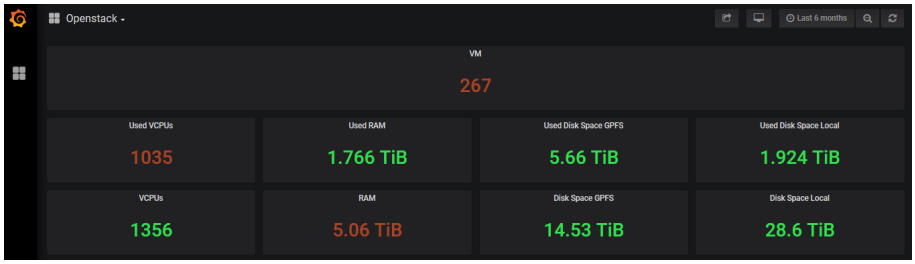


Figure 2. Cloud@CNAF monitoring and status

6. References

[1] Cloud@CNAF - maintenance and operation, C. Duma, R. Bucchi, A. Costantini, D. Michelotto, M. Panella, D. Salomoni and G. Zizzi, CNAF Annual Report 2016, https://www.cnaf.infn.it/Annual-Report/annual-report-2016.pdf

[2] Web site: https://www.openstack.org/

[3] The flood, L. dell'Agnello, CNAF Annual Report 2017, https://www.cnaf.infn.it/wp-content/uploads/2018/09/cnaf-annual-report-2017.pdf

[4] Web site: https://deep-hybrid-datacloud.eu/

[5] Web site: www.extreme-datacloud.eu

[6] Web site: https://eoscpilot.eu