



PUCRS – Gelato Projects

The Pontifical Catholic University of Rio Grande do Sul, Brazil, was established in 1931 and has since graduated more than 100,000 students. Currently, PUCRS offers 60 undergraduate courses of study, 24 Master's programs and 15 Ph.D. programs through 22 units. Current enrollment is 30,403. The Faculty of Computer Science began its activities in 1973 and today more than 1000 students are enrolled in undergraduate and graduate programs. In 1993 PUCRS began hosting industry-sponsored research laboratories that have evolved into collaborative research projects with key organizations in computer and information technologies. With the R&D group of HP Brazil, PUCRS has several research groups including the Research Center in High-Performance Computing (CPAD), the OS Scalability Group (PeSO) and the Research Center in Software Testing (CPTS) involved with Gelato. Research activities relevant to Gelato include:

- resource management and monitoring in heterogeneous clusters and Grids (including IPF machines);
- high-performance applications on multiprocessors and clusters;
- operating system scalability on multiprocessor architectures (including IPF nodes);
- virtualization with the Xen virtual machine monitor and its utilization in resource management and in NUMA multiprocessors;
- performance/availability testing and security testing of IA64 Xen monitor.





CPAD – Resource Management in Heterogeneous Clusters

➤ Overview/Problem Definition

- Investigation of the challenges in system monitoring and performance analysis for heterogeneous clusters including IPF machines and virtual machines. Evaluate applications performance using metrics and heuristics composed by regular system metrics (e.g. CPU, memory and network utilization) and hardware specific metrics obtained through hardware counters
- Emulation of large scale environments using clusters. Analysis of virtualization benefits in distributed environment. Investigation of advantages and limitations emulating large-scale environments using Xen. Development of a tool to facilitate the deployment of Xen Virtual machines in clusters





CPAD – Resource Management in Heterogeneous Clusters

◆ Technical Approach

- To validate the researched concepts we intend to:
 - ◆ analyze applications performance using high (system) and low level (hardware counters) metrics in a distributed infrastructure composed by heterogeneous and virtual machines
 - ◆ analyze open-source deployment tools and large scale environments characteristics
 - ◆ build a tool to deploy large-scale environments using Xen in clusters
 - ◆ analyze the behavior of emulating large-scale environments in order to identify unchangeable characteristics





CPAD – Resource Management in Heterogeneous Clusters

◆ Current Status/Looking Ahead

- Performance evaluation of parallel applications (case studies) being executed in a heterogeneous environment using high and low level metrics
- Automatic tool to deploy and configure large-scale environments in clusters
- Development of a deployment tool to install Xen virtual machines in a site (based on ISO images)
 - ◆ Improving the architecture to be scalable
 - ◆ Including an incremental installation mode (like RDP)
 - ◆ Including management services (based on SNMP/WBEN)





PeSO – OS Scalability

◆ Overview/Problem Definition

- Although Xen supports SMP machines, its scalability on this type of machine has not been assessed. We will also improve Xen operating systems support in NUMA machines

◆ Technical Approach

- Evaluate Xen scalability in machines with several processors
- Investigate the ability of Xen to provide the correct NUMA information to the operating systems that are running on top of Xen





PeSO – OS Scalability

◆ Current Status/Looking Ahead

- Evaluation of Xen performance when running several different operating systems on machines with a different number of processors
- A patch for Xen to include ACPI information for the Linux operating system.





CPTS – Performance and Security Testing for XEN Virtual Machine Monitor

◆ Overview/Problem Definition

- Performance is one of the main concerns related to virtualization; it is important to evaluate the impact of introducing the additional computation layers necessary to provide virtual resources to applications. Providing consistent performance measures of such a complex system is a challenging task, due to the several variables that need to be controlled. We are investigating performance metrics of relevance for XEN IA64 virtual machine monitor and a benchmark-based testing strategy for these metrics
- Investigation of strategies for security testing of Xen. Some security vulnerabilities can be detected with static analysis of the source code. Our goal here is to investigate the application of this approach in Xen, using the results of analysis as a test coverage metric. The idea is to focus on possible vulnerabilities introduced by the virtual machine monitor



CPTS – Performance and Security Testing for XEN Virtual Machine Monitor

◆ Technical Approach

- Study of performance/availability metrics for virtual machine monitors
- Elaboration of performance models
- Investigation/development of benchmarks for comparing the actual performance with the results predicted by the model
- Study of source code analysis techniques applicable to Xen
- Selection and/or development of testing strategy/algorithm
- Implementation (if needed)
- Experiment with one module of Xen, to be defined with HP



CPTS – Performance and Security Testing for XEN Virtual Machine Monitor

◆ Current Status/Looking Ahead

- Security testing technique and tools for IA64 Xen
- Security testing results
- Performance test benchmarks and results for IA64 Xen
- Technical reports and papers describing the results.