Overview

Commercial clouds bring a great opportunity to the scientific computing area. Scientific applications usually need huge resources to run on. However not all of the scientists have access to significant high-end computing systems, such as those found in the Top500 list. Cloud has gained the attention of the scientist as a competitive resource to run HPC applications at a lower cost. But as a different infrastructure, it is unclear whether clouds are capable of running scientific applications with a reasonable performance.

The goal of this project is to assess the ability and the cost of the Amazon EC2 cloud running scientific applications, using customized instances against the local systems with no virtualization. We develop a full set of metrics and conduct a comprehensive evaluation over Amazon EC2 in the following aspects. This work will explore low overhead virtualization techniques (e.g. Palacios VMM), investigate network performance and how it might affect network bound applications, and explore a wide range of parallel and distributed file systems for their suitability of running in a cloud infrastructure.

Finally, we analyze the cost of using cloud for scientific computing and try to find the most cost-effective instances in different use case scenarios.

Methodology

Our method evaluates the capability of different instance types of Amazon EC2 cloud for scientific computing and analysis the cost of cloud computing. The method is divided into three parts:

- First: run the micro benchmarks to measure the actual performance and compare with the theoretical peak that we expect to get.
  - also include a non-virtualized system, to understand virtualization effect.
- Second: evaluate the performance of a virtual cluster of multiple instances, running real applications.
- Third: analyze the cost of the cloud based on the actual performance results.

Performance Results

**Compute performance**

- Low efficiency on compute performance
- High overhead of virtualization on processors

**Network performance**

- Predictable/stable network performance on single client/server case
- Poor scalability on multiple client case, Not scalable/predictable

**Memory Performance**

- The memory bandwidth scales perfectly on some instance types. HPC instances beat not-virtualized nodes at large scale
- Unstable write performance, Stable read performance

**I/O Performance**

- Poor performance on EBS drives because of access over network.
- S3 read throughput is lower than FusionFS and PVFS at smaller scales. The throughput increases linearly with scale. That means it will outperform the other two at larger scales.

**Virtual Cluster Performance**

- Poor efficiency at larger scales
- Reason: poor network performance, virtualization effect

References

- Amazon EC2: [http://aws.amazon.com/ec2/]