Closer to the Cloud
- A Case for Emulating Cloud Dynamics by Controlling the Environment

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Latency-Sensitive Applications on the Cloud

- Complex
- Multi-tiered
- SOA
- Stringent SLA

- $$$ savings
- Geo-redundancy
- Elasticity
- Scalability

Test beds
Performance Fluctuations in Microsoft Azure

- Short-term and long-term variation in DB latency
- DB performs 100% worse on Day 1 than on Day 2
- Variation in RTT of TCP streams observed in Amazon EC2
- Our study confirms - hotcloud10 (CloudCmp), SoCC10 (YCSB)
Control over the Environment: A Technique

- Experiments in the wild – cloud provider 1
- Experiments in the wild – cloud provider 2

Trace collection and analysis

Data model to emulate on GENI

Performance prediction and redesign

Application/research prototype under development

- Commercial clouds?
  - No control over the environment and shared infrastructure
- Cloud test beds like Open Cirrus, Eucalyptus?
  - Can emulate cloud dynamics and federated, but no control over the environment
Sample Enterprise Application Day Trader
Single Data Center Deployment on GENI

- **Test bed**
  - User workload generator (grinder) running in Purdue
  - Workload from DaCapo benchmark for Enterprise apps
  - Application instances running on nodes from Utah
  - Delay node between BS1 and BE
Predicting Performance of Applications by Replaying Trace

- DB latency trace from Azure (slide 3) replayed between BS and BE
- Total application response time for each user request plotted
- More or less follows network delay between BS and BE
- Also measured error percentage – always within 1 %
Multi Data Center Deployment on GENI

- **Test bed**
  - User workload generator in Purdue
  - Two instances of the application components
  - One deployment in Utah and another in Kentucky
  - Delay node between FE1 and BS1 in Utah

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**FE1**
- asterisk.emulab.net (Utah)
- 2 ms to BS1
- 41.2 ms to BS2
- 0.5 ms to FE2

**FE2**
- **BS1**
- **BS2**
- **BE**
- Delay node
- 2 ms to FE1
- 41.2 ms to BS1
- 41.2 ms to BS2
- 41.2 ms to BE
What –if Analyses on Application

- **No delay**: DC2 slower than DC1
- **Delay 250 ms**: DC1 slower than DC2
- **DC1 – DC1**: FE1 – BS1 in Utah & DC2 – DC2: FE2 – BS2 in Kentucky
An Adaptive System - Dealer

- Cloud environment is highly dynamic
  - Problem isolated to one component in a DC
- Current redirection mechanisms
  - Abandon entire deployment
- Dealer: Adapts to cloud dynamics
  - Components deployed on multiple DCs
  - Fine-grained component level redirection
  - Optimally suggests path based on latencies
Evaluation of the Adaptive System

- **Control Input**: Step

- **Output**: Dealer path change

  - DC1 – DC1: FE1 – BS1 & DC1 – DC2: FE1 – BS2
Conclusions

- To open up new avenues in cloud research
  - Control over test bed environment – critical
- Can be used as a technique by developers and researchers for
  - emulating real cloud dynamics to
    - predict application performance
    - compare cloud providers
    - what-if analyses on application
    - develop solutions for performance problems
Q & A
Back up slides
Future Directions

- Dynamically change the delay
  - Multi data-center deployment like Emulab
- Emulating cloud data stores
  - Blobs, Queues, Big-Table provided as service
- Installing and running Cassandra on GENI
Accuracy and Repeatability Requirements

- Error percentage:
  - (observed latency – expected latency)/expected latency in %
  - observed – ping, expected – delay applied
  - always within +/- 1% error bound
- Require such high degree of accuracy and repeatability
## SQL Azure Performance Issue Snapshot (6 Days)

We maintain the history of the health status for each service for the past five weeks in the form of running logs. This history is shown in the table below. Mouse over a status icon to see a detailed incident report and click on the arrow icon at the top of the table to move back and forth through the weeks.

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<th>Sep 25</th>
<th>Sep 24</th>
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*Page Last Updated: 26 Sep 2011 5:09 PM UTC*

- Normal service availability
- Performance degradation
- Service interruption
- Additional information

**North Central US Performance Issue**

9:28 PM UTC: A small number of customer databases have been impacted by a performance issue triggered by load on the system. We are currently working on a solution to improve the service and reduce the impact to our customers. If you are impacted by this please contact us so that we may assist you.

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### Features
- Compute
- Database
- Virtual Machines

### Scenarios
- Websites
- Social Applications
- Social Games

### Decide
- Videos
- FAQ
- Whitepapers

### Learn
- Get Started
- Download SDK
- Code Samples

### Community
- Blog
- Events

### Support
- Understand Your Bill
- Pricing
- Service Dashboard

### Buy
- Offers
- Resizing Calculator
Performance Fluctuations in Amazon EC2

- Simple Experiment
  - RTT measured for a TCP stream
  - Both inter and intra DC show variation
Day Trader Communication Pattern

- Response time = component latency + communication latency
- Multiple calls between components for a given user request