# HyCloud: Hybrid Cloud Resource Allocation Using Simulated Annealing

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## Problem statement

Cloud Computing provides a powerful and flexible paradigm allowing users to pick and choose variety of resources and services. However, currently, users are still limited to the choices only available within a single cloud service provider which may not be the optimum allocation of resources such as for minimizing overall task completion time with the same cost.

We consider a Hybrid Cloud Platform which enables users to choose machines across multiple cloud service providers to provide the optimum machine allocations to complete user tasks within required SLA (task completion time) & cost constraints. Further, we incorporated real benchmark data[1] and performed simulation over representative scenarios after surveying 25 or more real Use Cases[2].

## Optimization Problem

### Constrained Optimization Problem Formulation

$min$ total cost to complete the task

$= min$ total cost $(C)$/time $\cdot$ completion time$(T)$/task $(1)$

s.t. total cost $< \alpha$ and completion time $< SLA$

### Machine Profiles

Machine types: $W = \{DB, \ WEB, \ Compute, \ Storage\}$

Cost Profile: $C = \{C_{DB}, \ C_{web}, \ C_{Compute}, \ C_{Storage}\}$

Completion Time Profile: $T = \{T_{DB}, \ T_{web}, \ T_{Compute}, \ T_{Storage}\}$

**Leveraged actual benchmark data and cost information[1] of Amazon, Google, and Microsoft for generating Machine Profiles**
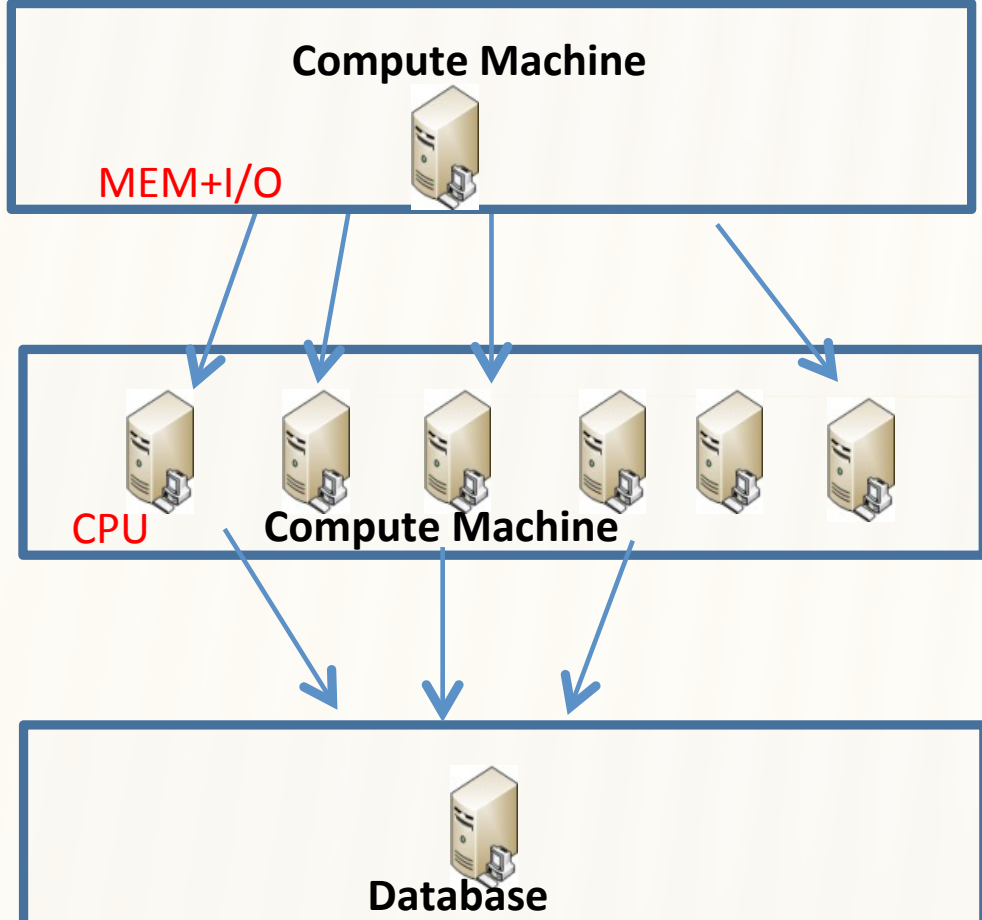
### Simulated Annealing (SA) Approach

Use the heuristic SA to obtain a global minimum to solve (1), finding a set of machines among different cloud service providers. Our SA algorithm takes the specific network topology, machine profiles, and SLA and searches a set of machines that yields the highest performance per cost.
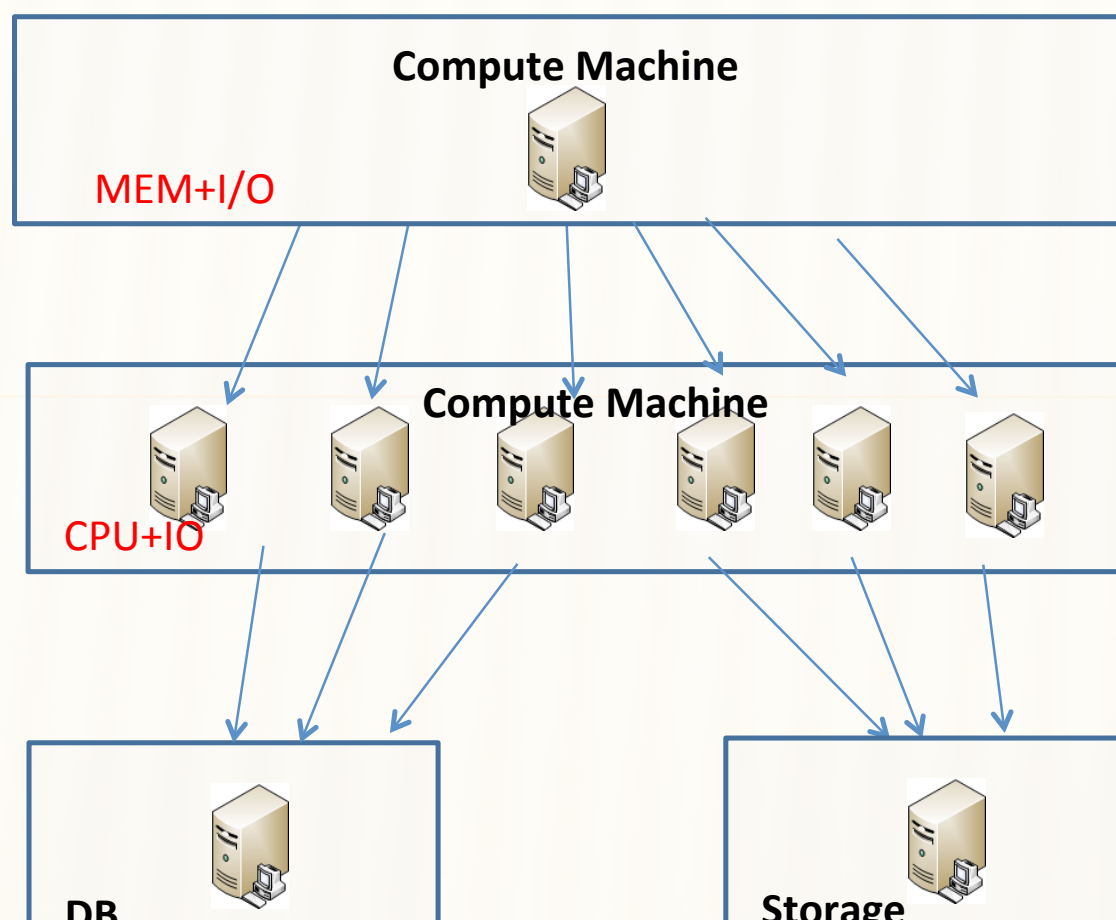
## Use Cases

### Web Service/Health Care App



### Large Scale Storage App
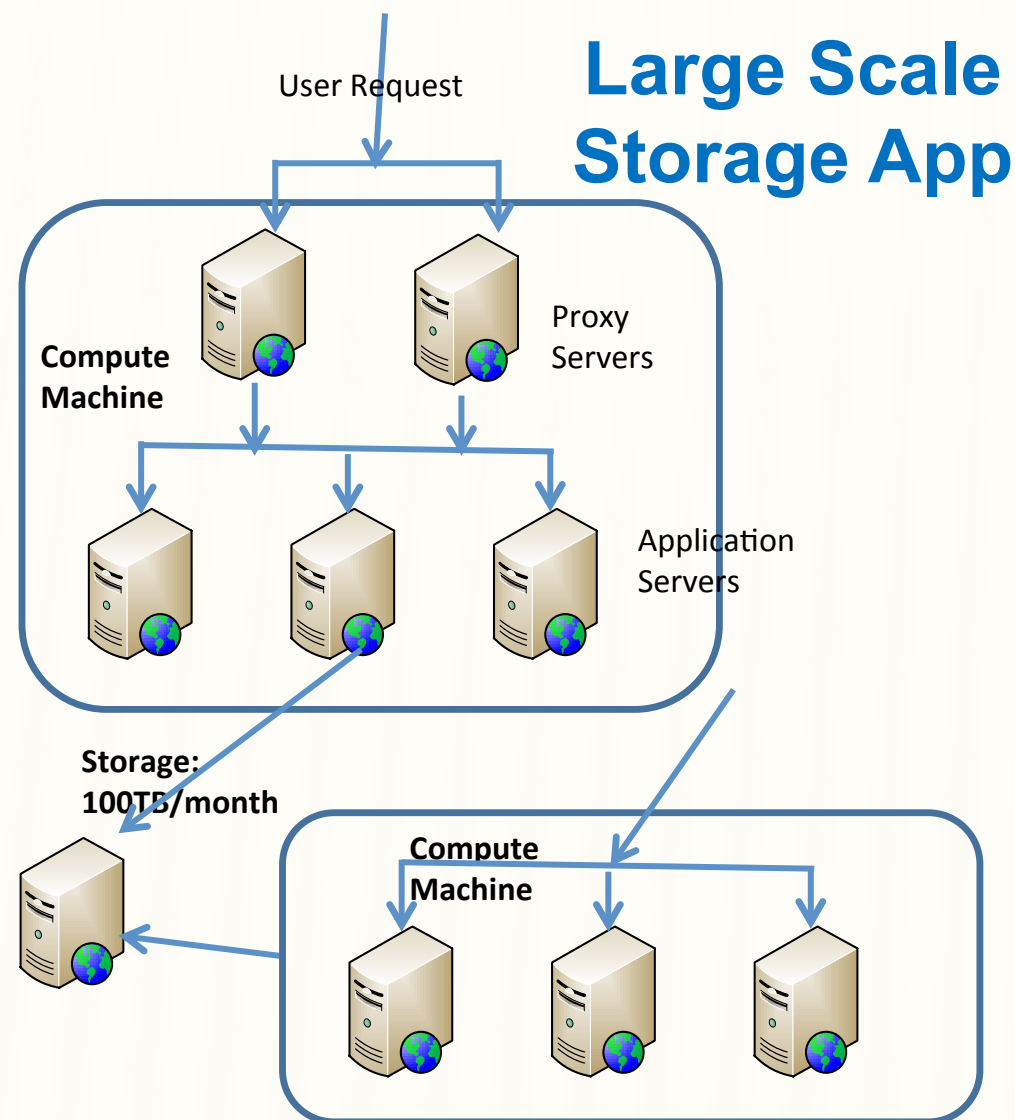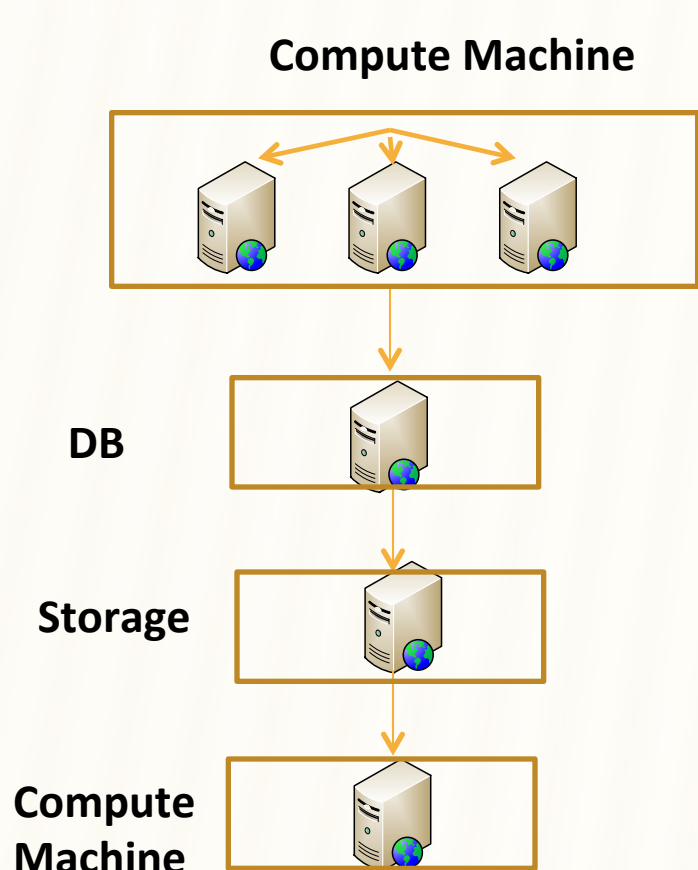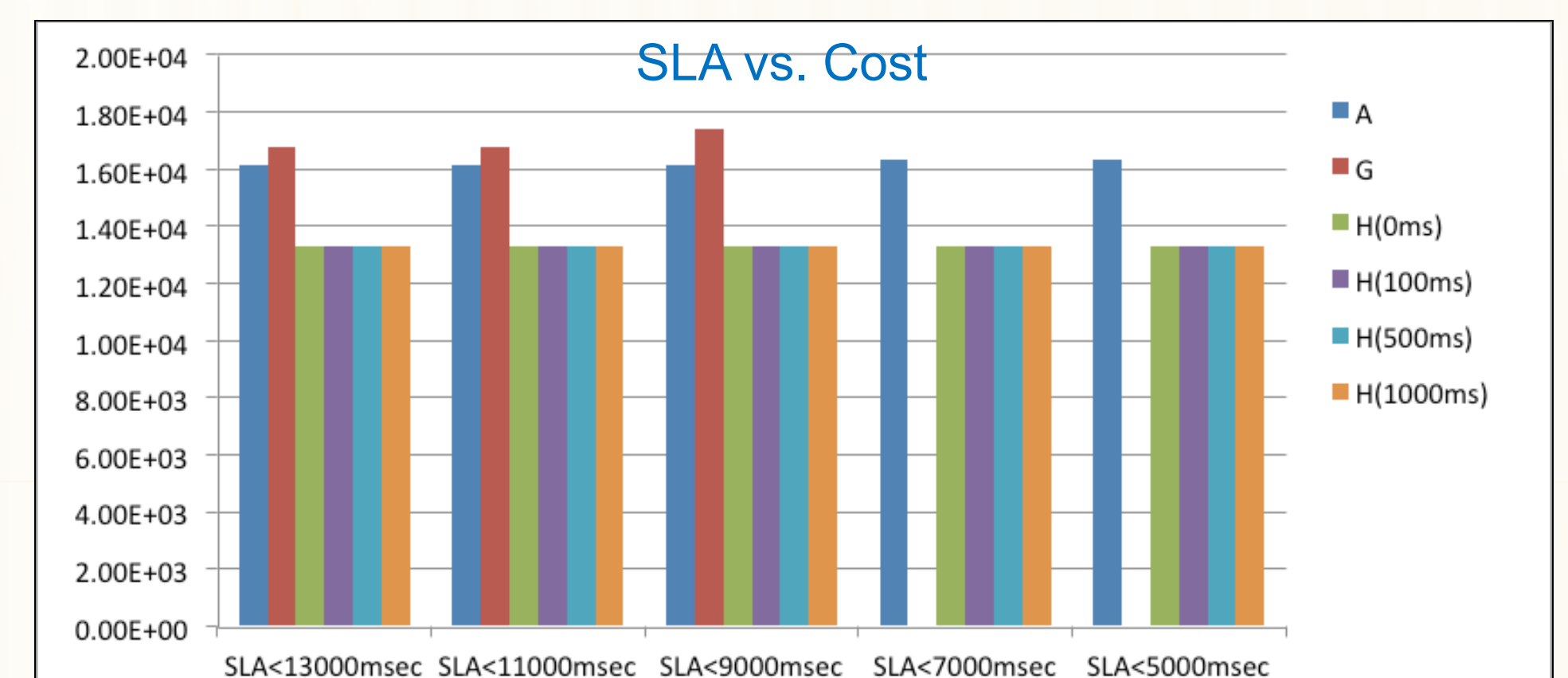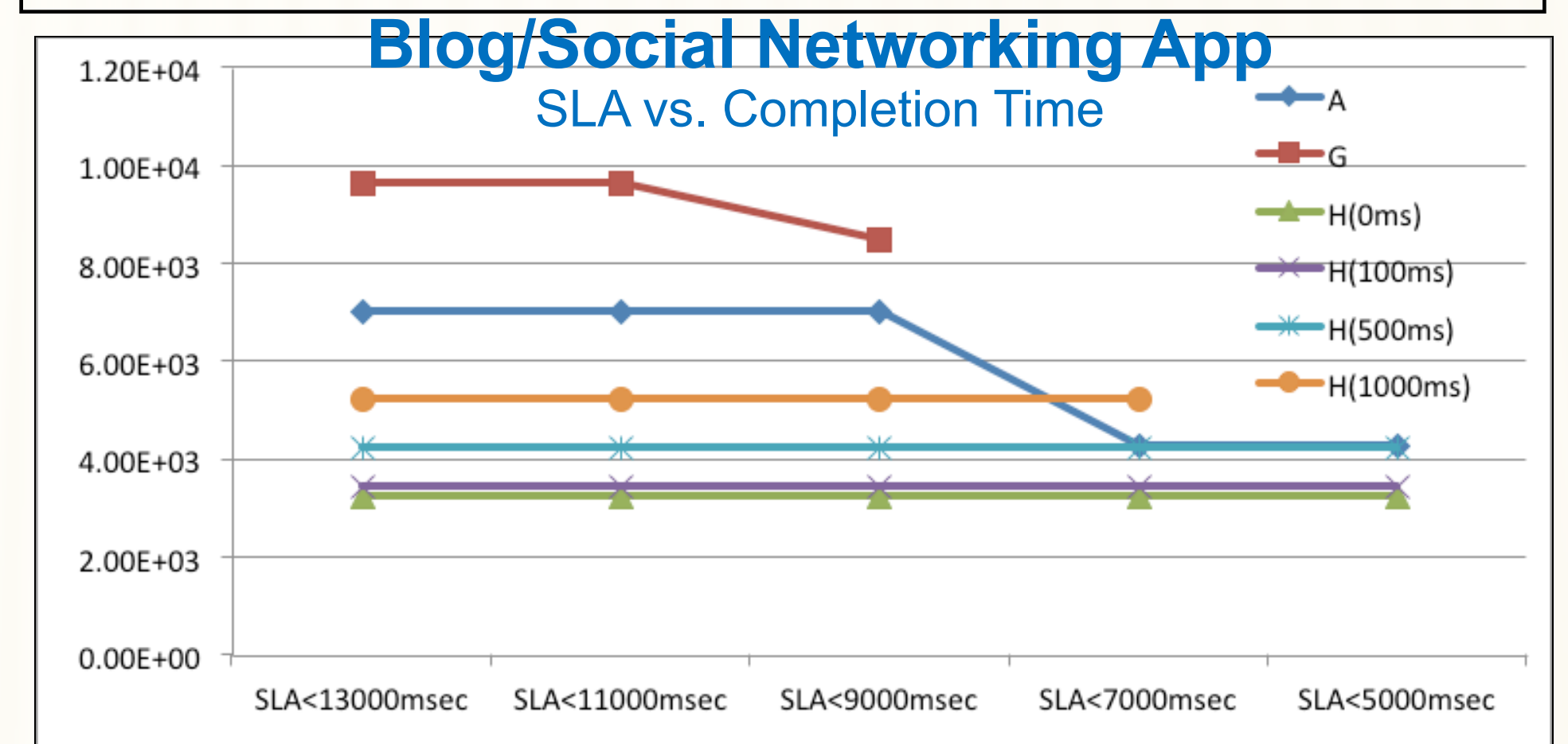


### High Performance Computing



### Blog/Social Networking App



## Simulation Results

### Web Service/Health Care App



SLA vs. Completion Time

A: Amazon, G: Google, H(x msec): Hybrid with x msec overhead



SLA vs. Cost

### Blog/Social Networking App



SLA vs. Completion Time



SLA vs. Cost
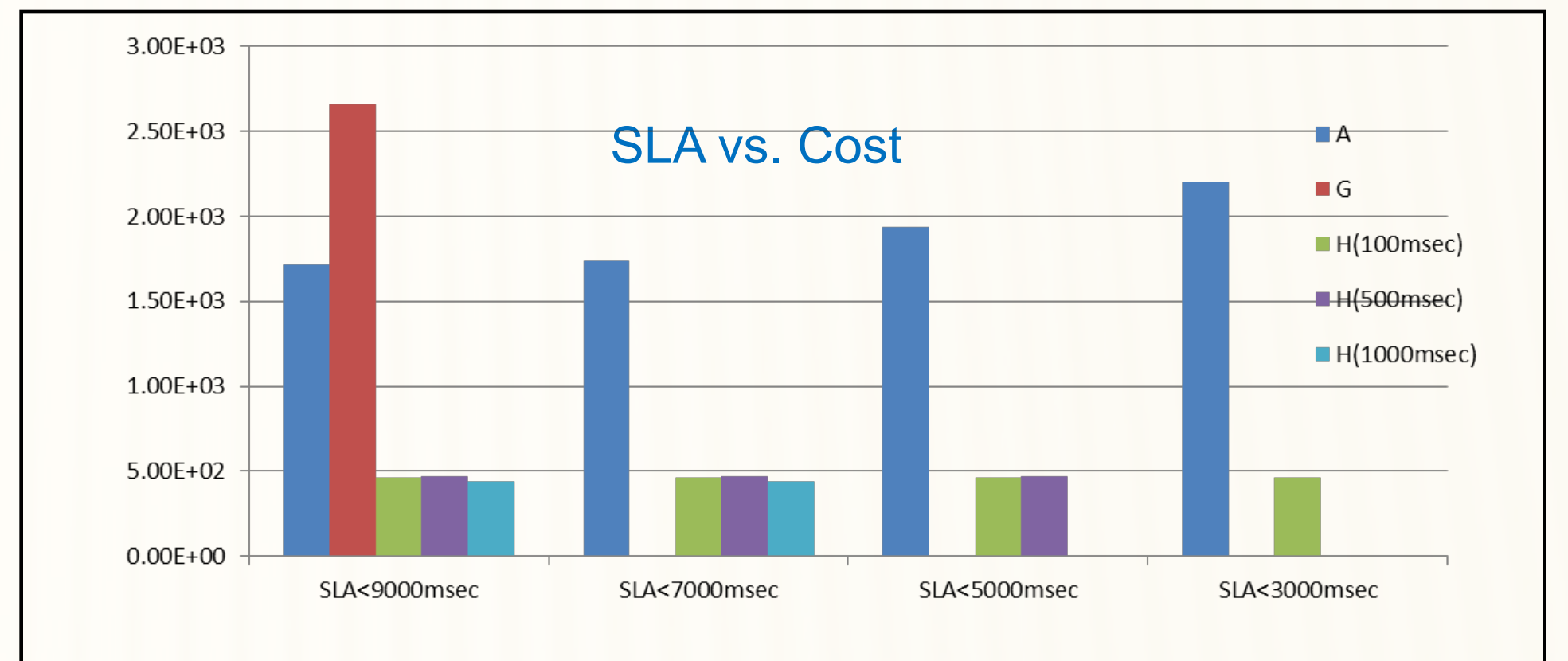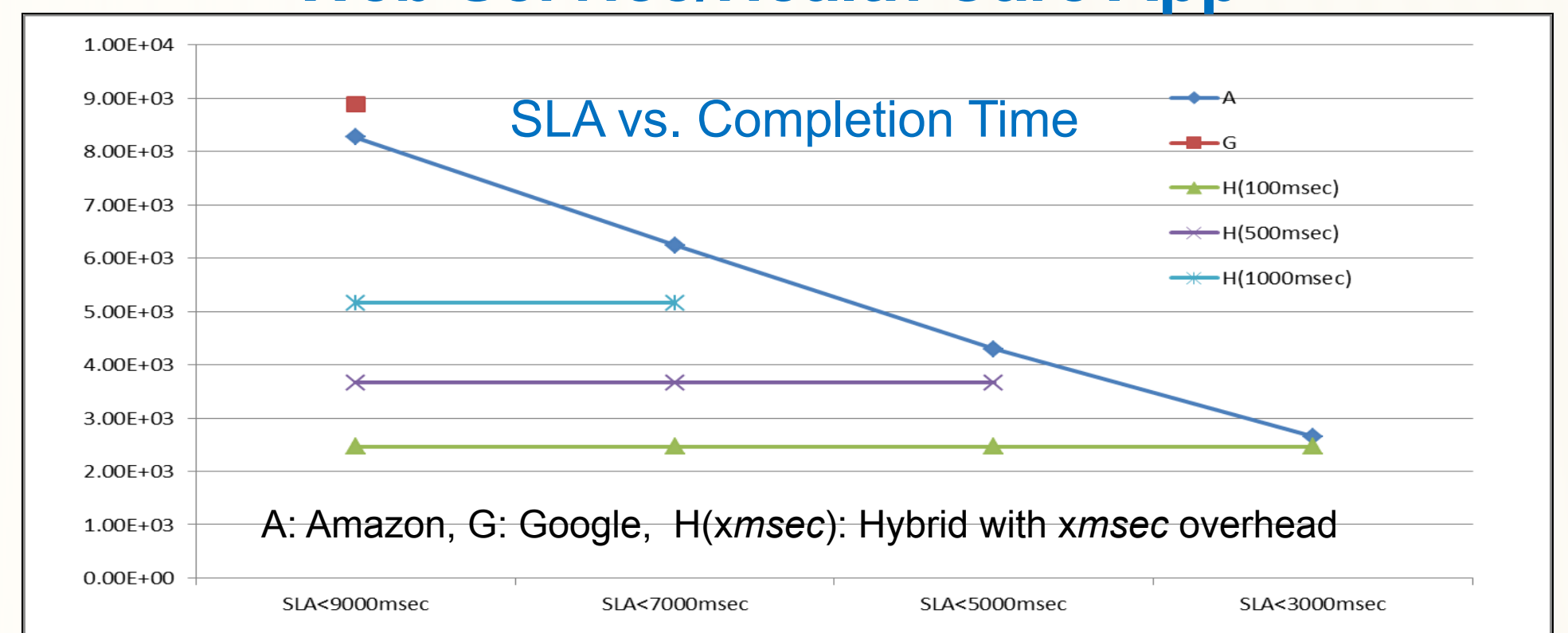
**Demonstrated the clear performance and cost benefits of HyCloud in most use cases**

## Main Contributions

- **Incorporate real cloud machine benchmark data[1] and surveyed various Cloud Computing Use Cases**
- **Characterize the tradeoff between Hybrid Approach vs. Single Provider Approach and quantify the benefits of Hybrid Approach with representative Use Cases**

## Work in Progress

- **Working on extending our findings to more general cases:** How could one allocate resources given $V$ providers and $W$ resources ? *HyCloud(V, W, SLAs, T, C)*
- **Researching on High Level/Top Down Approach to Perform Resource Abstraction and Decomposition**

[1] Ang Li, Xiaowei Yang, Srikanth Kandula, Ming Zhang CloudCmp: Comparing Public Cloud Providers, *Internet Measurement Conference, Nov 2010.*

[2] http://aws.amazon.com/solutions/case-studies/

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