CLOUD COMPUTING

Qi Zhang · Lu Cheng · Raouf Boutaba

State-Of-The-Art And Research Challenges, University of Waterloo, CA 2010

SUMMARY OVERVIEW

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SUMMARY

In their article "Cloud computing: state of the art and research challenges", Professors Qi Zhang, Lu Cheng, Raouf Boutaba, from the University of Waterloo, attempt to define and describe a recent paradigm of hosting and service delivery emerging on the Internet called cloud computing. Due to its tremendous opportunities for the IT industry, the article provides an amazing introduction to this field while stating its essential concepts, architectural designs, prominent characteristics, key technologies as well as research directions.

Definitions   The professors explain how cloud computing has changed the role of a service provider who, on the one hand, has an infrastructure that manages the cloud platforms and its usage-based pay-as-you-go pricing model, which on the other hand, provide the service for the end users.

They also list and discuss some other Cloud computing features such as active low cost by easily specifying and accessing massive resources with less risk and more affordable maintenance while insisting on the significant challenges that are presented.

As of what they say, cloud computing is based on gathering resources from servers to be virtually assigned to the requested applications.

The National Institute of Standards and Technology NIST defines it as follows,

> 66 Cloud computing is a model for enabling convenient, on-demand network access to a shared pool of configurable computing resources that can be rapidly provisioned and released with minimal management effort or service provider interaction.. 99

Related technologies   The professors insist that cloud computing is not a new technology but a new working model using certain existing technologies in a more optimal way.
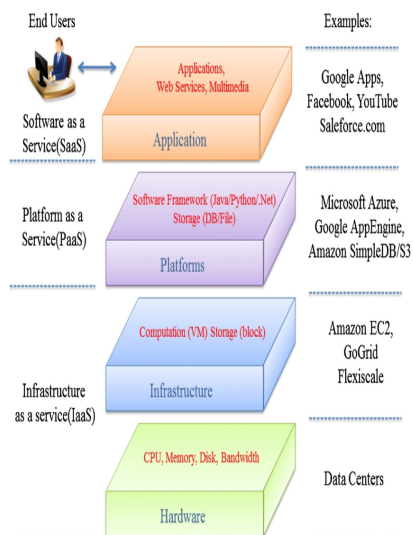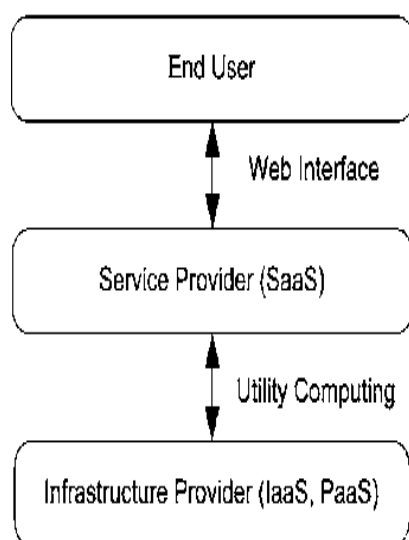
Figure 1: Cloud computing architecture.

Figure 2: Business model of cloud computing.

In addition, they explain that cloud computing combines computing technologies equivalent to a grid that bring together connected resources to reach a specific objective or a utility that delivers as much resources as paid for or even an autonomic one that establishes a self operating systems without forgetting the virtualization that expands, theoretically, the physical hardware. All that is collected to make resources available for use.

Cloud computing architecture   The authors point out that compared to its ancestors, cloud computing has a more convenient architecture that consists of 4 aspects of control, in which the deepest one treats hardware while the other processes software and between them comes the infrastructure skin that controls the indispensable virtualization and on top of all of that the actual cloud applications occurs.

Business model   The article lists the 3 paid services cloud computing business model offers to users, IaaS, PaaS and SaaS.

Both, Infrastructure as a Service that controls the infrastructural resources such as virtual machines and the Platform as a Service that tackles the operating system, are believed to be provided by the same companies.

Finally, software as a service is responsible for providing the required applications on the web.

Types of clouds   The professors suggest that to proceed to a cloud environment, companies must choose between many types of clouds that most benefits them. A public cloud that provides resources to the pubic or a private cloud limiting the usage by a single firm or the combination of the two in a hybrid cloud without forgetting the virtual private cloud that features its own virtual private network.

Surprisingly, The professors note that hybrid cloud were predicted to be dominant but virtual private clouds have become more popular.

Cloud computing characteristics   The article state the many characteristics of cloud computing compared to its predecessors that data centers contains more than one provider services while the infrastructure gather computing supplies and propose it to the end user and the cloud can even be accessed and modified from anywhere in the world by connecting to the internet without forgetting its service-driven operating model and its pay-per-use pricing alongside that manageable consumption.

Architectural design of data centers   In this part, the professors explain the data centers, the location of storage and computation power of the cloud and it consists of many network devices.

Furthermore, the core, aggregation, and access layers represent the layers of the data centers.
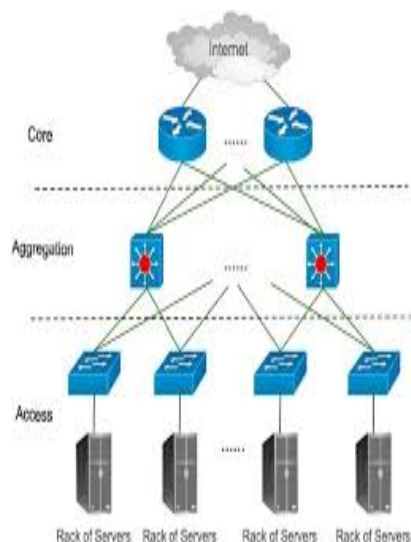
Figure 3: Basic layered design of data center network infrastructure.

The Data center planning should give any host the highest ability to make contact with another host and a virtualization that grants the VM state to circulate quickly all over the network.

They believe that Data centers must be very resilient, this does not mean that failures will not occur, but they must be built so as not to be affected and must have a scalable network infrastructure that should also be backward compatible.

It is reported that a new innovation called modular data center MDC is experiencing popular growth due to its redundancy.

Distributed file system over clouds   The article concentrate on 2 distributed file system over many units, Google File System (GFS) and Hadoop Distributed File System (HDFS), and indicate that newly created data centers use clusters of servers and a Google mapReduce program implemented to manage groups of computers.

Research challenges

The professors concentrate on the fact that cloud computing is still new on the market even though it's been widely used. However, many new positives and negatives may pop up in the near future. The dynamism in the cloud computing is key although it faces some expected problems that has been on study since sometime now, even before cloud computing.

Automated service provisioning   They believe that resource control has 2 very important and necessary techniques, it can be either proactive, the one who uses the planned demands, or reactive, the one who reacts to requests, on his way to allocate the needed resources.

Virtual machine migration   They encourage the use of virtualization by insisting on its pros especially when migrating virtual machines that allows a powerful sensitive storing in data centers and if enabled, it balances the charge but avoiding problems could be the real benefit here.

Server consolidation   They suggest that server consolidation must not affect the performance while impressively reducing energy waste and even heavily using the resources.

Energy management   The authors think that attention to energy capability is starting to grow in face of this serious matter.

Traffic management and analysis   They see that data analysis is becoming the big deal, but in the meantime, it's not the center of attention, keeping in mind the challenge that faces the Internet service providers or ISPs in distributing traffic to data centers.

Data security   They're afraid that data security is another concern in cloud computing having in mind that service providers do not have direct access to the security in the data centers so it should depend on the infrastructure provider to guarantee that.

Software frameworks   They have found new research that is focusing on the cloud computing platform to host exhaustive applications using hadoop while other research is trying to make it energy-conscious.

Storage technologies and data management   The software use mapReduce frameworks that are made for distributed processing of exhaustive missions but encounter some compatibility issues that they believe should be fixed as soon as possible.

Novel cloud architectures   Therefore, as they explain it, most of the clouds are installed in economical and manageable data centers, but this had to be done by sacrificing the resulting expensive energy, for this reason, a study has found a new way that is in using voluntary resources that likewise face its own challenges.

Zhang, Cheng and Boutaba conclude the article by focusing on the growing importance nowadays of the cloud computing as a managing and delivering services but despite that, a long way of researches should go ahead before having the optimal final product.

In this summary, we looked at the article "Cloud computing: state of the art and research challenges" trying to understand the cloud computing world and data centers, its pros, its cons and the challenges rising ahead beside the researches and invention that should be made for it to achieve full potential and gain more popularity and confidence on the market