

Infrastructure as a Service (IaaS)

COSC349—Cloud Computing Architecture David Eyers

Learning objectives

- Define **laas**
- Give examples of public laas providers
- Explain benefits and challenges using laas
- Describe how laas is usually charged for
- Understand the core components required to be provided by an laaS platform such as **OpenStack**

Sketch how VM spot pricing helps clients and providers





Infrastructure as a Service (IaaS)

- Infrastructure as in physical hardware ...but with hardware virtualised as a service
- Computing is typical laas commodity
 - Networking also needed to reach VMs
 - Storage typically provided in multiple ways:
 - Install OSs from existing templates
 - Means for VMs' data to be read & written



Popular IaaS offerings in the public cloud

- Gartner report includes 2023 laaS market shares:
 - 39.0%—Amazon Elastic Compute Cloud (EC2)
 - 23.0%—Microsoft Azure
 - 8.2%—**Google**
 - 7.9%—**Alibaba**
 - 4.3%—Huawei
 - 17.6%—others

COSC349 Lecture 9, 2024—<u>Gartner report states laaS revenue grew 16.2% in 2023</u>

Top-5 cover over three-quarters of total market share Also, Amazon's lead is significant (but slowly diminishing)



Advantages of IaaS over other models

 laaS 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 2023 is available as a public download

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You can ensure you have high Quality of Service (\$\$\$)



Downsides of IaaS

- Lots of deployment work is necessary before any
 - You need to select the operating system you will use
 - VMs need to have disks, etc., provisioned

All infrastructure management is up to you

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application code can actually be run—slow start-up Also, you must keep your operating system updated (i.e., secure!)

 You manage scaling up your apps over multiple machines You can build web application load-balancers, etc., but the cloud already has them now, so you will be duplicating effort

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Charging—what do you pay for in IaaS?

- CPU-wise, your use is opaque to cloud provider

 - Then multiply by the amount of time VM is 'powered on'
- Other resources that are likely to be charged for:
 - Network traffic to/from Internet & across regions

 - Additional public IP addresses for your VMs

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• Typically rate for 'size' of VM: number of CPU cores; RAM; etc. Often pay by hour units, but AWS has per-second Linux billing

 Amazon EC2 doesn't charge inwards from Internet (... lock-in risk?) Block storage & snapshots—charged regardless of VM on or off



Amazon EC2 instance types

- At launch EC2 had a one-size-fits-all approach to VMs • 2007-10-16: EC2 gives choice: small, medium & large • 2020-08-06: At least **298** instance types

 - 2021-06-29: Nearly **400** instance types
- Classifications include
 - General purpose—balance CPU, RAM, storage Compute optimised, Memory optimised, Storage optimised Accelerated—GPGPUs, HPC and FPGAs (Bare metal instance types were not included)
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Amazon's VM spot pricing

- Amazon address this (in part) using spot pricing Heavily discounted prices on VMs... but these VMs can be **terminated** with just two minutes' notice!
 - - You choose: hibernate; stop or terminate your VM

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 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

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—<u>https://catalystcloud.nz/</u>
 - 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

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Spark & others offer laaS within NZ... soon(?) MS+AWS...



How do you run an IaaS cloud?

- 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

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FYI: 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

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- Rule-based alarm actions: Aodh
- Cloud Services
 - Object storage:
 Swift
 - Database: Trove
 - Elastic map reduce: Sahara
 - Bare metal: Ironic
 - Shared file system: Manila

