PANACEA

PANACEA will propose innovative solutions for a proactive autonomic management of cloud resources, based on a set of advanced machine learning techniques and virtualization.

AT A GLANCE

Project title
Proactive Autonomic Management of Cloud Resources

Project number
610764

Project coordinator:
Olivier Brun, LAAS-CNRS, Centre National de la Recherche Scientifique (FR)

Partners
International Research Institute for Autonomic Network Computing (DE),
Imperial College of London (UK),
ATOS (ES),
IBM– Science and Technology LTD (IL),
QoS Design (FR),
Universidad Complutense de Madrid (ES)

Duration
30 months

Total cost
€ 3.17M

Programme
FP7 ICT *Call 10*

Website
http://www.panacea-cloud.eu/

Context of the Project

In a Cloud Computing platform, software migrates from the desktop into the "Clouds" of the Internet, offering to the users anytime, anywhere access to their programs and data. Present Cloud Computing platforms do not support mechanisms for recovering from many inevitable hardware/software failures.

The design that is holistically needed has to deal with the fact that some components are very likely to fail and the QoS requirements of applications and services will not be met. The challenge is then to investigate and implement methods that help to shield the end user from such anomalies (failures and QoS violations) and keep the applications and services running. Virtualization is a critical mechanism for that because it allows to quickly move workload from one source to another one. Our key observation is that virtualization would allow proactive resource management, and thus increase availability and QoS, if we could correctly predict anomalies (the time to failure of cloud applications and services, violation of QoS constraints and DDoS attacks).

Objective

The major Panacea objective is to create a Machine *Learning* (ML) framework for a proactive autonomic management of cloud

resources, as a remedy to the exponentially growing cloud complexity. It will permit, based on advanced ML techniques, monitoring, controlling and proactively managing applications' executions and services in the cloud.
The goal is to build a level of virtualization of resources so that any given event is not tied to one box necessarily or one storage disk. Once you get that kind of leverage, you can build the set of functions that relate to autonomic *self * properties-configuring, healing, optimizing and protecting:* The objective of PANACEA is the realization of the *autonomic properties:*

- *self-healing* against anomalies by recovering from multiple node and link failures, and using proactive rejuvenation of applications and servers for preventing crashes and increasing the availability,
- *self-configuring* by efficiently mapping user's requirements onto Distributed Clouds and configuring on-the-fly in the presence of anomalies
- *self-optimizing* using proactive migration of virtual machines from one cloud resource to another, and using proactive redirection of flows to avoid congested areas in the networks
- *self-protecting* using proactive reconfiguration of overlay networks to protect against DDoS attacks.

Proposed technical solution

The PANACEA distributed architecture is a two-level architecture. The first system level is composed of private research clouds controlled by Intra- Autonomic Cloud Manager(s) (Intra-ACM) monitoring, controlling and proactively managing applications' executions inside each cloud. The second system level is a federation of "private research clouds" controlled by the Inter-Autonomic Cloud Manager (Inter-ACM) in charge of monitoring the quality of the paths in the overlay network and proactively reconfiguring it.

The ML framework will allow predicting the failure time of software, or user applications running on Virtual Machines and the violation of expected response time of cloud services. The complexity of prediction models will be reduced by removing a number of irrelevant parameters from the training data set while preserving the accuracy of predictions.

To deal with the vast number of possible resources to monitor, our main approach will consider the use of mobile agents, which will move on the cloud, interacting with other agents, reading computing and network sensors, and making autonomous decisions on what to measure, when to report and to whom.

Distributed Machine Learning will be used to enforce "self-organizing paths" on an overlay network, which will maintain the quality-of-service of end-to-end flows in the presence of traffic congestion.

To ensure a reliable operation of PANACEA, replication services, leader election and distributed locking mechanisms shall be used wherever critical information is maintained.

Impact of the project

PANACEA will provide the infrastructure foundation that will allow cloud scale autonomic management. PANACEA will reduce the cost for cloud providers to supply reliable cloud infrastructure through better management of failing resources. This will translate into lower costs and better performance for users. By increasing the reliability of cloud provision for cloud users, thus reducing one of the barriers to adoption of cloud computing, consequent benefits to the economy and cloud market can be expected.