

Analysis of Cloud Computing Architectures

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Abstract: Cloud computing has recently emerged as a new paradigm for hosting and delivering services over the Internet. Mobile cloud computing, new technology in the field of cloud computing enables cloud users to access cloud from their mobile devices (e.g. Laptops, PDA, and Smartphone's). Computational power and battery life is one of the major issues of these mobile devices. To overcome these problems clones of mobile devices are created on cloud servers. In this paper, we define clone cloud architecture and virtualized screen architecture in cloud computing. Clone Cloud is for the seamless use of ambient computation to augment mobile device applications, making them fast and energy efficient and in a Virtualized Screen; screen rendering is done in the cloud and delivered as images to the client for interactive display. This enables thin-client mobile devices to enjoy many computationally intensive and graphically rich services.

Keywords: Cloud Computing, Service Models, Clone Cloud, Virtualized Screen

I. INTRODUCTION

Cloud Computing has been one of the most booming technology among the professional of Information Technology and also the Business due to its Elasticity in the space occupation and also the better support for the software and the Infrastructure it attracts more technology specialist towards it. Cloud plays the vital role in the Smart Economy, and the possible regulatory changes required in implementing better Applications by using the potential of Cloud Computing[1][2]. The main advantage of the cloud is that it gives the low cost implementation for infrastructure and some higher business units like Google, IBM, and Microsoft offer the cloud for Free of cost for the Education system, so it can be used in right way which will provide high quality education [3].

A. Cloud Computing Service Models

Cloud computing can be classified by the model of service it offers into one of three different groups. These will be described using the XaaS taxonomy, first used by Scott Maxwell in 2006, where "X" is Software, Platform, or Infrastructure, and the final "S" is for Service. It is important to note, as shown in Figure, that SaaS is built on PaaS, and the latter on IaaS. Hence, this is not an excluding approach to classification, but rather it concerns the level of the service provided. Each of these service models is described in the following subsection.

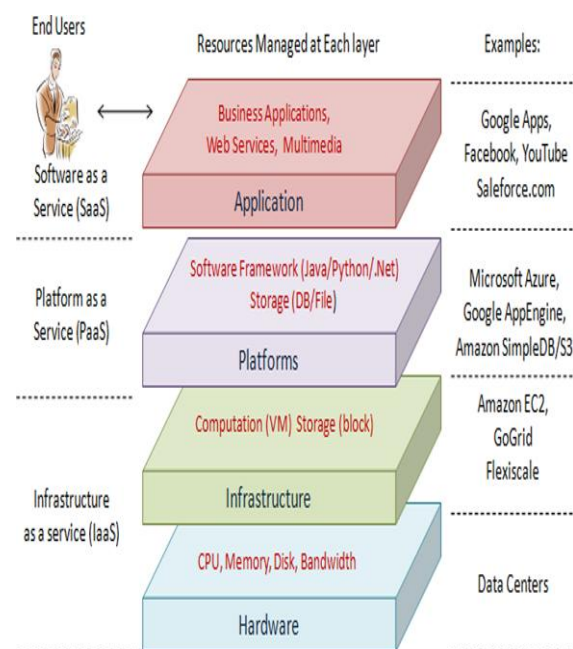


Fig. 1 Cloud computing Architecture

1) IaaS (Infrastructure as a Service):

The capability provided to the customer of IaaS is raw storage space, computing, or network resources with which the customer can run and execute an operating system, applications, or any software that they choose. The most basic cloud service is IaaS [7]. In this service, cloud providers offer computers as physical or as virtual machines and other resources.



2) PaaS (Platform as a Service):

In the case of PaaS, the cloud provider not only provides the hardware, but they also provide a toolkit and a number of supported programming languages to build higher level services. The users of PaaS are typically software developers who host their applications on the platform and provide these applications to the end-users.

In this service, cloud providers deliver a computing platform including operating system, programming languages execution environment, database and web servers.

3) SaaS (Software as a Service):

The SaaS customer is an end-user of complete applications running on a cloud infrastructure and offered on a platform on-demand. The applications are typically accessible through a thin client interface, such as a web browser. In this service, cloud providers install and operate application software in the cloud and cloud users access the software from cloud clients. This service is based on the concept of renting software from a service provider rather than buying it. It is currently the most popular type of cloud computing because of its high flexibility, great services, enhanced capability and less maintenance.

B. Deployment Models

Clouds can also be classified based upon the underlying infrastructure deployment model as Public, Private, Community, or Hybrid clouds. The different infrastructure deployment models are distinguishing by their architecture, the location of the data center where the cloud is realized, and the needs of the cloud provider's customers [4]. Several technologies are related to cloud computing, and the cloud has emerged as a convergence of several computing trends.

1) Types of Cloud Computing Environments:

The cloud computing environment can consist of multiple types of clouds based on their deployment and usage [6].

Public Clouds

This environment can be used by the general public. This includes individuals, corporations and other types of organizations. Typically, public clouds are administrated by third parties or vendors over the Internet, and services are offered on pay-per-use basis. These are also called provider clouds.

Private Clouds

A pure private cloud is built for the exclusive use of one customer, who owns and fully controls this cloud. Additionally, there are variations of this in terms of ownership, operation, etc. The fact that the cloud is used by a specific customer is the distinguishing feature of any private cloud.

This cloud computing environment resides within the boundaries of an organization and is used exclusively for

the organization's benefits. These are also called internal clouds.

Community Clouds

When several customers have similar requirements, they can share an infrastructure and might share the configuration and management of the cloud.

Hybrid Clouds

Finally, any composition of clouds, be they private or public, could form a hybrid cloud and be managed a single entity, provided that there is sufficient commonality between the standards used by the constituent clouds.

II. AUGMENTED EXECUTION OF SMART PHONES USING CLONE CLOUDS

B Chun,[10] introduce the concept of clone cloud. The idea of introducing this concept is to improving the performance of hardware limited smart phones by using their proposed clone cloud architecture. The core method is using virtual machine migration technology to offload execution blocks of applications from mobile devices to Clone Cloud.

Clone Cloud boosts unmodified mobile applications by off-loading the right portion of their execution onto device clones operating in a computational cloud. Conceptually, our system automatically transforms a single-machine execution (e.g., computation on a smart phone) into a distributed execution optimized for the network connection to the cloud, the processing capabilities of the device and cloud, and the application's computing patterns. The underlying motivation for Clone Cloud lies in the following intuition: as long as execution on the clone cloud is significantly faster than execution on the mobile device (or more reliable, more secure, etc.), paying the cost for sending the relevant data and code from the device to the cloud and back may be worth it [9].

III. CLONE CLOUD ARCHITECTURE

The design goal for Clone Cloud is to allow such fine-grained flexibility on what to run where. Another design goal is to take the programmer out of the business of application partitioning [10]. In a Clone Cloud system, the 'Clone' is a mirror image of a Smartphone running on a virtual machine. By contrast with smart phones, such a 'clone' has more hardware, software, network, energy resources in a virtual machine which provides more suitable environment to process complicated tasks. In the diagram, a task in smart phone is divided into 5 different execution blocks (we mark them as different colors), and the smart phone is cloned (virtualized) as an image in distributed computing environment. Then the image passes some computing or energy-intensive blocks (the Green blocks) to cloud for processing. Once those execution blocks have been completed, the output will be passed from Clone Cloud to the Smartphone [11].

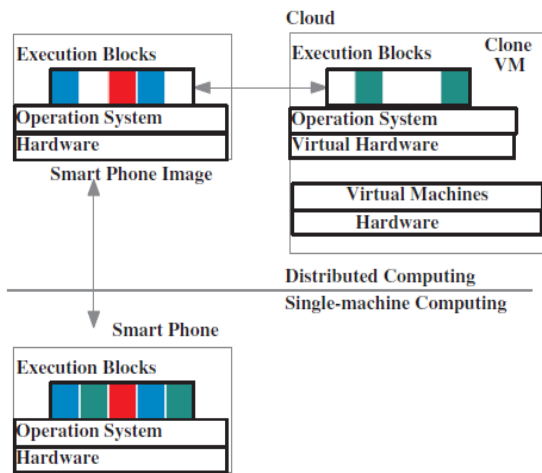


Fig. 2 Clone Cloud Architecture

A major advantage of the Clone Cloud is enhanced smart phones performance. Byung takes a test by implementing a face tracking application in a smart phone with and without Clone Cloud. The result shows that only 1 second is spent in Clone Cloud environment but almost 100 seconds in the smart phone without Clone Cloud. Another advantage of Clone Cloud is reduced battery consumption as smart phones do not use its CPU as frequently. The disadvantages of Clone Cloud are handover delay, bandwidth limitation. As we know that the speed of data transmission between smart phones and base station is not consistent (according to the situation), therefore, the Clone Cloud will be unavailable if mobile users walk in the signal's blind zone.

A. Evaluation of Applications

To evaluate the Clone Cloud Prototype, Byung-Gon Chun [10] implemented three applications. We ran those applications either on a phone—a status quo, monolithic execution—or by optimally partitioning for two settings: one with Wi-Fi connectivity and one with 3G.

We implemented a virus scanner, image search, and privacy-preserving targeted advertising. The virus scanner scans the contents of the phone file system against a library of 1000 virus signatures, one file at a time. We vary the size of the file system between 100KB and 10 MB. The image search application finds all faces in images stored on the phone, using a face-detection library that returns the mid-point between the eyes, the distance in between, and the pose of detected faces. We only use images smaller than 100KB, due to memory limitations of the Android face-detection library. We vary the number of images from 1 to 100. The privacy-preserving targeted-advertising application uses behavioural tracking across websites to infer the user's preferences, and selects ads according to a resulting model; by doing this tracking at the user's device, privacy can be protected.

1) Time Save

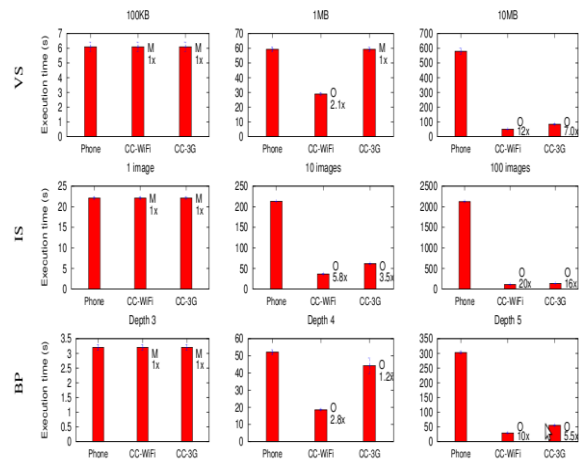


Fig. 3 Mean execution times of virus scanning (VS), image search (IS), and behaviour profiling (BP) applications with standard deviation error bars, three input sizes for each. For each application and input size, the data shown include execution time at the phone alone, that of Clone Cloud with Wi-Fi (CC-Wi-Fi), and that of Clone Cloud with 3G (CC-3G). The partition choice is annotated with M for “monolithic” and O for “off-loaded,” also indicating the relative improvement from the phone alone execution

2) Energy Save

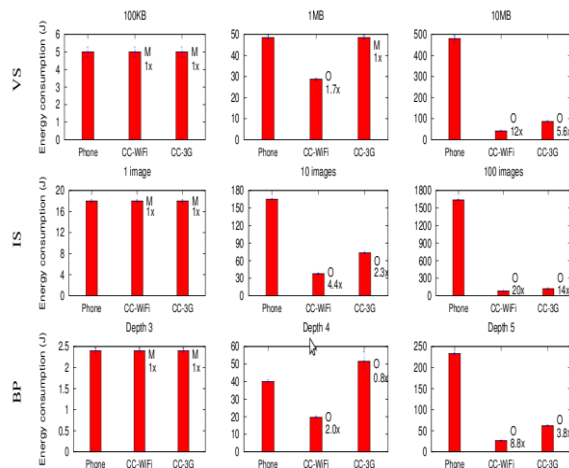


Fig. 4 Mean phone energy consumption of virus scanning (VS), image search (IS), and behaviour profiling (BP) applications with standard deviation error bars, three input sizes for each. For each application and input size, the data shown include execution time at the phone alone, that of Clone Cloud with Wi-Fi (CC-Wi-Fi), and that of Clone Cloud with 3G (CC-3G). The partition choice is annotated with M for “monolithic” and O for “off-loaded,” also indicating relative improvement over phone only execution.

Fig. 3 and 4 shows execution times and phone energy consumption for the three applications, respectively. All measurements are the average of five runs. Each graph shows Phone, Clone Cloud with Wi-Fi (CC-Wi-Fi), and Clone Cloud with 3G (CC-3G). CC-Wi-Fi and CC-3G results are annotated with the relative improvement and the partitioning choice, whether the optimal partition was to run monolithically on the phone (M) or to off-load to the cloud (O). In the experiments, Wi-Fi had latency of 69ms and bandwidth of 6.6Mbps, and 3G had latency of 680ms, and bandwidth of 0.4Mbps.

Clone Cloud chooses to keep local the smallest workloads from each application, deciding to off-load 6 out of 9 experiments with Wi-Fi. With 3G, out of all 9 experiments, Clone Cloud chose to off-load 5 experiments. For off-loaded cases, each application chooses to offload the function that performs core computation from its worker thread: scanning files for virus signature matching for VS, performing image processing for IS, and computing similarities for BP. CC Wi-Fi exhibits significant speed-ups and energy savings: 12x, 20x, and 10x speed-up, and 12x, 20x, and 9x less energy for the largest workload of each of the three applications, with a completely automatic modification of the application binary without programmer input. A clear trend is that larger workloads benefit from off-loading more: this is due to amortization of the migration cost over a larger computation at the clone that receives a significant speedup.

A secondary trend is that energy consumption mostly follows execution time: unless the phone switches to a deep sleep state while the application is off-loaded at the clone, its energy expenditure is proportional to how long it is waiting for a response. When the user runs a single application at a time, deeper sleep of the phone may further increase observed energy savings. We note that one exception is CC-3G, where although execution time decreases, energy consumption increases slightly for behaviour profiling with depth 4. We believe this is due to our coarse energy cost model, and only occurs for close decisions.

CC-3G also exhibits 7x, 16x, and 5x speed-up, and 6x, 14x, and 4x less energy for the largest workload of each of the three applications. Lower gains can be explained given the overhead differences between Wi-Fi and 3G networks. As a result, whereas migration costs about 15-25 seconds with Wi-Fi, it shoots up to 40-50 seconds with 3G, due to the greater latency and lower bandwidth. In both cases, migration costs include a network-unspecific thread-merge cost—patching up references in the running address space from the migrated thread—and the network-specific transmission of the thread state. The former dominates the latter for WiFi, but is dominated by the latter for 3G. Our current implementation uses the DEFLATE compression algorithm to reduce the amount of data to send; we expect off-loading benefits to improve with other optimizations targeting the network overheads (in particular, 3G network overheads) such as redundant transmission elimination.

B. Problem in Clone Cloud

The disadvantages of Clone Cloud are [11] handover delay, bandwidth limitation. As we know that the speed of data transmission between Smartphone and base station is not consistent (according to the situation), therefore, the Clone Cloud will be unavailable if mobile users walk in the signal's blind zone.

Offloading all applications from Smartphone to the cloud cannot be justified for power consumption, especially for some lightweight applications which are suitable to be deployed in local smart phones.

IV. VIRTUALIZED SCREEN

Screen rendering [13] can also be moved to the cloud and the rendered screen can be delivered as part of the cloud services. In general, the screen represents the whole or part of the display images. In a broad sense, it also represents a collection of data involved in user interfaces such as display images, audio data, mouse, keyboard, pen and touch inputs, and other multimodality inputs and outputs. Screen virtualization and screen rendering in the cloud doesn't always mean putting the entire screen-rendering task in the cloud. Depending on the actual situations—such as local processing power, bandwidth and delay of the network, data dependency and data traffic, and display resolution—screen rendering can be partially done in the cloud and partially done at the clients.

A. Screen Virtualization

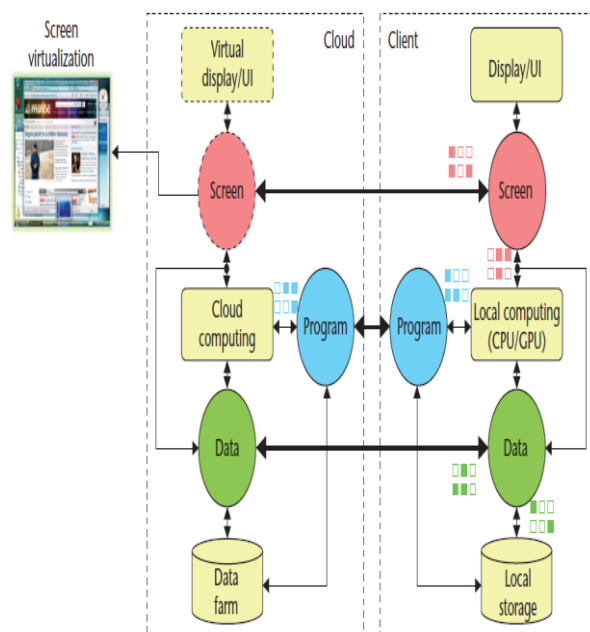


Fig. 5 The Conceptual diagram of the cloud client computing architecture.

Rendering a screen in the cloud also introduces obstacles for the client devices to access the virtual screen, if it needs to maintain high-fidelity display images and responsive user interactions. Fortunately, we have already developed a number of advanced multimedia and networking technologies to address these issues.

Ultimately, we would like to define a common cloud API for cloud computing with scalable screen virtualization, with which the developers never have to care where the data storage, program execution, and screen rendering actually occur because the cloud services for the API will adaptively and optimally distribute the storage, execution, and rendering among the cloud and the clients.

B. Remote Computing With Virtualized Screen

The cloud-computing conceptual architecture depicted in Fig 5, we have developed a thin-client, remote-computing system that leverages interactive screen-remoting technologies.

Thin-client, remote-computing systems are expected to provide high-fidelity displays and responsive interactions to end users as if they were using local machines. However, the complicated graphical interfaces and multimedia applications usually present technical challenges to thin-client developers for achieving efficient transmissions with relatively low bandwidth links. Figure depicts the proposed thin-client, remote-computing

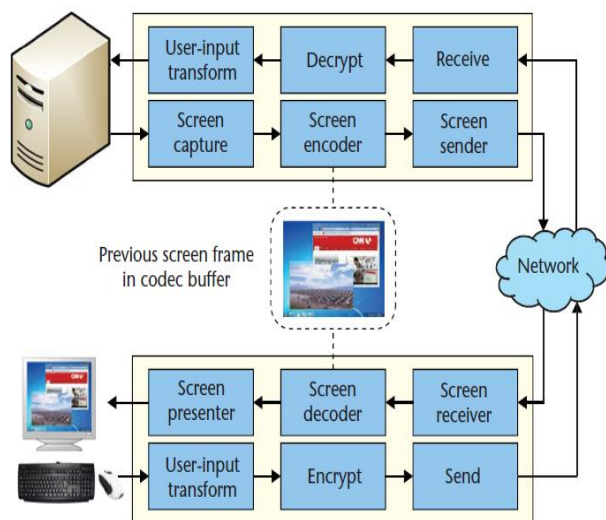


Fig. 6 The interactive screen remoting system

System, which decouples the application logic (remote) and the user interface (local) for clients to use remote servers deployed as virtual machines in the cloud. The servers and the clients communicate with each other over a network through an interactive screen-remoting mechanism. The clients send user inputs to the remote servers, and the servers return screen updates to the clients as a response.

V. CONCLUSION

Cloud Computing refers to the delivery of computing and storage capacity as a service to a heterogeneous community of end-recipients. The cloud computing technology provides four deployment models: public cloud, private cloud, hybrid cloud and community cloud; three service models: IaaS, PaaS and SaaS. This paper takes a step towards seamlessly interfacing between the mobile and the cloud. This system overcomes design and implementation challenges to achieve basic augmented execution of mobile applications on the cloud, representing the whole-sale transfer of control from the device to the clone and back. Offloading all applications

from smart phones to cloud needed more power consumption. To overcome this, there is a concept of Virtualized Screen in which screen rendering will be move from smart phones to cloud as a service. Only part of the smart phone's screen is virtualized in cloud.

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