Cloud Computing Environments and Technologies

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There are many vendors offering Cloud based services

- Each offers different services
- Each offers a different level of architectural abstraction
- Each offers different development tools and environments

We will look at three leading vendors in the current market representing a good spread of the different approaches to Cloud computing

- Amazon AWS
- Google AppEngine
- Microsoft Azure

Amazon AWS Introduction

Amazon Web Services (AWS):

- Offers IaaS services to developers and end users
- Includes both "traditional" Cloud services as well as more tailored solutions
- Compute services
- Storage services
- Web hosting services
- Workflow services
- Provides a range of tools to aid the developer
- Transparent charging model
- AWS API is becoming a popular standard for tool design and implementation of IaaS based applications
- Offers SLAs for its services, and differentiates price on availability promises (99.99% vs. 99.999999999% availability)

Amazon AWS Introduction

- Multiple Availability Zones like US-west, Asia-Pacific, Europe, US- East
- Redundancy — Enhanced Availability
- Global presence
- Redundancy protects against Resource Failure; every S3 object has three copies, each stored on an individual machine.
- AWS Queue service spreads user queues across multiple machines, using redundancy to maintain availability.

Geographic Distribution Protects Against Infrastructure Failure- Every region has at least two availability zones, i.e. separate data centres, to provide higher-level redundancy for applications; zones are located far enough apart to be resistant to natural disasters

Amazon AWS Introduction

- Monitoring Prevents Problems — CloudWatch: (how to know when the formerly neat-and-tidy redundant application is no longer so because of failure?) You can set up CloudWatch to monitor many AWS resources, including EC2 instances, EBS volumes, SQS queues, and more
- Simple Notification Service (SNS): Can deliver alerts to you via e-mail, SMS, HTTP
- Web service that can publish messages from an application and deliver them to other applications or to subscribers. SNS provides a method for triggering actions, allowing clients or applications to subscribe to information (like RSS), or polling for new or changed information or perform updates.

Amazon AWS Introduction

Amazon's view:

- No Capital expenditure
- Pay as you go
- Pay only for what you need
- Elastic capacity
- Faster time to market
- Focus on your business

AWS provides the ultimate do-it-yourself solution. They provide the hardware, and the storage, and not much else. You build your stack from the ground up, maintain it, upgrade it, and so forth. Your app scales if and only if you write it to scale, which is no small challenge. But, you get complete control over your hardware.

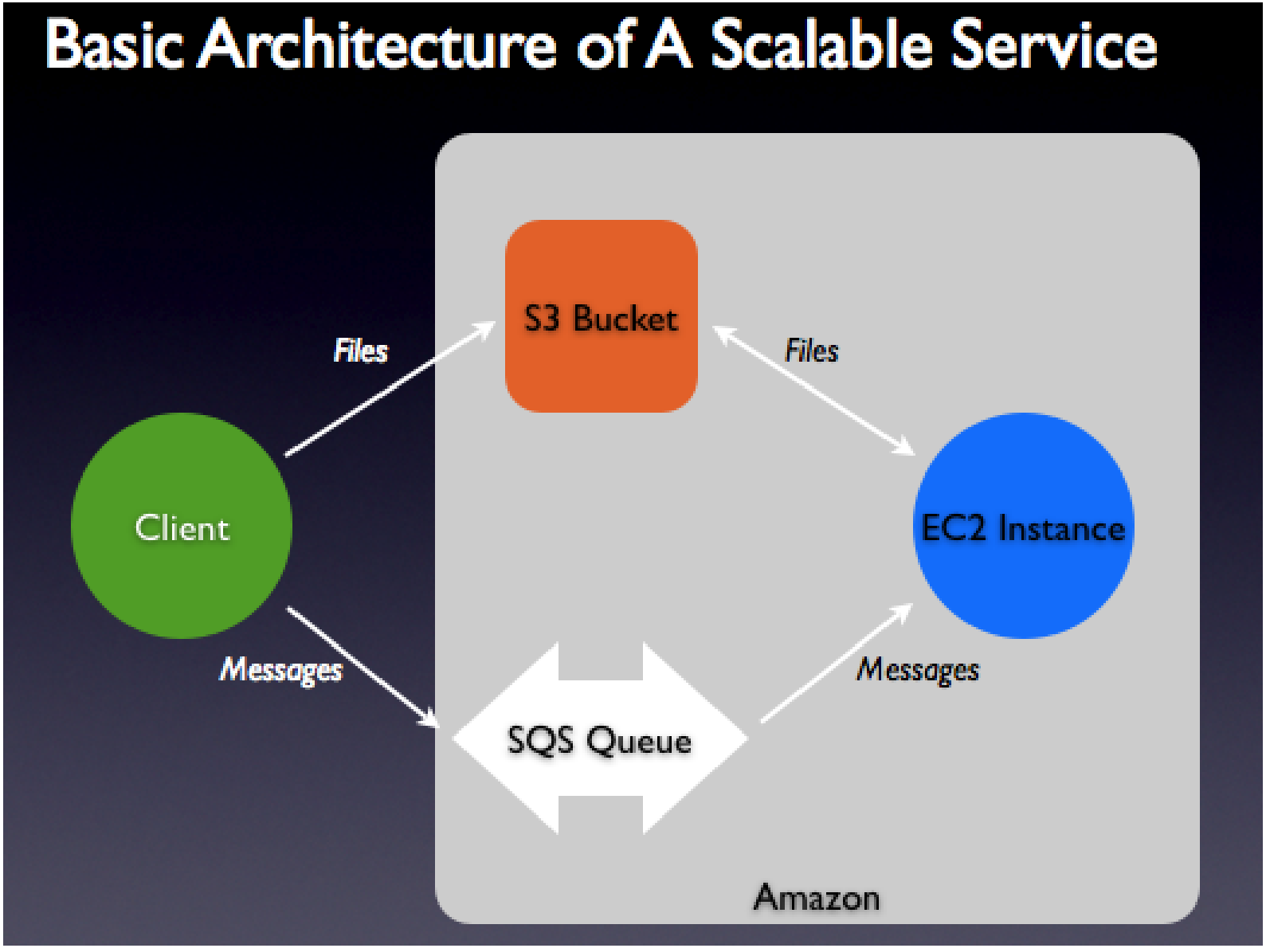
Amazon Web Services

Collection of Cloud Offerings (mostly IaaS):

- Elastic Compute Cloud (EC2);
- Elastic Map Reduce;
- Auto Scaling;
- SimpleDB: Big Table like NoSQL database;
- Simple Queue Service (SQS)
- Simple Notification Service (SNS)
- Simple Email Service (SES)
- Virtual Private Cloud (VPC)
- Simple Storage Service (S3)
- Elastic Block Storage (EBS)
- ElastiCache;

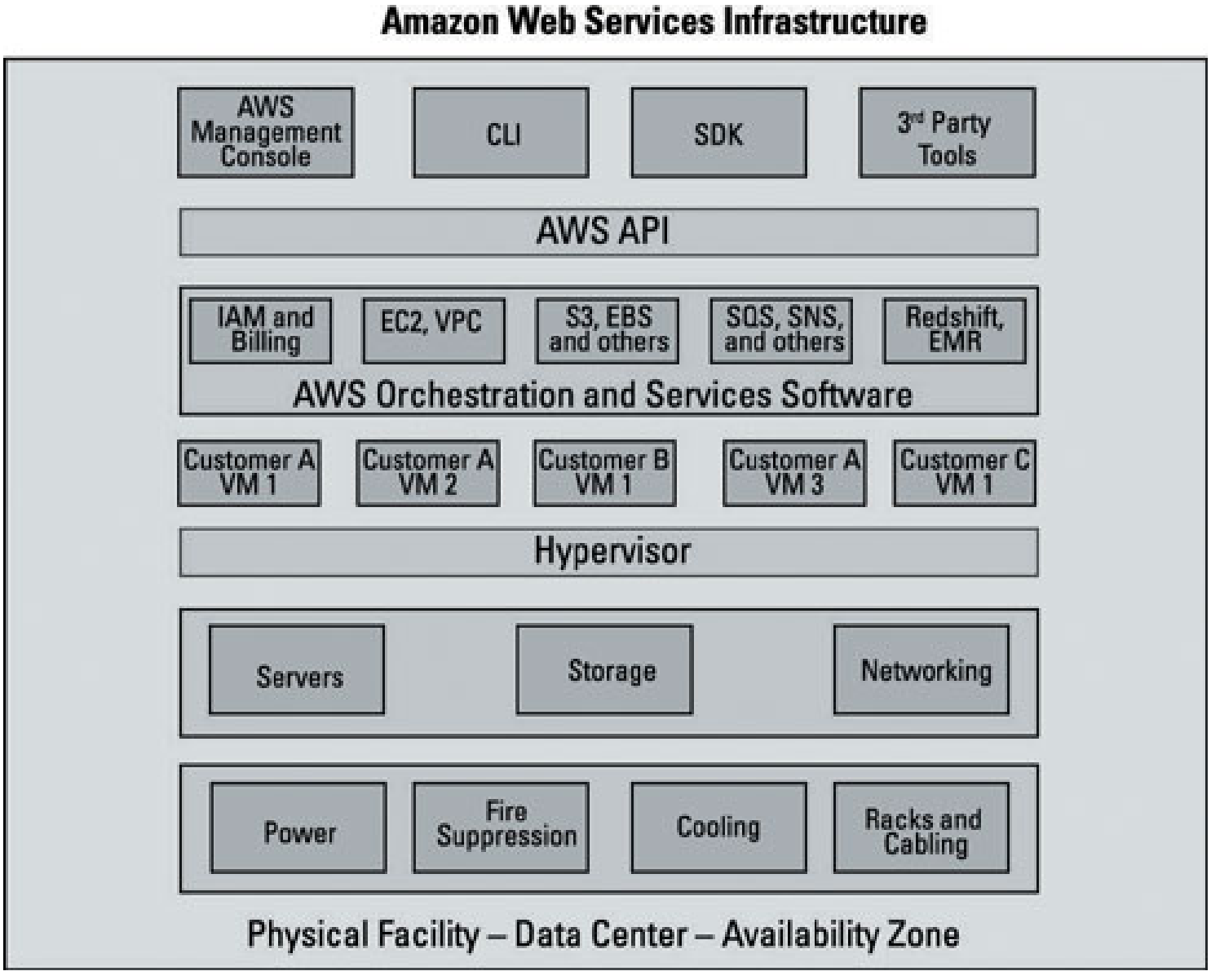
plus 3rd party offerings for MongoDB and CouchDB.

Amazon AWS



http://aws.amazon.com/articles/Python/691

Amazon AWS API



http://www.dummies.com/how-to/content/the-amazon-web-services-api-in-real-world-use.html{}

Amazon AWS API

AWS API Interaction mechanisms:

AWS management console: graphical web interface

- allows you to interact with service (and your own) computing resources.
- The primary mechanism used to operate AWS.

CLI/SDK

- For s/w engineers who write applications that need to interact with AWS services directly
- offers a simpler programmatic interface to the set of functions that do the heavy lifting of interacting with the AWS API.

Third Party Tools

- May extend or simplify AWS; or offer new functionality; or load testing services

AWS storage services

Simple Storage Service (S3): Highly scalable object storage in the form of unstructured collections of bits

- Host binary data (files, images, videos, etc.)
- Accessible through the web with or without authentication

Provides a simple web service interface that can be used to store and retrieve objects from anywhere on the web; Also offers Data Encryption at Server-Side and Client-Side.
Can be used to store any type of data– websites images, logs, etc; Storage containers are referred to as buckets (named), like a directory

AWS storage services

Using S3 Web API, you can:

- Create, edit, or delete existing S3 buckets
- Upload new objects to a bucket and download them
- Search for and find objects and buckets
- Find metadata associate with objects and buckets
- Specify where a bucket should be stored
- Make buckets and objects available for public access
  $\Rightarrow$ Can use S3 as 3rd level backup component in 3-2-1 backup strategy.
- Original data (1), a copy of your data (2), and an off-site copy of your data (3);

AWS storage services

Elastic Block Storage (EBS): Highly available and reliable data volumes that can be attached to a virtual machine (VM), detached, and then reattached to another VM

- Virtual hard disk (HDD) volumes
- persistent storage
- Used with the EC2 to keep the OS file system
- EBS is storage for people and S3 is storage for applications

Glacier: A data archiving solution; provides low-cost, highly robust archival data storage and retrieval

DynamoDB: Key-value storage; provides highly scalable, high-performance storage based on tables indexed by data values referred to as keys

Also offers a managed database service called Relational Database Service, or RDS

Amazon AWS and Netflix

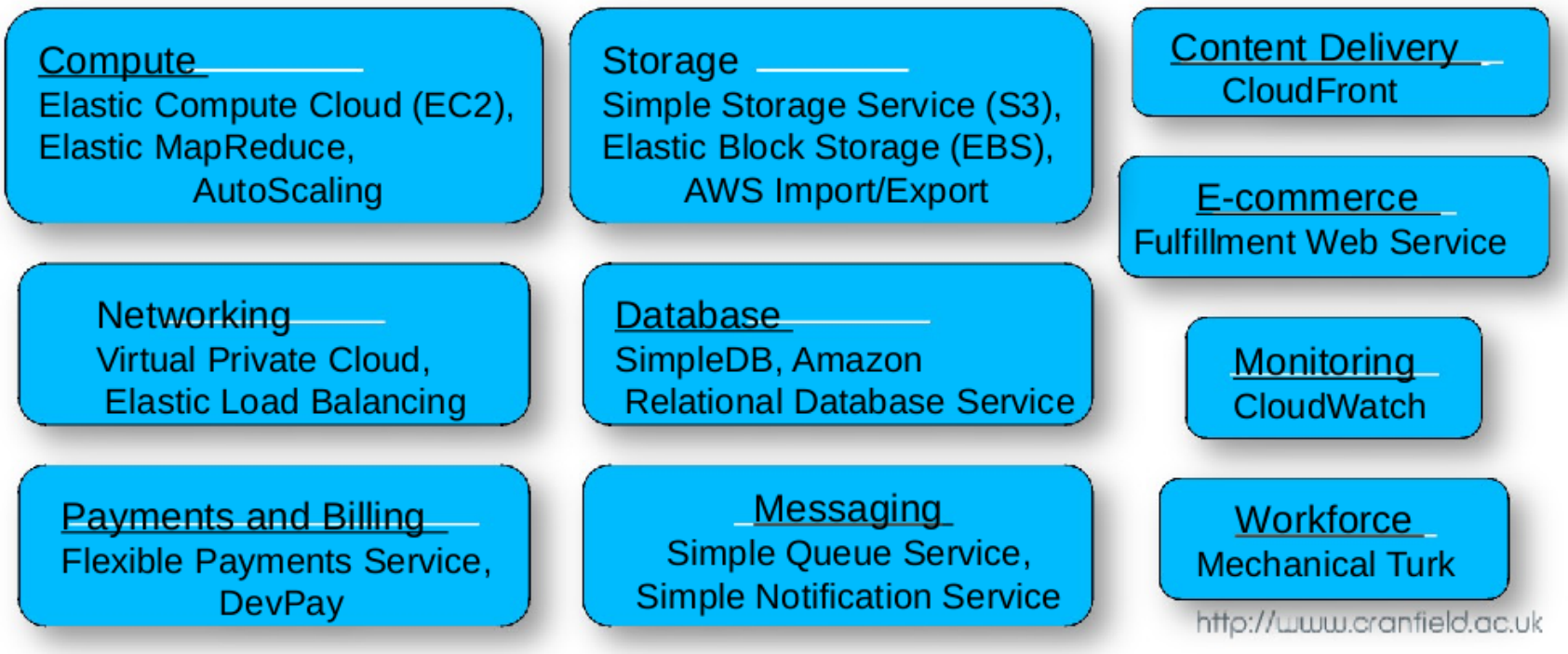
- Online video streaming service Netflix runs on AWS, so we too use AWS
- Every time you log on to Netflix, browse its selections, read your personalized recommendations, view your queue, or select a video to watch, it's all running on AWS.
- Netflix uses AWS for much more than these functions.
- All the transcoding that Netflix must perform (the process of converting one digital format to another, or several others, because Netflix must create separate versions for different mobile phones, tablets, TVs, and gaming devices) is done using AWS.
- All use of AWS by Netflix is via the AWS API.
- Netflix runs tens of thousands of AWS EC2 instances, and trying to track and manage that number of resources via the AWS Management Console would be unworkable. So Netflix created its own AWS management tools to manage any of its applications running in AWS
- Over 29 million subscribers. At peak viewing times, Netflix accounts for a staggering 30 percent of total Internet traffic. Of all Internet-connected TVs, 40 percent are used to access Netflix shows.

AWS Success Stories

- HTC
- Expedia
- Pinterest
- Novartis
- Pfizer
- Nokia
- Nasa
- Adobe
- Dow Jones
- Netflix
- New York Times
- Reddit
- Etsy

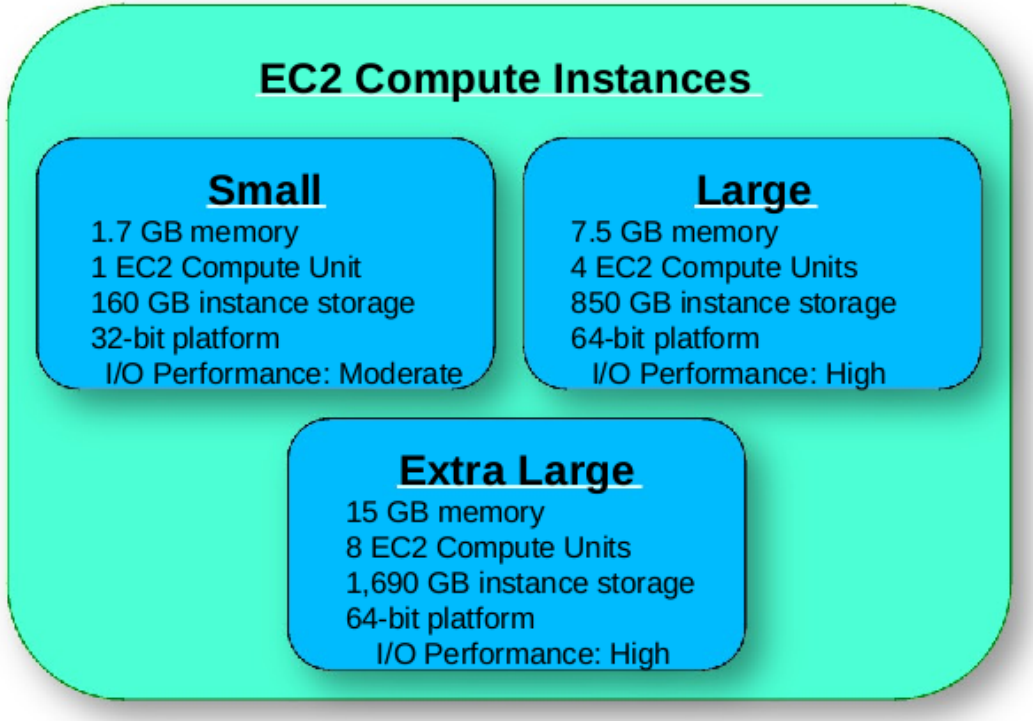
Amazon AWS Services

Amazon offer extensive range of computational resources and services



Amazon EC2 (Virtual Servers) Instances

Different instance types to suit requirements



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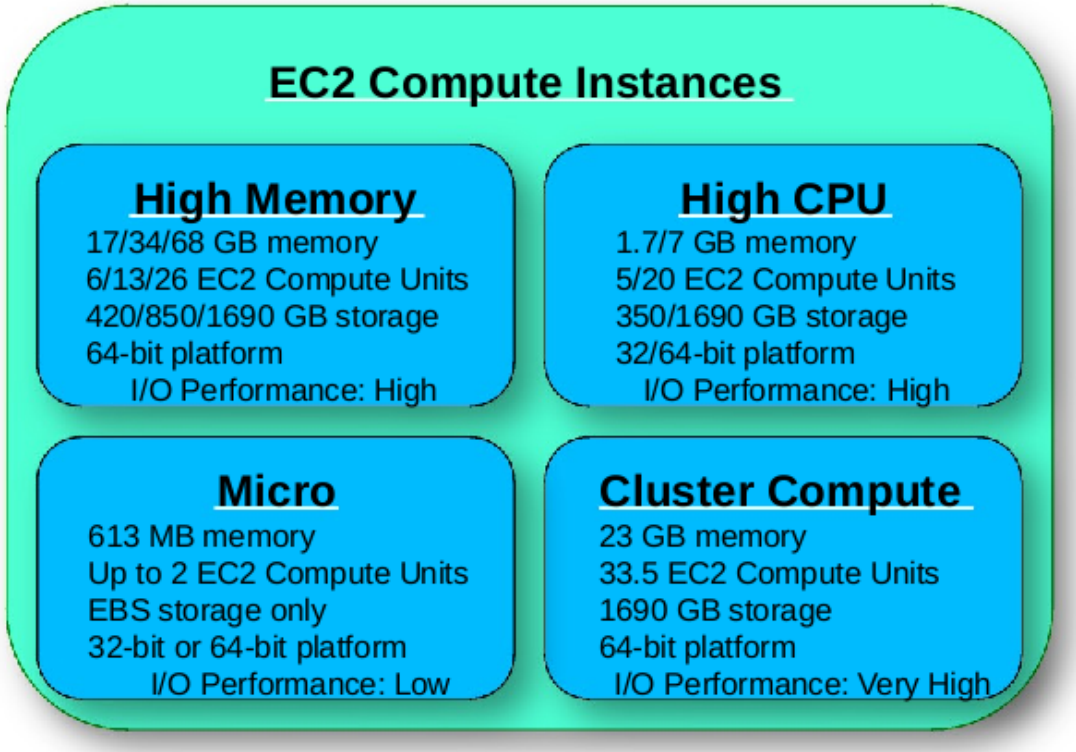
Amazon EC2 Instances

Specialist Instances are also available



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Amazon AWS Pricing Policies

Three different pricing policies

On-demand Instances standard per hour charge model

Reserved Instances up-front payments, lower hourly rate

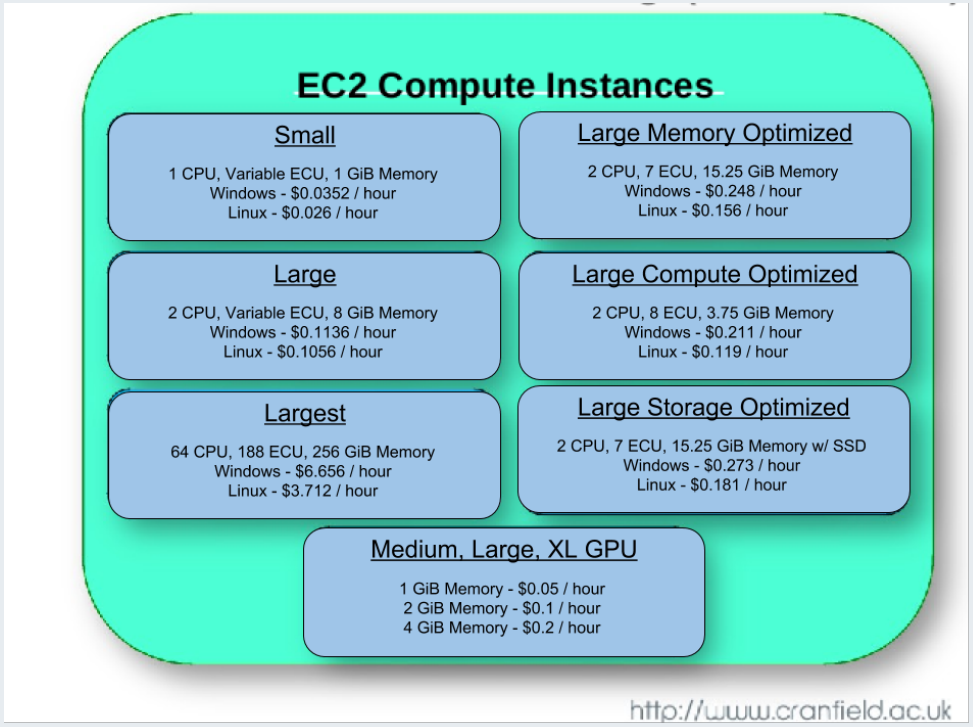
Spot Instances Allow you to name/bid your own price for Amazon EC2 computing capacity

- Customer specifies maximum price
- Actual spot price fluctuates according to surplus of instances available on AWS
- If current spot price is greater than customer max price, instance is shut down until the price falls below the customer max level again

Amazon AWS Typical Costs

- Reserved Pricing and Spot pricing are about half the on-demand rates
- Reserved Instances are guaranteed to run, whilst spot instances are not

On-demand Instance Pricing (EU-Ireland)



`http://aws.amazon.com/ec2/pricing/` **November 2017**

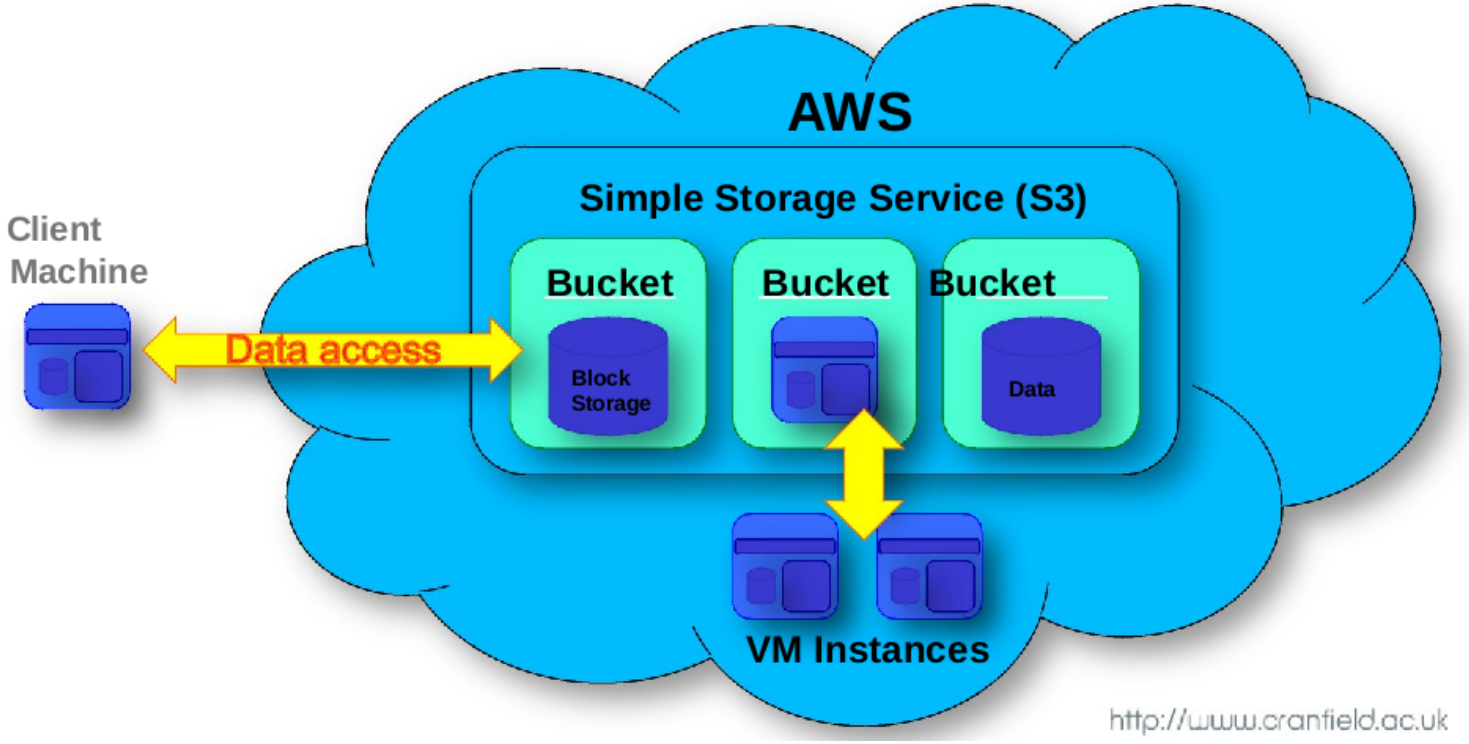
Amazon Storage Options

Simple Storage Service (S3)

- Large, highly scalable underlying storage solution
- Store and retrieve data objects to/from S3 over the web
- Control and access to data provided by web services or REST interface
- Data and objects are stored in user defined buckets, which can be located in any of the availability zones according to performance or legal requirements
- Customised instance images can be stored in S3
- Economical and trustworthy, it is extensively used by developers
- Reliable. According to Amazon's SLA, it guarantees 99.9% uptime
- Faster compared to other storage services

Amazon Storage Options

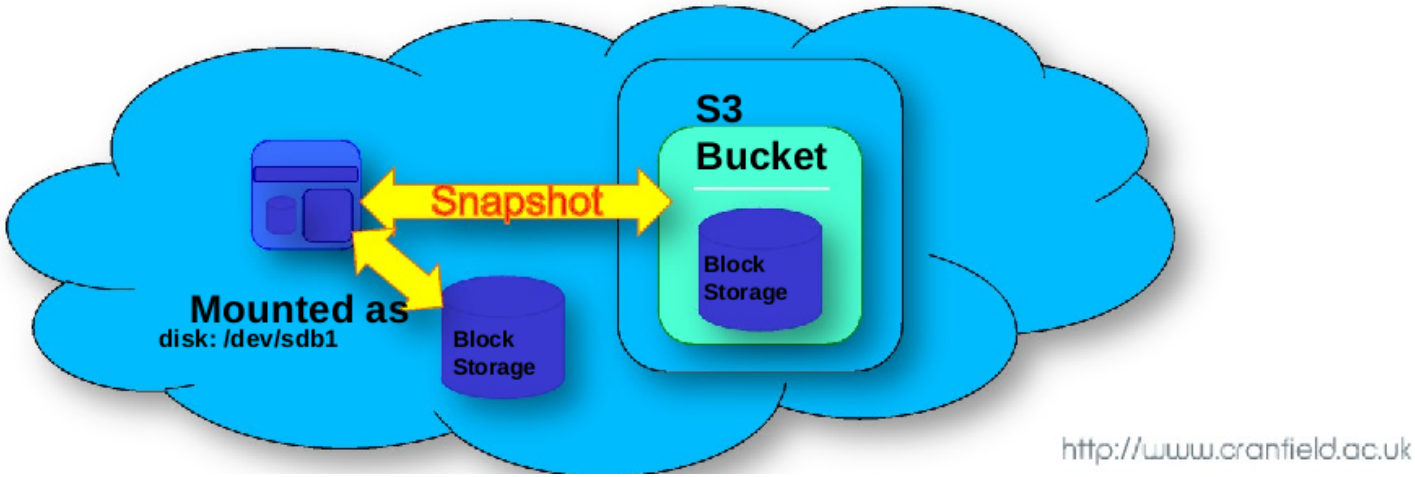
Available to VM instances and to physical machines accessing the service externally



Amazon Storage Options

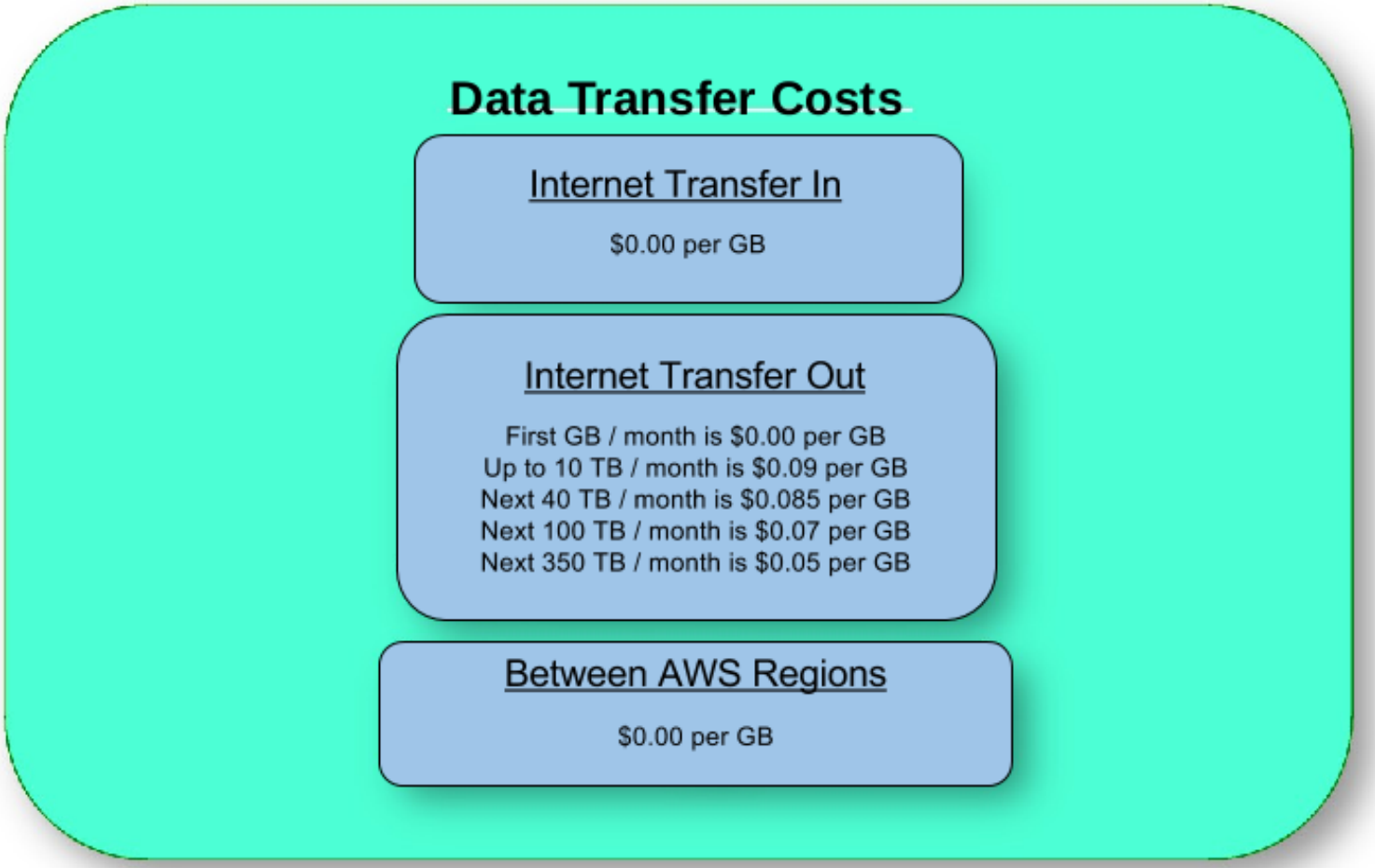
Elastic Block Storage

- Disk in the cloud- 1 to 1000 GB in size, auto replication
- Block level storage for use with Amazon instances
- Mounted as a hard drive within the instance
- Allows data to be stored according to developer specifications
- Persistence — remains available after the instance has been stopped



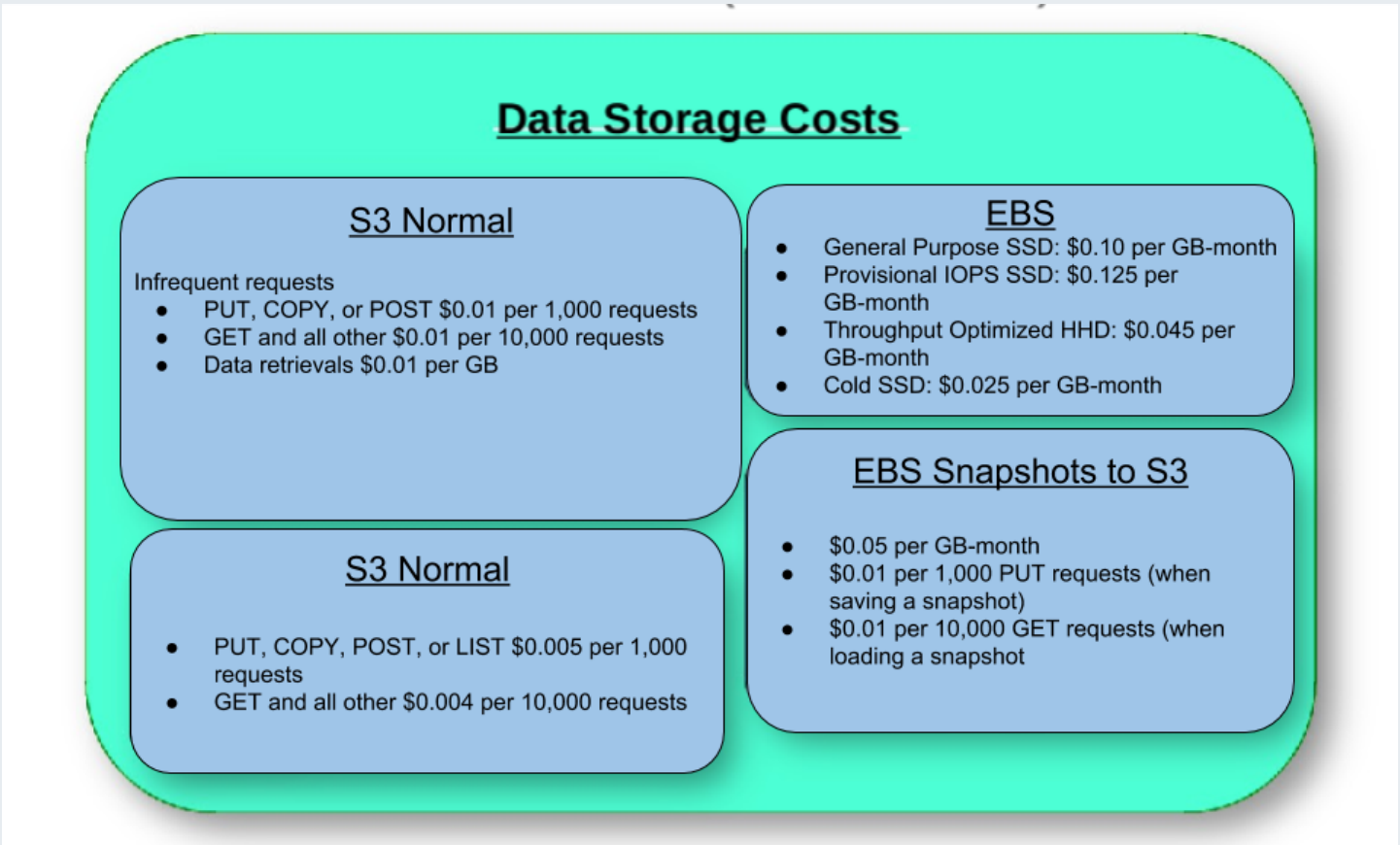
Amazon AWS Typical Costs

Data Costs



Amazon AWS Typical Costs

Data Costs (EU Ireland)



Source: http://aws.amazon.com/s3/pricing/ and http://aws.amazon.com/ec2/pricing/ November 2017

AWS Development Tools

AWS provides four key tools to aid development

1) EC2 API and AMI Tools

- A pristine copy (template) of your server that you can use to launch any number of instances.
- You can build any number of servers from AMI.
- AMI has the core OS, all appropriate device drivers, and any applications and state information, common preinstalled tools
- Might have your prebuilt web application based on deployment
- Amazon has prebuilt AMIs to get you started. In addition, there are many third-party AMIs, and you can build your own
- When you subscribe to AWS, you can choose to use one of its hundreds of canned AMIs or to create a custom system and capture that system's image to an AMI.

AWS Development Tools

2) AWS Toolkit for Eclipse

- An open source plug-in for the Eclipse Java IDE
- Can develop, debug, and deploy Java applications using Amazon Web Services

3) AWS Management Console (GUI)

Browser-based graphical user interface (GUI) for Amazon Web Services (AWS)

- It interfaces with all AWS resources - EC2, S3, ELB, RDS, Auto Scaling
- Users can also manage their accounts, deploy new applications and monitor existing ones.

4) ElasticFox (Plugin Firefox EC2)

a plug-in for the Mozilla Firefox browser allowing access to AWS accounts to manage your Amazon EC2 account

Amazon EC2 Pros and Cons

Pros

- No lock-in. Relatively easy to move code to another box.
- Code in C#, .NET, ASP.NET MVC / Visual Studio
- SQL Server (Express/Compact)
- Amazon staff very active in the community

Cons

- No free quota - minimum cost per month, even if 0 visitors
- Scaling harder (if required) - need to handle data spread across N instances
- Single point of failure with single Micro instance