Lian Cheng & Megh: Introduction to Automated Cloud

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Overview

- Introduction to Clouds
- Lian Cheng
- Megh : Automated Cloud
- Discussion

INTRODUCTION TO CLOUDS

What's the Buzz?

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With Cloud Computing, The Sky's The Limit

William Craig
CONTRIBUTOR
I write about the secret of company culture in entrepreneurial success

There are a lot of technical buzzwords floating around the business world right now, but "cloud" may still be one of the most misund
Technology (NIST), the official

Cloud computing is a model f
configurable computing reso
be rapidly provisioned and r
This cloud model promotes a
models, and four deployment

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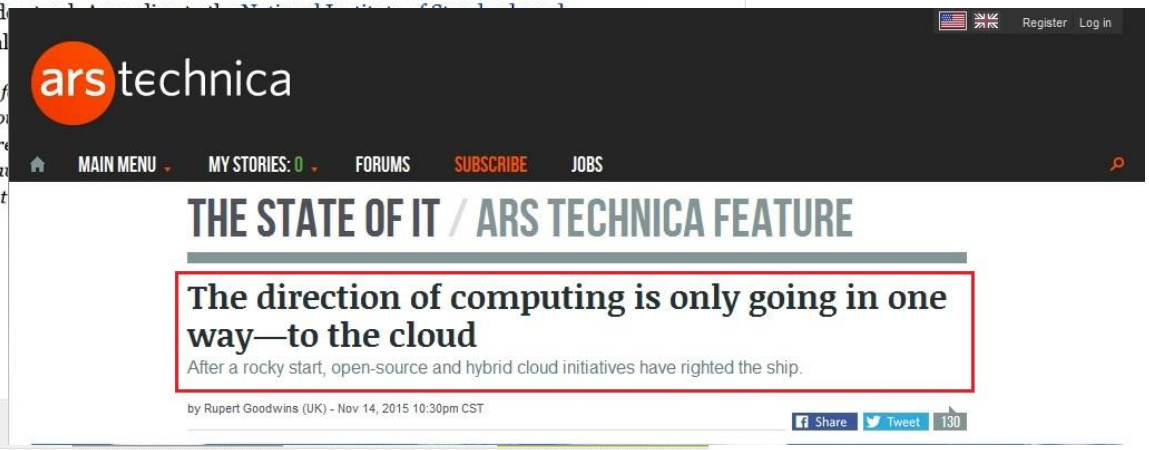

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The direction of computing is only going in one way—to the cloud

After a rocky start, open-source and hybrid cloud initiatives have righted the ship.

by Rupert Goodwins (UK) - Nov 14, 2015 10:30pm CST

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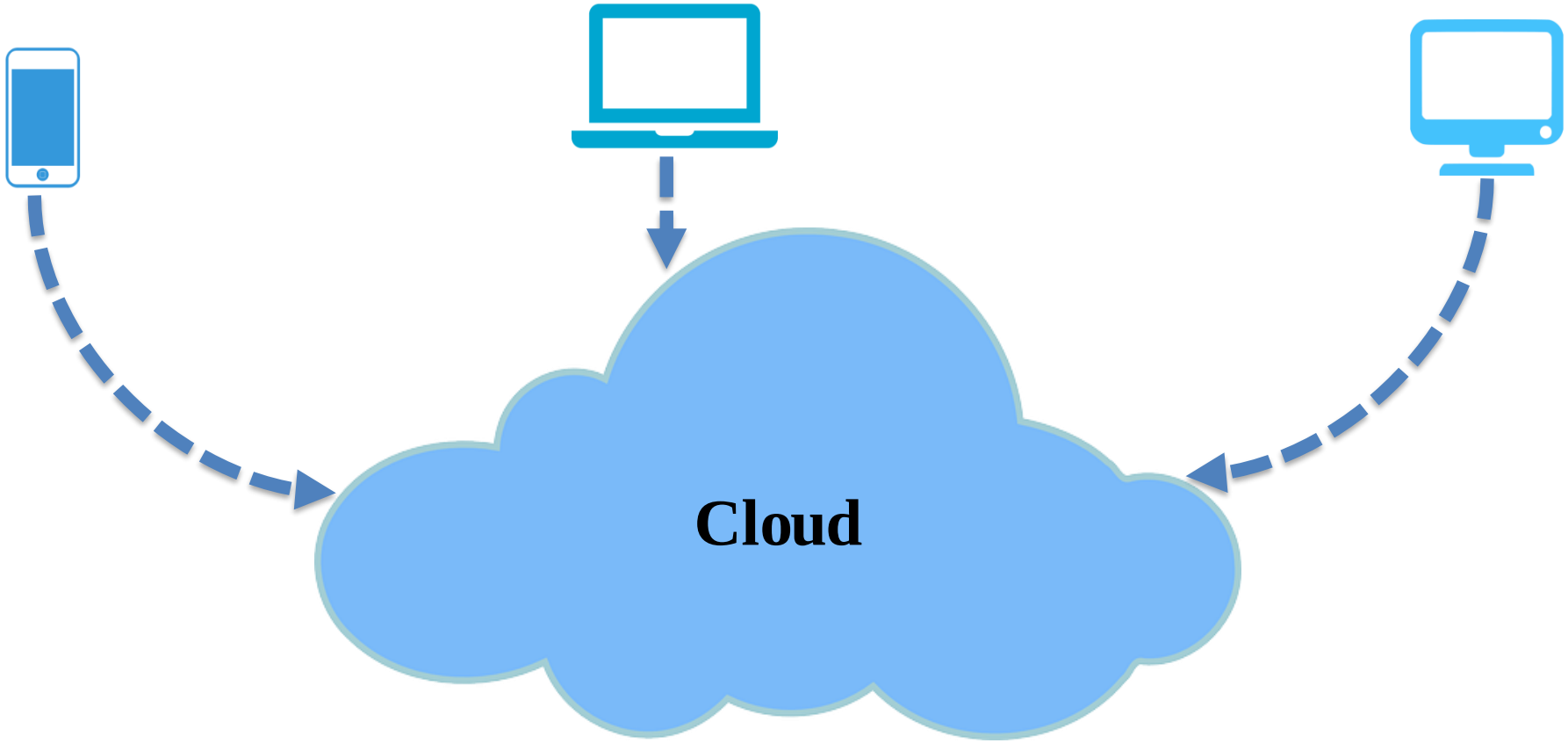
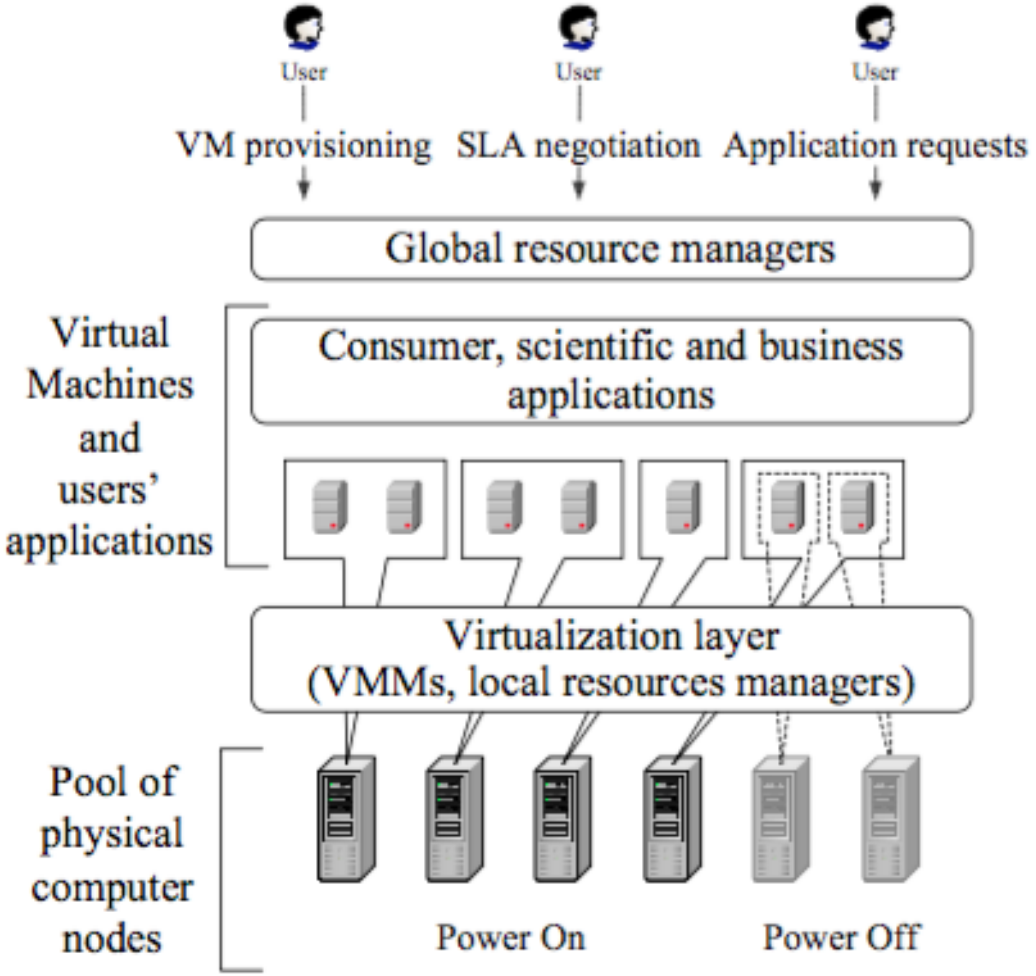
What is Cloud Computing?

- **Cloud computing** is a model that enables *on-demand network access* to a shared *pool of configurable computing resources* (e.g., networks, servers, storage, applications, and services)



What is in there?

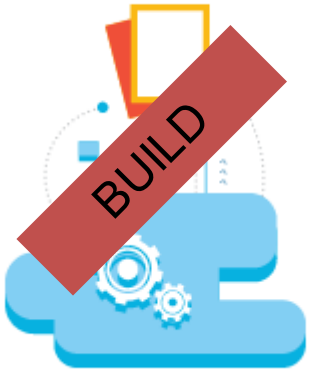


Services

SaaS

Allows users to run their applications to a remote physical machine via internet.

PaaS



Provides hosting OS and optional building block services that allow users to run and build their own tailor-made applications.

IaaS

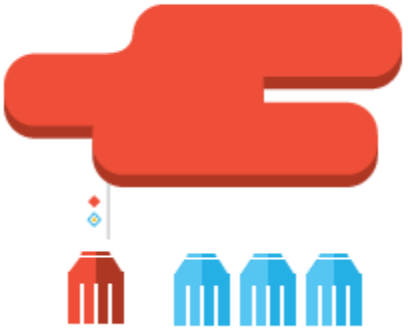
Outsources the computing resources including servers, networking, storage, and data center space on a pay-as-you-go basis.

Location

Public

Allows users to run their applications to a remote physical machine via internet.

Private



Provides hosting OS and optional building block services that allow users to run and build their own tailor-made applications.

Hybrid

Outsources the computing resources including servers, networking, storage, and data center space on a pay-as-you-go basis.

The Contract

- **SLA** (*Service Level Agreement*)
  - Performance objectives
    - Availability
    - Response time
    - Capacity
  - Security objectives
  - Data management objectives

- **SLA violation**
  - Power failure
  - Hardware fault
  - Oversubscription
  - The demand of the CPU performance exceeds the available capacity

Pros

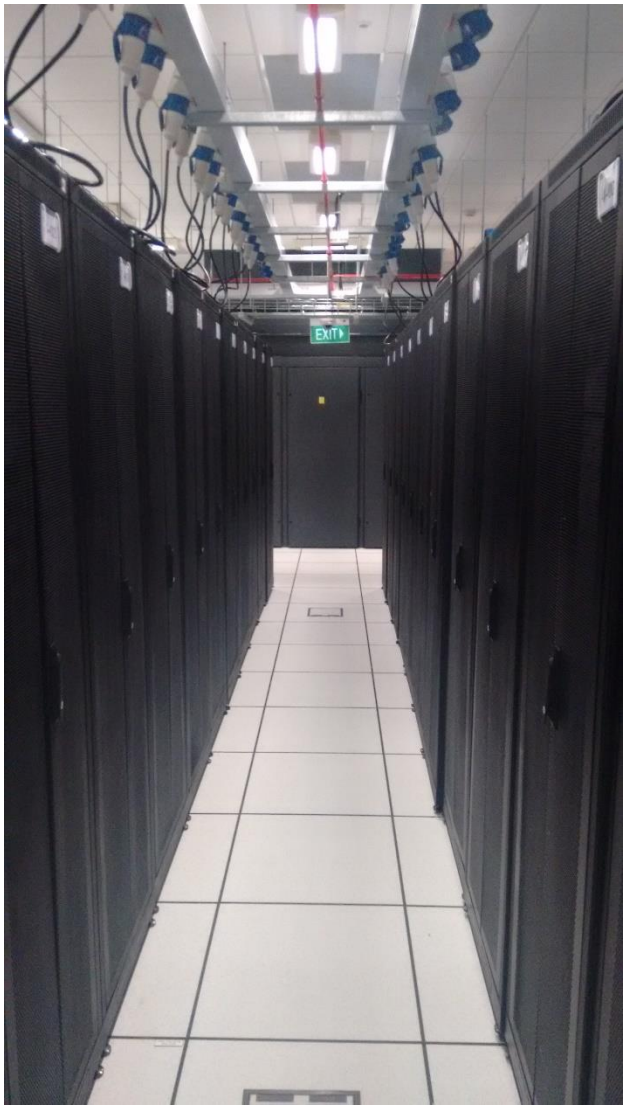
- Agile
- Cheap (Pay-as-you-go)
- Independent of Device and Location
- Scalable
- Flexible
- Low Maintenance

Cons

- Reliability
- Security
- Lock-in to service
- Regulations and legal issues
- Complex interfacing

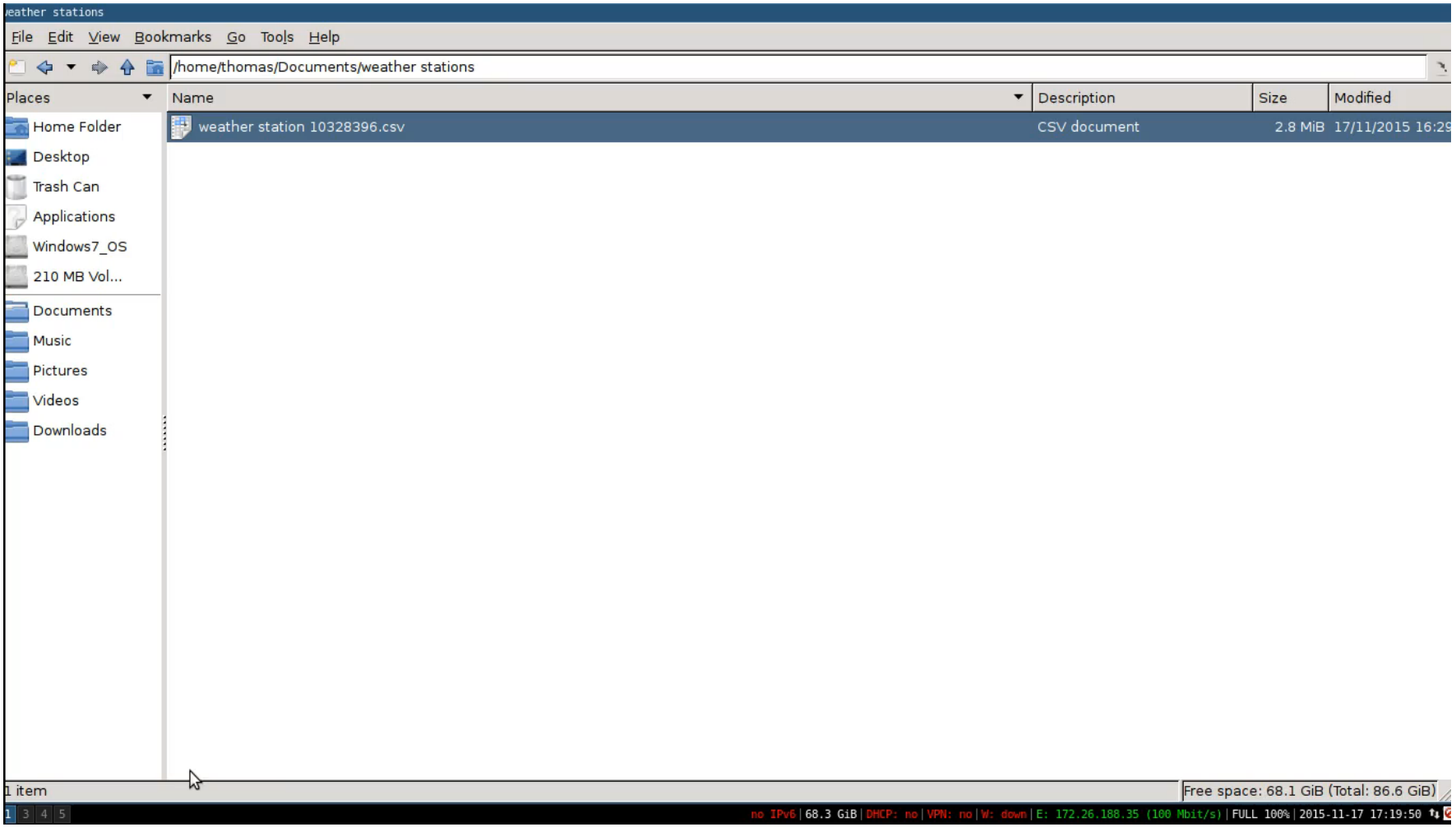
LIAN CHENG

A Glimpse



- Lian Cheng: The cloud deployed by NUS and SJTU
- Features:
  - Open source
  - Hybrid deployment
  - Scientific computing friendly
  - Special workflow structure for queries

Demo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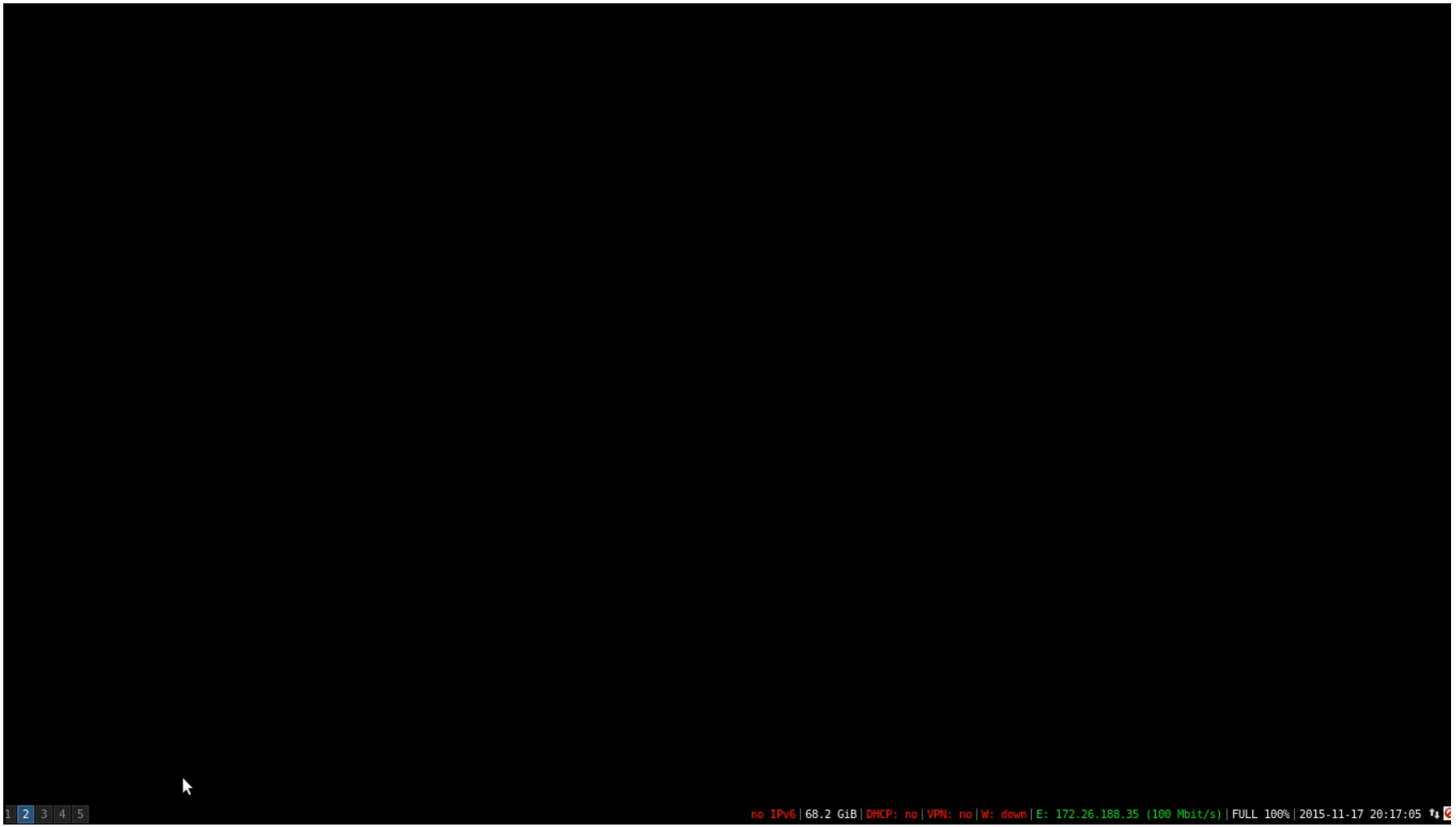
1 item
Free space: 68.1 GiB (Total: 86.6 GiB)
1 3 4 5
no IPv6 | 68.3 GiB | DHCP: no | VPN: no | W: down | E: 172.26.188.35 (100 Mbit/s) | FULL 100% | 2015-11-17 17:19:50

Demo

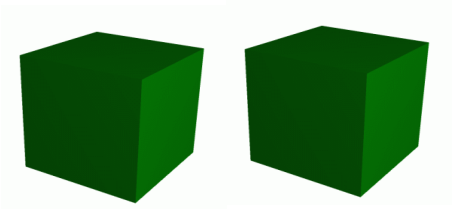

1 2 3 4 5
no IPv6 | 68.2 GiB | DHCP: no | VPN: no | W: down | E: 172.26.188.35 (100 Mbit/s) | FULL 100% | 2015-11-17 20:17:05

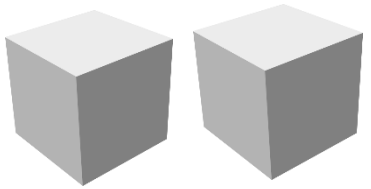
MEGH: AUTOMATED CLOUD

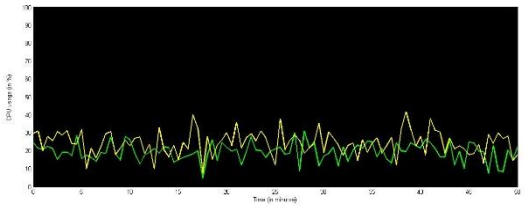
Challenges of Cloud Provider

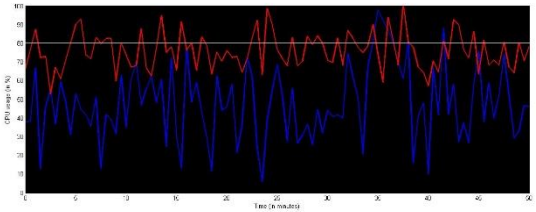
- Managing and scheduling resources
- Satisfying increasing user basis
- Maintaining SLA
- Providing better performance

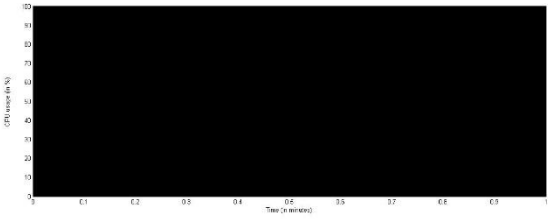
Before Migration



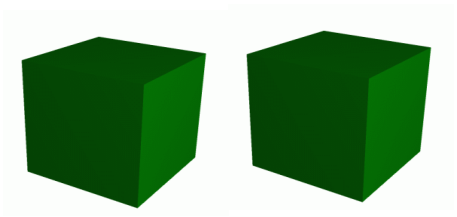


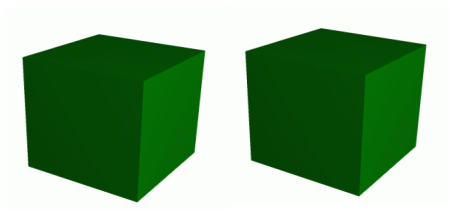


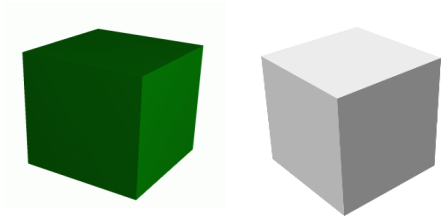


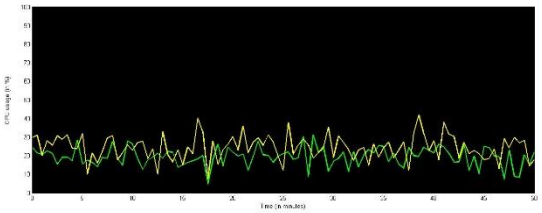


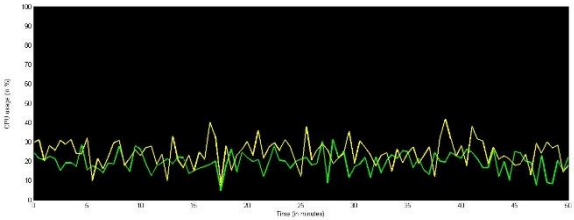
After Migration

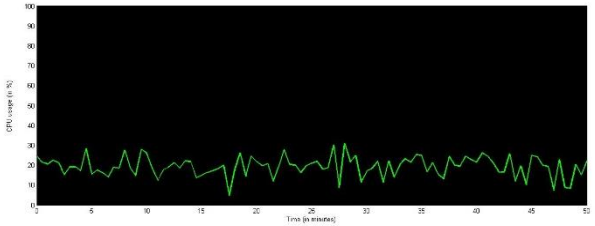












Which VM to move?
When to move?
Where to move?

Issues

- But it takes migration time T_m to move and for that the performance is decremented for down time
- To keep SLA intact, T_d has to be as low as possible
- To eliminate disruption in running applications, its better to start it before the overflow or "LIVE migration" T_d
- Inefficient migration schedule causes higher expenditure of energy consumption

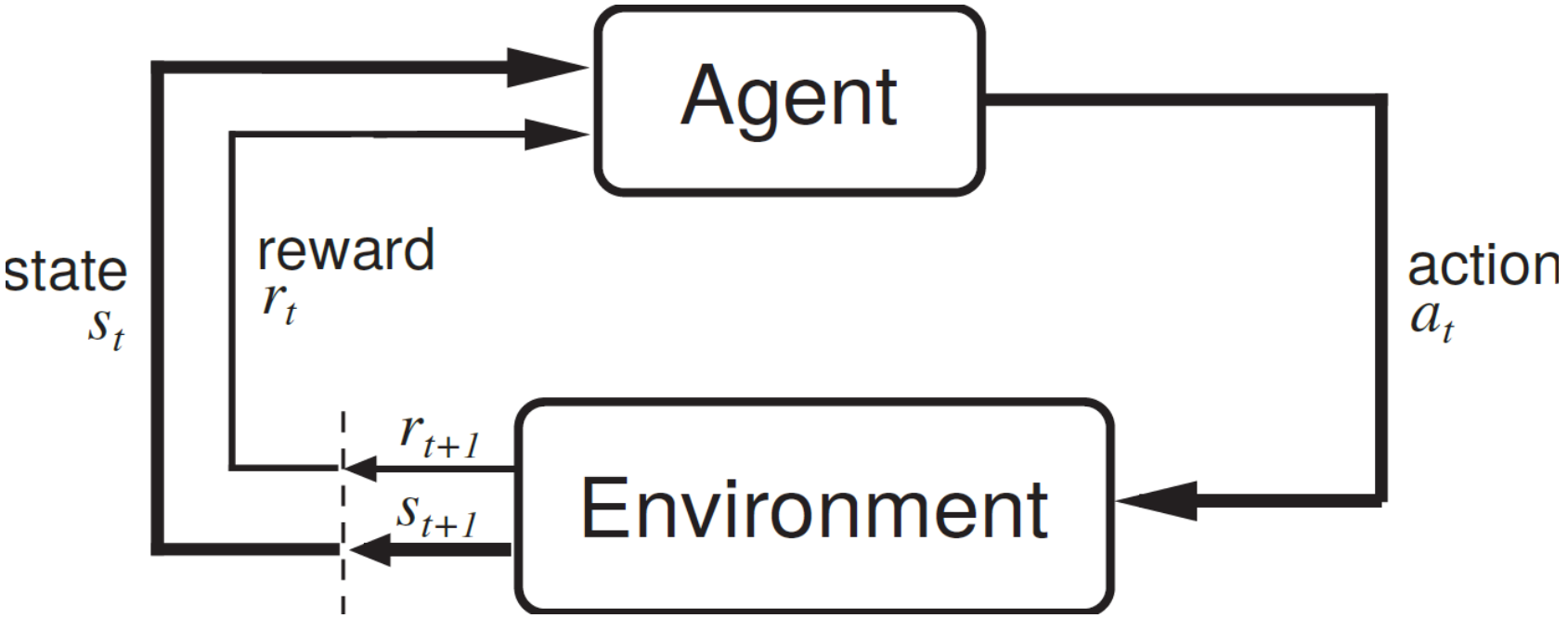
What if the system learns to answer these questions from past experiences?

Megh: Automated Cloud Center

- We propose an automatic live migration strategy that learns from its experience
- The process of *live VM migration* is modelled as a *Markov decision process* (MDP)
- This tries to answer THE *three questions* by optimizing the cost function
- MEGH learns the stochastic nature of workloads to predict optimal schedule of migration

What is Reinforcement Learning?

- RL is more like LIFE!!
  - It is about an agent learning from its environment through interactions

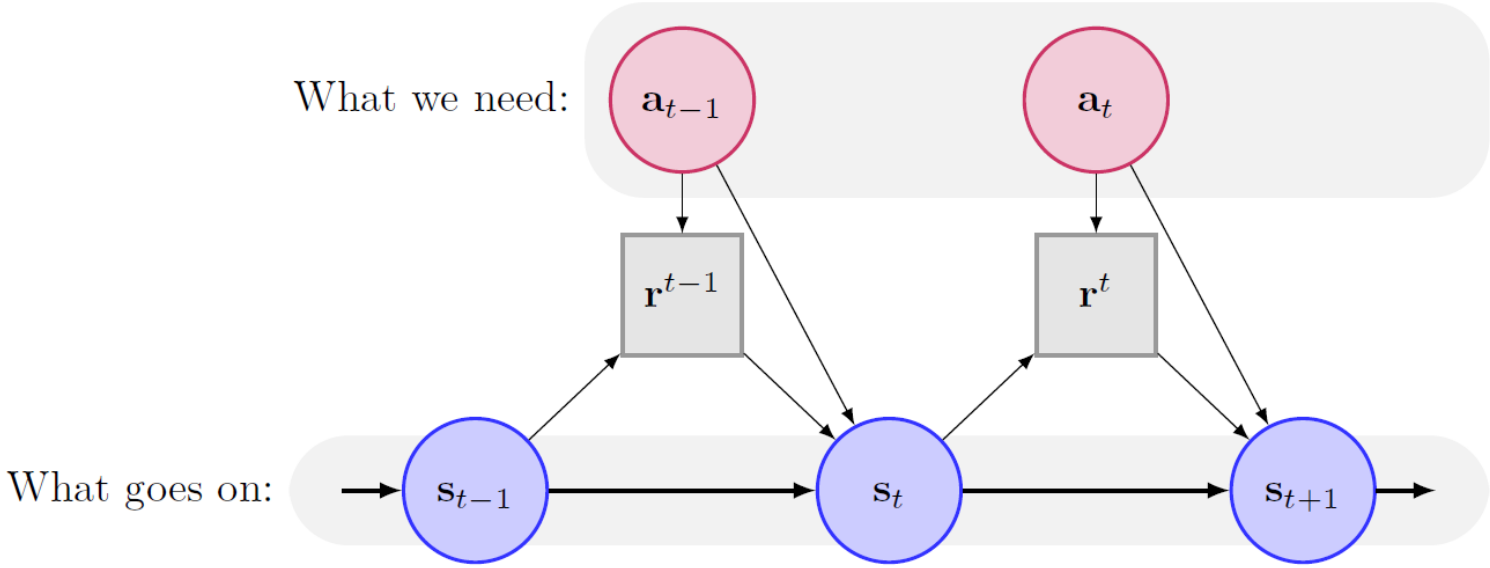


- Components:
  - State
  - Action
  - Reward
  - Utility

Markov Decision Process (MDP)

- **Markov assumption**: The future is independent of the past given the present

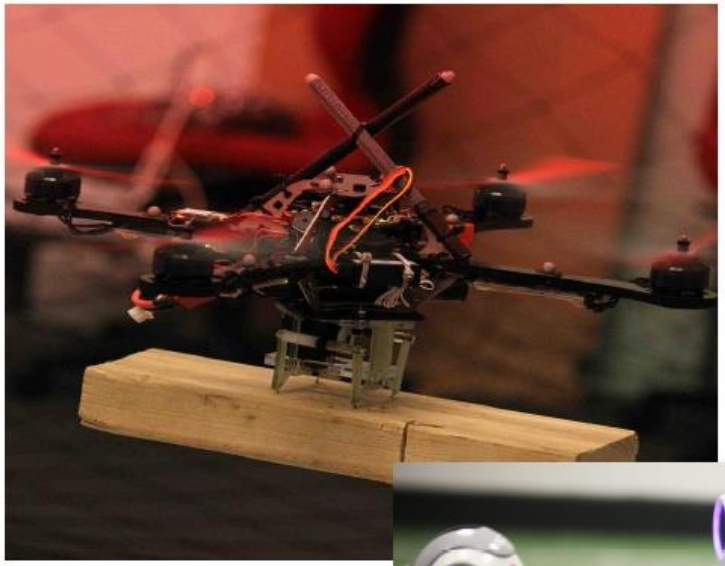
$$\mathbf{P}(s_{t+1} \mid s_t) = \mathbf{P}(s_{t+1} \mid s_0, s_1, ..., s_t)$$



- Using Bellman optimality condition, the **best policy** can be given by

$$\pi^*(s) = \underset{a \in A}{\operatorname{argmax}} \left(R(s,a) + \gamma \sum_{s' \in S} T(s,a,s') V^*(s') \right)$$

Applications of RL



More Applications

CROC: The Hunter

Application in MEGH

- **Model:** MDP
- **State:** VM configurations on physical machines (PMs) of cloud
- **Action:** Configuration changes due to varying workload
- **Penalty function:** Cost of the action

$$\text{Cost}(t) = \int_{\tau=0}^{t} C_p(\tau)\, d\tau + C_v(t)$$

Cost of energy consumption Cost of SLA violation

- **Transition function:** Transition from one state to another on an action. It has to be learned
- **Policy:** A sequence of configuration changes depending on the workloads

A Few Observations

- A basic version of Megh is tested on Cloudsim dataset
- It is converging to give optimal policy before 100 iterations
- The workload variation can be modelled as an exponential family that gives us a sound mathematical structure

DISCUSSIONS

Conclusion

- Features of cloud computing raises it as the “new” paradigm of computing.
- But still there are challenges to solve.
- We are building up Lian Cheng as an open-source cloud system.
- Its unique GUI and workflow makes it user-friendly specially for large query processing.
- The automated system Megh shows an efficient way to provide better performance for this cloud.

Future works

- Providing Lian Cheng as a live cloud service soon.
- Deploying an efficient automated system that learns to handle its workloads and resources by itself.
- Solving more challenges of cloud computing using Lian Cheng.
- Developing reinforcement learning techniques to solve problems from different fields.

Thank you…