End-to-End Security and Performance Evaluation in the Clouds

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Abstract

While many researchers have investigated the performance and security of cloud services in data centers, there is a lack of studies on the end-to-end performance and security of cloud services.

This Research project is designed for the development of tools to support security and performance evaluation of cloud services. These tools will help assess the risk and performance of intermediate routers along the path between the cloud providers and the user.

Methodology

An at-scale experiment is performed by allocating Emulab and PlanetLab nodes as users, generating traffic to virtual instances deployed at various locations of well known cloud providers. In the process, we collected security and performance related data of the intermediate routers.

SECUperf is a software program which takes use of other well known tools to gather security and performance information from these nodes and uses central and distributed databases to store the data collected through this software.
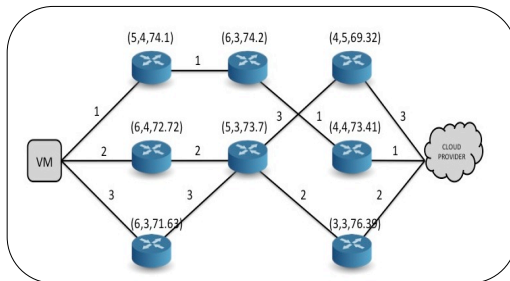
Sample Routing Metrics from Experiments
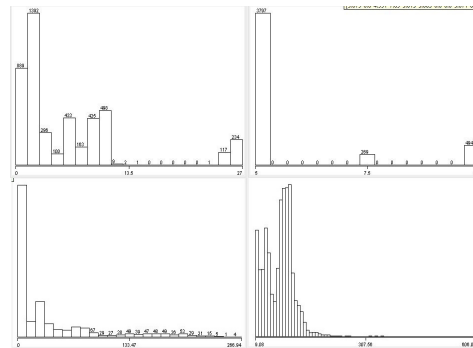
Frequency Analysis of Port Index, OS Rating, Available Bandwidth and End-to-End Delay

Security and Performance Evaluation of Routing Paths

Security index: the vulnerability rating of a router is mainly determined by the vulnerability of its operating system (vos) and the vulnerability of network ports (vnp). The vos and the vnp are derived from the analysis of collected data in the clouds and vulnerability database. Consequently, security index is defined as a combination of vos and vnp.

Performance index: bandwidth, packet loss, and the end-to-end delay between users and cloud providers are mainly considered in the study. Performance index is defined as their combination.

Graph search algorithms are employed to obtain the optimal paths subject to QOS requirements in terms of security and performance.

Significance of Work

SECUperf helps a user make the selection of a cloud service provider.

SECUperf helps a cloud provider assess the end-to-end security and performance of cloud services in support of cloud service improvement.
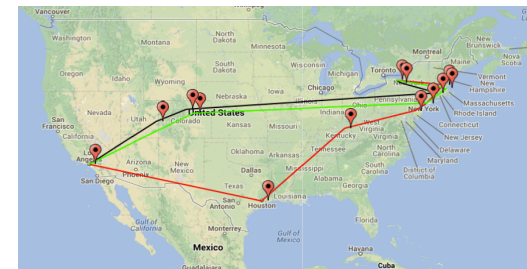
Optimal Path Selection based on Security and Performance of Routers

Conclusion and Future Work

- Designed and developed SECUperf for the security and performance assessment of cloud services. SECUPerf is used for:
  - ✓ Users: cloud service selections
  - ✓ Service provider: cloud service improvement
- Assessed more than 15,000 paths with over 1000 unique routers and performed region specific router vulnerability analysis.
- The experiments showed that about 26% of the routers in the path between cloud users and their provider are either OS vulnerable or port vulnerable.