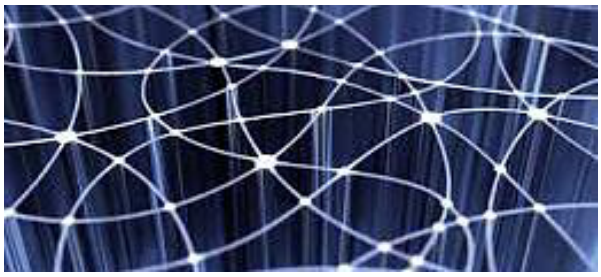

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PERFORMANCE ANALYSIS OF VIRTUALIZATION FOR HIGH PERFORMANCE COMPUTING

The field of High Performance Computing (HPC) is growing rapidly to meet the need of solving Big Data problems. As HPC systems grow more powerful and complex, administrative and utilization challenges are introduced. The Cloud computing paradigm offers promising Virtualization technologies for managing large HPC systems and optimizing their usage. However there are still major obstacles which need to be addressed in order to efficiently run HPC applications within a Cloud system.

One of the main obstacles of implementing Virtualized computer environments in HPC clusters is the impact they have on performance. HPC clusters rely heavily on computational throughput and memory bandwidth, as well as on high performance networks, such as Infiniband, to provide communications between interconnected hardware. Virtualization has a negative performance impact on all of these factors, with network performance being particularly affected by such technologies. With the recent release of Single Root I/O Virtualization (SR-IOV) for Infiniband; virtual machines (VMs) can directly and more efficiently access the network.

This paper presents results of an in-depth performance evaluation of the KVM hypervisor deployed within an HPC cluster environment. The HPC Challenge benchmark was used to assess Virtualization impact on various aspects of cluster performance. Focus was placed on establishing a good baseline performance, then on comparing virtual machine performance in a number of tests. An evaluation was also done on other relevant topics such VM to CPU mapping policies and Gigabit Ethernet versus Infiniband performance, as well as the impacts of hyper threading and software optimization.

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