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Cloud Research - Implementing Scientific Research Information Systems in Open Source Cloud Platforms

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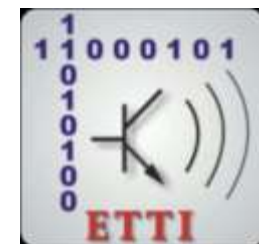
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Content

- Short Biography
- Cloud Computing Introduction
- Description of SlapOS Cloud Architecture
- Implementation and Testing of Cloud Research Platform
- Conclusions

Short Biography

- Graduated from the Faculty of Electronics, Telecommunications and Information Technology at the University “Politehnica” of Bucharest (UPB), Romania in 2000.
- Master diploma in Quality Management (2001) and Strategic Management (2002) from the University “Politehnica” of Bucharest.
- Currently, Ph.D. Student in the field of security technologies with focus on open source, cloud computing, mobile and BYOD initiatives.



Cloud Computing Introduction

- Infrastructure as a Service (IaaS)
- Platform as a Service (PaaS)
- Software as a Service (SaaS)
 - Communication as a Service (CaaS)
 - Enterprise Resource Planning (ERP)
 - Remote telemetry and monitoring
 - Many others (CRM, SQL, Wiki, etc..)
- SlapOS is an open source Cloud Operating System - motto = "everything is a process"

Cloud Computing Introduction

- Research on Cloud Computing has focused on the implementation of Scientific Research Information Systems in large Data Centers, however the costs are high.
- Rather than centralizing Cloud Computing resources in large data centers in our approach we propose that Distributed Cloud Computing resources are aggregated from a grid of standard PCs hosted in homes, schools, offices and small data centers.
 - new levels of cost efficiency;
 - drastically reduced environmental impact;
 - higher protection of researcher Freedom;

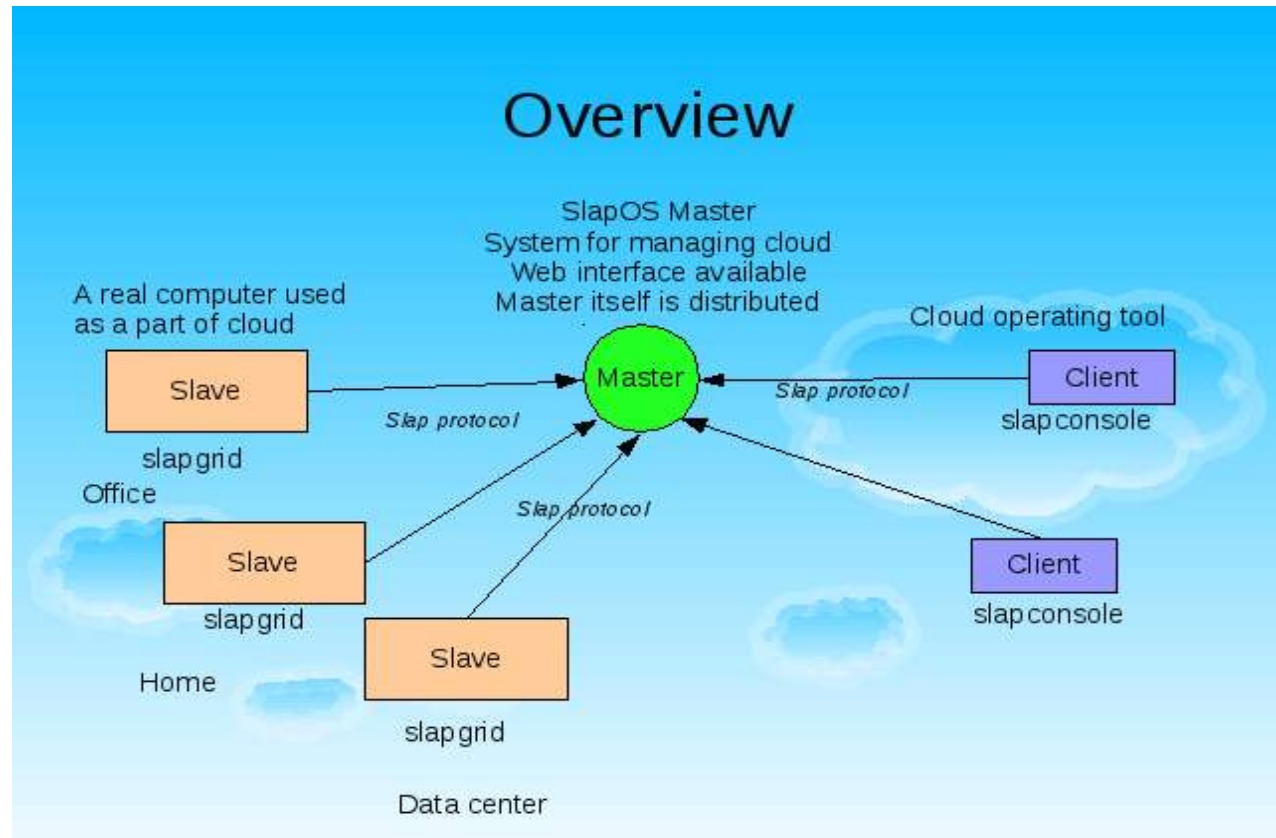
Description of SlapOS Cloud Architecture

- The architecture used in our approach is a distributed cloud environment that is deployed on “volunteer PCs” and run SlapOS open source cloud provisioning system, either standalone or in combination with existing virtualization technologies (OpenStack, OpenNebula, Eucalyptus, OCCl, VMWare, etc.)
- Cloud Computing for Scientific Research has focused on the implementation of Service Level Agreements (SLA)
 - However, in case of Force Majeure such as natural disaster, strike, terrorism, unpreventable accident, etc., Service Level Agreements (SLA) no longer apply.

Description of SlapOS Cloud Architecture

- SlapOS is based on a grid computing daemon called slapgrid - capable of installing any software on a PC and instantiate any number of processes of potentially infinite duration of any installed software.
- Slapgrid daemon receives requests from a central scheduler the SlapOS Master which collects back accounting information from each process.
- SlapOS Master follows an Enterprise Resource Planning (ERP) model to handle at the same time process allocation optimization and billing.

Description of SlapOS Cloud Architecture

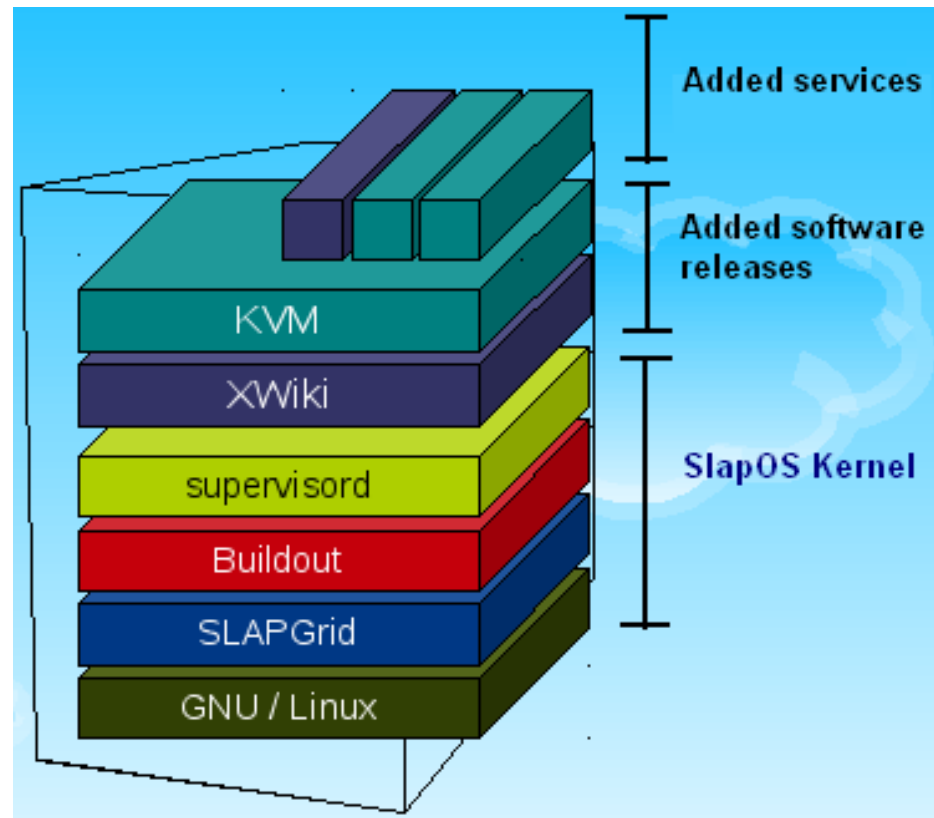


- SLAP stands for “Simple Language for Accounting and Provisioning”

Description of SlapOS Cloud Architecture

- SlapOS Nodes and SlapOS Master exchange are interconnected through the HTTP and XML based SLAP protocol.
 - SlapOS Master sends to each SlapOS Node a description of which software should be installed and executed.
 - Each SlapOS Node sends to SlapOS Master a description of how much resources were used during a given period of time for accounting and billing purpose.
 - Use of SlapOS generated X509 certificates for each type of identity: X509 certificates for people who login, an X509 certificate for each server which contributes to the resources of SlapOS and an X509 for each running software instance which may need to request or notify SlapOS master

Description of SlapOS Cloud Architecture

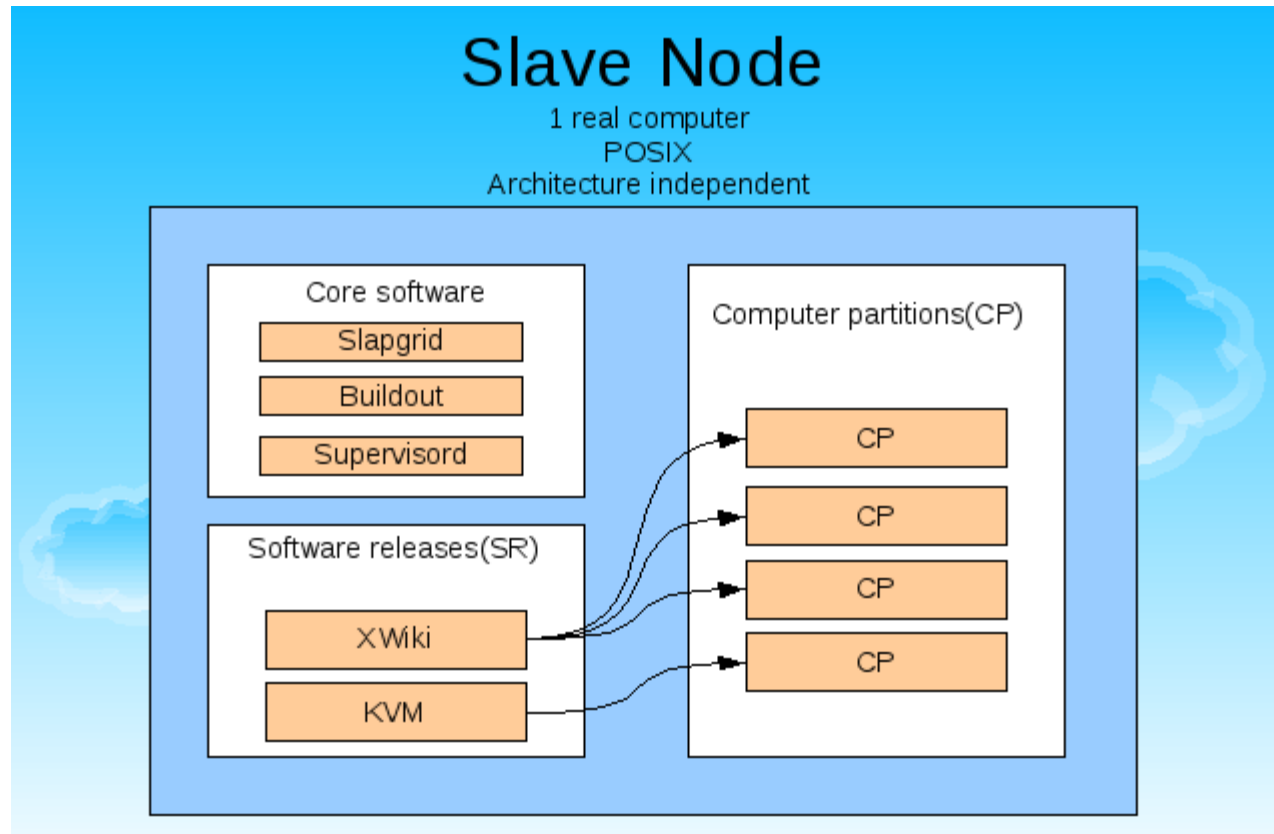


- SlapOS Kernel and User Software

Implementation and Testing of Cloud Research Platform

- Our platform - hosted on several servers running Ubuntu Linux – Apache – MySQL template with current software release.
 - Cloud research platform where SlapOS Master runs ERP5 Cloud Engine, a version of ERP5 open source ERP capable of allocating processes in relation with accounting and billing rules
- Initial versions of SlapOS Master were installed and configured by human.
 - In current version SlapOS Masters are implemented themselves as SlapOS Nodes, in a completely reflexive ways.
 - A SlapOS Master can thus allocate a SlapOS Master which in turn can allocate another SlapOS Master, etc.

Implementation and Testing of Cloud Research Platform



- POSIX operating systems include for example GNU/Linux, FreeBSD, MacOS/X, Solaris, AIX, etc.

Implementation and Testing of Cloud Research Platform

- Each slave node is divided into a certain number of so-called computer partitions.
 - Computer partition = lightweight secure container, based on UNIX users and directories rather than on virtualization.
- A typical barebone PC can easily provide 100 computer partitions and can thus run 100 wikis or 100 research sites, each of which with its own independent database.
 - A larger server can contain 200 to 500 computer partitions.
 - Current implementation does not prevent from running virtualization software inside a computer partition, which makes SlapOS at the same time cost efficient and compatible with legacy software

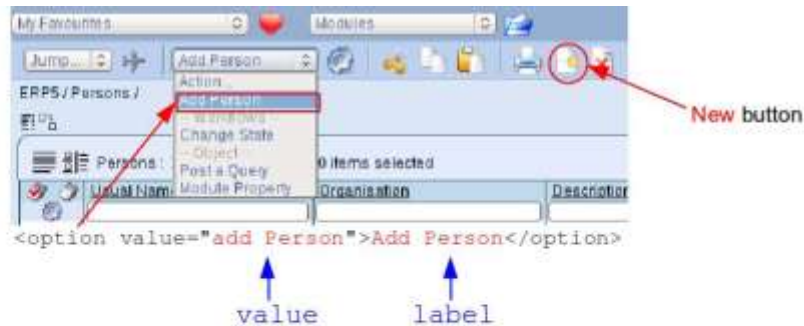
Test Implementation and Testing of Cloud Research Platform

- Solutions tested (I)
 - ERP5 and configure tables in the so-called catalog, in such a way that document properties extracted from the object database are structures in such a way that reporting can be extremely fast
 - JEDOC PALO which allows performing simple analytics and data mining reports very easily thanks to its ability to dynamic pivot tables. This solution can be considered if reports with graphs are needed with usage of only menu driven reports.

Implementation and Testing of Cloud Research Platform

- Solutions tested (2)
 - Rapid-I, an open source analytics solution that is more complete than PALO, but also more complex. The RapidMiner provides more than pivot tables and this solution is used by big companies to do machine learning, or to predict trends or behavior from recorded data.
 - R, the open source statistical language which can be used with all scientific mathematics and this language comes from the statistical language rather than from the informatics (such as Rapid-I). The main challenge with R is that it requires to know how to program it and use it. It uses fewer menus and more the programming skills of the user.

Implementation and Testing of Cloud Research Platform



By value	<code>browser.mainForm.submitSelectAction(value='add')</code>
By label	<code>browser.mainForm.submitSelectAction(label='Add Person')</code>
New button	<code>browser.mainForm.submitNew()</code>

Create: 0.4234s

Save: 0.5932s

Validate: 0.4126s

- There are two partitions created, one holds the installation of MySQL and the other partition holds the application (for example Wiki) automatically configured to connect to MySQL together with Apache and PHP.
- For each operation the average time is calculated and finally displayed. The final results show that the average of each operation is approximatively half the acceptable timeframes of 1s

Conclusions

- SlapOS is capable of allocating virtual machines, application servers, databases and even ERP applications beyond the borders of IaaS, PaaS and SaaS in Cloud Computing.
- With SlapOS it is also possible to create a rich library of open source applications hosted on the Cloud for research and education entities that want to have free online access to the know how of Cloud Computing
 - SlapOS should also soon serve as a platform for open source software publisher to turn their software into multi-tenant SaaS.
 - On the other hand know how is attracted continuously by companies such as Google, Facebook and Microsoft where it remains secret
- SlapOS is the proposed testbed to make sure that Distributed Cloud Computing knowledge remains shared and open



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