EUNIS 2016: Hybrid clouds infrastructures in Higher Education Institutions – A proof of concept

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1. Abstract

Taking into account recent developments concerning the cloud computing paradigm, the need for integration and interaction between datacenters at the level of higher education institutions, in order to meet growing computing needs, it is relevant to study and apply models of clouds federation to meet these needs. This article establishes the guidelines for a study which is being developed, that are based on the design of a model for a federation between higher education institutions. This work is based on the establishment of guidelines for best practices in the idealization, design and implementation of hybrid clouds federation. This work is presented as a technical approach to the implementation of an Academic Cloud Federation.

2. Introduction

The need to address the growing demand for computing power drives the need for more and more institutions to invest in resources for research purposes, and new organizations for management at resources level but also at the institution organizational level in order to maximise the efficiency (and redundancy) with the support from platforms in the realm of Cloud Computing. A practical example this is the *Conseil Européen pour la Recherche Nucléaire* (CERN), with the implementation of a private cloud based on OpenStack platform, that in less than two months of implementation created a proof of concept (Bell, 2013).
The CERN need for computing power and need to provide this capability to research teams in different areas results in a constantly evolving and engagement to the support platforms used (Sverdlik, 2014). CERN is currently one of the major contributors to the OpenStack community with the release of modules source code blocks for the platform (Verge, 2014).
Since Cloud Computing is a major research area within several international research organizations, a definition of guidelines is relevant, following a logical continuity definition of recommendations for best practices guides following the recommendations of GÉANT that listed a set of standards for the creation of a federation of hybrid clouds at the level of higher education institutions (GÉANT, 2016).

BonFIRE is a multi-site testbed that supports testing of cloud-based and distributed applications (Kavoussanakis et al., 2013). In this facility is offer a federated, multi-site cloud testbed for the users as an homogeneous way to interact with the facility (García-Pérez et al., 2014). This facility is connected to FEDERICA and GÉANT Auto BAHN (Büchli et al., n.d.; "FEDERICA Project," n.d.; Hume et al., 2012; Rabljenovic et al., n.d.). The FED4FIRE project is have the intention to federate bonfire and all similar facilities used for research and experimentation, facilitating and extending its use for for example research in smart cities, on the top of BonFIRE and other networks ("Federation for Future Internet Research and Experimentation," n.d.)

3. Conception

The essence of hybrid clouds federation model relies on the integration of several private clouds presents in higher education institutions in order to disclose it as a single cloud with more features and resources. We present the guidelines for a study which is being developed based on the design of a model for Academic Cloud Federation and the subsequent implementation. The core of the model is based on the integration of various private clouds of higher education institutions in order to aggregate private clouds into a single cloud. One pillar in the model is the intrinsic autonomy attributed each institution, which is very important. The other pillar is the model supports for different approaches, taking into account the degree of relationship and integration pursue by each institution. The model gives the possibility of the federation itself or its constituent clouds, each independently, to be interconnect with strategic partners or public clouds. This approach opens paths to versatility and flexibility in the federation level of integration. As more institutions join this federation more resources are likely to be shared as well, providing ground to research in areas such as quality of service policies, administrative security, management and access control or auditing among others.

Table 1 shows the classification for each of the interconnected component which make up the model recommended for this work.

Table 1 - Classification table of the recommended model

Zone Clouds	Clouds of various institutions of higher education
External Clouds	Clouds external to institutions, public or private partners
Connections type A	Connecting links between zone clouds and external Clouds
Connections type B	Connecting links between the various zone clouds

Figure 1 shows as each component is integrated into the model and how they are interconnected to obtain the desirable Academic Cloud Federation.

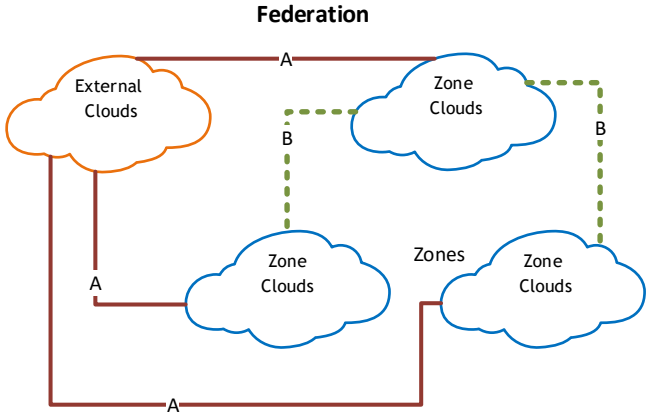

Figure 1 - Model proposed federated Cloud

Connections between each of the institutional clouds or with external clouds always assume the Internet connection of each of the Institutions.

Currently the Foundation for National Scientific Computing (FCCN), a unit of the Foundation for Science and Technology, IP (FCT), has the main mission to plan and manage the operation of the Network for Science, Technology and Society (Rede Ciência, Tecnologia e Sociedade RCTS) (FCT, 2015). The RCTS network is a high-performance network for institutions with higher communication requirements that includes universities, government laboratories and polytechnics (FCCN, 2015a). The connection between the various institutional clouds is performed on a high-performance network, managed by FCCN, with different high access bandwidth, reducing the constraints inherent in the use of internet connections provided by commercial operators (FCCN, 2015b). For the production deployment a dedicated backbone is provided for the implementation of the federation based on RCTS network.

A study by the EMC Corporation in, states that the growing reliance on technology would be the main factor for the increase of business risks (Risks, Availability, & Increasing, 2013). Organizations require new IT models where availability is almost continuous, with more control and visibility of information, establishing a trust-based infrastructure.

Even the National Institute of Standards and Technology (NIST) has released a guide planning and taking contingency plans for information technologies systems (Swanson et al., 2002). Thus it would be necessary to draw a plan in which the system continuity would not be affected by any adverse conditions such as technical failures, dead services, natural disasters (storm or energy interruption for example).

The possibility of using a model for shared resources could allow setting processes, policies and restore critical system procedures following a catastrophic event in a less arduous task. With shared resources, geographically separated, the model will add the advantage for increasing fault tolerance and increased availability of service. The intuitions can think, discuss, analyse, test and implement a global strategy and contingency measures involving the federated academic cloud, increasing and improving the services already provided by each institution to its users.

Randles et al. addresses a comparative study for the implementation of a load balancing algorithm for cloud computing (Randles, Lamb, & Taleb-Bendiab, 2010). This algorithm, coupled with the existence of a geographically distributed infrastructure, thought, designed and engineered to provide high availability allow the development of resilience to the Academic Cloud Federation.

4. Conclusions

At this stage of the study we are testing the proof of concept in terms of a federated structure of higher education institutions. With satisfactory preliminary results but with the awareness of the need for some more research to mitigate a number of aspects in the form of improvements and manage minor implementation problems. The model emphasizes the creation of a strong technological base, supporting all the needs of higher education institutions wherever possible, even at the implementation phase of the Academic Cloud Federation, providing innovation, support, knowledge and confidence. Networking with other institutions presents as guarantee for support at critical moments, when faced with the lack of resources within the own private cloud. This confidence is important for institutions to take their strategic decisions without being limited to their own internal limitations, allowing to be more versatile in the search for new directions. At the same time we will need to consider how to control and aggregate information from logs recorded by the system from different players in the federation. This need arises from the natural shared management of the federation. After an institution of higher education is integrated into the federation, it will naturally to have some sort of federation administration access. In this sense it is urgent to draw up a notebook of good management practices and in parallel, review of knowledge extraction mechanisms from operations' logs made by all stakeholders in the system.

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Pedro Lopes is in the final research stage to complete the PhD in Computer Sciences in Universidade de Trás-os-Montes and Alto Douro (UTAD). He is System and Network Administrator in Instituto Superior Politécnico de Viseu (IPV), and invited teacher in IPV. He is a Microsoft Certified Professional with MCP, MCSA and MCSA Messaging.

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