Service and Business Models with Implementation Analysis of Distributed Cloud Solution

Olga Yanovskaya[1], Maria Anna Devetzoglou[2], Vyacheslav Kharchenko[1,3] and Max Yanovsky[1],

[1]National Aerospace University named after N.E. Zhukovsky "KhAI", Kharkiv, Ukraine
[2]International Creativity Engineering Group, Athens, Greece
[3]Centre for Safety Infrastructure-Oriented Research and Analysis, Kharkiv, Ukraine
[1]{O.Yanovskaya, M.Yanovsky}@csn.khai.edu
[2]M.Devetzoglou@interceg.com
[1,3]V.Kharchenko@khai.edu

Abstract. The service and business models of a Distributed Cloud solution based on peer-to-peer technology are presented in this article, in order to implement the proposed solution. Methods for organizing the interaction between the participants' nodes and nodes that are non-participants in the Distributed Cloud are proposed. Passive replication is used to improve service reliability. A competitive analysis of existing solutions within the scope of a decentralization approach for content sharing is conducted. Average response time to a request for a centralized client-server and distributed Cloud architecture is estimated.

Keywords. Distributed Cloud, Peer-to-Peer Network, Data Center, Participatory Business Model, Service Reliability.

Key Terms. DataCloud, Reliability, Model, Infrastructure, Market.

1 Introduction

The IT industry constantly grows, raising the expectations of big organizations and individuals alike, changing the way things are done nowadays; in fact, without it, it would be impossible to conduct business and human interaction as we know it today would be greatly different across numerous professional and social sectors. At the same time, gradually more people and enterprises access the Internet, adding to the increasing needs of computing and generating data through various devices, at an accelerating rate. This data is required to be stored and handled in order to be secure and available to be retrieved once the user requests it.

To accommodate demand, large, expensive, energy hungry data centers have been built that only powerful company can afford to have. Additionally, they require high costs of maintenance, personnel, power back up systems and space. Located at a physical place, they are vulnerable to local conditions, be it weather phenomena, regional power cuts, earthquakes etc. Furthermore, 2% of global CO_2 emissions are attributed to the ICT industry, a significant part of which is caused by data centers. High investment costs for data centers prevent smaller companies from entering the market, making it necessary to improve service reliability, energy and cost efficiency of Cloud computing infrastructure.

Currently, the concept of P2P technology is not new but its application to cloud computing is at its early stages. However, it is gradually growing as more new companies begin to join the race to provide smarter and cheaper solutions. More specifically, the majority of the companies that are active in P2P cloud technology are strongly focusing on storage and sharing of documents, in order to facilitate storing options and to assist teams or groups to virtually interact through their documents. Additionally, they enhance user experience due to optimized infrastructure, collaboration and sync. BitTorrent goes a step further, by offering information sharing from device to device, skipping the use of cloud [1]. Within this suggestion, we propose a method for Cloud data center architecture modernization [2]. The method assumes implementation of distributional technologies such as peer-to-peer (P2P) networks to Cloud architecture. Distributed Cloud computing, being part of cloud computing, supports customers' needs and provides main cloud benefits. However, it differentiates itself from the existing Cloud Computing in a unique way: it is anthropocentric, revolving around people and their activities, making them sources and consumers at the same time. In addition to its human-centered function, P2P Cloud Computing is a new application of previous technologies, one that can provide both, value and results.

2 State of the Art

According to a Cisco study [3], it is estimated that data traffic will reach 7.7 ZB by 2017 and the need for more websites constantly and steadily rises. This need does not only apply to professionals and big companies that either have the money to allocate the task to a skilled person or have the skills themselves. It also corresponds to a wide number of individuals and companies that, although experienced in a number of sectors, may not have the skills or financial resources to create their content.

Currently, customers deal with scalability issues by using the services of Cloud providers. Studying the pricing of these services [4], it is found that customers may very well enjoy the benefits of the Cloud but at a rather significant cost. Many Cloud providers have joined the sector and provide solutions to customers. For companies that aim to scale up and grow, this can have a heavy toll on their budget and, in more than one cases, budget limitations may actually delay or even prohibit growth. According to the IDC, the cloud software market is forecast to surpass $75 B by 2017, while at the same time, the percentage of IT budget expected to be spent on cloud-based applications and platforms by current organizations within the next 2 years reaches 53.7%. Regarding storage as a service model, several solutions within the use of the decentralization approach were developed for content sharing. The following table depicts competitive products, their key features, their advantages and disadvantages.

Table 1. Competitive analysis of existing solutions within the use of decentralization approach for content sharing

Name	Key features	Advantages	Disadvantages
SpaceMonkey	Storage solution based on P2P technology that saves users' data both locally and remotely in a separate, remote 1 TB hard drive with 2 TB space using as P2P sync [5].	A cross-platform application. Free for the first year.	Expensive device ($795). Annual payment $49. Can only be used as Cloud storage and doesn't support other types of Cloud services.
Project Maelstrom	Web browser based on the Chromium Project that allows access to static web pages using torrent protocol [6].	No limits to file size and transfer speeds.	Can only be applied for static web pages without server part (database, cgi, etc.).
Wuala	Secure Cloud storage, a haven in the Cloud to store customers' files [7].	Components are secure against cryptanalysis (AES-256 for encryption, RSA 2048, SHA-256). System has redundant storage in different locations.	No free subscription. Can only be used as Cloud storage and doesn't support other types of Cloud services.
Sherly	Sharing large files (>20Gb) with secure access control [8].	Robust reporting. Simple access to management controls. Build-in auditing tools. Does not distribute copies of users' data but grants access to it instead. Can be used in both ways with either hardware (Sherlybox) or software.	Can only be used as Cloud storage and does not support other types of Cloud services.
Symform	Customers get 1GB free for every 2GB contributed [9].	A cross-platform application. Free and paid subscriptions.	Can only be used as Cloud storage and does not support other types of Cloud services.
BOINC	Uses the idle time on users' computer (Windows, Mac, Linux, or Android) to perform scientific computing [10].	Free.	Software is for volunteers within the academic society. Does not provide profits to users.

As seen by the table above, almost all of the presented solutions provide users with only one type of Cloud services – storage as a service, meaning they are unsuitable for deploying applications and service delivery. Moreover, the expenses issue remains unsolved.

The aim of this paper is to present the concept of a decentralized cloud architecture based on P2P technology, estimate its availability and to highlight the changes it may bring to business models within the sector. The paper is structured in the following way: section 2 presents the current status of the technology and benefits of Cloud usage. Section 3 describes the proposed solution. In section 4, the service model of the distributed cloud is presented. Sections 5 and 6 examine the response time to a request and the service availability respectively, while section 7 contemplates the business model that may be formed around the proposed idea. Finally, section 8 provides a case study for the implementation of the solution while the conclusion is presented in section 9.

3 Description of the proposed solution

When a company or individual wants to create a website about their activities or themselves, they usually have two options to select from, in order to successfully complete the task.

1. Hire professionals who will handle all the necessary steps, from ensuring a domain name to publishing the website. This solution is time efficient for the customer, as they do not allocate internal resources to such tasks and receive a ready-to-use product.
2. Use internal skills and set up the website on their own. This implies that members of the team have the skill and experience to create the website. The team has to allocate responsibilities, select and ensure a domain name, find and pay for a reliable host, use a template or create their own (based on their level of skills), insert and organize all content and then manage it.

Both solutions require a significant amount of money and, if the second option is selected, time and skills while at the same time, they completely depend upon the server and the data center that hosts them. In addition, there are fixed costs that need to be paid on an annual basis for maintaining it. Businesses may end up paying more than they actually use, limiting collaboration within the business teams due to teams operating in silos, easily maxing out their budget and facing scalability problems, which is one the biggest issues for companies when they plan for growth.

Cloud computing has been introduced as a new approach to satisfy customers' needs and is expected to continue its impressive growth. Cloud technologies facilitate data storage, data exchange and organization amongst businesses and individuals, provide flexibility, vastly reduce infrastructure costs and allow the workforce to better concentrate on their work, leading to increased productivity and efficiency.

However, the relationship between Cloud providers and companies/individuals is no different to any other model of service: supplier – buyer. This one-way model allows customers to store, manage and share data privately or publicly, using the Cloud service that the supplier provides.

The business model Cloud computing is founded on is a very intriguing and value centered model as it enables users to pay per use instead of paying on a time-set basis, regardless of the use they make. Distributed Cloud technology introduces a new type of Cloud services based on peer-to-peer technology that aims to facilitate and enhance content creation and resource sharing. The idea of distributed Cloud computing is to combine the Grid and Cloud concepts. For a distributed Cloud, users' workstations provide their own computing recourses (storage and computing power) to Cloud participants. The network architecture is based on the principle of equal interaction between nodes. The number of users who may share the resource increases as a function of the resource's popularity. This means that the more popular a resource is, the more the users that can access it and share it. Apart from the above advantages, the unique point of differentiation lies within scalability. Peer-to-peer technology enables users to scale their content for free, regardless of the scalability level.

As a result, both, small and big companies can use the same technological basis to scale their content and grow to new levels.

4 Distributed P2P Based Cloud Service Model

The focus of the study is to improve the process of allocating resources between user nodes in a Cloud with a distributed architecture [2] and to reduce the response time for such a Cloud. Fig. 1 illustrates an implementation of the proposed approach.

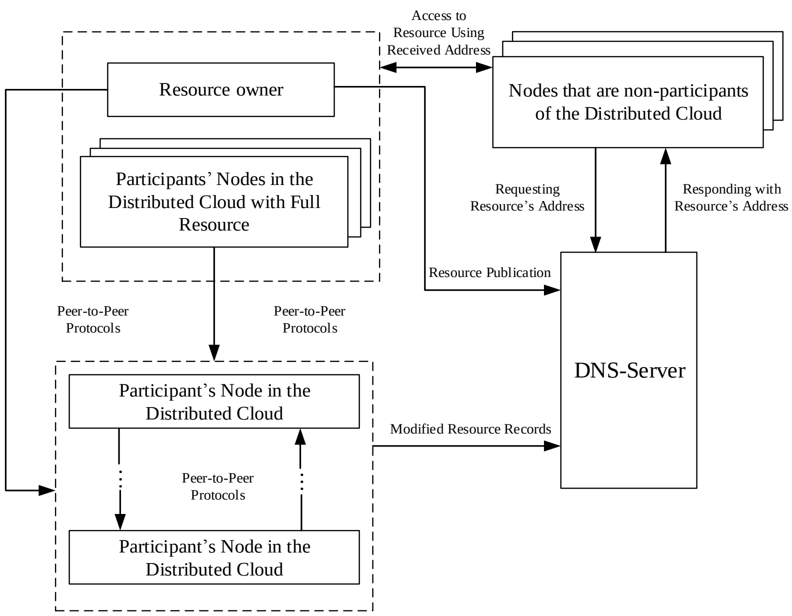

Fig. 1. Service model of the distributed Cloud

The solution can be found in organizing the decentralized resources between user nodes in a Cloud by using peer-to-peer protocols. Each node acts in 3 ways: as a client when making a request to the resource, as a server when responding to requests providing the resources and as a resource owner who has permission for full access. The initial stage entails the process of publishing the resource by its owner. It consists of creating an association between the domain name and the resource by adding the network address of the owner and the unique resource identifiers to DNS-record.

The domain name is used as a unique identifier while the resource allocation process is coordinated through the DNS-server by modifying the resource records. After the participant's node processes the request of a resource, it addresses it to the DNS-server and receives the address of the resource owner. The next stage is the resource replication process, which is implemented by a cache of request, and the response data on the storage of the user's workstation node makes it possible to share the result of the cache with other Cloud nodes. As a result, the node that responds to a request acts as a server and its address is added to one of the resource records of the DNS-server. It enables the node participant of the distributed Cloud to access the resource from several addresses contained in the DNS records, due to the fact that the requested resource is replicated, thus increasing the availability of the service. The more popular the resource, the more nodes can share it.

However, server functionality requires from the participant node to share the hardware resources of its workstation, such as storage space and processing power. The participants' nodes that interact with each other are equal and the implementation of the distributed Cloud on the users' side is achieved through the installation of a software on the workstations of each participant node. Furthermore, it is possible for participants' nodes that are non-members to access the resources through a regular request to DNS-server and to get the network addresses of the owner's station or the participants' nodes with the full resource. After receiving their addresses, they can interact with each other. However, it is important to note that for such users, the bandwidth is limited by the number of users that use the standard interaction mechanism.

5 Response time to a request

The response time to a remote Cloud server depends on several factors, such as customers' geographical location in relation to the server, the available bandwidth of communication channels and network interfaces, the number of concurrent user connections to the server, the rate of requests, the hardware configuration of the server etc. [11].

The average response time (receiving the service) for the end-user in a Cloud client-server architecture in general form can be expressed by the following formula:

$$t_{rrt\_c\text{-}s} = t_{base\_c\text{-}s} + t_{response\_serv} + t_{response\_BD}, \quad (1)$$

where $t_{rrt\_c\text{-}s}$ – the average time to access the resource,

$t_{base\_c\text{-}s}$ – the basic transmission delay on the communication channels,

$t_{response\_serv}$ – the server response time,
$t_{response\_BD}$ – the data base response time.

Consequently, the basic delay of the network transmission response is determined by the ratio of the data transmitted to the bandwidth:

$$t_{base\_c\text{-}s} = V/C, \quad (2)$$

where V – the data response size,
C – the available bandwidth.

The available user goodput is limited by the following: - the network adapter, - actual Internet access speed determined by the ISP, - the server bandwidth, - communication channels [12]. Thus, all users that are concurrently connected to the server evenly share the bandwidth. It means that the available goodput of the connection between the client and the server is determined by the goodput of the "bottle neck" of the route between the client and the server [13].

Therefore, to determine the value of the available goodput, the following expression can be used:

$$C = min\ (G, G_{serv}, G_{link}), \quad (3)$$

where G – the available user goodput,
G_{serv} – the available server goodput,
G_{link} – the available link goodput.

In cases where nodes of the distributed Cloud interact with each other, the average response time is defined by the sum of the basic time delay of the network component and the delay that is related to the process of finding and selecting the nodes that provide part of the resource, combining all the parts of the resource together and other time delays.

$$t_{rrt\_p2p} = t_{base\_p2p} + t_{interaction}, \quad (4)$$

where t_{rrt_p2p} – average time to access the resource,
t_{base_p2p} – basic transmission delay of the communication channels,
$t_{interaction}$ – interaction delay between nodes that provides resource or its part.

The basic transmission delay on communication channels, as previously mentioned, is determined by the bandwidth of the "bottle neck" of the network. The transfer of several parts of the resource may occur concurrently from multiple nodes with sufficient bandwidth. The overall delay network component will be determined by the slowest transmission time:

$$t_{base\_p2p} = max\ (t_{b\_p2p\_1}, t_{b\_p2p\_2}, \ldots, t_{b\_p2p\_N}), \quad (5)$$

where $t_{b\_p2p\_i}$ – the basic delay of the transmission communication channel from node i,
N – the number of nodes, from where receiving the resources occur concurrently.

Given the constraints of the available bandwidth, the user network adapter and the internet speed connection:

$$t_{b\_p2p\_i} = \begin{cases} \dfrac{V_i}{min\ (G,\ G_i,\ G_{link\_i})}, \sum_{i=1}^{N} G_i \leq G; \\ \dfrac{V}{G}, \sum_{i=1}^{N} G_i > G. \end{cases} \quad (6)$$

where G – the available user goodput,

G_i – the available goodput of i node,

G_{link_i} – the available link to the i node goodput,

V_i – the size of the resource V, provided by node i.

For a comparative evaluation of the average response time to a request for centralized client-server and distributed Cloud architectures, initial data (Table 2) is collected based on the analysis of the research [11-14].

Table 2. Initial data

Available user goodput, G	10 Mb/s
Available server goodput, G_{serv}	10 Gb/s
Available link goodput, G_{link}	8 Mb/s
Available goodput of i node, G_i	2 Mb/s
Available link to the i node goodput, G_{link_i}	5 Mb/s
The data response size, V	100 kB

Fig. 2 depicts the results of an estimation of the response time to a request for a centralized client-server *t_rrt_c-s* and a distributed *t_rrt_p2p* Cloud architecture for different numbers of concurrent users.

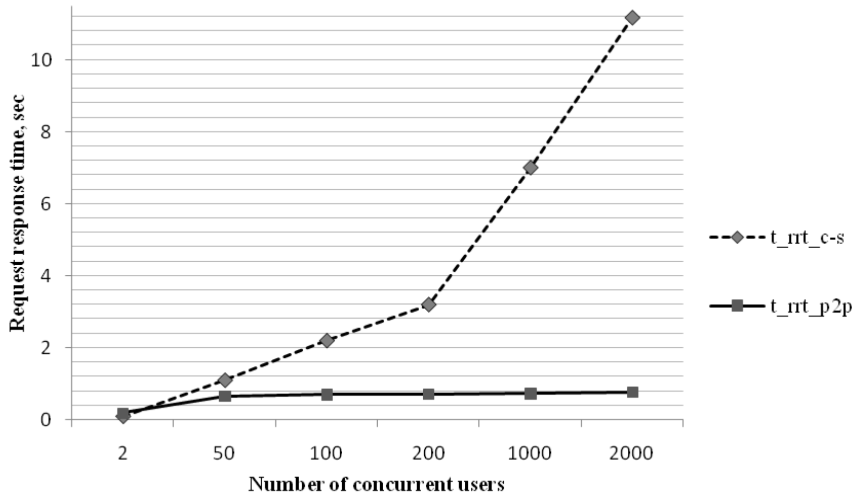

Fig. 2. Results of the response time estimation

Analyzing the graphical representation of the two types of architectures' behavior with the number of concurrent users makes it possible to conclude that the selected set of input data can achieve a significant reduction of response time in the case of a distributed Cloud architecture with 15 or more concurrent users that all interact with each other.

6 Service Availability

As previously mentioned, the main advantage of a distributed cloud architecture is the high degree of resource replication. The copies of the resource are distributed among the nodes that had previously requested it. Thus, the number, states and hardware properties of the nodes will determine the Service Availability. There are different methods for the evaluation of Service Availability [15]. Within the scope of this study, the evaluation of Service Availability deployed on two types of cloud architectures is considered: centralized and distributed. Furthermore, Service Availability evaluation does not take into account the hardware, software and network failures. It is assumed that service is available when there are no performance-related failures that usually occur when incoming requests are not served due to limited capacity of the server. If the service is implemented based on the standard cloud server, then the probability that an arriving request is lost due to buffer overflow is described by the formula [15]:

$$P_b = \begin{cases} \rho^b \cdot \dfrac{1-\rho}{1-\rho^{b+1}}, \rho \neq 1; \\ \dfrac{1}{b+1}, \rho = 1. \end{cases}, \quad (7)$$

where ρ – the server load,

b – the server input buffer size.

The server's behavior can be modeled by a M/M/1/b queue. Then, when the steady state probability of the up state corresponds to the system's steady-state availability and when it is equal to 1, then the availability of the service is:

$$A_{(WS)} = (1 - P_b). \quad (8)$$

In the case of applying the distributed approach, the service is successfully provided as long as at least one of the replication nodes is available. The model of the system's behavior is described as M/M/c/b queue, where c - the number of available nodes that function as a replication, b – the node input buffer size. The probability of requests being lost due to buffer overflow is given by [15]:

$$L_{b(c)} = \begin{cases} \dfrac{\rho_n^{\,b_n}}{c^{b-c}\cdot c!}\cdot\left[\sum_{j=0}^{c-1}\dfrac{\rho_n^{\,j}}{j!}+\sum_{j=c}^{b}\dfrac{\rho_n^{\,b}}{c^{j-c}\cdot c!}\right]^{-1}, b_n \ge c; \\ \dfrac{\rho_n^{\,b_n}}{b_n!}\cdot\left[\sum_{j=0}^{b_n}\dfrac{\rho_n^{\,j}}{j!}\right]^{-1}, b_n < c. \end{cases} \tag{9}$$

where c – the number of replication nodes,
ρ_n – the node load,
b_n – the node input buffer size.
Similarly (2), the availability of the service is:

$$A_{(NS)} = (1 - L_{b(c)}). \tag{10}$$

The initial data that is used for the evaluation of Service Availability is taken from [14]. The input data and evaluation results are summarized in tabl. 3:

Table 3. Input data and estimation results

ρ	b	c	ρ_n	b_n	$A_{(WS)}$	$A_{(NS)}$
1	3000	100	1	7	0.99966	0.999927

As seen from the table, for the given set of input parameters, Service Availability is implemented through passive replication based on the above properties of the distributed cloud. Service Availability increases significantly with the number of replication nodes is increased and is, therefore, dependent on the popularity of the resource. However, in cases where the service is insufficiently popular and has a low degree of replication nodes, it would be more appropriate for the implementation to be based on a centralized cloud architecture, where the replication of existing nodes can reduce the load on the server. In order to implement an autonomous and stable operation of the service-based distributed cloud infrastructure without a server, it is important to determine the number of nodes' replication as sufficient enough. This is a crucial area for further research. Furthermore, it is necessary to consider a new business model for such an approach.

7 Moulding a new business model

Customers of distributed Cloud vary from individuals who plan to make a website for personal reasons, to freelancers or professionals who need a reliable service at a smart price, all the way to small and large corporations who seek to be innovative but without compromising their financial resources.

The use of websites is global but the needs are very different, depending on the quality, quantity, target group and nature of the information of it. Studying the market and creating a list of questions to guide the team throughout the process of identifying each customer group, the following segments have been determined and are presented in table below.

Table 4. Customer segments and needs

Segment	Needs
Private individuals, blogs, small societies	- Interested in a small number of websites - Personal use mainly - Not significantly big amounts of data - Seek low prices and easy-to-use solutions
Professionals, freelancers, businesses	- Minimize IT costs - Flexibility & reliability - Scalability "Value for money" - Security
Startup companies and special organizations	- Low costs to create their web identity - Accessibility - Scalability - Use of innovative tools - Promotional tools

Emerging markets and technologies consist of a number of risks that should be taken into consideration before venturing. Distributed Cloud computing, slightly lagging Cloud computing, is at the beginning of its Life Cycle, where the early majority has already started adopting the technology for a number of daily applications. For a startup company, this point is a good one to enter the market, provided it can offer a unique differentiation and a well perceived value to its customers.

Various technologies have not only introduced new benefits and solutions to existing and new needs, but have also encouraged business models and strategies to change accordingly, in order to accommodate new trends and expectations. Cloud computing consists one of the most revolutionary technologies, mainly due to the fact that it shapes a different future. Through a shift in business conduct, it further empowers existing and new parties allowing more versatility, flexibility and innovation to grow.

However, technology does not create value on its own. It is the design and application of a sustainable and evolving business model that enables technology to create value for its users. A successful and well-developed business plan may result in cost reduction, strategic flexibility or even reduction in risk, amongst other benefits.

Existing business models have a distinct separation in roles. As depicted in Ostewalder's business model canvas, the company works with key partners and suppliers in order to create value for its customers and maintain a good and profitable relationship that will ensure a stable and increasing revenue stream. So far, usual business models may be characterized as "non-interactive" models, as the end-target (the customer) does not participate. Distributed Cloud enables business models to change and include their customers in the value creation process. Fig. 3 depicts the distinct roles and interactions between participating sides within distributed Cloud, as structured in the business model canvas.

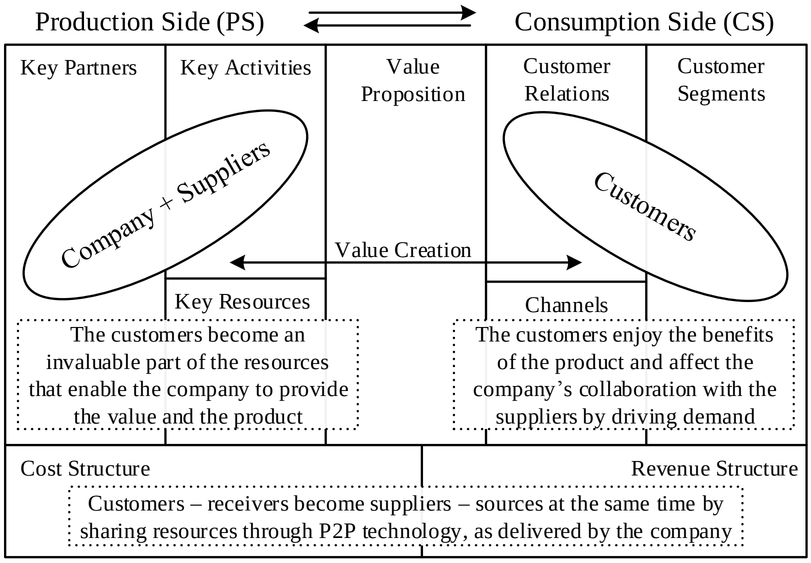

Fig. 3. Business model canvas

The Production Side (PS) refers to the cluster of parties that work together to create and deliver the value to the customers. Based on the customers' needs and demand, the PS organizes itself to ensure cost reduction, trusted relationships and quality partnerships that will lead to the product. The Consumption Side (CS) consists of the market cluster – the customers who are using the product and enjoy the benefits and the value it creates. Their needs and their demand is the major factor based on which the PS makes alterations and adjustments. For this reason, market and business intelligence is extremely critical, as the data provides companies with sufficient intel to allow trends predictions and needs insights. The capabilities of distributed Cloud technology set new foundations for business models to evolve and grow in order to better facilitate all interested parties. Distributed Cloud technology is a technology that interacts with users, depends on user popularity and constantly moves to adapt to its users. By natural consequence, business models that correspond to P2P technology need to interact with the user and adapt to changes in demand.

Distributed Cloud approach sets new roles and multiple sides to the business model canvas. Companies do not simply work with suppliers to create a product and customers and users of the technology do not simply purchase or enjoy the value of the product. Instead, the company becomes the technology facilitator and the customers become the suppliers as well. As a result, the business model that emerges is a model that is "alive" and "evolving" with change and a series of "participatory business models" is introduced, where customers obtain a double identity – that of the consumer and that of the source-supplier.

It is essential to notice that the Production Side of the business model canvas does not have any interaction with the Consumption Side, other than any alterations that result from business intelligence.

The double role of the customers is the key to this new business model ecosystem, significantly affecting the interaction between customer-user and customer-supplier, through the technology.

It is important to note that in such business models, monitoring intellectual property and rights is challenging and needs to be dealt with utmost care and responsibility in order to ensure protection of all participants.

In the field of distributed Cloud for website applications, the use of such a dynamic business model is essential, as it is the core of value creation and value delivery to customers. Users purchase or subscribe to the service to enjoy the benefits of the distributed Cloud solution as provided by the company, in the form of a software, thus becoming customers-consumers. In return, other customers-consumers that request access to the content of the website through the same software service, retrieve it from fellow customers-consumers who, having a virtual footprint of the information on their computers, they now become sources-suppliers for the new customers-consumers.

As a result, the group of people who share a common interest in the content they seek, participate in a "shared cluster" of information and act as both, sources and consumers of the content. Apart from the development of new business models, companies may find it beneficial to use distributed Cloud as it offers new options in terms of budget and scalability. Budget and scalability consist of the two main issues that companies face. Increased demand may indeed increase revenue stream. However, in order to meet this demand, companies need to invest in more resources. Even with current cloud services, suppliers' costs are high and not easy to handle.

Currently, companies increase their IT infrastructure and spend significant amounts on adding new serves in order to accommodate their customers' needs and the company's workload. Without this expansion, the company cannot achieve scalability.

Churn is also important, as users may activate and deactivate their nodes, altering the dynamic of the P2P system. However, the bigger the network of customers-sources, the more manageable is the churn, as the system will dynamically adapt to changes and maintain its efficiency.

Overall, distributed Cloud technology has a number of potential applications that can benefit different companies and users. However, the technology itself produces value when a major condition is met: the design of an appropriate, innovative and predictive business model that ensures value is captured and transferred to users, delivers results and revenue for the company and adapts to the dynamic nature of the system.

It is necessary to highlight that there is no correct business model. Different models may work as long as they incorporate the P2P values and focus on the double role of the customers. The term "participatory business models" is suggested to describe the new reality that companies and entrepreneurs are expected to face. Monetization through such a business model may be significantly more challenging compared to more popular business models but this may set the foundations for a new way of conducting business and commercializing technologies, ideas and goods.

8 Case study

In order to implement distributed Cloud solution, a number of expenses categories has been created:

- Operational expenses refer to the expenses that the company needs to cover in order to operate and run smoothly. The expenses required for the running and operation are originally limited to the renting of a small server of 50-70 accounts and to the costs of premises and power (office rent, electricity etc.). The initial premises costs are small due to the fact that a big part of the work completed will be through computers and virtual desktops.
- Labour expenses refer to the amount of money the company needs to pay for the services of its human resources. In this category, all expenses that refer to salaries of regular employees or outsourced partners are included.
- Variable expenses refer to the expenses of other parameters such as marketing campaigns, royalties to the university, depreciation of the investment within maximum 2 years etc. Variable expenses include marketing budget, university royalties of 3% for the first year and 5% onwards and depreciation of the investment cost within 2 years.

The proposed solution has a number of implementation stages in order to be fully developed and be ready to use. Strategic planning before starting the development will ensure time efficiency, productive allocation of tasks and smart use of resources. More specifically, the development stages of the project are summarized in the table below:

Table 5. Suggested implementation stages

Stage	*Description*
Stage 1. Implementation of the PaaS (platform as a service) service model, based on the distribution of tasks, services, websites and storage between the users.	Within the first stage, a number of steps are included: implementation of the static website functionality, distribution of the website tasks and storage between the users' hardware, and finally, implementation of the general service.
Stage 2. Implementation of the IaaS (infrastructure as a service) service model.	Implementation of the special software layer, which is responsible for distributing the system requests of the guest operating system between the participants' devices, allowing the running of a virtual machine.
Stage 3. Implementation of the SaaS (software as a service) service model.	The last stage assumes improvement of the software based on the specifically configured virtual machine that was mentioned above.

The distributed Cloud solution can begin its commercialization from within the academic society. The educational sector is a potential big customer that could highly benefit from the proposed approach, and the use of academic and EU connections can greatly help spread the technology. The aim is to begin locally by promoting the proposed solution through academic events and contacts with the respective IT administration departments in order to expand to more universities locally and internationally.

9 Conclusion

Cloud Computing has arrived at a very good timing to introduce a new reality based on current needs and future aspirations. Granted, as a new technology, it requires a number of years to set and to become popular, constantly raising awareness amongst people and introducing them to its benefits. The above trends demonstrate the high prospects of different types of Cloud Computing that is expected to grow in the following years in many markets and to extend to a variety of applications. Competition is an expected to be high and technology progress will demand constant update of versions and improvement of products and solutions, in order to successfully supply an ever growing market and a rapidly changing business and social environment.

The Distributed P2P based Cloud is a new solution that aspires to change the way companies and organizations work with regards to creating, publishing and sharing content. The purpose of the Distributed Cloud approach is to provide P2P Cloud services to individuals, companies and organizations with the view to facilitating cost-effective scalability, flexibility and efficiency and enhancing the experience of creating, organizing, publishing and sharing content. Its competitive advantage lies within the concept of reliability and scalability at significantly lower costs, allowing customers to differently allocate their financial resources or to grow even on a budget.

In addition, well-structured, targeted and smart marketing strategies are necessary to be developed in order to ensure strategic growth of the business sector and brand awareness amongst existing and prospective customers. The proposed solution combines Cloud computing and Grid technology with peer-to-peer networks through a software that allows users to participate in a single, decentralized Cloud system and use their workstations to allocate network resources. As a result, it partially or completely eliminates the need to use powerful, high-performance servers in virtual data centers and, ultimately, reduces energy consumption and negative impacts on the environment.

By applying Distributed Cloud technology, the dynamics of the system changes so that users become sources and consumers at the same time. This is the very core value of this technology as it enhances cost effective scalability and changes the way business is conducted, through a dynamic, alive and self-adjusting business model.

The interchanging roles of customers and suppliers within such a participatory business model encourages companies and entrepreneurs to focus more strongly on the value that can be obtained through the P2P technology within the distributed cloud, rather than the marketing of the product itself. Consumers are becoming more and more informed about how technology works and what benefits each provider gives them. This means, that shifting towards value creation and focus through customer participation may actually help companies differentiate themselves from the mass, attract more customers and, eventually, contribute to a new corporative culture.

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