ACE in Clouds: Availability Changes Everything

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Cloud Technologies

- Basic infrastructure components:
  - Physical servers (and virtual machines, aka VMs), racks, clusters
  - Power distribution units (PDUs) and cooling infrastructures
  - Switches, routers and datacenter networks

- Increasing adoption/reliance
  - Providers: Amazon, Google, Microsoft, Rackspace, SaleForce…
  - Clients: individuals, and small to large companies/institutions

- Availability/reliability is a top concern
  - availability = uptime / (total period) = 1 – downtime / (total period)
  - cited by 67%, followed by device based security (66%) and cloud application performance (60%).

Cisco Global Cloud Networking Survey, 2012.

Failures are all too common

- Frequent small-scale failures and infrequent large-scale failures
- Typical first year for a new cluster (Jeff Dean, Google)
  - ~0.5 overheating (power down most machines in <5 mins, ~1-2 days to recover)
  - ~1 PDU failure (~500-1000 machines suddenly disappear, ~6 hours to come back)
  - ~20 rack failures (40-80 machines instantly disappear, 1-6 hours to get back)
  - ~5 racks go wonky (40-80 machines see 50% packet loss)
  - ~3 router failures (have to immediately pull traffic for an hour)
  - ~dozens of minor 30-second blips for DNS
  - ~1000 individual machine failures
  - ~thousands of hard drive failures

Failures cost too much

http://www.emersonnetworkpower.com/en-US/About/NewsRoom/Pages/2011DataCenterState.aspx

Why Current Cloud Services Are Flawed

- Current Service Level Agreement (SLA) is loosely defined in terms of availability/reliability measurements.
  - SLA is a contract between a user and the service provider (price, service/ duration, and penalty etc.)

- Penalty term is not user-friendly. The refund is usually issued in the form of *credit* with a lot of exclusions.
  - Amazon EC2 will refund the user in the form of credit if fail to meet the SLA.
  - Rackspace will credit the user 5% month fee for each 30 mins network/ infrastructure downtime, up to 100% monthly fee of the affected server.

- Lack of high availability/reliability guarantee for critical services
  - Cannot guarantee 3-9's (99.9%), let alone 5-9's as in Telco networks.

Key Challenges and Solutions

A user/app may request:

- # of VMs n *(e.g., 100)* to achieve certain response-time performance
- Minimum desirable availability α *(e.g., 99.9%)*
- Desirable contract duration t (e.g., 3 months)

The cloud SP performs the following:

- Downtime prediction based on failure models
  - Model component failures
  - Determine downtime distributions
- Availability-aware cloud resource provisioning and allocation
  - Determine the optimal (minimal) # of backup VMs, k, to be allocated
  - Both risk and energy minimizing placement of $n+k$ VMs
- SLA contract design*
  - Determine its costs: Capex (~h(n; k)) and Opex (~energy consumption)
  - A price list (schedule) for <duration, availability-guarantee, penalty>

AQUA: An Analytic approach to Quantifying Availability for Cloud Resource Provisioning and Allocation

CSR Medium Collaborative
1409809 & 1409256

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Collaborator: Indiana Univ.
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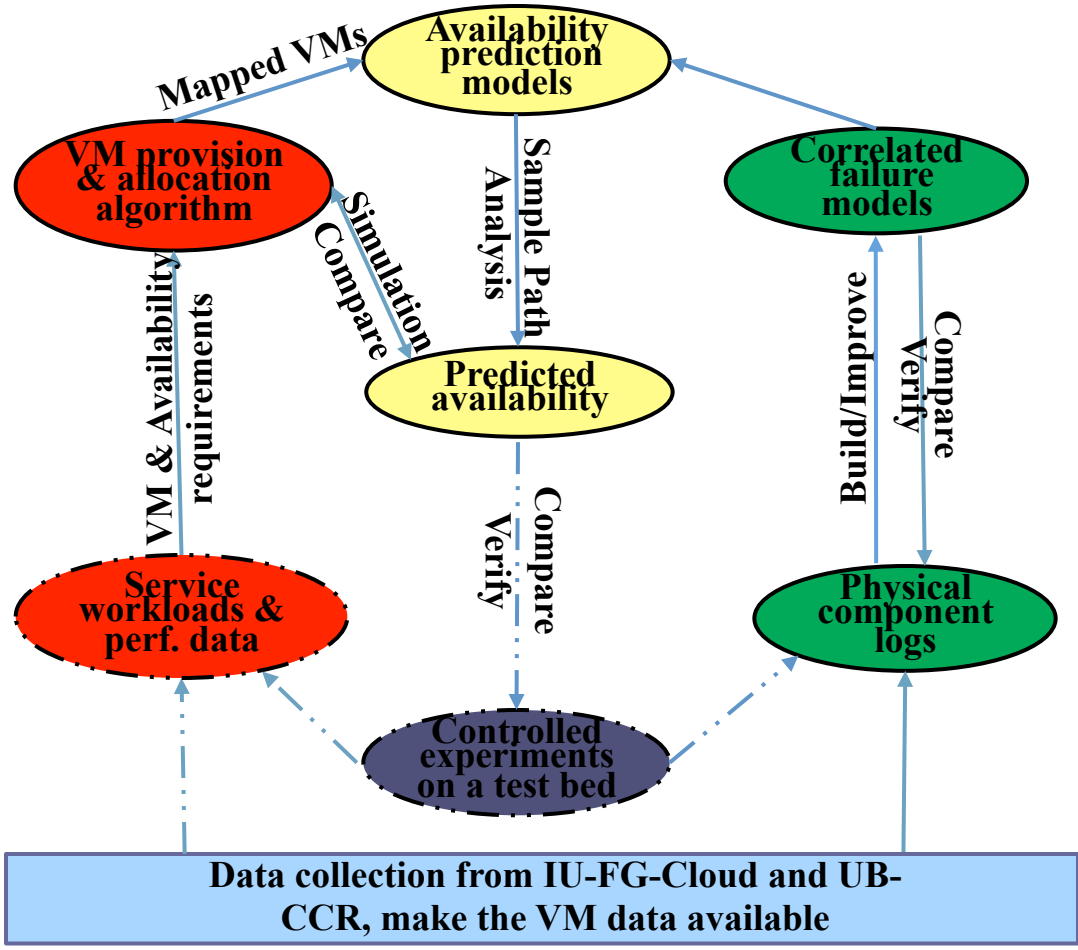
http://www.cse.buffalo.edu/AQUA/index.html

(the scope of the NSF project includes neither the work in the dashed ovals, nor SLA Contract Design)



More Information

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