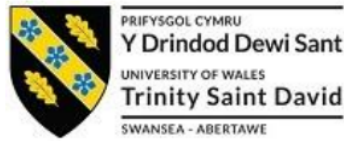


Assignment 1

by Hafiz Uddin

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SUBMISSION ID	141117691	CHARACTER COUNT	14350



University of Wales Trinity Saint David

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*How the field of computer networks has moved
towards a greater emphasis on software, with
particular focus on cloud computing*

Network Programmability
ACCA5029

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08/01/2021

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Abstract

As the rapid growth of the Networking industries advances, the need for better managed and more affordable services arises with it, along with the rapid expansions of cloud computing which brings new challenges with flexible virtual networks, scalability, manageability and dynamic network reconfiguration, these challenges are being alleviated through scalable cloud-based services and manageable software defined networking.

1.0 Introduction

How computer networks have moved forwards towards cloud computing with emphasis on software and cloud computing. Identifying how the shift towards cloud computing has impacted on the computer network industry, how the job roles of network professionals have evolved to meet the technical challenges of the cloud. How RESTful web services have been used to facilitate these changes. Why software defined networking has become so heavily adapted by the industry, despite meaning an adaptation to the job role of network engineers. Why standards, such as json and REST have been selected and utilised.

2.0 Methodology

What is cloud computing and how has it impacted on the computer network industry?

2.1 Cloud computing is a storage-based system where companies can store their data and software. The data and software can be stored, maintained, and upgraded at minimal costs. Cloud computing eliminates the need to buy data centres and computer infrastructures and enables the industry to rent cloud space for these services. Some of the services available through cloud computing are basic storage, software applications. AI, networking, it can cover most services that a datacentre can offer but in cloud to rent for a fraction of the costs as it is based on the usage, pay as you go service.

2.1a Some of the advantages of cloud computing would be the cost savings in comparison to buying the physical devices, infrastructure and software platforms, managing these and the upkeeps of these compared to the price of renting these and not having to have the staff to manage and maintain these, the speed of delivery, the scalability of cloud computing, as software and hardware can be upgraded and updated instantaneously to all devices and the ability to do all these at anytime from anywhere where there is access to the internet.

2.1b Some of the disadvantage are network disruptions these can be problematic as these can leave users unable to access all their data and software until the network is fixed, this can also be the same if the users or employees do not have internet access.

Another disadvantage would be service provider system crash or outage; this can be very disruptive to the company or its employees and this can be several hours before it can be rectified also bringing the security implications as it gives opportunities to cyber criminals to access the data and use it for criminal activities. [1]

2.2 There are three main layers to the cloud computing model or architecture,

- Infrastructure-as-a-Service (IaaS),
- Platform-as-a-Service (PaaS),
- Software-as-a-Service (SaaS).

2.2a IaaS is a cloud service which is owned and managed by a cloud service provider, this service owns and manages the hardware parts, you are able rent these to install and manage the software and data yourselves. This service gives you greater control of the data and software stored on the cloud, the operating system, networking, applications, data and database, these are accessed through an API or a dashboard and are offered on a pay as you go service which makes better business sense for small and growing companies as they can add or reduce the space they need as their business moves forward and only pay for the service they use and reducing the need to buy the hardware. [2]

2.2b PaaS service is like the IaaS service except that some of the services that you manage is managed by the cloud service this includes the operating system and database. Less IT management is needed by your company and more is managed by the service providers. As this is also a pay as you go service you can buy as much or as little of the service you require. PaaS enables multi-user interface access to the applications to give you better and enhanced workflows and coordination. [2]

2.2c SaaS is the most popular service used by companies as this offers the most support with the easiest of use by multiple users. It stores all applications and software which can be accessed and used by many users simultaneously and is managed by the cloud provider. The only responsibility of the company is to manage their own data. [2]

2.3 As networking is now moving to cloud computing the services included in networking are also moving to cloud computing and Software Defined Networking (SDN) to store and manage Network devices and software. Software Defined Networking has four parts which make up the architecture – [3]

1. Centralization of the control plane
2. Separation of the data and control plane
3. Programmability of the control plane
4. Standardization of application programming interfaces (API)

Having the control plane centralized makes it more efficient to send and receive the data from its destination and the data then passed to the correct end users. It enables intelligent control and management of the network giving better control over network bandwidth and optimization whilst also allowing users to dynamically access and configure resources on their cloud through shared storage spaces over the internet at remote locations. [3]

Separating the data and the control plane simplifies the process of forwarding packets and it is easier to manage those packets. Making the control plane programmable as it is separated from the forwarding functions and can be easily configured through programmability. This enables network engineers to configure, manage, optimise, and secure the network dynamically through an API (Application Programming Interfaces). [3]

2.4 API's enable the network to be controlled or programmed intelligently using software programs making them easily and consistently managed, just like other systems APIs are one of the common ways to communicate between devices as integration and interconnectivity become more important. REST APIs use HTTP which keeps the connection private through the support of TLS (Transport Layer Security), this enables the security features to help keep communication secure and encrypted. TLS is a standard that ensure the connection between the host and client or server to server communication is kept private and encrypted. HTTPS represents the TLS being present and indicates the URL is secure.

The move towards cloud computing has impacted on the networking industry professionals by providing the industry with the ability to manage more efficiently through programmability, giving the ability to scale the network without affecting performance and bringing virtualization into networking which enables the

management of hyper-scale data centres. With this approach the network industry does not need to implement each physical device with protocols as the planes are separated, they can be implemented through the external controller with SDN software running on it. [3]

In broader terms networking is moving from physical devices to manage networks to virtual devices to manage networks through SDN applications and platforms, software and hardware which has been made available as a manageable service on the internet virtually. [3]

2.5 Network engineers would have to adapt the RESTful web services to be able to maintain and manage networks which are cloud based. REST stands for Representational State Transfer and uses HTTP resources and can be accessed using APIs on a common interface. Resources are accessed, modified and managed through the server which are identified by URI (Uniform Resource Identifier) resources.

Network engineers would have to adapt their work to learn the various text resources available and adapt to using SDN to manage their network, the most popular of these resources are XML and JSON. Most Networks use JSON as their resource. [4]

On a REST based services there are four common methods used these are -

Get – This allows the user to get information from the API they are accessing, this can be data from the web-based service or a device/s that you need information from.

Post – This allows the user to write information to the API, allowing you to add data to an existing resource or device.

Put – This allows the user to change or make updates to the API, this would allow users to fix or repair resources or devices that are malfunctioning, make changes to networks which are either expanding or decreasing in size by changing IP addresses, adding devices or resources needed.

Delete – This allows the user to delete or remove information from the API. [4]

2.6 A RESTful website is where there are open sourced or open protocols to access and exchange data between networks or network devices using programming languages and or software applications, it can be also used to exchange information between web services over networks. RESTful webservices enable the exchange of data between different platforms using various languages, this is also known as interoperability and this is possible due to the use of open standards in the REST architecture. RESTful webservices allow network engineers to manage networks better. [4]

2.7 REST architectural service is the preferred over other similar API services as it uses less bandwidth and is operable over programming languages like JavaScript and Python. Using RESTful APIs to communicate over the internet to create, organize, access, and change web and network services is a flexible and logical choice for network engineers to manipulate network devices on the network. As RESTful webservices use stateless calls it works well over cloud applications which allows them to make changes to components when they require, or they fail through an API these can be controlled and redeployed freely. REST is a web service which is a stateless application, this means that the communication or data that it has during a communication will not be stored, it is used to process short term requests made by the user to get a response. [4]

2.8 SDN –

The application layer, the control layer and the infrastructure layer make up the three layers of the SDN architecture.

Software Defined Networking has been adapted by the network industry as it enables applications to be controlled and optimized through available resources, by de-coupling of the network control plane from the

data plane SDN can address issues like the ever-growing sizes of networks, the lack of programmability of the network devices by centralisation of software-based entities which can be programmed by the user through a standard interface. SDN bestows an effective networking environment, simplifies network architecture, and enables a centrally controlled or programmable control plane using software applications on the SDN controller e.g., APIs at anytime from anywhere with internet access. Networks can now be tailored to each company's individual needs with the ability to monitor and change network behaviours as and when needed. The centralized SDN control plane works with a south bound interface for all communications to infrastructures and hardware's and the northbound interface for all network communications and the ability to design applications and program implementations. [5]

2.9 Text-based language such as Json and architectural style such as REST have been selected and utilised by the network industries as Json (JavaScript Object Notation) a text-based language is easier to read for humans and write to, it is easier for machines to parse and generate data making Json the chosen data interchangeable language choice for network engineers. Json is for the building blocks of layer 2 and 3 on networks, it is used for the network configurations of network devices, it is used to monitor data, collect, and configure routing information's and network topologies. Json is based on a key-value pairs structure and is used to exchange data between web services and web servers, it has a minimal number of value types which includes strings, numbers, lists, objects, Booleans and null, as these are common basic programming language types, it is the preferred language over other language formats and its easy use on various platforms to transfer and exchange data over web and back end devices, making Json and REST the de-facto standard. Due to Json's simplicity of design, manipulation and the support by most programming languages and web services, and almost all languages can read and process its plain text files makes Json the preferred choice for the network industries. [6]

3.0 Conclusion

As networking moves forward towards the cloud so does the role of the network engineers to be able to adapt and learn new skills, be able to manage the networks in a virtualized environment using SDN which will mean the need to learn programming, but as most of the adapted platforms which are being introduced and used are interoperable, this means that they are able to interact with the majority of the platforms used within networking. The interoperability within these platforms would be important as the job role of the network engineer would be made easier by the means of managing the network virtually at any time anywhere, this gives a lot of flexibility towards the new job role and the majority of network industry are adapting quickly as it also makes business sense. Corporate businesses are moving their networks to the cloud as it is tailored to their individual business needs and a lot cheaper. The emphasis is also on the stability and speed of updating and repairs, the stability and speed of the network and the notion of the pay as you go makes it more attractive to today's business mind. Although there will be some areas of which will have to be looked at like the security as the central point of interaction if attacked could be catastrophic to any business although the security so far looks promising. The use of SDNs to control and manage the network at face value looks very promising for both the network and cooperate businesses and therefore network engineers would have to learn the skills required to keep up to date as the job role has changed for the better. This is also due to the fact that the demands are always growing for network usage and managing the infrastructure is becoming more and more difficult to be able to meet the needs of the expanding and reconfigurations of the networks to meet these needs.

The solution to these is cloud computing through virtualization with software defined networking and RESTful websites (APIs).

Network virtualisation is slowly taking over our lives, we seem to be doing more and more things online virtually than we actually realise, from online shopping to online education, this brings the need for better and more scalable network.

4.0 References

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- [6] J. Freeman, "What is JSON? A better format for data exchange," InfoWorld, 25 October 2019. [Online]. Available: <https://www.infoworld.com/article/3222851/what-is-json-a-better-format-for-data-exchange.html>. [Accessed 19 December 2020].

Assignment 1

GRADEMARK REPORT

FINAL GRADE

58/100

GENERAL COMMENTS

Instructor

Engagement with Literature Skills (40): 19

Knowledge and Understanding Skills (30): 18

Cognitive and Intellectual Skills (20): 14

Transferable Skills for Life and Professional Practice (10): 7

A good effort overall Hafiz - some reasonably detailed research completed.

Your research practice needs a little work - the majority of sources are non-authoritative and from the web, which has hampered your mark in this assessment.

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