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CLOUD COMPUTING USABILITY IN MOBILE COMMUNICATION NETWORK

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ABSTRACT

Cloud computing is a modern technology that makes computing power universally available and provides cloud utilities in resources acquisition. The integration of cloud computing into the mobile computing environment overcomes obstacles related to the performance, like storage and bandwidth to the communication network resources. We are witnessing a rapid adoption of smarter devices all around us, which brings with it orders of magnitude in heterogeneity. Here comes the challenge to optimize performance for devices that are so diverse in terms of energy consumption, processing power and communication capabilities.

We can extend the capabilities of mobile devices through cloud offloading. In this paper we briefly explain two applications that make use of cloud offloading to improve its performance as well as to save mobile battery lifetime. The first application is based on CBIR, Content Based Image Retrieval and the second one is a Cloud-based Mobile Social TV. In both the applications storage and other computations are offloaded into the cloud.

KEYWORDS: Mobile Cloud Computing, CBIR, IaaS, PaaS

INTRODUCTION

Cloud computing is a new paradigm in which computing resources such as processing, memory, and storage are not physically present at the user's location. Instead, a service provider owns and manages these resources, and users access them via the Internet [1]. For example, Amazon Web Services lets users store personal data via its Simple Storage Service (S3) and perform computations on stored data using the Elastic Compute Cloud (EC2). This type of computing provides many advantages for businesses—including low initial capital investment, shorter start-up time for new services, lower maintenance and operation costs, higher utilization through virtualization, and easier disaster recovery—that make cloud computing an attractive option. Reports suggest that there are several benefits in shifting computing from the desktop to the cloud [2], [3].

The primary constraints for mobile cloud computing are limited energy and wireless bandwidth. Cloud computing can provide energy savings as a service to mobile users, though it also poses some unique challenges. A survey last year by ChangeWave Research [4] revealed short battery life to be the most disliked characteristic of Apple's iPhone 3GS, while a 2009 Nokia poll showed that battery life was the top concern of music phone users. Many applications are too computation intensive to perform on a mobile system.

If a mobile user wants to use such applications, the computation must be performed in the cloud. In this paper, we first describe the design of a novel mobile social TV system, CloudMoV [5], which can effectively utilize the cloud computing paradigm to offer a living-room experience of video watching to disparate mobile users with spontaneous social interactions. In CloudMoV, mobile users can import a live or on-demand video to watch from any video streaming site, invite their friends to watch the video concurrently, and chat with their friends while enjoying the video. It therefore blends viewing experience and social awareness among friends on the go. Secondly we describe mobile image processing. In both cases cloud computing is integrated to mobile computing environment which not only improves its performance but also saves battery lifetime of the mobile devices.

OBJECTIVES OF THE STUDY

To study the importance of cloud computing in mobile communication network.

CLOUDMOV: ARCHITECTURE AND DESIGN

As a novel Cloud-based Mobile sOcial tV system, Cloud- MoV provides two major functionalities to participating mobile users: (1) Universal streaming. A user can stream a live or on-demand video from any video sources he chooses, such as a TV program provider or an Internet video streaming site, with tailored encoding formats and rates for the device each time. (2) Co-viewing with social exchanges. A user can invite multiple friends to watch the same video, and exchange text messages while watching. The group of friends watching the same video is referred to as a session. The mobile user who initiates a session is the host of the session. We present the architecture of CloudMoV and the detailed designs of the different modules in the following.

KEYMODULES

Figure 1 gives an overview of the architecture of CloudMoV. A surrogate (i.e., a virtual machine (VM) instance), or a VM surrogate equivalently, is created for each online mobile user in an IaaS cloud infrastructure. . The surrogate acts as a proxy between the mobile device and the video sources, providing transcoding services as well as segmenting the streaming traffic for burst transmission to the user. Besides, they are also responsible for handling frequently exchanged social messages among their corresponding users in a timely and efficient manner, shielding mobile devices from unnecessary traffic and enabling battery efficient, spontaneous social interactions. The surrogates exchange social messages via a back-end PaaS cloud, which adds scalability and robustness to the system. There is a gateway server in CloudMoV that keeps track of participating users and their VM surrogates, which can be implemented by a standalone server or VMs in the IaaS cloud. The design of CloudMoV can be divided into the following major functional modules.

- **Transcoder:** It resides in each surrogate, and is responsible for dynamically deciding how to encode the video stream from the video source in the appropriate format, dimension, and bit rate. Before delivery to the user, the video stream is further encapsulated into a proper transport stream. In our implementation, each video is exported as MPEG-2 transport streams, which is the de facto standard nowadays to deliver digital video and audio streams over lossy medium.
- **Reshaper:** The reshaper in each surrogate receives the encoded transport stream from the transcoder, chops it into segments, and then sends each segment in a burst to the mobile device upon its request (i.e., a burst transmission mechanism), to achieve the best power efficiency of the device. The burst size, i.e., the amount of data in each burst, is carefully decided according to the 3G technologies implemented by the corresponding carrier.
- **Social Cloud:** The social cloud is built on top of any general PaaS cloud services with Big Table-like data store to yield better economies of scale without being locked down to any specific proprietary platforms. Despite its implementation on Google App Engine (GAE) as a proof of concept, our prototype can be readily ported to other platforms. It stores all the social data in the system, including the online statuses of all users, records of the existing sessions, and messages (invitations and chat histories) in each session. The social data are categorized

into different kinds and split into different entities (in analogy to tables and rows in traditional relational database, respectively) [6]. The social cloud is queried from time to time by the VM surrogates.

- **Messenger:** It is the client side of the social cloud, residing in each surrogate in the IaaS cloud. The Messenger periodically queries the social cloud for the social data on behalf of the mobile user and pre-processes the data into a light-weighted format (plain text files), at a much lower frequency. The plain text files (in XML formats) are asynchronously delivered from the surrogate to the user in a traffic-friendly manner, i.e., little traffic is incurred. In the reverse direction, the messenger disseminates this user’s messages (invitations and chat messages) to other users via the data store of the social cloud.

- **Syncer:** The syncer on a surrogate guarantees that viewing progress of this user is within a time window of other users in the same session (if the user chooses to synchronize with others). To achieve this, the syncer periodically retrieves the current playback progress of the session host and instructs its mobile user to adjust its playback position. In this way, friends can enjoy the “sitting together” viewing experience. Different from the design of communication among messagers, syncers on different VM surrogates communicate directly with each other as only limited amounts of traffic are involved.

- **Mobile Client:** The mobile client is not required to install any specific client software in order to use CloudMoV, as long as it has an HTML5 compatible browser (e.g., Mobile Safari, Chrome, etc.) and supports the HTTP Live Streaming protocol [7]. Both are widely supported on most state-of-the-art smartphones.

- **Gateway:** The gateway provides authentication services for users to log in to the CloudMoV system, and stores users’ credentials in a permanent table of a MySQL database it has installed. It also stores information of the pool of currently available VMs in the IaaS cloud in another in-memory table. After a user successfully logs in to the system, a VM surrogate will be assigned from the pool to the user. The in-memory table is used to guarantee small query latencies, since the VM pool is updated frequently as the gateway reserves and destroys VM instances according to the current workload. In addition, the gateway also stores each user’s friend list in a plain text file (in XML formats), which is immediately uploaded to the surrogate after it is assigned to the user.

In this application the entire storage including the user details resides in the cloud. The videos are streamed from the cloud via internet. Computations are also offloaded into the clouds computing nodes. A breakdown analysis conducted by Carroll et al. [8] indicates that the network modules (both Wi- Fi and 3G) and the display contribute to a significant portion of the overall power consumption in a mobile device, dwarfing usages from other hardware modules including CPU, memory, etc. Offloading to cloud alone cannot increase the battery lifetime. We target at energy saving coming from the network module of smartphones through an efficient data transmission mechanism design. We focus on 3G wireless networking as it is getting more widely used and challenging in our design than Wi-Fi based transmissions. Based on cellular network traces from real-world 3G carriers, we investigate the key 3G configuration parameters such as the power states and the inactivity timers, and design a novel burst transmission mechanism for streaming from the surrogates to the mobile devices. The burst transmission mechanism makes careful decisions on burst sizes and opportunistic transitions among high/low power consumption modes at the devices, in order to effectively increase the battery lifetime.

MOBILE IMAGE PROCESSING

This application is implemented using an android smart-phone and a cloud infrastructure. The android application is capable of capturing image using its camera and send to a cloud server for content based image retreival. For reducing the processing overload of CBIR in android phones, the captured image is sent to a cloud server running CBIR algorithm over a stored image repository for searching images with similar feature set.

- **Android Module:** Is an android application that enables the user to take an image using his camera and search for similar images stored in cloud server. The Communication between android phone and cloud server is done using Wi-Fi connectivity.
- **Cloud Server Module:** Is implemented using two or three laptops running debian Linux servers which are clustered to run openstack cloud server. The cloud server manages the different instances running CBIR application server, image storage server and image repository management server.
- **CBIR Module:** Is the application server running CBIR (content based image retreivel algorithm). One Function of this module is to categorize the available images from the storage repository based on the image feature sets. Other function of this module is to accept the image to search from the android smart phone and run a CBIR search over that image and provide a better result to user with matching image feature sets.
- **Image Repository Management Module:** Is a web application running in cloud server, which helps the user to upload images to the storage repository and also to delete image from repository.

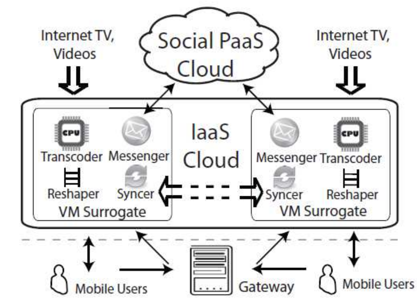

Figure 1: Architecture of Cloud MoV

CONCLUSIONS

In this paper we introduced two mobile applications that use cloud computing technology. The rapidly increasing power of personal mobile devices (Smartphone, tablets, etc.) is providing much richer contents and social interactions to users on the move. This trend however is throttled by the limited battery lifetime of mobile devices and unstable wireless connectivity, making the highest possible quality of service experienced by mobile users not feasible. The recent cloud computing technology, with its rich resources to compensate for the limitations of mobile devices and connections, can potentially provide an ideal platform to support the desired mobile services. We are using the IaaS cloud services in both the applications. The open source tool used is open nebula and the upcoming open nebula sunstone technology is used for the cloud implementation.

The cloud helps to utilize the power properly. In cloudMOV an android mobile user that is the client is connected to the cloud and the user can watch the video with his friends who are online at the same time. The videos are uploaded in the multimedia repository and the proper sharing is achieved by the DASH. MySQL is used for storing the user information. While watching the video the user can also chat with the friends. As like any social network this application is also support the friends inviting and chats. Future work is to add additional features to this application such as online video chatting.

In mobile image processing application preprocessing the images saves energy if the reduction in transmission energy compensates for the energy spent due to preprocessing. If the wireless bandwidth is high, the value of the former reduces. Moreover, different images may have different values of the latter based on their contents. Hence preprocessing must be adaptive based on the wireless bandwidth and the image contents. Our analysis suggests that cloud computing can potentially save energy for mobile users. How-ever, not all applications are energy efficient when migrated to the cloud. Mobile cloud computing services would be significantly different from cloud services for desktops because they must offer energy savings. The services should consider the energy overhead for privacy, security, reliability, and data communication before offloading.

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