Carbon Price of Cloud Computing

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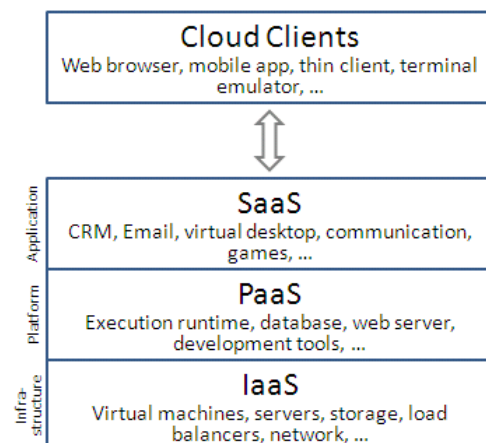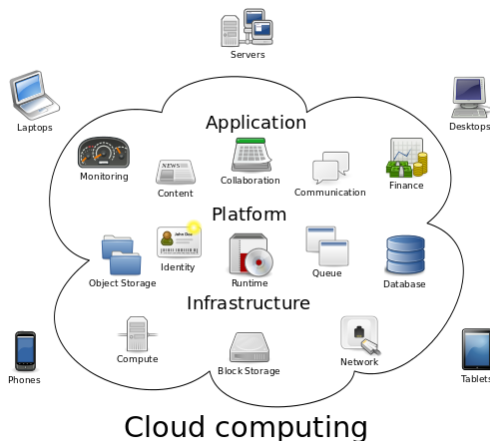
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Abstract: The digital cloud is thought to be invisible. Instead of physical storage devices like books, CDs, DVDs, newspapers, and magazines, we have pure data, traveling throughout the interconnected web. Now we can access everything at a push of a button. But is the cloud actually invisible? No, there is a physical substance to it: the data centers. The data centers space all over the world is big enough to fit approx. 6000 football fields. These data centers obviously run on electricity. And if the source of electricity is fossils, it does have a carbon price. As cloud computing is essential in modern practices, it cannot be compromised. Hence, a detailed analytical study is essential to bring down the negative impact of cloud computing on the environment. This paper overviews the effects of cloud computing on nature and advanced technologies which can be used to solve its negative impact.

Keywords: Cloud, The Web, Data Centers, Carbon Price.

I. INTRODUCTION

Understanding the Cloud:
Cloud computing, often referred simply as 'Cloud', is the delivery of computer services (everything from applications to data centers) over the Internet.

Cloud computing

The resources on the cloud can be shared by different clients allowing companies to avoid the upfront infrastructural cost. Using cloud computing, a company can focus on its core business instead of focusing on computer infrastructure. TBR predicts worldwide public cloud revenue will increase from $80B in 2015 to $167B in 2020. [1] Clouds can be broadly classified in public, private and Hybrid clouds. Each one of them having their own advantages and disadvantages.

Service models:
The services offered by cloud providers are based on different models - Software as a Service (SaaS), Platform as a Service (PaaS) and Infrastructure as a Service (IaaS).

Software as a Service(Saas)
The consumers are given capabilities to use certain applications running on the cloud. Consumers are not responsible for managing the underlying Network infrastructures such as servers, OS, storage etc.

Platform as a Service(PaaS)
The consumers can deploy onto the cloud infrastructure using libraries, services, and tools supported by the provider. The consumer cannot manage the underlying infrastructure but has control over the application deployed.

Infrastructure as a Service(Iaas)
The consumers are given control over processing, networking, storage, and other fundamental computing resources. The consumer does not manage the underlying network but has control over deployed applications, storage, and operating system.

Deployment Models:

Private Clouds:
The cloud infrastructure which is solely deployed for a particular organization is known as Private Cloud. It requires huge capital. They have a significant physical footprint, space allocation, carbon emission, and hardware control.

Public Clouds:
Clouds which are distributed over a network open for public use are called Public Clouds. Public Cloud services can be free or charged, depending on the provider. Public Clouds are concerned with security issues as they are open to public use.

Hybrid Clouds:
Hybrid Clouds are a combination of different clouds which act as different entities but are bound together. Hybrid Clouds can provide the benefits of different cloud models while discarding their disadvantages. For example, an organization may want to store customer's data on their private cloud due to security issues but want to use public clouds for applications and services.
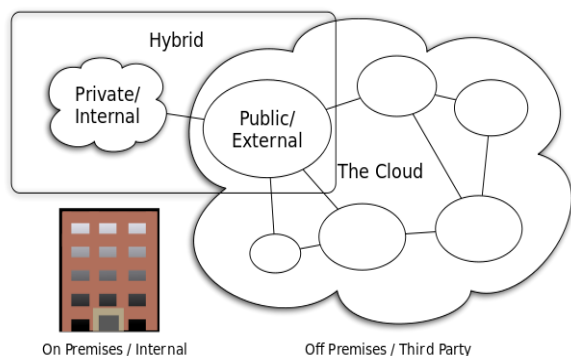
Cloud Computing Types   CC-BY-SA 3.0 by Sam Johnston

Benefits of cloud:
1.   Cost
Cloud computing reduces the capital expense of buying hardware and software and setting up on-site data centers. It also reduces the costs needed for maintenance.
2.   Speed
The data centers which provide cloud services have high-end systems with advanced systems. This provides much higher speed compared to on-site data centers.
3.   Productivity
On-site data centers demand lots of off topic works such as setting up, maintenance etc. By implementing cloud services, an organization can focus on their core business.
4.   Scalability
The cloud works on the global scale. A business can access cloud services from any part of the world.

5.   Reliability
As the data are present in a single location, it can be secured with advanced technologies. Also, backups and restoring of data is much easier by implementing cloud services.

II.   ENVIRONMENTAL HAZARDS

Cloud computing is considered to be greener to on-site server approach, which surely it is. But with companies implementing the cloud infrastructure is growingly rapidly. The benefits of clouds have shadowed its demerits. According to new Greenspace reort[2], 2% of the total carbon emission in the world is caused by the IT industry. With the increase in users online, the amount of data stored in the cloud is increasing day by day. As we continue to generate more data, the need to set up more servers increases. For instance, Antivirus Corporation, McAfee states that the amount of energy requires filtering the spam mail sent annually is equal to power 2 million houses in the United States[3]. GreenPeace reports that by 2020, cloud computing culture will feed on electricity fodder of approximately 1,963 million kilowatt hours and this is equal to CO_2 excretion of 1,034 megatons.[4]
And with advancement in technologies, analysts suggest that the data we store over the Internet will increase exponentially.

Many of the data stored are rarely used and are regarded as Digital Waste. Same pictures are uploaded with different pixel sizes. Word and Pdf documents are present which are no longer used (due to incompatibility with the upgraded version) adds to the digital waste. Social media is growingly at a great pace. People posts photos and videos which are never bothered to look at after several days. Methods of formatting file suits need to be transformed in order to minimize the burden of Digital Waste.

III.   GREENER APPROACH

Cloud computing cannot be completely ignored. The utilization of clouds has given significant levels in an increase of business profits as well as reduction of Carbon emission. But, with the constant increase in data, the amount of carbon footprint produced by the data centers will also increase.
Many companies have taken steps in order to make their clouds greener, some of them being Microsoft, Google, Facebook etc.

Google was one of the first company which took steps to reduce energy consumption by its servers worldwide. The major approach Google is trying to promote is the use of Renewable energy. Facebook's new center in Iowa, is promised to be completely powered using wind energy. There has been an advancement in hardware and software

for a greener alternative. European online space suppliers have designed cooling apparatus to regulate temperature in their premises.

As the negative impact of clouds can't be completely abolished, the following approaches are most welcome.

➢ **Use of Renewable Resources to power data centers**

The clouds won't be completely green unless it is power by renewable sources. The major difficulty in this method is it is practically not possible to power huge servers with just renewable energies. Also, the amount of energy generated by renewable sources is not constant and depends on weather conditions and geographical factors.

Instead of having one huge data center, it can be divided into several small centers using renewable sources.

➢ **Virtualization**

Virtualization is arguably the most adopted IT method of making a company green. Virtualization enables servers to operate at levels nearer to their speculative upper limit. Virtualization reduces the use of hardware, thus reducing the total cost and carbon emission.

➢ **Quantum Computing**

The next advancement in IT sector is Quantum Computing. It enables the use qubits. Qubits can have the value of 0, 1 or both, which is better than the traditional binary bits. This will considerably reduce the amount of energy utilized by the factor of several thousand.[5]

➢ **Relocating data centers**

Heat generated by data centers is one of the major energy consuming activity. Shifting the data centers to the Arctic region where it will naturally cool is a good approach.

➢ **Giving power to user**

We need to be responsible at a personal level. We need to start taking care of the items we upload and not waste them. We could request to remove the waste items. We could allow our digital waste to be automatically deleted after a certain interval of non-use.

IV. CONCLUSION

Everything comes with a price, so is the case with cloud computing. We can't do much to minimize its ecological effects on a global level, but with the advancement, in technologies, we can take various measures to reduce it on a personal level.

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