



Infrastructure as a Service (IaaS)

COSC349—Cloud Computing Architecture

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Learning objectives

- Define **IaaS**
- Give examples of **public IaaS providers**
- Explain benefits and challenges using IaaS
- Describe how IaaS is usually **charged for**
- Sketch how VM **spot pricing** helps clients and providers
- Understand the core components required to be provided by an IaaS platform such as **OpenStack**

Infrastructure as a Service (IaaS)

- The name does a good job of indicating purpose:
 - Infrastructure is in the sense of **physical server hardware**
 - ... but this hardware will instead be **virtualised as a service**
- Computing infrastructure is the typical IaaS commodity
 - **Networking** will also need to be configured to reach VMs
 - **Storage** is typically provided in multiple ways:
 - An image store allows installation of OSs from an existing pool
 - Some means to allow VMs' data to be read and written

Popular IaaS offerings in the public cloud

- Gartner report includes 2018 IaaS market shares:
 - 47.8%—Amazon Elastic Compute Cloud (EC2)
 - 15.5%—Microsoft Azure
 - 7.7%—Alibaba
 - 4.0%—Google
 - 1.8%—IBM
- Top-5 cover over three-quarters of total market share
 - Also, Amazon's lead is rather significant

Advantages of IaaS over other models

- IaaS tenants have the greatest **power and flexibility**
 - Anything that can run virtualised can probably be deployed
- **Low levels of lock-in** to any given provider
 - Typical VM resources are largely interchangeable
 - e.g., VM images can be moved from EC2 to/from local VirtualBox
 - Amazon Linux 2 is available as a public download
- You can ensure you have high **Quality of Service** (\$\$\$)

Downsides of IaaS

- Lots of deployment work is necessary before any application code can actually be run—**slow start-up**
 - You need to install your own operating system
 - Also, you need to keep your own operating system updated
 - VMs need to have disks, *etc.*, provisioned
- All **infrastructure management** is up to you
 - Increasingly fiddly to scale up to multiple machines
 - You can build web application load-balancers, *etc.*, but the cloud already has them now, so you will be duplicating effort

Charging—what do you pay for in IaaS?

- CPU-wise, your use is **opaque to cloud provider**
 - Typically rate for “size” of VM: core count; RAM; *etc.*
 - Then multiply by the amount of time VM is “on”
 - Often **pay by hour units**, but AWS has per-second Linux billing
- Other resources that are likely to be charged for:
 - **Network traffic** to/from Internet & across regions
 - Amazon EC2 doesn't charge inwards from Internet
 - **Block storage and snapshots**
 - Additional **public IP addresses** for your VMs

Amazon EC2 instance types

- At launch EC2 had a one-size-fits-all approach to VMs
- 2007-10-16: EC2 adds two instance types, to give us:
 - Small, medium and large
- 2019-08-01: More than 182 instance types...
- Classifications include
 - General purpose—balance CPU, RAM, storage
 - Compute optimised, Memory optimised, Storage optimised
 - Accelerated—GPGPUs and FPGAs
 - (Bare metal instance types were not included)

Amazon's VM spot pricing

- Computers don't wear down proportionally to their use
 - Thus cloud providers have incentive to **ensure high utilisation**
 - However, they need to ensure they don't violate guarantees
 - *i.e.*, claiming CPU allocations are available when they aren't
- Amazon address this (in part) using **spot pricing**
 - Heavily discounted prices on VMs... but with a catch:
 - The VMs **can be terminated** with two minutes' notice
 - You choose: hibernate; stop or terminate your VM
- AWS also discounts long-term use—**Reserved Instances**

“Local” IaaS options: Catalyst Cloud

- IaaS platforms exist within New Zealand—ideal when:
 - **data sovereignty** is a concern
 - **fast network response** times for NZ clients is crucial
- Catalyst Cloud—<https://catalystcloud.nz/>
 - Three regions within NZ (~AWS Availability Zones)
 - Likely more expensive than AWS, etc., but price isn't everything
 - Provide free credit for trying out their services
- Catalyst are great promoters of open source software
- Spark & others offer IaaS with NZ too... **soon Microsoft!**

How do you run an IaaS cloud?

- Unlikely something that you will start doing lightly...
 - However hybrid and private cloud models require **local clouds**
- Organisations like telcos have large data centres
 - Increasingly software for those organisations will be virtualised
 - Thus offering cloud services is about **management and billing**
- Existing enterprise virtualisation platforms now do cloud
 - e.g. VMware provides tools for managing fleets of VM hosts
- Numerous open source products such as **OpenStack**
 - Key is the effecting **delegated administration**—i.e., self-service

OpenStack has many components

- (Taxonomy is mine!)
- Core VM support
 - Compute (Nova)
 - Networking (Neutron)
 - Block storage (Cinder)
 - Image (Glance)
- Management
 - Identity (Keystone)
 - Dashboard (Horizon)
 - Orchestration (Heat)
- Workflow (Mistral)
- Telemetry (Ceilometer)
- Messaging (Zaqar)
- DNS (Designate)
- Search (Searchlight)
- Key manager (Barbican)
- Container orchestration (Magnum)
- Root Cause Analysis (Vitrage)
- Rule-based alarm actions (Aodh)
- Cloud Services
 - Object storage (Swift)
 - Database (Trove)
 - Elastic map reduce (Sahara)
 - Bare metal (Ironic)
 - Shared file system (Manila)