COLLEGE OF COMPUTING TECHNOLOGY - DUBLIN
BACHELOR OF SCIENCE IN INFORMATION TECHNOLOGY

CLOUD COMPUTING FUNDAMENTALS & PLATFORMS

Assessment 1 – Physical Server Hardware Research

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1 Scenario

You are the assistant to the Network Administrator of a networking consultancy company called CompuTech. Your company will be providing Networking consultancy services for DigiTech (which is a small product services company). DigiTech runs their applications in their server room but their equipment is getting old and slow.

They are consulting with you so that they can decide about modernizing the network infrastructure of their office or perhaps migrating their Web site from their server room on to a public Cloud.

2 Modernizing the network infrastructure

In Table 1 we show the network equipment required for the client. We included Make and Model, Seller, URL, Price and Purpose of each proposed network equipment.

Because DigiTech is a small product services company, we decided to propose articles of not very high costs instead of very hight performance equipment; which would raise the cost unnecessarily.

After a research where the most important network companies (HP, IBM, Cisco) where considered, we decided to choose DELL due to:

- The excellent support and detailed online exploitation of the available items,
- Best prices.

The total cost of the proposed network infrastructure refresh is € 23,988.01 (See Table 1 for details).

Network Equipment Item	Make and model	Seller	Purpose – URL	Image
Server with the following specifications	**DELL: PowerEdge R440 Server**	Dell	This server has been customized at DELL Web site: http://www.dell.com/en-ie/work/shop/scc/sc/servers?~ck=mn	
Intel Xeon Processor(s)	Intel® Xeon® Silver 4116 2.1G, 12C/24T, 9.6GT/s, 16.5M Cache, Turbo, HT (85W) DDR4-2400			Figure 2.2
RAM: 32 GB (minimum RAM)	32GB RDIMM, 2667MT/s, Dual Rank	Dell		Figure 2.3
Hard disks: 4 x 2TB SATA	2TB 7.2K RPM SATA 6Gbps 512n 2.5in Hot-plug Hard Drive	Dell		Figure 2.4
RAID 5 (with on-board RAID controller)	C4, RAID 5 for 3 or more HDDs or SSDs (Matching Type/Speed/Capacity) **Controller:** PERC H330+ RAID Controller, Adapter, Low Profile	Dell	The storage configuration RAID allows to combines multiple physical disk drive components into one or more logical units for the purposes of data redundancy, performance improvement, or both [Wikipedia]	Figure 2.5
Power Supply: UPS - 1500 VA	Dual, Hot-plug, Redundant Power Supply (1+1), 1100W -48VDC Only	Dell		Figure 2.6
3 Year Warranty (optional)				
Total price for 5 server				Figure 2.7
Rack to hold all 5 blade servers	APC NetShelter SV - Rack - cabinet - black - 48U - 19-inch	Dell	Hold all 5 servers	Figure 2.8
26-port Gigabit Ethernet Switch	Cisco SG200-26P	Sold by Homegoods Shop and Fulfilled by Amazon.	Connect devices within a local network. https://www.amazon.com/Cisco-SG200-26P-Ethernet-Mini-GBIC-SLM2024PT/dp/B004GHMU5Q	Figure 2.9
Load Balancer	Barracuda Networks BBF240A33 LOAD BALANCER 240 WITH 3 YEAR EU+IR	NeoBits	A Load balancer improves the distribution of workloads across multiple computing resources https://www.amazon.com/Barracuda-Networks-BBF240A33-LOAD-BALANCER/dp/B00J0N10TI/ref=sr_1_6?s=pc&ie=UTF8&qid=1520773155&sr=1-6&keywords=load+balancer	Figure 2.10
Windows Server 2012 Datacenter Edition	Microsoft	Microsoft		Figure 2.11
Total				

Table 1: Specific requirements for the network equipment

Figure 2.1: DELL: PowerEdge R440 Server - http://www.dell.com/en-ie/work/shop/povw/poweredge-r440

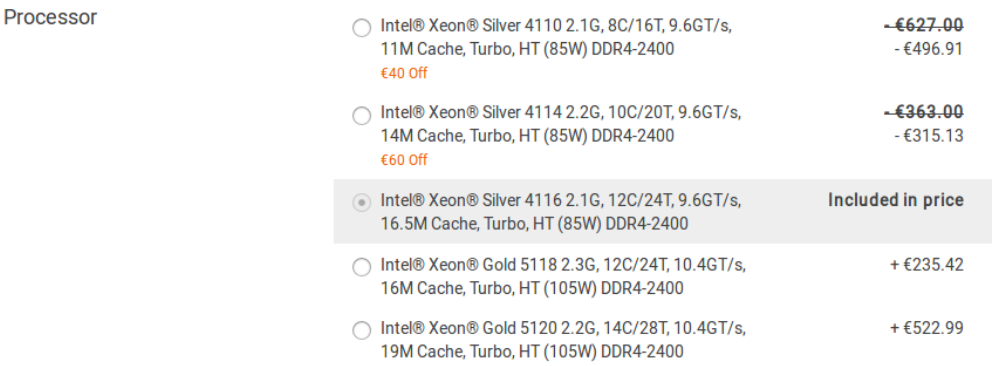

Figure 2.2: Server configuration: Processor

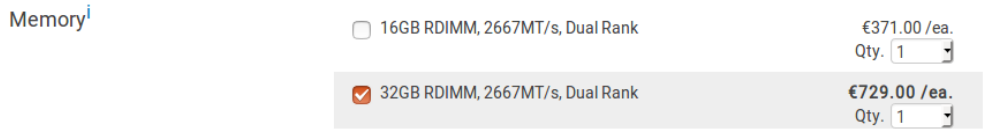

Figure 2.3: Server configuration: RAM Memory

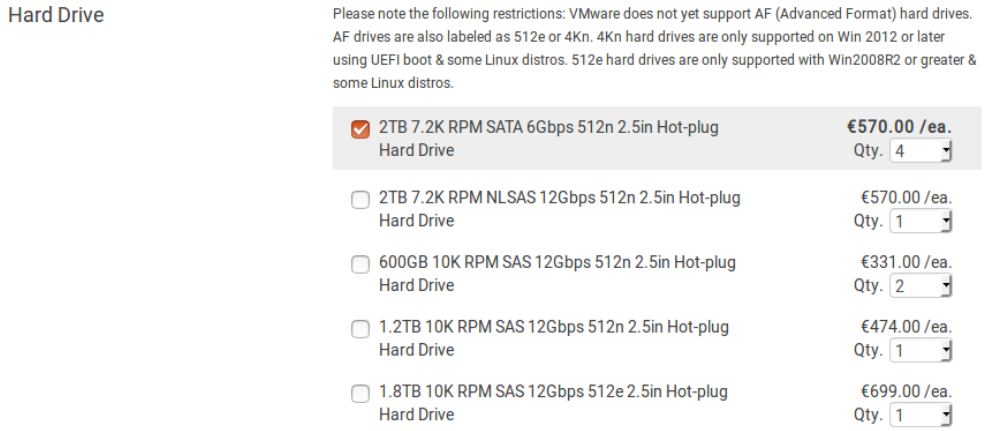

Figure 2.4: Server configuration: Hard Drive

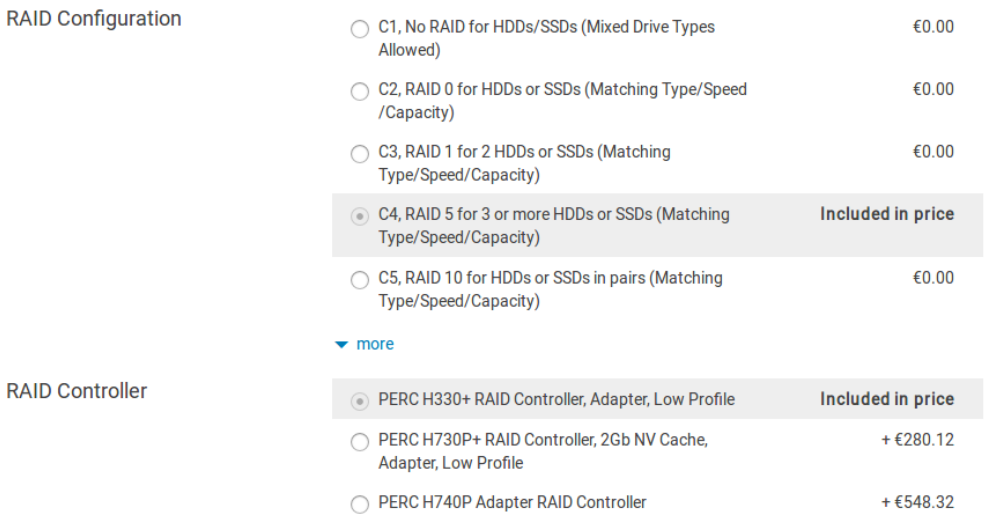

Figure 2.5: Server configuration: RAID

Figure 2.6: Server configuration: Power supply

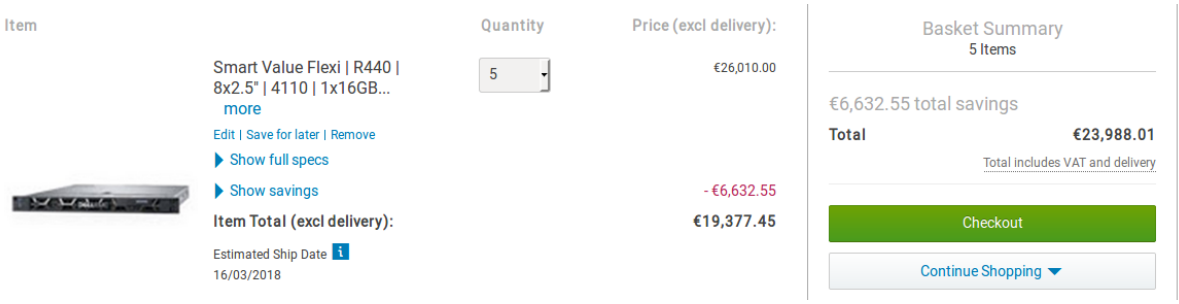

Figure 2.7: Total price for 5 servers

Figure 2.8: Rack

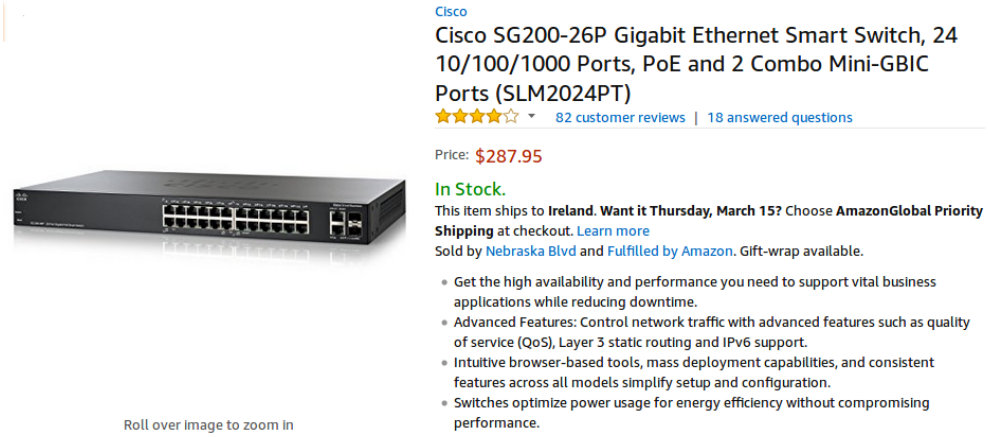

Figure 2.9: 26-port Gigabit Ethernet Switch

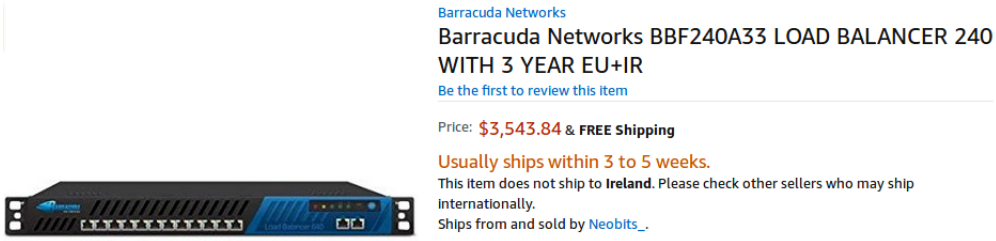

Figure 2.10: Load balancer

Edition and pricing overview

Edition	Ideal for...	High-Level Feature Comparison	Licensing Model	Pricing Open NL (US$)
Datacenter	Highly virtualized private and hybrid cloud environments	Full Windows Server functionality with unlimited virtual instances	Processor + CAL*	$6,155**
Standard	Low-density or non-virtualized environments	Full Windows Server functionality with two virtual instances	Processor + CAL*	$882**
Essentials	Small business environments	Simpler interface, preconfigured connectivity to cloud-based services; no virtualization rights	Server (25 User Account Limit)	$501**

Figure 2.11: Windows Server 2012 Datacenter Edition

3 Case study of one company that successfully migrated their on-premise network onto a public Cloud provider

In this sections we describe the experience of the company InformaIT when migrating his on-premise application (The Document Comparison system - DC) to the cloud. This case study was done by Rabetski et Schneider (2012). Therefore, below we will show a summary of the original paper. We will focus on the aspects that we consider most important.

«InformaIT is a small independent software vendor (ISV) that focuses on document management systems.» [Rabetski et Schneider (2012)]

«The Document Comparison system (DC) was selected as a candidate for experimenting on the migration of applications to the Cloud. DC is a small web-based enterprise solution that enhances document management processes. The main purpose is to provide a fast and easy way to compare textual and graphical content of different digital documents.» [Rabetski et Schneider (2012)]

3.1 On-premise deployment model

3.1.1 DC architecture

DC contains five main components (See Figure 3.12):

- **Frontend web application:** The frontend is a simple ASP.NET web application running under IIS on Windows OS. It provides web interfaces for end-users, so they can upload digital documents, change configuration settings, analyze the result, and generate re-ports. [Rabetski et Schneider (2012)]
- **Backend engine:** The backend is implemented as a Windows service (.NET based). It performs long running computational tasks. e.g. the rasterization of digital documents. [Rabetski et Schneider (2012)]
- **Shared file store:** The file store serves as a shared storage for system components. It keeps persistent data and organizes asynchronous communication between the frontend and the backend. [Rabetski et Schneider (2012)]
- **Distributed cache:** The cache layer keeps frequently used data, which increases the performance of the system. For example, the frontend stores the latest document comparison result there. [Rabetski et Schneider (2012)]
- **Database:** Unlike many document management systems, DC is not database-centric. The amount of data in the database is quite small and is used infrequently. [Rabetski et Schneider (2012)]

3.1.2 On-premise distributed deployment model of DC

An on-premise distributed deployment model of DC is shown in Figure 3.13:

- Frontend web application (ASP.NET) are composed into a Web Server Farm. [Rabetski et Schneider (2012)]
- They store frequently used data in a distributed cache that is usually located on a separate server. [Rabetski et Schneider (2012)]
- Backend engines are deployed separately as well. [Rabetski et Schneider (2012)]
- A shared network folder plays the role of persistent file storage. Microsoft SQL Server is used as a database. [Rabetski et Schneider (2012)]
- End-users are usually located in the same environment where the system is running. [Rabetski et Schneider (2012)]

3.1.3 Advantages of the On-premise model

This on-premise deployment model gives several advantages:

- First, it keeps data and code physically close. It results in very low latencies and no bandwidth limitations. [Rabetski et Schneider (2012)]
- Second, sensitive data never goes outside the organization, which provides a high level of security. [Rabetski et Schneider (2012)]

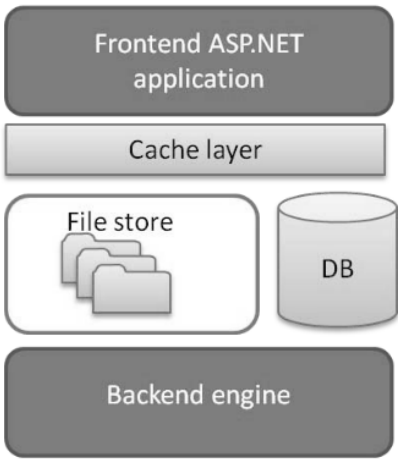

Figure 3.12: DC components [Rabetski et Schneider (2012)]

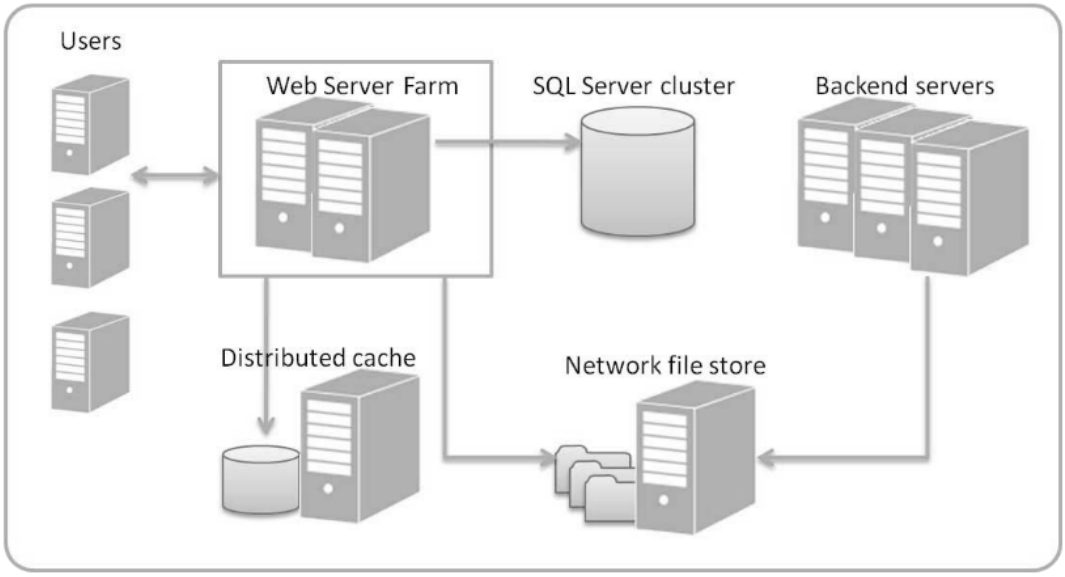

Figure 3.13: On-premise distributed deployment model of DC [Rabetski et Schneider (2012)]

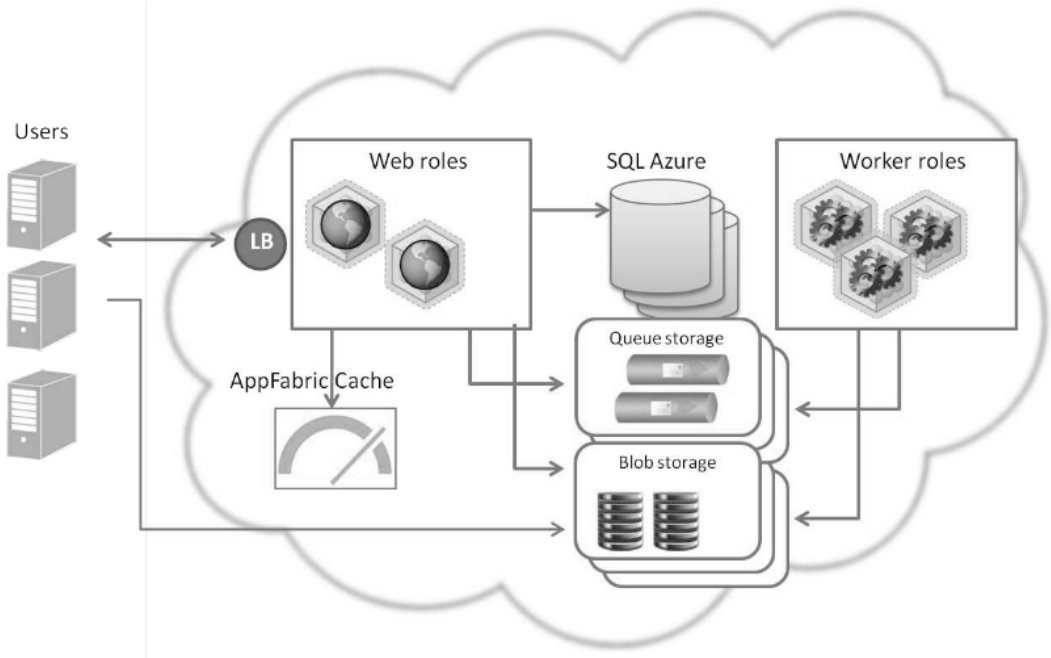

Figure 3.14: Cloud deployment model of DC [Rabetski et Schneider (2012)]

3.1.4 Disadvantages of the On-premise model and Motivation for the migration

- In this On-premise model, DC is deployed on servers located in the data centers of customer organizations. This means customers have to take care of the infrastructure, and have technical personnel to maintain it. [Rabetski et Schneider (2012)]
- **The biggest motivation for the migration is the potential for more sales:** DC is currently oriented to big and medium organizations that have enough resources, own infrastructure, and technical personnel to install and run the system. Furthermore, the license cost is quite high. Potential customers such as small companies cannot afford DC. Some of them would like to use the system inconstantly and pay only for the amount of compared data. SaaS version of DC can bring the product to such customers. [Rabetski et Schneider (2012)]
- **Another cloud computing advantage is easier installation and upgrade procedures:** The system is currently distributed across many customers. InformaIT has to convince each customer to replace an on-premises package and then assist during the actual upgrading. Some customers still run older versions of the system, which brings an additional support overhead. [Rabetski et Schneider (2012)]

3.2 Cloud deployment model of DC

3.2.1 Choosing a cloud provider

The first step when moving an on-premise application to the Cloud is to choose a proper cloud provider. We examined three major cloud providers (AmazonWeb Services, Google AppEngine, and Microsoft Azure). Based on our finding we conclude that Google AppEngine is the worst candidate for DC because it does not support .NET applications, while Amazon AWS and Microsoft Azure both fit for the migration quite well. After further analysis we prefer Windows Azure to Amazon AWS for several reasons: [Rabetski et Schneider (2012)]

1. It requires less configuration effort,
2. It has a faster deployment model, and
3. It allows consistent development experience for applications that are well-versed in Microsoft technologies. [Rabetski et Schneider (2012)]

3.2.2 Compatibility issues

- Current solution uses .NET 2.0 and VS2005 that are not supported by Microsoft Azure. [Rabetski et Schneider (2012)]
  - Solution: The platform uses the latest product versions. The system should be migrated to .NET 3.5/4.0 and VS2010 [Rabetski et Schneider (2012)]
- The system cannot register COM components directly from code due to environment limitations. [Rabetski et Schneider (2012)]
  - Solution: There are some workarounds that allow using COM components for Azure applications: Registration-Free COM and role startup scripts. [Rabetski et Schneider (2012)]
- Standard ASP.NET session state modes do not suit Azure environment. In-Process mode is not an option because of a non sticky load balancer. [Rabetski et Schneider (2012)]
  - Solution: The system needs distributed session storage in order to scale. We suggest using AppFabric Cache (or optionally Table Storage). Microsoft Azure offers an easy way of using these storages. [Rabetski et Schneider (2012)]

3.2.3 Cloud DC architecture

- **The frontend:** Azure Web Role is an obvious choice for our ASP.NET frontend. Web Role has a preconfigured IIS and a built-in load balancer for web applications. Still, there are some limitations to keep in mind. For example, the Azure load balancer is not sticky, meaning that two requests from the same user can be processed by different Web Role instances. Also, Web Role supports only IIS 7.0 and requires .NET 3.5/4.0. [Rabetski et Schneider (2012)]

- **The backend engine:** The backend maps to a Worker Role, since it suits perfectly for long running background tasks. It is worth noting that roles do not have administrative privileges in the environment. It restricts the execution of tasks that change OS configuration e.g. registration of a COM component or changing OS registry. [Rabetski et Schneider (2012)]

- **The distributed cache:** Microsoft Azure has only one service for distributed cache so far, AppFabric Cache. Alternatively, cached data can be stored in either SQL Azure or regular Azure Storage. Though AppFabric Cache is considered to have better performance compared to the alternatives, it is quite expensive and limited in size (4GB maximum). We choose AppFabric Cache under the assumption that the size of data stored in cache will be significantly reduced. Otherwise we suggest using Table Storage. [Rabetski et Schneider (2012)]

- **The database:** On-premise DC version uses a Microsoft SQL Server database. We find SQL Azure to be a perfect cloud alternative. [Rabetski et Schneider (2012)]

- **The file store:** We have found out that the local file storage is not persistent and cannot be shared with other roles. All data stored locally gets lost if the role dies. The only persistent option for Azure applications is Azure Storage. We suggest using Queue Storage for messaging and Blob Storage for the files shared among roles. [Rabetski et Schneider (2012)]

3.2.4 Performance problems

A cloud environment entails increased latencies and unknown hardware underneath. Therefore, DC can have the following performance bottlenecks in the Cloud:

- The execution of heavy computational tasks (like digital document rendering) that require efficient hardware; and session handling that is latency sensitive. These operations represent the highest risk when moving DC to the cloud environment, because they might lead to significant system performance degradation. [Rabetski et Schneider (2012)]

3.3 Analysis and conclusions

From the study carried out by Rabetski et Schneider (2012) we want to highlight the following:

The advantages of a Cloud deployment model presented in this work are:

- Customers can acquire the software in a much easier way and at a lower price: For customers, an On-premise deployment of the application requires resources such as infrastructure and technical personnel, which makes the deployment more difficult and raises costs. Therefore, as stated by Rabetski et Schneider (2012), «the biggest motivation for the migration is the potential for more sales.»
- Easy installation and upgrade procedures: On a Cloud deployment model, InformaIT doesn't need to assist every single customer during upgrading.

From the paper, we can also notice the importance of choosing a cloud provider. It is common to find compatibility issues between the on-premise deployment and the possible deployment on a cloud provider. Therefore, it is vital to choose the most compatible provider with our system to avoid making unnecessary modifications. For example, the paper show that Google Cloud can't be chosen in this case because it doesn't support .NET applications as DC.

Regarding the disadvantages of Cloud deployment, we can see that the most important issue that is show in the paper is related to performance problems. As mentioned in the paper, a cloud environment increased latencies. As a result, the performance of heavy computational tasks can be affected.

Finally, we want to state that of migrating a system to the cloud is a process that depends on the specific characteristics of each system. That is why a detailed analysis must be carried out to determine if a cloud deployment would be appropriate an in case it is, to determine the most appropriate path in the migration process.

Declaration

I hereby declare that all of the work shown here is my own work.

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