

Community Clouds

A centralized approach

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Abstract— Community cloud is one of the rising ideas in the area of cloud computing. Many companies do not move into the cloud, as they need tailored solutions to ensure industry specific security and regulatory requirements. A community cloud can perfectly fulfill this requirement and costs can be spread among several organizations. Providing a community cloud involves aspects like security, privacy, identification and access management that includes lot of organization. This prevents providers and users to build a community cloud despite its advantages. However, until now it is not as widely spread as other deployment models like public or private clouds. One reason is that providing a community cloud needs a lot of organizational effort and communication. Additionally no standard concept for doing this is elaborated so far. Some providers are offering community clouds or certain organizations build one. Nevertheless, each community cloud underlies a different approach. This paper discusses the federated and brokered approaches. Additionally, a centralized approach on how a community cloud can be built will be introduced.

Keywords-Cloud Computing; Community Clouds; Service Market; Brokering Service

I. INTRODUCTION

Cloud computing has become a significant technology trend and provides new possibilities and advantages. It has open new opportunities to businesses on how to improve the usage, efficiency and reduce spending of their IT systems. According to NIST (National Institute of Standards and Technology of the US) several service and deployment models are proposed [1]. As a deployment model beyond private and public clouds, the concept of a community cloud is proposed. Community clouds are a union of private clouds, which are tailored to a specific vertical industry, such as government, healthcare or finance, offering a range of services including infrastructure, platform or software. Often, organizations that have shared concerns (e.g., mission, security requirements, policy, and compliance considerations) need to fulfill specific security and regulatory requirements [1].

The use of community clouds is not widespread yet, but there is definitely interest. Gartner shows with its Hype Cycle for Cloud Computing that Community Clouds are in its advent. Nevertheless, Gartner sees a high potential for the topic within the upcoming two to five years [2].

Figure 1. Hype Cycle for Cloud Computing, 2012

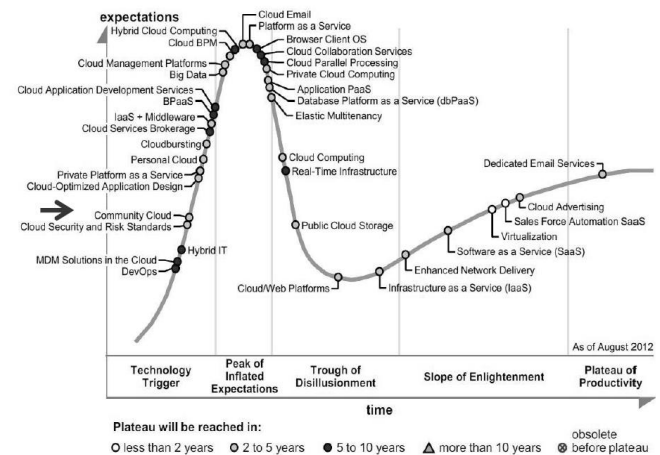


Figure 1. Gartner's Hype Cycle for Cloud Computing 2012 [2]

But what are the reasons community clouds are not widely used? Community cloud is a way of congregating users under an umbrella of services. Some businesses may hesitate to share common resources with competitors. A first obstacle on the way to a community cloud is to identify the appropriate community and to convince possible community mates to cooperate with. A second big drawback of this deployment model is to define the management, roles and responsibilities within all stakeholders. For interested customers, these additional efforts can be very discouraging to use such a shared cloud environment.

Despite the fact that community clouds are not yet established, there are some examples in the market. In particular, the industries of health, finance and government are early adopters of community clouds rollouts.

Most advantages of a community cloud are covered in the general benefits of cloud computing such as cost reduction and the shift from capital expenditures to operational expenditures. Nevertheless, a community cloud offers special advantages compared to other deployment models [3], [4]:

- Secure, private multi-tenant cloud computing satisfies demanding requirements of the organizations
- Flexible solutions to differing market needs
- Matching market fluctuations in demand

- Application or sensitive data can remain in the community network
- Less management than a private cloud
- Cost reduction by eliminating owned infrastructure and software licenses needs
- More efficient and potentially lower cost than existing systems and less cost than building an own private cloud or data center.

Several studies are showing that most of customers' concerns regarding clouds are compliance related issues. For example, a study published in early 2011 by KPMG [5] explains that companies are currently facing most often legal challenges. So, there are issues like security, uncertainty about the future control of their own data and to meet legal compliance, which hint potential users.

Thus, an important benefit of a community cloud is to address compliance requirements for specific groups like similar industries and to offer appropriate solutions to its concerns.

The aim of this paper is to discuss the different management models (federated, brokered and centralized) for such community clouds. After the introduction, challenges of community clouds will be discussed. The third section gives a short overview on current management models and introduces a centralized model. Thus, in the fourth section, a high level architecture of a centralized system will be suggested. The subsequent parts, sections V – IX, are explaining the different layers of the introduced models, from infoplace, to quality gate, over a brokering service, the cloud service management to finally the concept of a service market. The last section concludes the paper and gives a short overview on future work and next steps.

II. CHALLENGES OF COMMUNITY CLOUDS

Besides the introduced drivers, we see some key challenges within the idea of community clouds, which need to be considered before building up such kind of cloud.

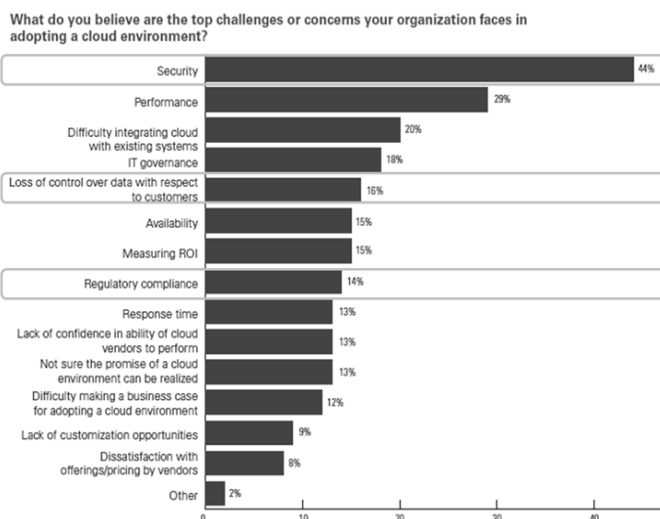


Figure 2. Customers' concerns entering a Cloud [5]

1) Organizational Structures and management models for building community clouds

By building up a community cloud, different stakeholders are involved. Thus, when considering a community cloud, at least as a special form of private cloud, two roles can be identified: the service providers and the service users.

Going one step further, a community deployment model can consist of several users and several providers, offering different services with some times similar functionality. This is mandatory to be able to prevent the well-known vendor lock-in effect [6]. However, this requires appropriate organizational structures and management models to avoid the loss of advantages. Several models will be discussed in the upcoming section.

2) Communications

Already before planning a community cloud, communications between the different stakeholders are crucial. Customers need to understand the advantages and risks of cloud services within such a closed environment. But, also, provider(s) have to understand the specific requirements each community has.

Even at an earlier stage, while thinking about the idea to build up a community cloud, an appropriate community has to be identified. Communications have to be initialized with first community members (clients and users). Thus, we suggest that the first step for building a community cloud is the establishment of an appropriate community. This community should create the business case, set the rules and organization form, and choose other members and providers.

But, communications between customers and providers, like announcements of common SLA adjustments, are playing also a key role during the cloud operations. To ensure a good cooperation between the community network, rules and responsibilities have clearly to be defined and announced to all stakeholders.

3) Ease of use

While establishing the cloud environment, not only security, efficiency and compliance issues have to be considered. As cloud promises fast and on-demand provision of IT services, customers have to decide easily, which services they need and want to use. Also ordering and service termination processes have to be allocated in such a way that users care able to access and execute services as easy as possible.

III. MANAGEMENT MODELS FOR COMMUNITY CLOUDS

Management models for community clouds follow either a federated or a brokered approach [7]. In a federated approach all institutions (members of the community cloud) share their own resources, whereas in a brokered approach sharing of the resources takes place through a third party, the

so-called broker. This means, the broker procures the resources (services) to the community cloud members.

Today the implementation of a federated management model most often faces challenges mainly due to two main reasons. First, it is difficult to tackle liability issues like the legal impact of a service outage or responsibilities. Secondly, it is hard to provide cost transparency. Questions about the responsibility of paying support, maintenance and operational costs are arising. However, such a federated model comes with its benefits. The vendor lock-in issue does not exist, risks are distributed and costs are reduced. Furthermore, it offers full control of the community members who can share best practice and their industry specific services.

Today, the brokered model is the usually deployed one, when implementing a community cloud. In the brokered model, institutions share provider resources through a so-called broker. The broker acts as an intermediary and should provide expert advice to the community. It takes care of trust establishment and contract settlement. The institutions only have one party to trust and one contract to sign. The brokers can also handle disputes in the cloud [8]. This model is transparent in terms of operation and accountability, awareness raising, guidance on expectations regarding the use of the community cloud, levels of security, and meeting legal obligation (compliance). Operations can be spread across multiple cloud providers whereby continuity is given. The broker is fully responsible for security issues, it forces specific security and regulatory requirements. Participating institutions do not need to test whether a cloud provider is effectively mitigating risks. It is the role of the broker to assure such aspects for the community. At last, a broker can provide value-adding services like federated identity management or resource federation [7].

Contrariwise, a third model, the centralized one, has only one IaaS provider and one broker. The model foresees an IaaS provider as the leading party, which is responsible for (i) establishing the infrastructure platform of the cloud including services such as

- Computational Power
- Networking
- Storage
- Virtualization
- etc.

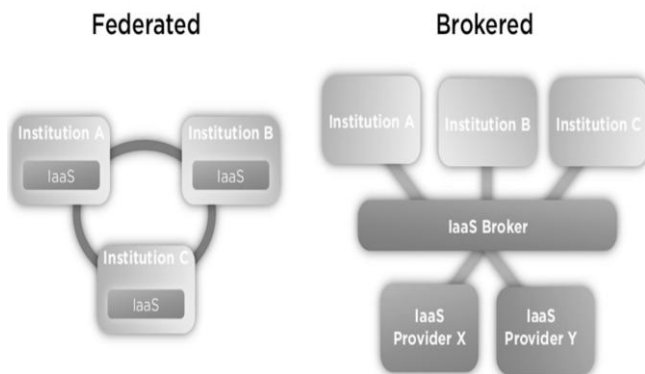


Figure 3. Two main models for Community Clouds [7]

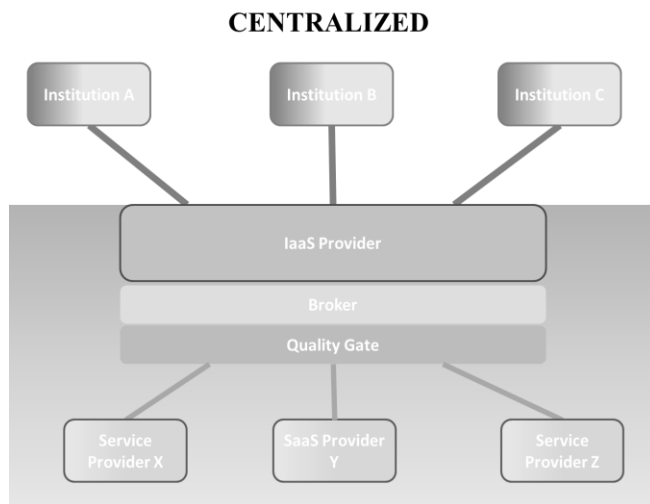


Figure 4. A centralized approach

and (ii) for procuring PaaS and SaaS providers. The broker is responsible for expert advice and acts as an intermediary. In this model the broker has different duties, as described in the brokered model. Operations are spread across multiple service providers.

With regards to performance aspects, it has to be considered that a centralized model is highly dependent of a sole IaaS provider. Thus, we are expecting that in a worst case scenario, the centralized approach can be less performing compared to the other models. While the federated and brokered models are offering the opportunity to change the provider in such a case, the centralized one does not.

IV. ARCHITECTURE OF A CENTRALIZED APPROACH

Following a centralized approach opens a wide range for the establishment of architecture of a community cloud. Besides choosing an IaaS provider for the leading provider role, we recommend five layers within the community cloud architecture. These layers support customers and service providers through different stages of the service lifecycle.

The cooperation between each of the five components establishes a trustworthy usage of the different cloud services within the community. It offers flexibility to the community, with regards to organization and communication aspects.

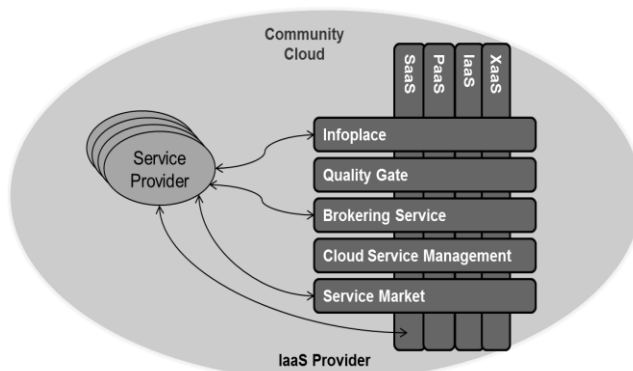


Figure 5. Proposed components of a centralized community model

Additionally, it ensures that users can easily get the needed services with a low commitment to time, money and management resources. Each of these five layers from infoplace, Quality Gate, to Brokering Service, Cloud Service Management and Service Market will be introduced within the following sections.

V. INFOPLACE

A so-called infoplace builds the entry point for the community members and can clearly support the establishment of the communication between the members of a community cloud.

Whereas potential cloud customers are facing several challenges and open questions like

- Which services are appropriate to obtain from the cloud environment?
- Do Cloud Services fit to the IT of my company?
- What are the advantages and benefits, given through Cloud services?
- Is my company prepared for the cloud?

the infoplace offers assistance to the customer, e.g. readiness assessments to evaluate potential technical or organizational gaps within the company.

An additional advantage of the infoplace is the use case repository. The use case repository enables to store the collected cloud use cases within the community. It follows a developed framework, which defines different areas of interest inside such a use case. Following this scheme also establishes that use cases can be compared on the different topics like the service model but also on technical and management issues.

The use cases should be (i) a viable source for the user to see how other have compete their cloud projects and (ii) to support the user by identifying different workloads / process areas, which are predestined to run in a cloud.

For realizing these infoplace requirements the University of Applied Science Northwestern Switzerland is building a platform for guiding users through the cloud life cycle. For this need, they introduce a project named CLiCk (Cloud Life Cycle).

The vision of the CLiCk-Infoplace is the provision of self-services and supportive information, which can be accessed on an appropriate platform through the accordant enterprises [9].

VI. QUALITY GATE

All actors within the community cloud need to fulfill certain criteria. Not everyone is allowed to use the services, not every application will be offered in the cloud, and not all service providers fulfill the compliance requirements of the users. Therefore a quality gate service has to be provided. The Quality Gate describes an independent service within the community cloud. Its main purpose is to assess the general and industry specific criteria, which have to be followed by all stakeholders in a community cloud (users and providers). General criteria could be for example the ability of auditing. Industry specific criteria can dictate e.g.

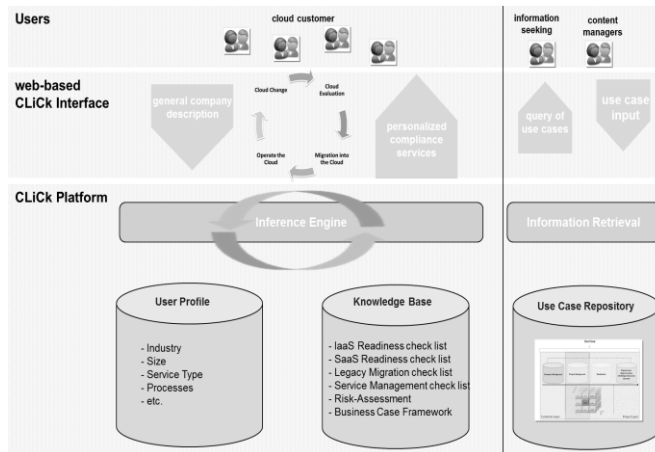


Figure 6. The CLiCk Infoplace [9]

form, location and minimal duration of storage for digital records [10]. The quality gate includes:

- *Quality of Service Providers:* The quality of service providers needs to be assured because the community has to follow certain legal restrictions. E.g. the service provider needs to prove, that their company obeys to according laws or that they handle sensitive data with needed concern. Another aspect is the sustainability of the service provider, it is important for the success that the company will exist further. To ensure the quality of service providers certain standards need to be fulfilled. These standards can be ISO standards or other certifications.
- *Quality of Services:* The offered services need to have a certain quality. For example a finance application for financial administration has the restriction that it needs to be certified by the government. The quality assurance service should elaborate a list of criteria, which an application needs to fulfill. This list of criteria differs depending on the type of application. For example an application for wage payment has other criteria than an application for drawing mind maps.
- *Quality of Customers:* The third category of the quality assurance process concerns the users. Goal is to assess candidates for community membership. While establishing the introduced community it is important to setup the conditions for entering the community and using the services out of the cloud.

To ensure a high level of trust, the role of assessing the introduced quality criteria within the gate should be executed by an independent actor.

Criteria should be defined and collected continuously through a consortium of community members and project independent advisories.

VII. BROKERING SERVICE

Cloud brokering is not yet finally defined. Several opinions about what, who and how cloud brokering services should be able to fulfill exist. One perspective of brokering

has been explained in Section III within the brokered community cloud model. A more generic view, applicable for most cloud deployment models is given by Buyya [11]. It can be understood as a part of a global marketplace, where service providers and consumers join to find suitable match for each other. It provides various services to its customers such as resource discovery, meta-scheduler, reservation service, queuing service, accounting and pricing services [11]. Gartner explains cloud brokering as a “cloud services brokerage (CSB) is a service provider that plays an intermediary role in cloud computing” [12]. They see three different types of brokerage scenarios: aggregation, intermediation and arbitration [13].

Within the introduced community cloud approach, brokering services are understood as a provision and convey of the available services. The cloud broker has knowledge about the used services by each customer and the available services in the market. If a customer needs a new service, e.g. additional software, or an altered quantity of a service, the brokering service executes the new requirement immediately and orders it from the service market. Like in the brokered community model, the broker can also take a leading role for contracting.

VIII. CLOUD SERVICE MANAGEMENT

The fourth layer deals with service management aspects. The cloud service management denotes the implementation and management of additional services that meet the needs of the community members and includes facilities like:

- a) *Installation and Configuration:* executes administrative tasks that occur primarily in the introduction, the transition or the early use of cloud computing. It includes, for example, adjustments of organizational processes and structures, and descriptions of specific cloud projects or complex issues and how these can be overcome.
- b) *Resource Management:* This topic deals with the distribution of the (hardware) resources (e.g. based on best practices) - also with regard to high scalability and flexibility. It also includes interoperability aspects, so far by defining standards for higher compatibility between different services is provided.
- c) *Service Monitoring and Reporting:* offers automated services to control if agreed parameters like availability, speed and quality of provided services are accordantly to Service Level Agreements. This includes also a customer service for reporting current figures about usage, costs and delivered performance of services.

A cloud service management can be provided through an appropriate mix of people, process and information technology.

IX. SERVICE MARKET

The final element of a community cloud is the provision of the individual cloud services independent from IaaS, PaaS or SaaS.

On a so called service market, customers are able to compare, select, buy and review applications. Users choose out of a set of qualified cloud services. Any offered service is tested and approved in the quality gate through an independent consortium. Usage of the service market has to be as simple and easy as other well know application stores like, e.g., Apples iTunes or Google’s Play.

While the infoplace supports customers to find the appropriate service, the service market leads the client to the final purchase of a service. A service market model is potentially valuable for any sort of IT product or service that is sufficiently industrializes and packaged in order to be consumed by a non-expert end-user. Such kind of application store can become the marketplace to access cloud, commercial software products, skills, as well as to finally succeed reusing and exchanging software across different companies. The goal of a service market is to make IT offerings transparent, unambiguous and comparable. Furthermore, reduced procurement times, increased user satisfaction, and reduced costs should be the outcomes of such a marketplace.

The idea behind a marketplace is not explicitly bound to a community cloud. But according to Buyya et al. [14] it is predestinated to be applied for a specific industry respectively community similar to the logistics clouds.

X. CONCLUSION AND FUTURE WORKS

Cloud Computing is still in its advent, and the number of interested business and depending business models is increasing. But many institutions, whether potential customers or consultancies are hesitating to consume IT services in a cloud approach. As shown, many issues concern security and compliance areas. IT has not yet been successful in getting these issues out of the way to the cloud.

To decrease such security and compliance issues, a community cloud is one approach to face these challenges and to use the advantages of the cloud approach like reducing costs, faster time to market at the same time.

While a community cloud can improve the security and compliance issues, it also brings additional challenges. Compared to other deployment models, organizational and communication efforts within a community cloud are increasing as a whole. As other deployment models, like public and private, commonly are describing a business to business (customer to provider) dependency. A community approach opens relations to the entire community (customers and providers). To ensure the success and proper management of a community cloud the stated increased organizational and communication efforts is essential.

In a good working cooperation the additional effort can be spread over all community members and will not cause more effort for the single instance than using other deployment models.

For the process of establishing a community cloud we propose as a first step to identify and coin a proper community with specific similar concerns. This community shall define the requirements, goals, organizational and management approaches of the cloud. As concerns regarding compliance most often are related with the cloud data center location, the introduced centralized approach, including one leading IaaS provider, should enlighten the given regulatory requirements and ensure that Platform- and Software providers are in line with the community concerns too.

The introduced layered approach of the centralized solution supports the community to establish a vendor independent (excluding the infrastructure provider), flexible and high quality shared IT environment, where advantages of cloud computing can be gained. Thus, community members are able to focus on core businesses instead of handling with IT issues.

Whether a brokered, federated or centralized approach, community clouds in general are offering a considerable option for businesses with sensible IT issues. We see the community deployment model as a serious suggestion for future IT services in areas with special security and compliance needs.

As the introduced centralized approach is only a first high level architecture, the authors are currently identifying different domains to initiate a first pilot. Goal is to find few partners for establishing a pilot of a centralized community cloud. First talks are held with partners from energy, health and public industries. Based on their feedback funding and further partners in the industries for a pilot project will now be identified. As a first step of such a pilot program, the domain specific requirements will be assessed to setup the base for the different layers.

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