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Research Article

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CLOUD COMPUTING IN MICROSOFT AZURE (IaaS, PaaS, SaaS)

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ABSTRACT

Aiming to offer an infrastructure and an active application platform, Cloud Computing provides everything like a service, which is scalable and efficient in terms of cost for customers. The on-demand provisioning of computational feature, storage, and bandwidth resources has driven modern businesses into cloud services. Being less expensive and more secure, Azure Cloud computing is reliable, and flexible than on-premises servers. This paper addresses what Microsoft Azure offers, like the performance, benefits and flexibility. We test three types of services in Azure: Software as Service SaaS, Platform as Service PaaS, and Infrastructure to use as a service called IaaS.

Keywords: Cloud Computing; Windows Azure; IaaS (Infrastructure as a Service; PaaS (Platform as a Service); SaaS (Software as a Service); AWS (Amazon Web Services); Google Cloud; Virtual Machine..

INTRODUCTION

Before starting to talk for Microsoft Azure we will see why such a service exists. Almost every company needs their server in the modern world. There are too much tasks for it to do, computing calculations, data administration, storage for data and more. The existence of a massive server in just one place might not be the best solution for the company. This way of processing come with a lot of expenses, for IT specialists, for hardware and upcoming upgrades. The computing power gets concentrated in a single place, so it is more vulnerable. The best solution for this is using a cloud computing service, just like the cloud that Microsoft provides called "Microsoft Azure". The main focus of cloud computing is to maximize efficiency of the shared resources. Cloud computer offers some important features like they are agile, have reduced price, easier maintenance, reliable, high levels of security, highly scalable, etc. Security issues have been faced by cloud computing because of sensitive data access, data, privacy, authentication, bug manipulation, recovery, responsibility, account control. [1]

Types of Cloud Computing

There are 3 ways for deploying the cloud services: private and public cloud also a mix of both called hybrid.

- **Public-clouds** owned and operated by a 3-party cloud providers they use their own servers and storage for the users. Microsoft Azure, Amazon Web Services, Google Cloud are some example of the most used cloud providers nowadays. The cloud provider owns everything servers, hardware, software and is responsible for the infrastructure. The users need a computer, phone or any electronic device with an internet access and a browser to access and manage the services.
- **Private-cloud** is owned by private businesses and organization, they use their own servers and hardware. Usually the private clouds are situated at the organization datacenters. Also, some companies hire 3rd-party providers so they can host the private clouds. The private cloud uses the same infrastructure and service as the private network.
- **Hybrid-clouds** is a combination of both public cloud and private ecloud, tied together by technology which permits application and data being shared between them. The hybrid cloud is very flexible because it gives business and reorganizations the possibility for moving from private cloud to public cloud. It gives you a lot of options for deployment also helps optimizing the security, compliance, and existing infrastructure. [2]

Service Models

The cloud model promotes accessibility and is composed of 5 essential features, 3 service models, Software as a Service (SaaS), Platform as a Service (PaaS) & Infra-structure as a Service (IaaS).

Software as a service (SaaS) gives customers the possibility to connect and to use cloud based applications across Internet. Most used applications nowadays are e-mail, calendaring tool, and office package (Microsoft Office).

Advantages of SaaS

SaaS gives organization the possibility to use and run their applications on a virtual environment. Nowadays, there no need to spend money buying high-priced software applications that consumes too much time installing, and requires a lot of money.

Challenges in SaaS Adoption

Some limitations slow down the acceptance of SaaS and prohibit it from being used in some cases: reports since data are being stored on the vendor's servers, data security becomes an issue. SaaS applications are hosted in the cloud, far away from the application users. This introduces latency into the environment.

Platform as a service (PaaS) is a complete development and deployment environment in the cloud, with resources that enable you to deliver everything from simple cloud-based apps to sophisticated, cloud-enabled enterprise applications. By purchasing the resources you need from a cloud service provider on a pay-as-you-go basis you can access them over a secure Internet connection. PaaS allows you to avoid expenses and complexity of purchasing and managing software licenses, the underlying application infrastructure and

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middleware, container orchestrators such easKubernetes, or the development tools and other resources. You can manage the applications and services you develop, and the cloud eservice provider typically manages everything else. Platform as a Service, it is often referred to as simply PaaS, is a category of cloud computing that provides a platform and environment to allow developers build applications and eservices all over the internet.

Benefits of PaaS

Organizations don't have to invest in physical infrastructure. They don't need to purchase hardware themselves or employ the expertise to manage it. This leaves them free to focus on the development of applications.

Benefits of PaaS

There are approximately three limitations that characterize the PaaS security platform.

- Information processing.
- Information interactivity.
- Storing data.

Infrastructure as a service (PaaS) Infrastructure as a service (IaaS) is an instant computing infrastructure, being provisioned and managed all over the internet. It is one of the four types of cloud services, along with SaaS, (PaaS), and server less. This service quickly scales up and down with demand, and lets you pay only for what you use. You can avoid the expenses and complexity of purchasing and managing your own physical servers and various data center infrastructure. Each resource is offered as a separate service component, and for as long as you need it, you only need torrent a particular one. A cloud computing service provider, such as Azure, it will manage the infrastructure, while you buy, install, configure, and manage your own software operating systems, middle ware, and applications.

Benefits of PaaS

The following are examples of how IaaS can be utilized by an enterprise.

Enterprise infrastructure by internal business networks, such as private clouds and VLANs, which utilize pooled server and networking resources.

Cloud hosting of websites on virtual servers are founded upon pooled resources from underlying physical servers.

Virtual Data Centers (VDC): a virtualized network of interconnected virtual servers.

Scalability: resource is available as and when the client needs it and therefore, there are no delays in expanding capacity or the wastage of unused capacity.

No investment in hardware

Utility style costing: the service can be accessed on demand and client only pays for the resource that they actually use.

Location independence as long as there is an internet connection, the service can usually be accessed from any location and the security protocol of the cloud allows it. Physical security of Data Centre locations. No single point of failure.

Challenges in IaaS Adoption

Concerns about the security and confidentiality of organization's data. The lack of time and resources to sufficiently analyze the offerings and the providers. Uncertainty about the provider living up to their promises. Lack of confidence in a shared infrastructure. The provider is not capable of adding capacity in a dynamic enough fashion. Concerns about the security and confidentiality of data. Their lack of an internal strategy about IaaS. Their lack of personnel to design and implement the solutions. The relative immaturity of the technologies that would have to be installed and managed. The lack of significant enough cost savings.

RELATED WORK

There are three main competitors on Cloud Business, Google Cloud Platform (GCP), Microsoft Azure and Amazon Web Services (AWS) as per Figure.1.

Services	AWS	Azure	GCP
IaaS	Amazon Elastic Compute Cloud	Virtual Machines	Google Compute Engine
PaaS	AWS Elastic Beanstalk	App Service and Cloud Services	Google App Engine
Containers	Amazon Elastic Compute Cloud Container Service	Azure Kubernetes Service (AKS)	Google Kubernetes Engine
Serverless Functions	AWS Lambda	Azure Functions	Google Cloud Functions

Figure 1. AWS/Azure/GCP

AWS versus Azure

Figure.2 below is shown the main changes between AWS and Azure. It also gives an overall information regarding licenses and distinctive changes.

Parameter	AWS	Azure
Date Of Initiation	2006	2010
Market Share	40%	30%
Open Source	More open to open source community	Less open to open source community
Hybrid Cloud	It is a work in progress	Excels in Hybrid Cloud Mark
Licencing	Offers more flexibility	Catching up with AWS
Linux Ecosystem	Extensive support for Linux	Still building up

Figure 2. AWS versus Azure [4]

High Performance Computing Challenge (HPCC)

The HPCC benchmark suite presents several tests to measure arrange of performance parameters related to network band width, memory bandwidth ,local computational performance, and global computational performance. [5]

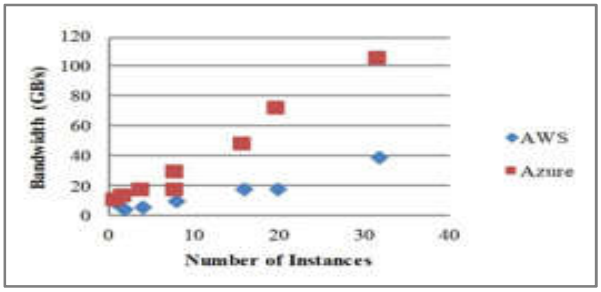

Figure 3. HPCC PTRANS bandwidth for AWS and Azure as a function of cluster size

Figure.3 compares the measured bandwidth observed with AWS and Azure, which illustrates that Azure's faster network performs better on this benchmark, as expected. Azure's eight instance test case was rerun because it seemed to produce an unexpectedly low bandwidth, and on the second run performs better.

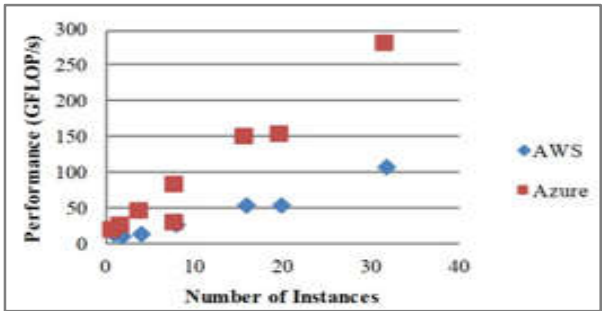

Figure 4. HPCC MPI FFT performance for AWS and Azure as a function of cluster

Figure.4 shows that Azure performs better than AWS for the MPI FFT, likely due to its faster network. Both of the eight instances in Azure results are shown in the graph, with the better performance coming from the second test with the larger PTRANS bandwidth.

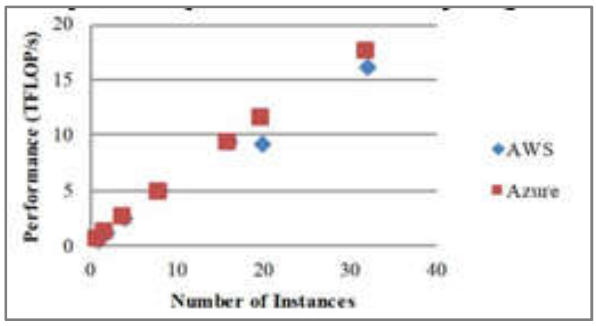

Figure 5. HPCC HPL performance for AWS and Azure as a function of cluster size

Figure.5 shows that AWS and Azure scale vey similarly for the HPL benchmark. Since the underlying processors have a similar amount of computational power, this is not a surprising result.

The HPCG benchmark was run with the same parameters for AWS and Azure, 1 MPI process per core, NX=NY=NZ=64, and a run time of 300 seconds. Because Azure has fewer cores(16vs18), it is running a slightly smaller problem size than AWS, but the work per core should be the same. The HPCG result shown in Figure.6,with AWS outperforming Azure, is a little surprising, as Azure's faster processors and network should give it an advantage on this benchmark.[11]

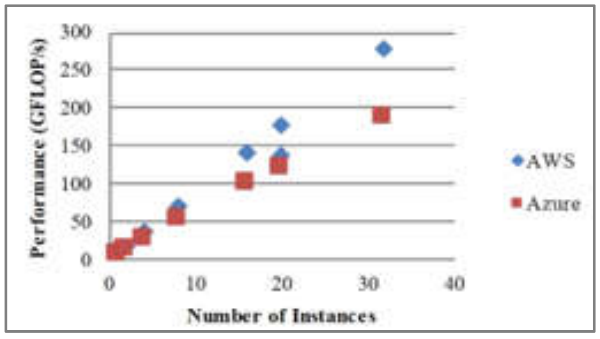

Figure 6. HPCG performance for AWS and Azure as a function of cluster size

Figure.7 is providing the cost analysis based on the HPCC HPL benchmark as s function of cluster size for AWS and Azure.

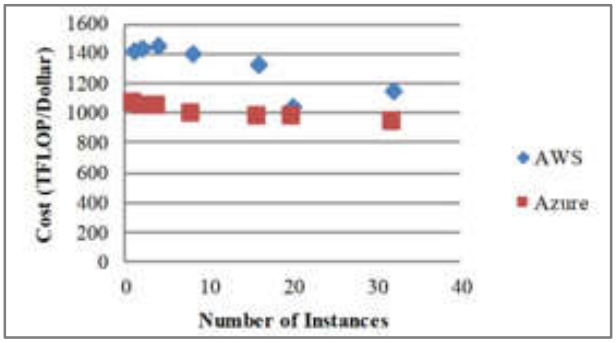

Figure 7. Cost Analysis

Based on [6] we performed and comparison showing it in two separated tables (Table 1 and 2) between AWS and Azure.

Table 1. Apache benchmark results

Test	*Azure (req/s)*	*AWS (req/s)*
Test 1	1116.64	1022.43
Test 2	1119.92	1026.06
Test 3	1121.67	1027.38
Average	1119.41	1025.29

Table 2. Ram speed benchmark

Test	*Azure (MB/s)*	*AWS (MB/s)*
Integer		
Add	8303.84	8318.52
Copy	7923.69	7934.63
Scale	6498.92	6522.35
Triad	1021.67	1027.38
Average	4399.17	4404.48
Float. point		
Add	2575.43	2637.03
Copy	2301.85	2306.91
Scale	998.71	1004.99
Triad	2503.42	2389.88
Average	1619.41	1657.77

A comparison of prices in official sites for Linux and Windows OS is given in Tables 3 and 4.

Table 3. Azure vs aws price comparison for windows os

WINDOWS OS (AUGUST 2018)

TYPE	vCPU	MEM.	AZURE	AWS
General Purpose	2	8GB	$0.4990	$0.6680
	4	16GB	$0.5970	$0.8560
	8	32GB	$1.1940	$1.7120
Compute Optimized	2	4GB	$0.5630	$0.6570
	4	8GB	$0.7260	$0.8340
	8	16GB	$1.4510	$1.6680
Memory Optimized	2	16GB	$0.6250	$0.7160
	4	32GB	$0.8500	$0.9520
	8	64GB	$1.7000	$1.9040

Table 4. Azure vs aws price comparison for linux os

LINUX OS (AUGUST 2016)

TYPE	vCPU	MEM.	AZURE	AWS
General Purpose	2	8GB	$0.0840	$0.0928
	4	16GB	$0.1670	$0.1856
	8	32GB	$0.3350	$0.3712
Compute Optimized	2	4GB	$0.0850	$0.0850
	4	8GB	$0.1690	$0.1700
	8	16GB	$0.3380	$0.3400
Memory Optimized	2	16GB	$0.1330	$0.1330
	4	32GB	$0.2660	$0.2660
	8	64GB	$0.5320	$0.5320

Google Cloud Platform versus Azure

Google Cloud Platform, can host a number of different systems and is proficient at handling both applications and enterprise development. While Google and AWS concentrate on public cloud computing, Azure's public cloud focuses on those who want to interoperate with their own data centres, where a lot of windows-based servers already are running. [7]. Using Microsoft Azure service, user must sign up for Microsoft account, and most business people already have Microsoft accounts.

Resource Management Interfaces

Azure and Google Cloud provide a command-line interface (CLI) for interacting with the services and resources. Azure provide the Windows Command Line, and Google provides the Cloud SDK. Azure and GCP also provide web-based consoles. Each console allows users to create, manage and monitor their resources. The console for GCP is located here; Azure's one is located here. [8].

Pricing Processes

Google Cloud follows a to-the-minute pricing process, while GCP may fall behind in additional features, it compensates in cost efficiency. The platform also has pay-as-you go pricing, billing per seconds of usage. Setting GCP apart, it offers discounts for long-term usage that starts after the first month. [9]

EXPLANATION OF PERFORMING TESTS

In this paper we will test three services that Azure offers, please refer to Figure.8.

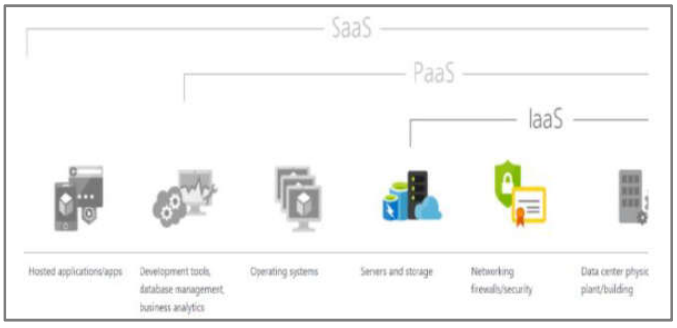

Figure 8. Azure Types of Services

We have implemented the IaaS and PaaS in Microsoft Azure using our premium subscription. For IaaS we have created a virtual machine with Windows Servers 2012 and step by step guide in portal https://portal.azure.com/#. For PaaS we have created a Web Services .NET framework since is the default language used by Microsoft.

EXPERIMENTAL ENVIRONMENT - REALIZATION

IaaS we will create a Virtual Machine within Azure. In order to create a secure and well organized IaaS service within our Azure Subscription we need to follow certain steps: After accessing Azure environment, the first thing to do is to create e *Resource Group*. The resource group is just like Folder that contains our services such as: VM, WebApp, Storage, Applications, etc. After clicking the Add button you will be redirected to the window shown in the second image below (Figure.9).

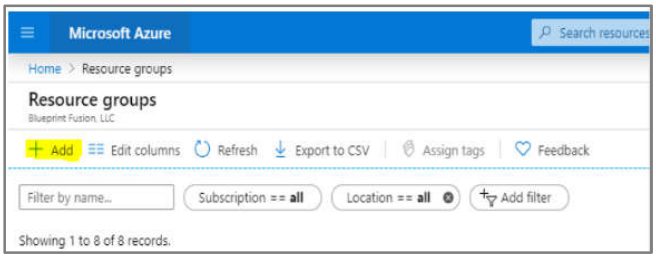

Figure 9. Add resource group

Select the subscription you want to assign the Resource Group to, Add a name for the resource group, Choose a Region for your Resource Group and click over create (Figure.10).

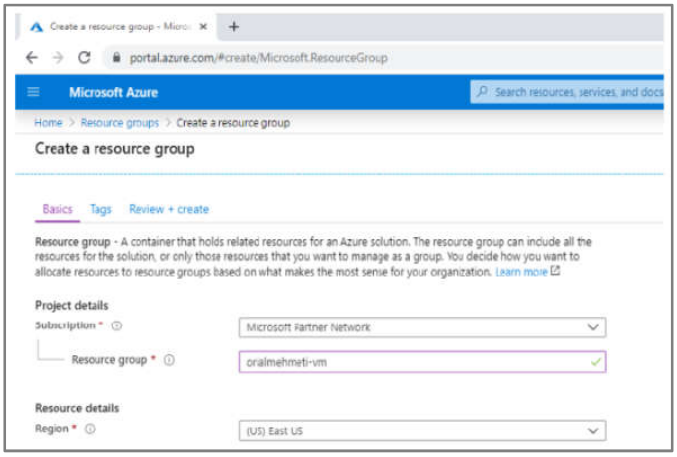

Figure 10. Create Resource Group

We now have created a Resource Group named **orialmehmeti-vm** (Figure.11).

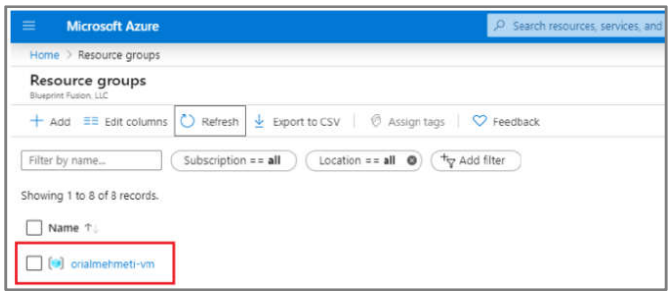

Figure 11. Orialmehmeti-vm

After the Resource Group is created, now we are ready to create our VM. To do that we just need to click *Create Resource* button. (Figure.12).

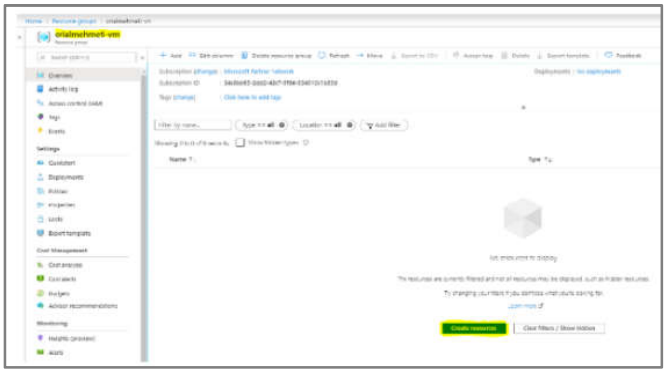

Figure 12. Create Resource

We are about to create a Windows Server 2012 R2 Data Centre edition (Figure.13).

Figure 13. Windows Server 2012 R2 Data Center Edition

The next step is to create our Virtual Machine (Figure.14). We made sure to evaluate firstly and Fill all missing elements in the installation process such as: Subscription, Resource Group, Virtual Machine Name, and Region. Another interesting element we added to our VM was to create an Availability Zone and store our VM in 3 physical locations within an Azure region.

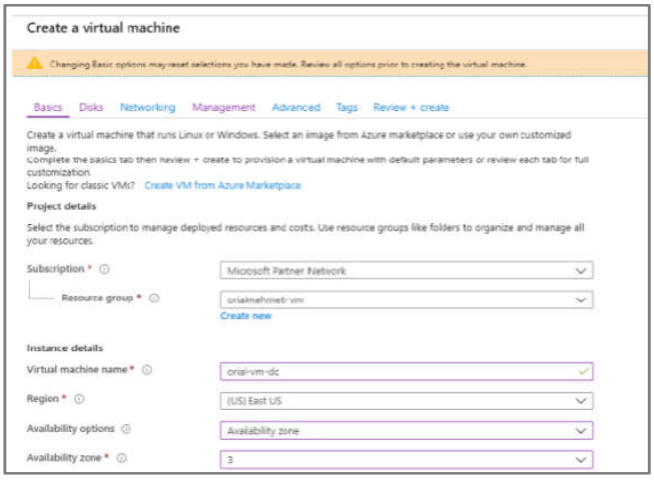

Figure 14. Creating VM

Availability Zones is a high-availability offering that protects your applications and data for data centre failures. Each zone is made up of one or more data centres equipped with independent power, cooling and networking. With Availability Zones, Azure offers industry best 99.99% VM uptime SLA [12]. The next step is to add an image which is Windows Server 2012 R2 Data centre and choose a size for our Operating System, We choose Standard DS1 v2 with virtual CPU with 3.5G memory with respective cost $91.98/month (Figure.15).

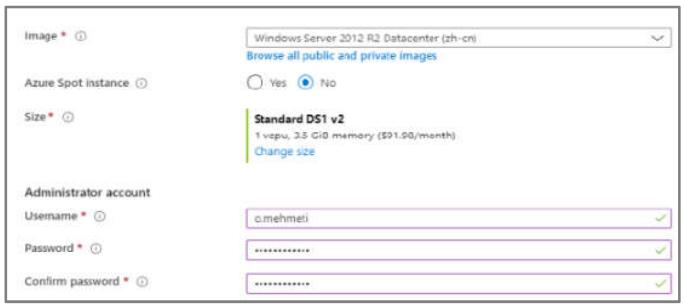

Figure 15. VM specifications

To access the Virtual Machine we need an inbound port. We choose RDP (Remote Desktop Protocol) (Figure.16).

Figure 16. Inbound RDP

For 99.9% connectivity SLA we have selected Premium SSD disk type (Figure.17).

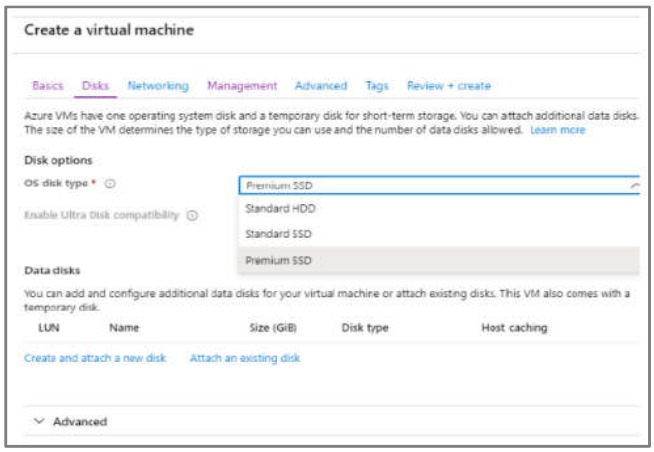

Figure 17. HDD selection

The Networking section is important for configuring network interface for our Virtual Machine such as Subnet, Public IP and Security elements (Figure.18).

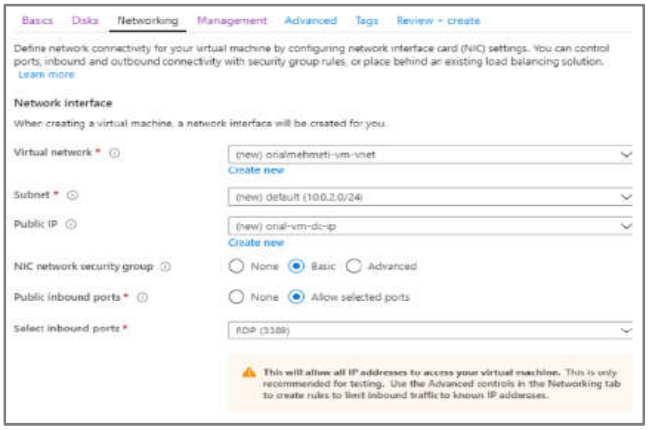

Figure 18. Network settings

The nest sections such as: Management, Advanced and Tags provides different optional customization for our Virtual Machine (Figure.19).

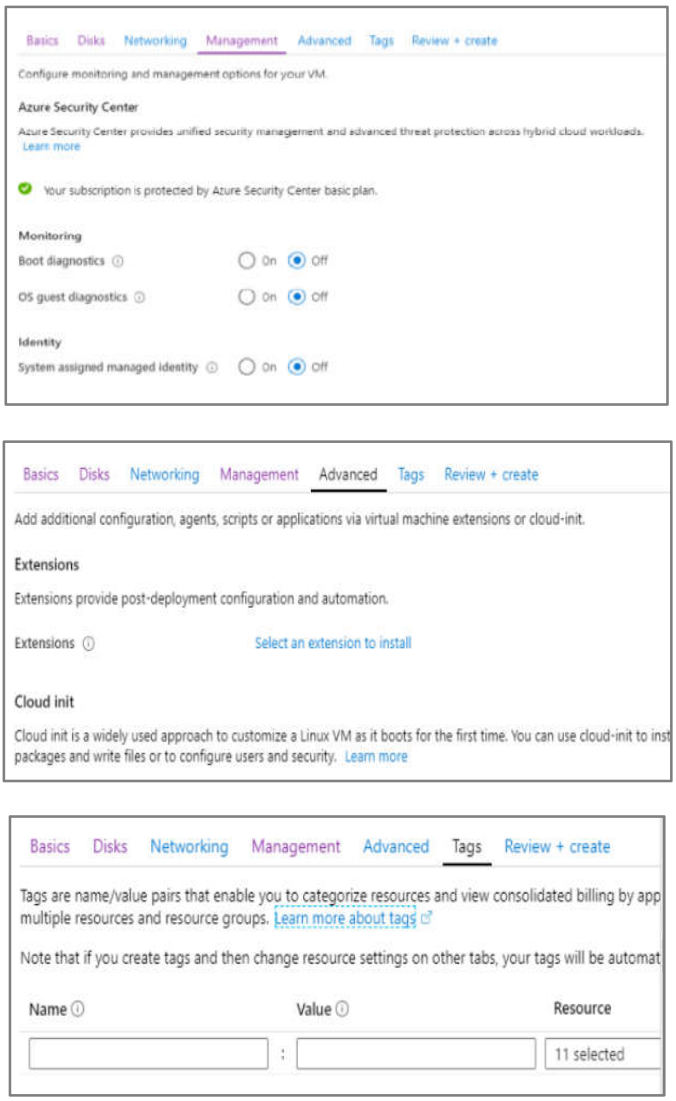

Figure 19. Additional settings

After successfully filling all elements in our installation process, a message telling you the "Validation Passed" will appear. As you can see the price for our Service is 0.1260 USD/hour (Figure.20).

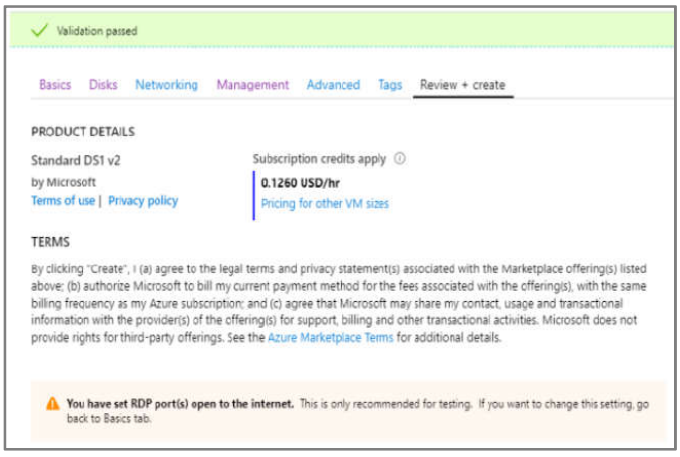

Figure 20. Price per hour

After hitting create we can see the Deployment is in Progress (Figure.21).

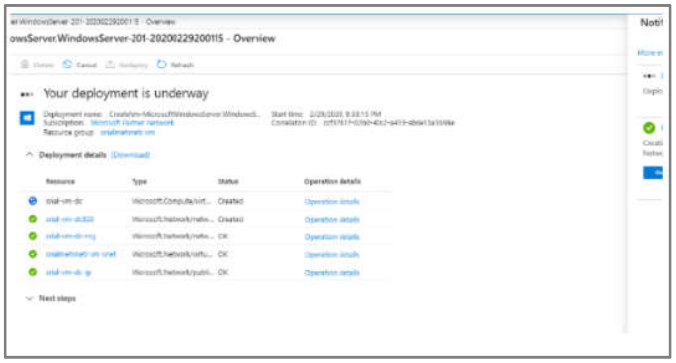

Figure 21. Deployment progress.

After less than 3 minutes the virtual machine is created and you can see the view in the image below (Figure.22).

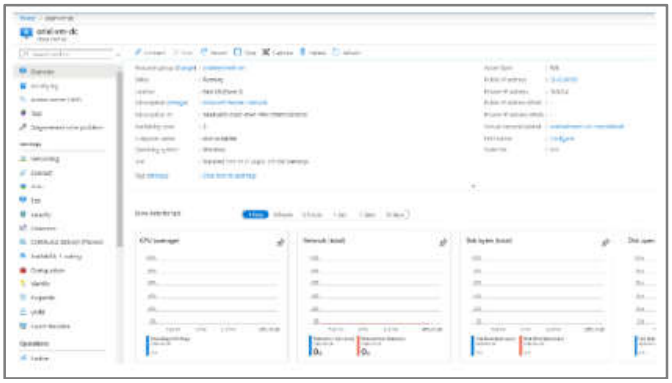

Figure 22. Creation finalized

To connect with our VM we need to click the Connect button and choose RDP (Figure.23).

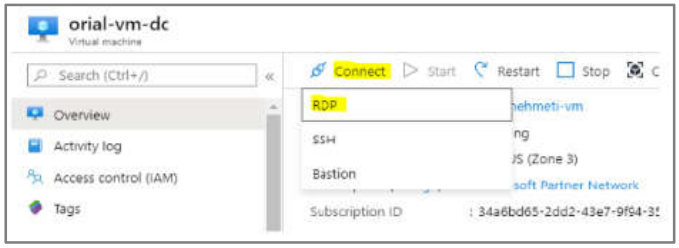

Figure 23. RDP access

Download the RDP file (Figure.24).

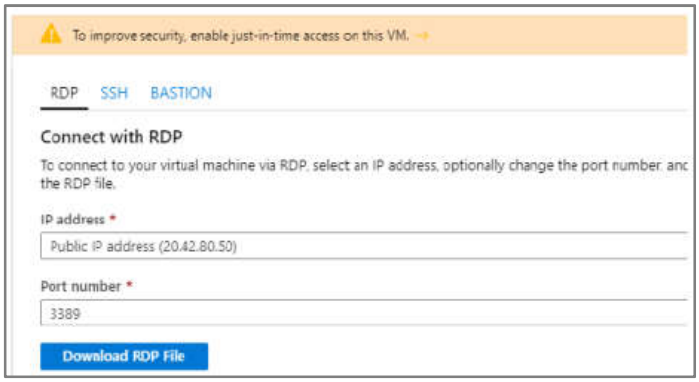

Figure 24. RDP file download.

The downloaded file has the IP and the information of our VM (Figure.25)

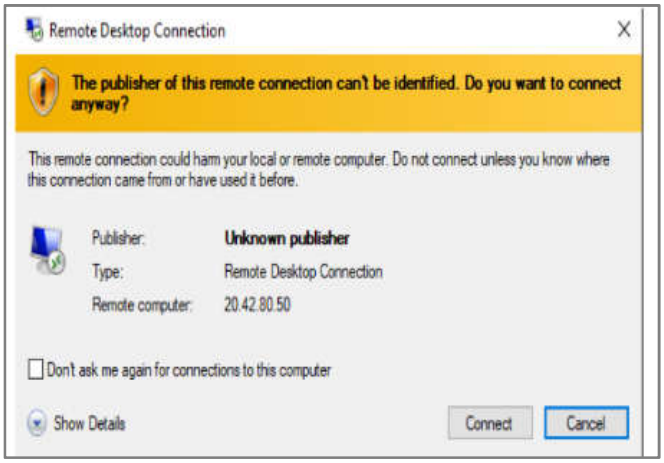

Figure 25. IP address info.

At this stage you can identify that we are able to access our Virtual Machine using RDP protocol (Figure.26).

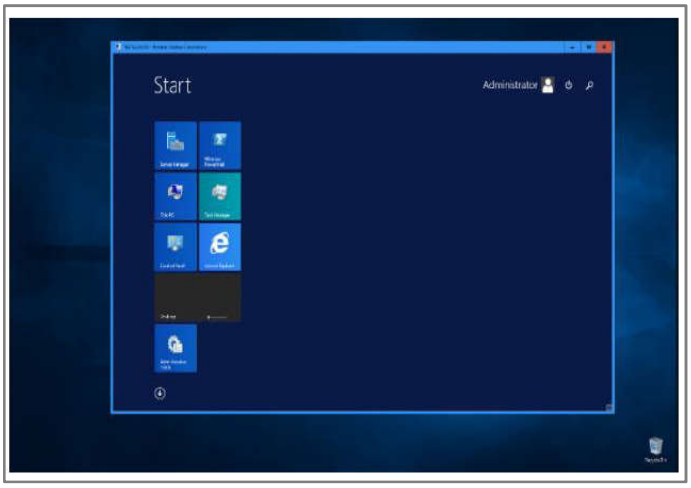

Figure 26. Entering into VM.

PaaS we will create a Web Service within azure – To Create a Web Service and Store a Website within Azure we need to perform the same steps as done for creation of VM but the resource is named Web App + MySQL (Figure.27).

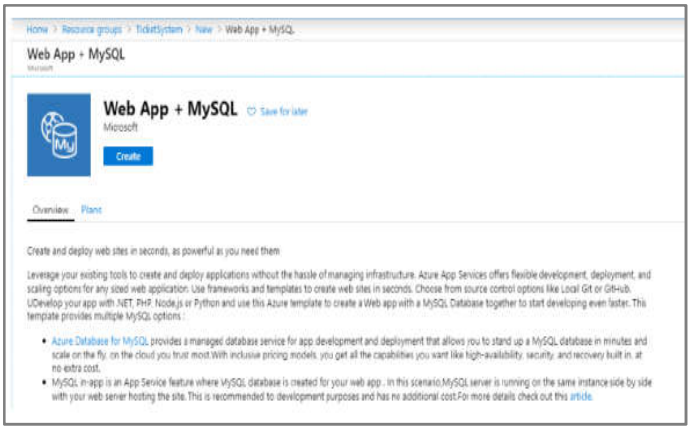

Figure 27. PaaS Creation.

Following the next step we have filled the elements such as: App name, Subscription, Resource Group, Database Provider. We also needed to create a Database Server which require a unique **Server Name** and unique **Sever Admin Login Name** and a unique **Database Name**. The Version we already used in 5.7 (Figure.28).

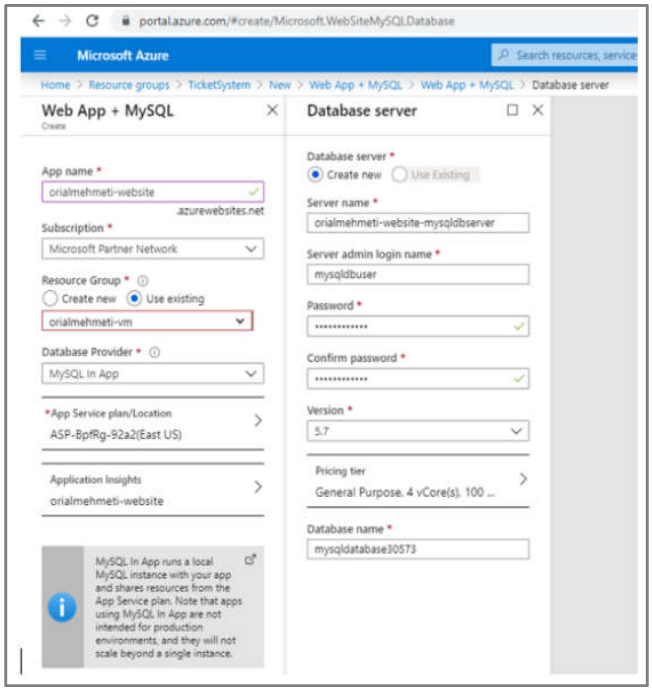

Figure 28. Configuration Details.

The DB Specifications (Figure.29)

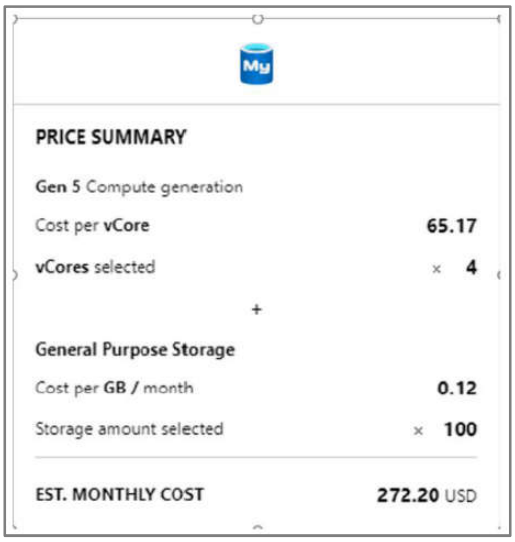

Figure 29. DB Specifications.

Click over Create Button (Figure.30).

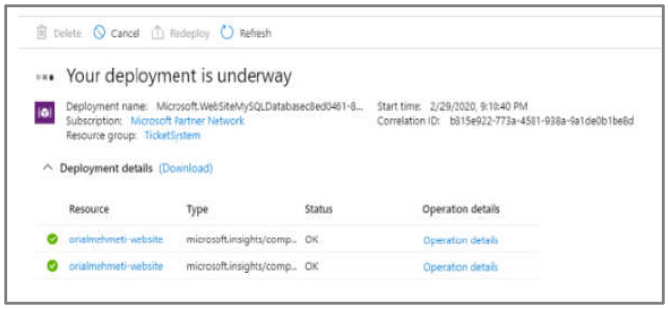

Figure 30. Click over Create Button.

Our App Service environment (Figure.31) with respective link https://orialmehmeti-website.azurewebsites.net/

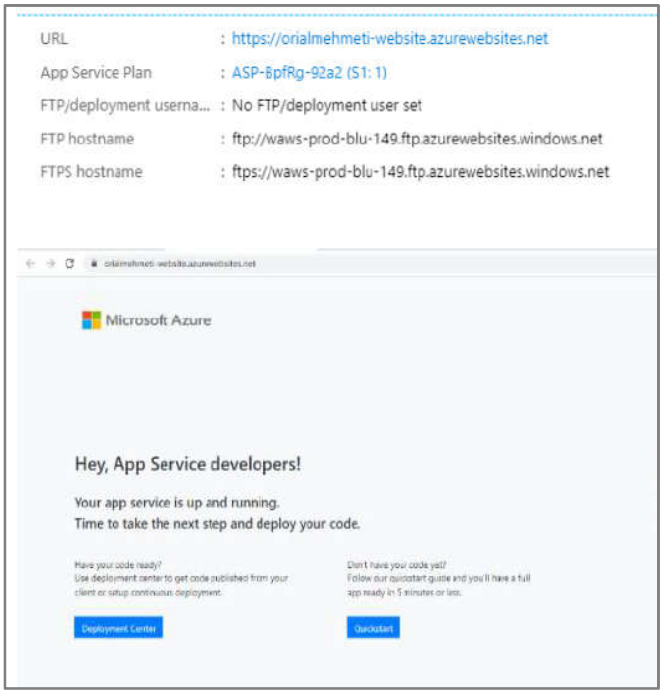

Figure 31. Web App Environment.

RESULTS EXPLANATIONS

As we can see from the above examples of creating a IaaS and PaaS in Microsoft Azure it only takes a few minutes to build the whole infrastructure which might take weeks and a whole IT team to build. You just need an expert in the field and you can save a lot of money using Cloud Computing in this case Azure. Cloud Computing provides promising services to the clients. Clients can use these services on demand and at some cost. This study was planned to review the services of cloud computing. SaaS allows client to run a software application over the internet without having to install it on his own computer, thus making things simpler and reducing maintenance costs (Figure.32).

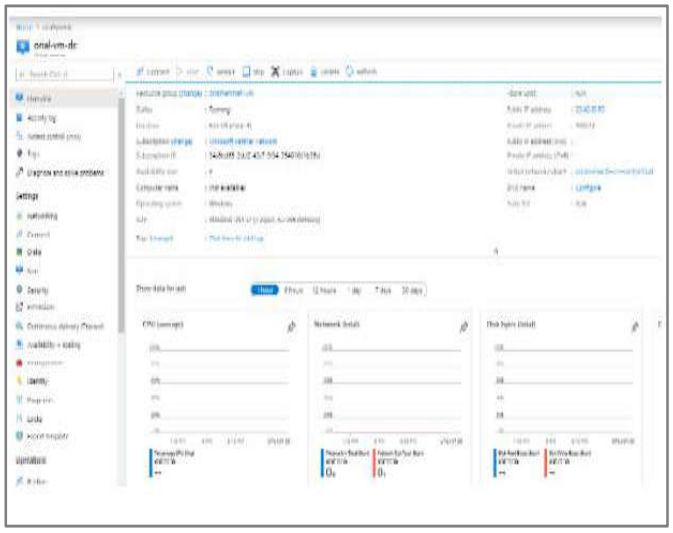

Figure 32. IassS and PaaS Platform

PaaS provides on-demand services, which include a computing platform and solution stack as a service to the clients. IaaS provides infrastructure to the organizations on a rented basis related to servers, computers, networking devices, hardware and software. This review discusses the benefits and challenges of cloud services. It is believed that these cloud services will be widely accepted by business organizations to carter their IT needs in the coming time and will redefine the new standards and protocols of Cloud Computing.

CONCLUSIONS

1. A successful implementation of any IT structure depends heavily on choosing and planning of an architecture to meet efficiently the needs of the computer system we want to develop.
2. In order to achieve the desired purpose beneficiaries of cloud should be very careful in choosing a provider.
3. Most important thing is paying only for what you use.

In this paper we have discussed about Microsoft Azure and how we can benefit from using it. We have create a IaaS, PaaS and discussed the comparison with other cloud computing platform like Amazon Web Services (AWS) and Google Cloud Platform (GCP).

FUTURE WORKS

The concern in the cloud computing is SECURITY around data, access and privacy protection. Cloud computing should be secure, robust and should mitigate the risks. [10] Artificial Intelligence and its data source will continue growing in the future. All businesses will continue to use AI in the workload. Being able to not only manage this growth but harness it effectively is where the future of AI in cloud computing is headed. Specialized hardware like GPUs will become even more embedded with AI workloads and deep learning with their high memory bandwidth and ability to do parallel computation.

REFERENCES

1. ECAI 2016 - International Conference – 8th dition Electronics, Computers and Artificial Intelligence 30 June - 02 July, 2016, Ploiesti, ROMÂNIA Cloud Computing and Windows Azure.
2. https://azure.microsoft.com/en-in/overview/what-is-cloudcomputing/#benefits.
3. Software as a Service, Platform as a Service, Infrastructure as a Service - A Review Sumit Goyal Member, IDA, New Delhi, India
4. A Comparison of Amazon Web Services and Microsoft Azure Cloud Platforms for High Performance Computing
5. Amazon Web Services, "Amazon C2 Instance Types," 2017. [Online].Available: https://aws.amazon.com/ec2/instance-types/.
6. Cloud Computing in Amazon and Microsoft Azure platforms: performance and service comparison Borislav S. Đorđević, Slobodan P. Jovanović and Valentina V. Timčenko, *Member, IEEE*
7. *A Precise Model for Google Cloud Platform* 2018 IEEE International Conference on Cloud Engineering'
8. *Computing Conference* 2017 IEEE Comparison of the Cloud Computing Platforms Provided by Amazon and Google
9. Why Google Cloud Platfrom? https://cloud.google.com/whygoogle/last access 2017
10. CLOUD COMPUTING SECURITY:AMAZON WEB SERVICE 2017 Fifth International Conference on Advanced Computing & Communication Technologies
11. Cloud Computing in Amazon and Microsoft Azure platforms: performance and service comparison Borislav S. Đorđević, Slobodan P. Jovanović and Valentina V. Timčenko, Member, IEEE 2016
12. https://docs.microsoft.com/en-us/azure/availability-zones/azoverview

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