Cloud Computing and Cloud Networking

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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
  - Thesis: "*On the Economics of Infrastructure as a Service Cloud Providers: Pricing, Markets, and Profit Maximization*"
- Research Interests
  - Cloud Computing, Software-Defined Networking (SDN), Energy Efficiency and Green Computing, Soft Computing and Machine Learning
  - 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 <u>shared pools</u> of configurable system resources in form of <u>services</u> that can be rapidly provisioned with minimal management effort, often over the <u>Internet.</u>

- – 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?

Every 18 months?

- **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
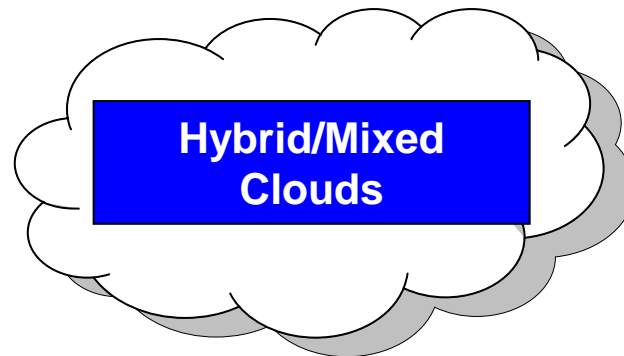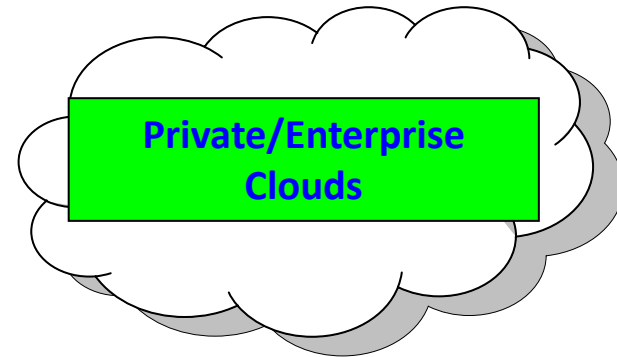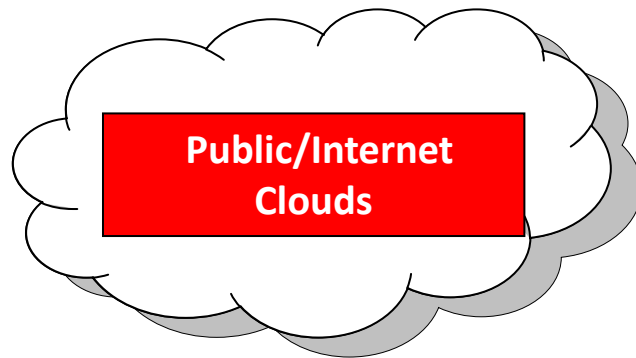
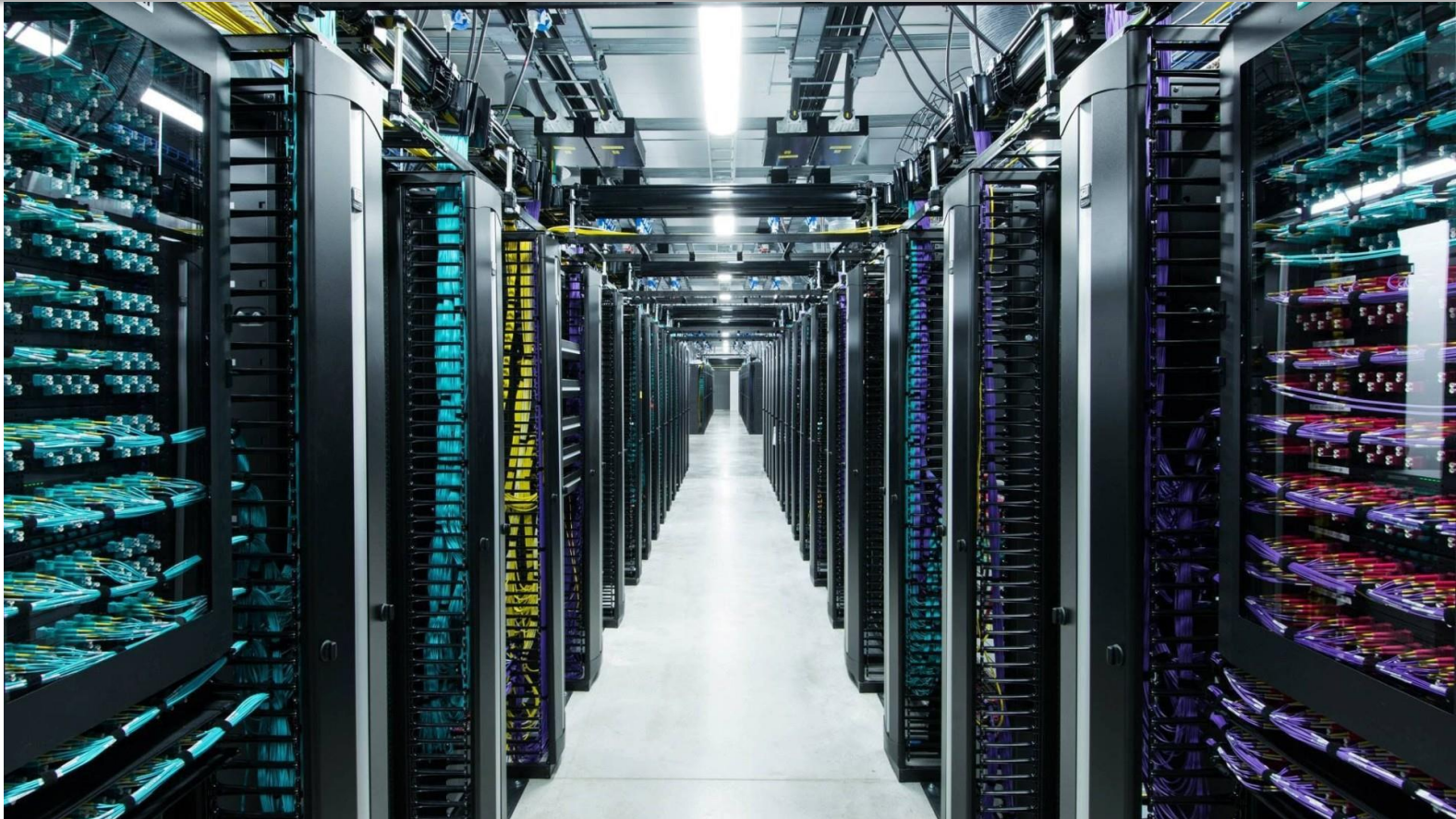# Popular Cases

Public Cloud Providers

Aggregators

Users

- Netflix (uses AWS)
- Snapchat (uses Google)
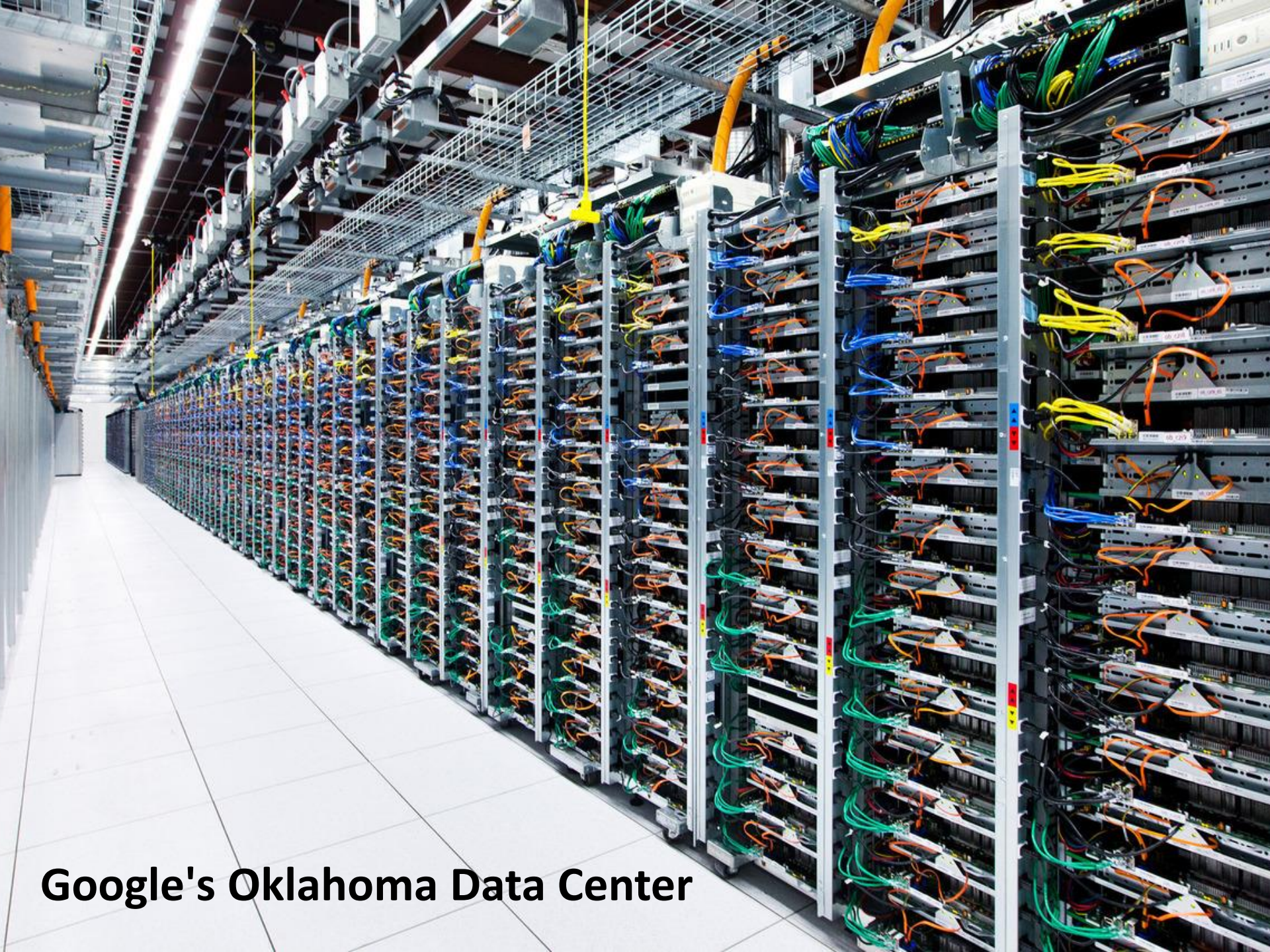- Dropbox (used to be using AWS)
- AccuWeather (uses Azure)

Inside a cloud data centre

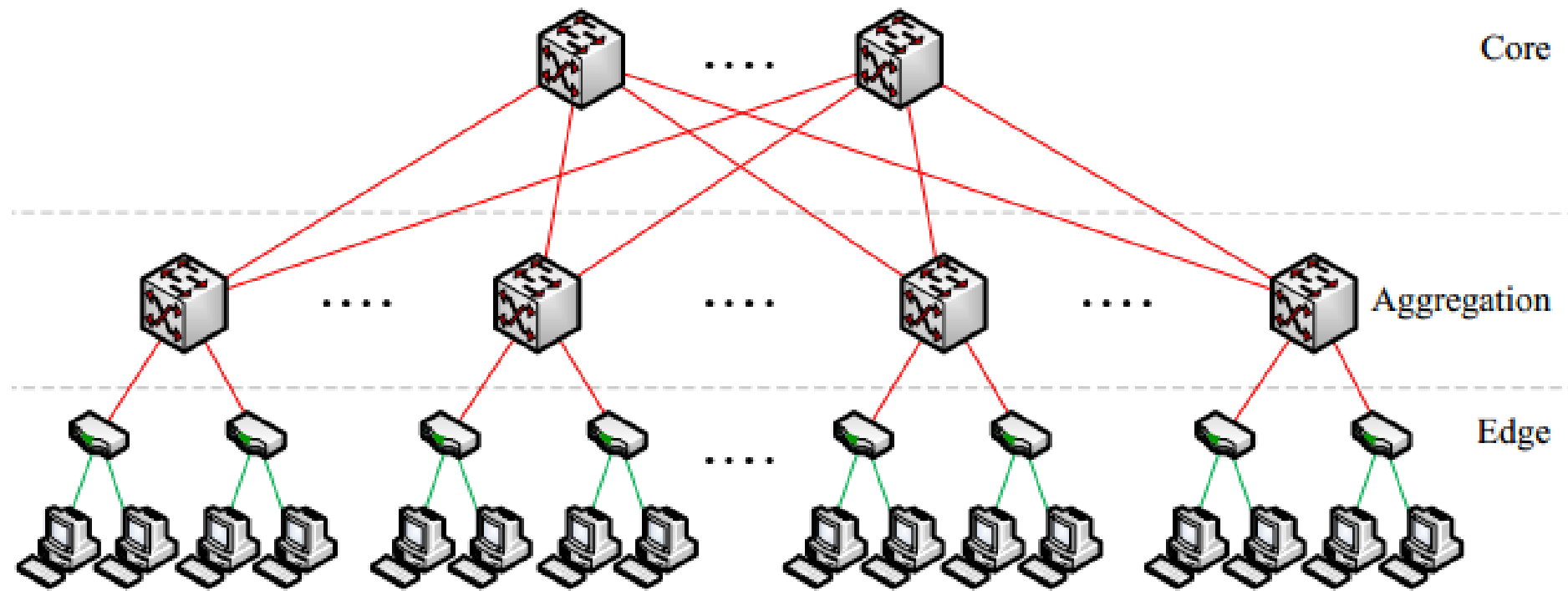http://bcsocialcredit.com/server-schrank/tolle-server-schrank-cropped-serverschrank/

Google's Oklahoma Data Center

More...

Cloud networking

Core

Aggregation

Edge

- 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

Software-Defined Networking

Control Plane

Data Forwarding Plane

Controller Software

Control Protocol
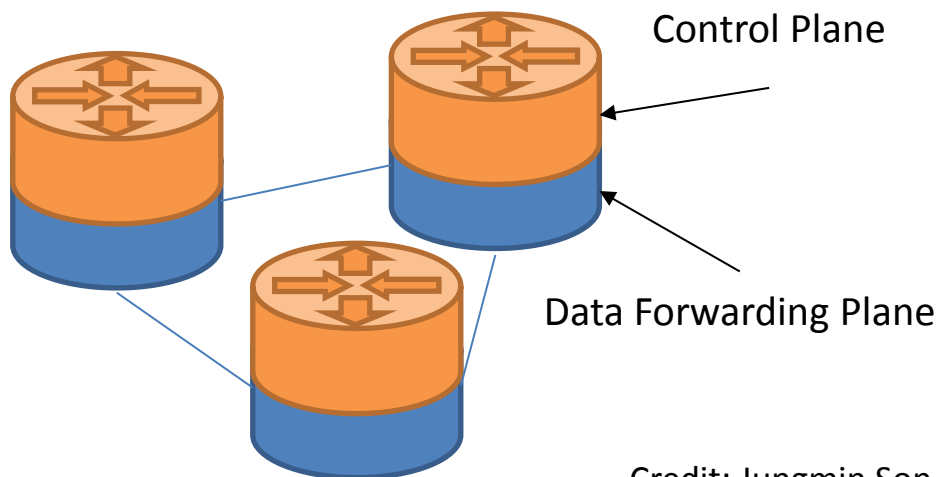
Credit: Jungmin Son
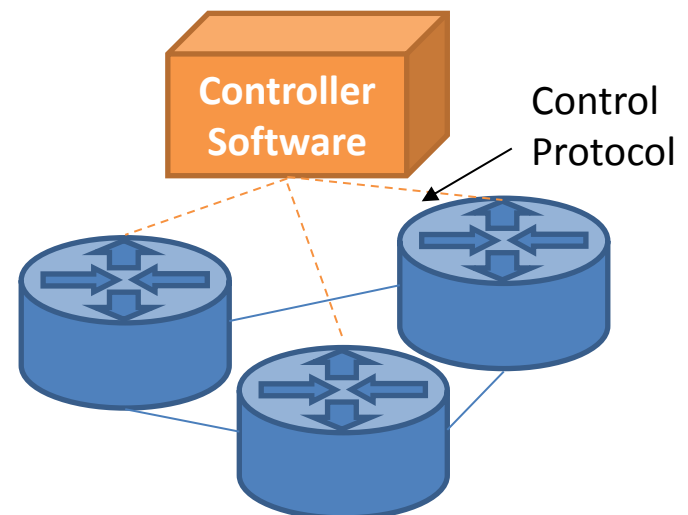
Benefits

- 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?