Cloud Computing and Cloud Networking

Dr. Adel Nadjaran Toosi
Cloud Computing and Distributed Systems (CLOUDS) Laboratory,
School of Computing and Information Systems
The University of Melbourne, Australia

Email: anadjaran@unimelb.edu.au
Homepage: https://adelnadjarantoosi.info/
Biography

- Research Fellow, *University of Melbourne*, 2015-2018
- I am joining *Monash University* as a Lecturer in May 2018.
- PhD, Computer Science and Software Engineering, 2010-2014
  - CLOUDS lab, Computing and Information Systems, University of Melbourne

Research Interests
- Focused on Resource Provisioning and Scheduling in Distributed Systems

Current Research
- Traffic engineering for energy efficient consolidation of virtual machines in SDN-enabled clouds
Agenda

■ What is cloud computing?
■ Inside a cloud data centre
■ Cloud networking
■ Demo
■ Conclusion
What is cloud computing?

- An IT paradigm that enables access to shared pools of configurable system resources in form of services that can be rapidly provisioned with minimal management effort, often over the Internet.
  - Allowing businesses to outsource their IT facilities to cloud providers
  - Avoid expensive up-front investments of establishing their own infrastructure
Essential characteristics

On-demand delivery of IT services
- Get more (or less) resources when you want, without interacting with other people

Broad network access
- Everything happens via the Internet

Resource pooling
- Huge amount of resources that are assigned to different users at different times

Rapid elasticity
- Get more (or less) resources in seconds

Measured service
- Long-held dream of computing as a utility
- Customers pay for what they use
Why Clouds?

- **Classical Computing**
  - Buy & Own
    - Hardware,
    - System Software,
    - Applications often to meet peak needs.
    - Install, Configure, Test, Verify
    - Manage
    - ...
    - Finally, use it
    - $$$$. . . .$(High CapEx)

- **Cloud Computing**
  - Subscribe
  - Use
    - Automation and reusable components
  - Pay for what you use, no upfront investment
Cloud Services

**Infrastructure as a Service**
- Choose number of virtual machines, operating system, memory, cores, and storage
- Install and configure all the software you want, as if it was a new server you just bought
- Don’t worry in finding where to put the servers, in installing air cons and fixing the hardware when it breaks

**Platform as a Service**
- Develop an app, and submit the code to the cloud, which deploys it
- Don’t worry about configuring Apache, Tomcat, Memcache, etc.
- Don’t worry in growing the infrastructure if your app becomes popular

**Software as a Service**
- Just use the application on line
- Don’t worry buying a license, installing, configuring, and updating the apps
Deployment Models

- Public/Internet Clouds
- Private/Enterprise Clouds
- Hybrid/Mixed Clouds
Popular Cases

Public Cloud Providers

- Amazon Web Services
- Google Cloud Platform
- Microsoft Azure

Aggregators

- Right Scale
- Telstra

Users

- Netflix (uses AWS)
- Snapchat (uses Google)
- Dropbox (used to be using AWS)
- AccuWeather (uses Azure)
Inside a cloud data centre

http://bcsocialcredit.com/server-schrank/tolle-server-schrank-cropped-serverschrank/
Google's Oklahoma Data Center
More...
Cloud networking
- Massive size: tens of thousands of hosts + thousands of switches
- Specialized hardware (middleboxes) implementing networking functions
  - NAT, load balancing, WAN optimization, firewall...
- Specialized communication protocols for top tiers
- Communication patterns between hosts change frequently
Software-Defined Networking

- Separation of control plane from data forwarding plane
- Platform is decoupled from infrastructure
- Centralized controller, network-wide control by controller SW that performs routing and traffic engineering

**Traditional Networking**

- Control Plane
- Data Forwarding Plane

**Software-Defined Networking**

- Controller Software
- Control Protocol

Credit: Jungmin Son
Benefits

- Enables dynamic configuration of networking
- Real-time responsiveness to traffic demands
- Programmable network
- Load balancing by network
- Open opportunities for innovation
- OpenFlow
  - De facto standard interface for SDN controllers
  - Describes an open interaction protocol in SDN that allows the controller to communicate with the forwarding plane
Network Function Virtualization (NFV)

- Migration of network functions to the software layer
- Enables better interoperability of equipments and more advanced network functions
- Virtualized Network Function (VNF)
  - deployable elements of NFV
Cloud Computing in 5 minutes

https://www.youtube.com/watch?v=QJncFirhjPg
Demo

- **Nectar Cloud**
  - provides cloud computing services to Australian researchers

- **Virtual Machine**
  - is an operating system (OS) or application environment that is installed on software, which imitates dedicated hardware.
  - The end user has the same experience on a virtual machine as they would have on dedicated hardware.

- **Web Server**
Conclusion

- New business model for ICT services
- The core of the cloud are data centres with thousands of hosts and network devices
- Advances in the technology are enabling software-defined networks and virtualization of networking functions
THANK YOU

Questions?