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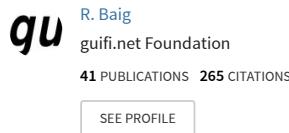
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Community Clouds at the Edge deployed in Guifi.net

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Abstract—Community clouds are a cloud deployment model in which the cloud infrastructure is built with specific features for a community of users with shared concerns, goals, and interests. Commercial community clouds already operate in several application areas such as in the finance, government and health, fulfilling community-specific requirements. In this demo, a community cloud for citizens is presented. It is formed by devices at the edge of the network, contributed by the members of a community network and brought together into a distributed community cloud system through the Cloudy distribution. The demonstration shows to the audience in a live access the deployed community cloud from the perspective of the user, by accessing a Cloudy node, inspecting the services available in the community cloud, and showing the usage of some of its services.

Keywords—community networks; cloud computing

I. INTRODUCTION

A community cloud is a cloud deployment model in which a cloud infrastructure is built and provisioned for use by a specific community of consumers with shared concerns, goals and interests [1]. Commercial community cloud solutions are a reality nowadays in several application areas and have been deployed in the financial, governmental and health sector, fulfilling the community-specific requirements, as shown in [2] and [3].

Non-commercial community clouds, however, have only been sketched so far by the visionary work of A. Marinos and G. Briscoe in [4], where the authors identified in the commercial cloud solutions a series of problems for consumers, such as the lack of control, privacy issues, dependency, and last not least, energy consumption. The authors argue that community cloud computing would address several application areas more suitably than commercial cloud approaches.

Our work builds upon the community cloud computing paradigm of [4]. In this demo paper, we show an operational community cloud system that is used and contributed by citizens.

II. COMMUNITY CLOUDS AT THE EDGE

A. Overview

We consider a particular case of a community cloud, which unlike commercial community clouds, is tailored to the specific

requirements and conditions of a community of citizens. In concrete, we look at a community cloud which we have deployed in a community network, specifically in Guifi.net [5].

Such a community cloud built with devices located at the edge [6] resembles in terms of distribution the scenario of Fog Computing [7]. Like in our case, in Fog Computing the resource-constrained devices are distributed geographically at the edge and close to the data obtaining sensors to carry out initial processing, before sending the aggregated data to cloud data centres. Similarly, services that are close to the end users are also our focus in the presented community cloud.

Community networks offer the social and technical conditions to make community clouds for citizens a reality, thus they enable to showcase this model for the Future Internet today. Users in the community network have at their nodes routable IP addresses. This IP range allows a user to host several servers and services at her location, which on contrary is not straightforward to do in a typical IPv4 Internet access provision for end users with dynamic IP address and devices behind a NAT.

From a social point of view, community clouds for citizens extend the sharing of infrastructure among users, which already happens in community networks at the network level [5], [8]. It is thus a favourable context to demonstrate the community cloud vision of [4] in a real case. The community cloud we show in this demo paper is therefore a cloud hosted on community-owned computing and communication resources providing services of local interest [9].

B. Materializing Community Network Clouds

1) Heterogeneous Hardware: Community clouds built from voluntary contributions by citizens consist of diverse types of hardware. Different to rack server-based cloud infrastructures hosted in large data centers, in the community cloud for citizens, the cloud infrastructure is distributed and extends to low-capacity resources installed at the premises of the users. The reduced energy consumption of such devices is important for users to be willing to run their cloud resources in a permanent way.

Figure 1 shows a typical node which has been recently

deployed in the Guifi community cloud. The device from Minix¹ comes with a low energy consuming Intel Z3735F (64-bit) processor, 2 GB of RAM and 32 GB of internal storage. Over the USB port, additional storage capacity can be added by the user.



Fig. 1. Example of a community cloud node.

Figure 2 shows another community cloud node. A Jetway JBC362F36W with Intel Atom N2600 CPU, 2GB RAM and 64GB USB is used as node for the community cloud. Here, an additional UPS keeps the node running in case of power failures.



Fig. 2. Example of a community cloud node.

2) *Cloudy Distribution*: In collaboration with the Guifi.net community network, we have developed *Cloudy*², a Debian-based distribution to build community clouds for citizens. Cloudy is open-source and can be downloaded from public repositories³. It is available as a system image to install on real hardware or in virtual machines, and as LXC container. Cloudy is meant to be installable on any kind of on-premise devices that an end user may deploy, which then can become part of the community network cloud. Therefore, Cloudy has been installed and tested on desktop PCs as well as on low-capacity single board computers (SBCs). Figure 3 shows Cloudy after installation on the Minix device. Cloudy has also been installed on popular SBC such as the RaspberryPI and BeagleBoard Black⁴.

Figure 4 shows the Cloudy Web GUI after login of the user. Typically, the user does all the configuration of the Cloudy community cloud node through the Web GUI.

¹<http://www.minix.com.hk/Products/MINIX-NEO-Z64-ANDROID-TV.html>

²<http://cloudy.community/>

³<http://repo.clcommunity-project.eu/images/>

⁴See boards and guides in <http://wiki.clcommunity-project/howto>



Fig. 3. Cloudy after installation on the Minix device.

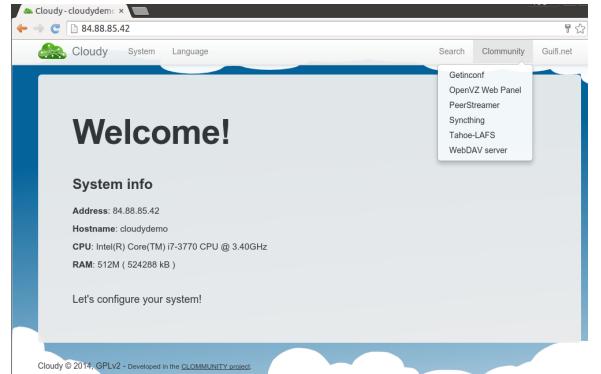


Fig. 4. Cloudy Web GUI and services in the Cloudy distribution.

3) *Services*: In Figure 4 it can be see that Cloudy contains three main types of services, which are search, community services, and Guifi.net services.

The *search service* is based on Serf⁵ and assists the user to publish the services offered at her own Cloudy node of the community cloud as well as to discover the services offered by other Cloudy nodes of the community cloud system. The search service is an essential service for the self-management in the community cloud since once Cloudy is installed, it allows the new node to become part of the community cloud.

Figure 5 shows the result when the search service is used to discover other Cloudy instances in the community cloud. In this instant, the search service found 32 more Cloudy nodes active in the community cloud. The number of active Cloudy nodes and running services inside the Guifi community network can be seen at any time through an open Cloudy instance accessible from the Internet⁶.

If clicked on the *community services*, a list of applications appear. These applications can be activated by the user. Currently, Cloudy provides Getinconf, OpenVZ, Peerstreamer, Syncthing, Tahoe-LAFS and WebDAV. OpenVZ allows Cloudy users to provide infrastructure resources to the cloud. Peer-

⁵<https://serfdom.io/>

⁶With guest:guest login at <http://84.88.85.42/>

Fig. 5. Service instances discovered by Serf.

streamer allows live streaming of events. Syncthing allows to synchronize and share folders among machines and users. Tahoe-LAFS provides a secure and fault-tolerant data storage service.

In the *Guifi.net* service menu, several services for the community network management become available for the user. These services include the Proxy3 service, which through the Squid-Proxy provides a gateway to the Internet, the SNPServices to enable network monitoring, the DNSServices to activate a DNS server, and finally, a Web-based integration of the Cloudy node into the community network database.

4) Assistance for Services Selection: Since in the operational community cloud the nodes are contributed by independent members of the community, there are many different service instances from which the user can chose from. Currently, at each Cloudy node, the user can conduct a “scan service” operation, which based on the RTT network metric, determines which of the available service instances are recommended for this specific user. Figure 6 shows how through indication of different colours, different service offers are suggested to the user.

III. DEMONSTRATION

The demonstration at the CloudNet 2015 conference is a live demo of the community cloud in *Guifi.net*. It consists of the following parts. We will connect to the Web interface of a Cloudy instance and explore the present status of the community cloud. We will use the search service to discover the services offered by other nodes. We will apply the scan service tool to obtain a recommendation for services to chose from. We will see the usage of some of the application services, such as Tahoe-LAFS, Peerstreamer and Syncthing.

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Fig. 6. Service suggestions in the community cloud.

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