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CLOUD ARCHITECTURE ASSIGNMENT 1

UNIVERSITY OF ST. LUKE'S

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Contents

Introduction

The technology infrastructure of the University of St. Luke's has been pushed to its limit with increasing student numbers and, with an increased need for online courses and services, a physical architecture is no longer effective. As such, they require a suitable cloud infrastructure that will fulfil their needs as they continue to expand in the future.

Why Cloud?

Scaling the universities infrastructure using conventional methods will become extremely costly as they expand with the need for physical servers, storage and locally installed applications on each workstation along with the physical space to house all of this equipment. Further problems arise when looking to use the University's resources remotely as it is simply not possible for remote students to use the physical systems.

Opting for a cloud based infrastructure removes the need for much of the physical infrastructure by virtualising the resources and paying to have them provisioned and managed by a cloud provider. Cloud providers such as Amazon and Microsoft allow customers to only pay for what they need and are able to quickly scale the infrastructure when it is needed and scale it back when it is not in use [1].

The Solution

To fulfil all of the requirements of the university, a hybrid cloud architecture primarily leveraging Amazon web services is the proposed solution.

Hybrid Cloud

The hybrid cloud architecture seamlessly integrates you physical infrastructure with your cloud infrastructure. Enables you to offload low value services to the cloud while retaining all of the security you get from local servers. This approach will enable the University to retain their existing infrastructure while gaining all of the benefits of the cloud. Their servers, workstations, printers and VIOP phones will all continue to be used but they will all be managed from the VPC.

Virtual Private Cloud – VPC

As the majority of the information stored in the university systems will be critical, ranging from personal and financial student data to saved thesis documents, storing all of this in a VPC is the most secure option. The VPC is a portion of the cloud that is restricted for use only by an organisation and the resources are not shared with other customers [2]. This is beneficial when hosting critical services and sensitive user data ensure that security risks form shared services are removed.

Cloud Provider Architecture - AWS

To fulfil all of the requirements of the university, a hybrid cloud architecture primarily leveraging Amazon web services is the proposed solution. AWS is the proposed cloud provider for this solution as it provides the vast majority of the services that the university requires leaving only minor, non-critical services to be hosted outside of the VPC.

Virtual Compute – EC2

The basis of AWS is the Elastic Compute Cloud (EC2) service will provide the virtual servers and workstations that represent physical machines in a conventional architecture. This service will be leveraged by all other services as it provides the base operating system upon with other services run. It can be quickly scaled up and down as required and it enables the customer to only pay for what is required [3].

Data storage – EBS

Amazon Elastic Block Storage (EBS) service provides simple, scalable file storage for use with Amazon EC2 instances [4]. EBS represents the traditional hard drivers in physical workstations, but without the need to buy new drives to increase the capacity or quantity of drives. EBS storage capacity is elastic which means that it grow sand shrinks on demand making is highly suitable for expanding student numbers and new volumes can be easily provisioned as the number of virtual machines increases.

Simple Storage – S3

Amazon Simple Storage Service (S3) is an alternative to, and used in tandem with, EBS. Instead of storing data in virtual volumes it stored data in “buckets” as separate objects. This is useful for storing portable university data such as web resources and virtual machine snapshots which may be needed in multiple locations [5].

Leveraged Services

Built on top of the above architecture are many virtualised services which are provided as all in one solutions removing the need to configure the virtual machines and related services individually. These will fulfil the service requirements of the university and provide all of the functionality of a physical implementation with the benefits of the cloud.

Secure Connection – Direct Connect

The local, physical data centres will connect via their existing backbone to the VPC using AWS Direct Connect [3]. This provides a secure route to the cloud and reduces bandwidth costs as all data first goes to AWS and much of it is managed internally removing the need for multiple connections to the internet.

Virtualisation - Workspaces

Having students and staff store their files on physical workstations creates problems with data portability and security due to machines being shared by multiple users. This problem can be solved by the use of Workspaces, a desktop virtualisation service that Amazon provides. Like many of the others that will follow, it is a collection of services including the EC2 instance for providing the underlying operating system and the EBS storage for persisting the data [6].

This service allows users to use the existing physical workstations to connect to the cloud infrastructure and their personal virtual desktop via the Amazon Workspaces Client application which is installed on the client device. Using this they are able to access a persistent Windows instance hosted in cloud and use it as they would a physical workstation.

Cloud File Storage – S3

With access to the Workspace not always being possible or convenient, simple user can be managed by creating a “Drop Box” like service using S3 giving access and sharing functionality to saved documents and files without the need for the more complex EBS required to store virtual workstation data [3].

Printing/Scanning

To allow users to print and scan on the local devices, the paths to the devices will be pre-defined in the users Workspace and will allow the user to send printing/scanning jobs to whichever device they choose no matter the physical location [7].

Email – Amazon WorkMail

WorkMail is a secure managed email and calendar service which allows users to use their email seamlessly on any of their devices or email clients such as Outlook from anywhere. WorkMail integrates with active directory to provide users access to their mailbox using their existing identity and functions on a pay as you go systems without needing to provision large email servers to manage it [8].

Database – RDS

To store relational data such as student/staff details and other information, Amazons Relational Database Service (RDS) will replace the locally hosted database solutions by offering a highly scalable database solution [9].

Backups – Glacier

Amazon Glacier is an extremely low cost solution for archiving data which will run on a nightly backup schedule to create backups of the data contained within the EBS and S3 services [10]. This system, while secure and reliable will be further backed up onto the physical systems of the University by connecting to Glacier and copying down the on a regular basis to provide an extra layer of reliability for the organisations data.

User Security – IAM

Amazons Identity and Access Management (IAM) provides an Authentication, Authorisation and Accounting (AAA) service which allows access to the system based on granular user privileges such as user groups (Student, Staff) [3]. This will be the used to manage access to all of the other services within the cloud such as Workspaces and WorkMail and ultimately provide the security for preventing unauthorised access to the VPC.

Reliability

The reliability of the cloud base architecture is only as good as the reputation of the provider and Aws provides many services and systems for ensuring maximum reliability [11].

ELB

The Elastic Load Balancing service manages user connections and load between all of the supported availability zones [12]. If all of a sudden Zone 1, hosted in EU-West-1 becomes very busy ELB will move the traffic to another zone within the same region (legal and security issues).

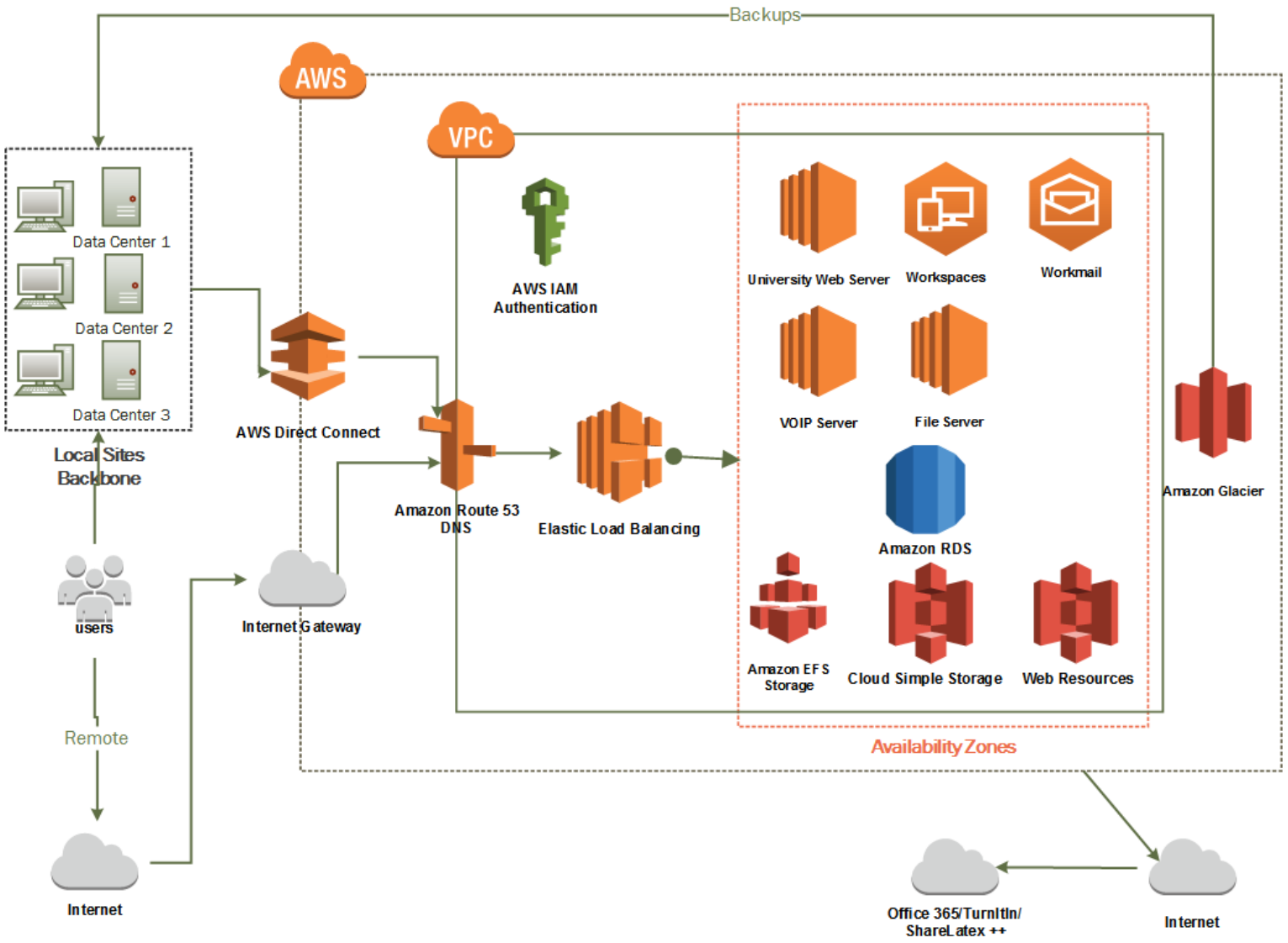
AWS Route 53

Route 53 provides secure routing and DNS services to the cloud network. This is a distributed service which ensures that routing requests from all regions are handled with the same speed and efficiency [13].

External Applications

As complete as AWS services are, they cannot fulfil all of the requirements of the university and, as such, external resources and other cloud services will need to be leveraged. Such services as Microsoft's Office 365 will be required to provide commonly used office applications to the users as well as other cloud services like TurnItIn to validate document submissions.

Architecture Diagram



Bibliography

[1] Cenon, “Cloud Computing: Its Benefits, and How it is Implemented by Universities,” cloudtweaks, 14 02 2012. [Online]. Available: http://cloudtweaks.com/2012/02/cloud-computing-its-benefits-and-how-it-is-implemented-by-universities/. [Accessed 2 11 2016].

[2] “Implementation Of Cloud Computing Inside College Campus Information Technology,” ukessays, 23 03 2015. [Online]. Available: https://www.ukessays.com/essays/information-technology/implementation-of-cloud-computing-inside-college-campus-information-technology-essay.php. [Accessed 5 11 2016].

[3] A. W. Services, “AWS Well Architected Framework,” AWS, 2015.

[4] AWS, “Amazon Elastic Block Store (EBS),” amazon.com, 2 1 2016. [Online]. Available: https://aws.amazon.com/ebs/. [Accessed 2 11 2016].

[5] AWS, “Cloud Storage with AWS,” amazon.com, 18 10 2016. [Online]. Available: https://aws.amazon.com/products/storage/. [Accessed 6 11 2016].

[6] AWS, “Amazon WorkSpaces,” amazon.com, 4 11 2016. [Online]. Available: https://aws.amazon.com/workspaces/. [Accessed 4 11 2016].

[7] AWS, “Printing From a WorkSpace,” amazon.com, 4 11 2016. [Online]. Available: http://docs.aws.amazon.com/workspaces/latest/adminguide/printing.html. [Accessed 4 11 2016].

[8] AWS, “Amazon WorkMail,” amazon.com, 4 11 2016. [Online]. Available: https://aws.amazon.com/workmail/. [Accessed 4 11 2016].

[9] AWS, “Amazon Relational Database Service (RDS),” amazon.com, 5 11 2016. [Online]. Available: https://aws.amazon.com/rds/. [Accessed 5 11 2016].

[10] AWS, “Amazon Glacier FAQs,” amazon.com, 5 11 2016. [Online]. Available: https://aws.amazon.com/glacier/faqs/. [Accessed 5 11 2016].

[11] cloudsecurityalliance, “Amazon AWS – 11 9’s of reliability?,” cloudsecurityalliance, 24 05 2010. [Online]. Available: https://blog.cloudsecurityalliance.org/2010/05/24/amazon-aws-11-9s-of-reliability/. [Accessed 5 11 2016].

[12] AWS, “Elastic Load Balancing,” amazon.com, 6 11 2016. [Online]. Available: https://aws.amazon.com/elasticloadbalancing/. [Accessed 6 11 2016].

[13] AWS, “Amazon Route 53,” amazon.com, 5 11 2016. [Online]. Available: https://aws.amazon.com/route53/. [Accessed 5 11 2016].