

GigaNuvem: A Low-Cost Edge Computing Cloud Solution for Academic Institutions in Brazil

Alysson Filipe, Rodrigo de S. Saldanha, Lucas R. Costa, Marcos F. Caetano, Paulo Angelo A. Resende and Leonardo Brandão

GigaCandanga Network (<https://gigacandanga.net.br>)



THE PROBLEM

The migration to the cloud computing paradigm, for R&E institutions, maybe a challenging due to their particular demands, high services costs, inappropriate connectivity infrastructure (latency, throughput, and volume), and concerns about the dependency on a specific supplier's solution.

PROPOSAL: GIGANUVEM

GigaNuvem is a low-cost edge computing cloud solution, based on a commodity cluster computing approach, under development by the Metropolitan Research and Education Network (MREN) of Brasilia/Brazil, GigaCandanga. Its focus is to provide cloud services with low latency, high throughput, and high availability for Academic Institutions connected to GigaCandanga and other interested networks.

The project is based on open source solutions built over top-of-shelf hardware. The commodity computing approach is a low-cost solution to build cloud computing infrastructure to release computational power for a lot of different applications. The flexibility of the solution allows dynamic and transparency attaching and detaching computer nodes to the infrastructure. The figure called Node Design presents an example of a top-of-shelf computer node used by the GigaNuvem solution.

The physical infrastructure of the datacenters is built using customized shipping containers, which are connected to the MREN at specific points, to enable physical resilience against eventual disasters. The use of customized shipping containers also reduce costs and simplify deployments. Each container is autonomous and can host up to 180 computer nodes. The cloud data has redundancy through copies stored in three different data centers. The project also implements a distributed storage system, called CEPH.

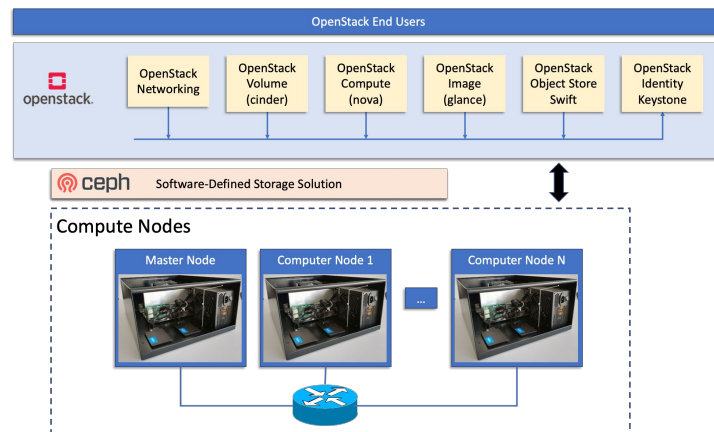
TECHNOLOGIES

The main used software technologies are described below:

- **GNU/Linux Ubuntu Server** - An open source operating system distribution installed in each computer node.
- **OpenStack** - the core of the GigaNuvem, OpenStack is an ecosystem of solutions that together represents an open-source Cloud implementation. The OpenStack architecture is complex and involves a large number of different modules, such as networking, volume (cinder), compute (nova), image (glance), object store (swift), identity keystone, among others.
- **Ceph** - Ceph is a software-defined storage solution designed to address the object, block, and file storage needs of data centers. Ceph provides enterprise scalable storage while keeping CAPEX and OPEX costs in line with underlying bulk commodity disk prices.

RESULTS

The main result of the project is an open infrastructure to support edge clouds based on free software for R&E institutions. Currently, GigaNuvem has been used for production services by five beta users. For a specific user, for instance, the GigaNuvem infrastructure was able to provide the main virtual learning environment for the University of Brasilia, with more than 20,000 users daily and an average of 2.90 TB of user data traffic per day.



CLOUD ARCHITECTURE



CONTAINER SOLUTION



CONTAINER DESIGN



COMPUTATIONAL NODE