Enhancing the Shared Experience with Interactive TV on Smart Phones using Cloud Services

Shirashyad Vinay V[1], Dr. G. F. Ali Ahammed[2]
[1]Student, M.Tech, Department of Computer Science, VTU CPGS, Bangalore vinayshirashyad@gmail.com
[2] Associate Professor, Department of computer Science, VTU CPGS, Bangalore

***Abstract*--The increasing use of mobile phones (Smartphones, tablets) is providing more social interactions between users at any part of the world on the go and has gained a huge popularity in communicating with friends and family. However, this trend is throttled due to the limited battery lifetime and due to limited connectivity of the network making it unfeasible for the mobile users. This results in the low Quality of Service to the users. This drawback of connectivity and the battery lifetime is a major concern to socialize using these small smart devices. The recent advances in the technology have gained some resources to make such interactive things easier to the users. The Cloud Computing technology with its rich resources compensate for the limited resources of the mobile devices and its connectivity. This platform provides an ideal platform to support the desired services for the mobile devices. The challenge here is how to effectively use the resources of cloud to alleviate mobile services. In this paper, we propose the design of a social TV using cloud technology for enhancing the Shared Experience with Interactive TV on Smart Phones. The system effectively utilizes both IaaS (Information-as-a-Service) and PaaS (Platform-as-a-Service) cloud services to offer video watching experience to a group of mobile users who along with watching video can also interact and get a Living room video watching experience. We apply a Surrogate into the IaaS for downloading video and social interaction between the users to guarantee a good streaming quality for each user of the cloud.**

I. INTRODUCTION

The campaign initiated by the smartphone company Apple inc. in the year of 2007 has made smartphones more handy and progressive, the smartphones now a days are shipped with multiple processors dual core, quadra core processors and with a Gigabyte of RAM and posses more computational power as compared to the computers some years ago. On the other side, the huge development of broadband cellular networks further made these smartphones more friendly and competitive. Apart from emails and web browsing smartphones are now a day's used in more challenging scenarios like gaming, real time video streaming and also in social networking like facebook messengers, Whatsapp applications.

We although find many social media applications emerging in smartphones and gaining acceptance in the communication world, many applications are still stranded by the limited battery power and the unreliable wireless communication medium. Recent advances in the cloud computing technology have emerged as a boon to overcome the limitations of smartphones and wireless medium. The cloud computing emerged as paradigm for low cost, nimble, scalable resource supply to support power efficient data communication in mobiles. Cloud computing with its virtually unlimited software and hardware resources can offload the tasks like computation and other tasks involved in smartphone application which reduces the battery consumption of the mobile devices.

The challenge lies in how to completely and efficiently exploit the services provided by cloud to facilitate mobile applications. There are many designs on mobile cloud computing systems [1][2][3] but most of them do not deal with stringent delay requirements for instant social interaction among mobile users. In this paper, we describe the novel smartphone social tv system, which can utilize the cloud computing paradigm efficiently and provide a effective spontaneous living room experience of watching video to disparate mobile users and instant social communications. In this application mobile users can import a live or on-demand video from any site providing live video streaming and invite their friends to watch video concurrently and chat with friends and family simultaneously to watching the video. As opposed to traditional tv watching, mobile based tv with social communication facility is well suited for today's modern life style, where family and friends are located at different places geographically but wish to share a co-viewing experience as in a living-room. While we presently have social tv enabled by set top boxes over traditional tv systems [4][5] it's a challenge to achieve this on smartphones where the concurrent viewing experience with friends is enabled .

We design this handheld smartphone based social tv to seamlessly utilize agile resources support and rich functionalities offered by both IaaS and PaaS cloud services. Our design achieves the following goals.

Flexibility in Encoding: There are variety of mobile devices having different size of displays, customized playback hardware's and different codecs. The traditional

solutions would adopt a few encoding formats available before release of the video program. But it is not possible to achieve the encoding for all the mobile platforms, if not only to current most popular models by the content providers. Our design customizes the streams for different devices at real time, by offloading the transcoding tasks to an IaaS cloud service. Here we employ a surrogate, which is a Virtual Machine (VM) for each user on the IaaS cloud. This surrogate downloads the video and transcodes it to the desired formats of the mobile devices while catering to specific configurations and the current quality of connection.

Utilization of Battery: The number of researches and analysis conducted by Carroll et al.[6] indicates that the network connectivity (WI-FI as well as 3G networks) and the display of mobile devices contribute to a overall consumption of battery power in mobile devices, overshadowing usages from other hardware modules like memory, CPU processes etc. Through an efficient data transmission mechanism design we target at energy saving coming from network modules of smartphones. We would focus on 3G communication networks rather than Wi-Fi based transmission as 3G is used widely and is challenging in our design. Based on cellular network we investigate the key 3G configuration parameters as the power states and inactivity timers and design a novel transmission mechanism for streaming to the smartphone devices through the surrogate.

Spontaneous Social Interactivity: There are number of techniques to enable instinctive social and co-viewing experience. First, effective synchronization mechanisms are used to assure that those joining the video watching may start from the same portion and share reactions on the ongoing video and comments. Synchronized playback is a feature of traditional TV, the current service Web 2.0 tv do not offer such kind of service to its users. Second, efficient message communications systems are mapped for interactions among the group of users and messages are arranged in some order depending on their retrieval frequencies to avoid interruptions in the process of viewing messages. The list of friends who are online can be retrieved at some extended interval of time but the chat messages should be delivered in timely manner. Textual chat messages are used rather than voice based messages in our design as text chats are easier to read/write and voice chats are more distractive as compared to text chats to any viewers and can be managed easily. We use PaaS (Platform-as-a-Service) to gain this social interaction.

Portability: The complete design back end and the front end is implemented using java, which is a pure object oriented language [7] and java helps to run same code on any kind of platform as it is a platform independent language. We have well designed generic data models for any kind of data storage like BigTable, the transcoding mechanism is implemented using ANSI C for its performance efficiency and uses no proprietary API's. HTML 5 supporting mobile devices, android devices and iOS systems can run the client module.

II. RELATED WORK

We find a large number of mobile tv systems which have emerged in the recent years, with advanced hardware and software specifications in smartphones. Some systems[8][9] offer the living-room experience to small screens but they are more focused in clearing the barrier in order to actualize the convergence of the mobile network and the local television network, than digging into the demand of social communications among the mobile users. Coppens et al. [4] try to add rich social communication to TV but has got limitations with traditional broadcast channels; Series of experiments were conducted on human social activities while viewing different kinds of programs. These designs even inspiring are not suitable for being applied to mobile device environment directly. Schatz et al. [10][11] have designed a system which is altered for Digital Video Broadcasting- Handheld and symbian based systems as opposed to a more broader audiences. Comparing to these all earlier implementations and work, we target our design for a handheld smartphone social TV framework, which boasts the co-viewing experiences among friends over smartphone devices. This framework is designed for all Web-based video programs which can be a live video or an on-demand video streaming and wide range of devices are supported with HTML-5 browsers and with no extra components on the device.

For any application which is targeted for the handheld devices, the main challenge and major concern is reducing power consumption. Recent studies by Carrol et al. [6], the cellular module including the wireless network card consume more than half of the overall power in mobile devices than the CPU. Our design would achieve more than 30% of power saving in by switching the device during streaming between low-power transmission and high power transmission modes. A recent study done by Zhang et al. [12] investigates the caching management problem of media under HTTP adaptive bit rate streaming over a lossy network, which complements the design of our work when we require video streams to be transcoded into numerous bit rates.

III. ARCHITECTURE AND DESIGN

As a novel social mobile TV based on cloud services, the major functionalities provided to the smartphone users participating in it: (1) **Ecumenical Streaming of Videos.** A smartphone user can stream a video from any source available on the web, it can be a live-video or from a TV program with sewed encoding formats and the transmission rates based on the mobile devices each time. (2) **Co viewing with Social communications.** In this, the user can send request to a group of friends in his friends list and invite them to watch the video as in a group and text chat while watching the video. We call this as a *Session* where a

group of people watch the same video together and the person who initiates this session is the host.

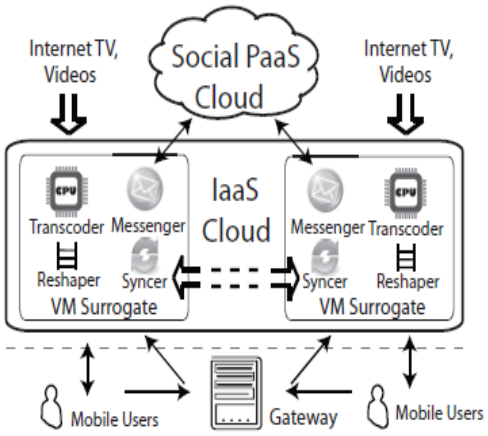

Figure 1: Architecture

A. Key Modules in this Design

Fig. 1 gives an overview of the design architecture. A VM or a surrogate (i.e., an instance of a Virtual Machine) is generated for each mobile user who is online on IaaS service of cloud infrastructure. The VM instance acts as a procurator between the source of video and the mobile device; this VM instance (Surrogate) provides transcoding services and sectioning the traffic for burst transmission to the end users of the system. Surrogate is also responsible for handling the text messages exchanged between the users in a timely and efficient manner, protecting mobile devices from unwanted traffic and enabling efficient usage of battery, spontaneous social communications. The social text messages are exchanged via a PaaS (back-end service) cloud, PaaS adds scalability to the system. A gateway server is available in the system to keep track of the users who are participating and which VM instance is allocated to the corresponding user implemented using IaaS cloud service.

The design of our system can be divided into the various functional modules.

- *Video Transrating/Transcoder:*

It is implemented in each VM instance/surrogate. This helps in deciding how to dynamically encode the video stream from the source of video in the earmark format, dimensions and the specified bit rate. The video stream is encapsulated into a proper transport stream before it is delivered to the end user. We implement this using the MPEG transport streams, which is the standard to deliver digital audio and video over the lossy transmission medium.

- *Reshaper:*

This is resided in the VM instance of each user and upon receiving the encoded transport stream it divides it into segments and transmits each in a burst to the requested mobile device to achieve the power efficiency of the device. Depending upon the 3G technology implemented by the service provider of the carrier the burst size is generated.

- *Google Social Cloud*

The prototype of the implementation can be implemented on any social cloud and can be ported from one cloud service to other platforms. All social data is stored in the system which includes online status of the users, existing session records and the invitations and chat history of each session. The social communications are divided into different kinds and into different entities like a table of rows in a relational database system. The VM surrogate queries the social cloud every short interval of time.

- *Messenger*

The messenger is the component on client side of user which can be used to exchange texts between users. This helps user to share his views and opinions and desires using the messenger.

- *Syncer*

This is the mechanism which helps the users viewing progress is similar to other users time window in the current session. Syncers communicate with each other directly which are on different surrogates.

- *End Users/ Client*

The end user is the person who uses the application using his mobile phone which supports HTML-5 mobile browsers like chrome, firefox etc and has the live streaming facility.

- *Gateway*

This gateway helps to check the user credentials during the login process and stores the details in MySQL database and can even store the available surrogates in the cloud. As the user logs in successfully the surrogate will be assigned to the user from the available surrogates in the database.

B. Loosely Coupled Interfaces

The interface between various module in our design which is comprised of mobile users, VM instances, the social cloud are purely based on the HTTP which is a standard for the devices which are interconnected. Due to this loosely coupled interface between the users and the system infrastructure any handheld devices can gain access to the services as long as it supports HTML browser.

We employ asynchronous mode of communication for social message exchanges and all these messages are exchanged via the VM instance to the social cloud which stores and organizes the large amount of data in a data store like BigTable. The surrogate queries frequently and processes the accumulated data into XML files for retrieval by users.

IV. CONCLUSION

This paper presents the details about enhancing the shared experience with interactive tv on smart phones using cloud services. This supports the functionalities of the cloud computing services and focuses on the VM (virtual machine) system technology which helps into the use of services on the cloudlet using the 3G or the Wireless LAN technology. This paper also presents the portable and generic social TV which uses both Information and Platform services of the cloud. The main focus of this paper is to increase the efficiency of the battery and to have

a living-room experience in watching videos with family and friends who are divided geographically across the world.

REFERENCES

[1] M. Satyanarayanan, P. Bahl, R. Caceres, and N. Davies, "The case for vm-based cloudlets in mobile computing," IEEE Pervasive Computing, 12 vol. 8, pp. 14–23, 2009.
[2] S. Kosta, A. Aucinas, P. Hui, R. Mortier, and X. Zhang, "Thinkair: Dynamic resource allocation and parallel execution in the cloud for mobile code offloading," in Proc. of IEEE INFOCOM, 2012.
[3] Z. Huang, C. Mei, L. E. Li, and T. Woo, "Cloudstream: Delivering high-quality streaming videos through a cloud-based svc proxy," in INFOCOM'11, 2011, pp. 201–205.
[4] T. Coppens, L. Trappeniners, and M. Godon, "AmigoTV: towards a social TV experience," in Proc. of EuroITV, 2004.
[5] N. Ducheneaut, R. J. Moore, L. Oehlberg, J. D. Thornton, and E. Nickell, "Social TV: Designing for Distributed, Sociable Television Viewing," International Journal of Human-Computer Interaction, vol. 24, no. 2, pp. 136–154, 2008.
[6] A. Carroll and G. Heiser, "An analysis of power consumption in as smartphone," in Proc. of USENIXATC, 2010.
[7] What is 100% Pure Java, http://www.javacoffeebreak.com/faq/faq0006.html.
[8] J. Santos, D. Gomes, S. Sargento, R. L. Aguiar, N. Baker, M. Zafar, and A. Ikram, "Multicast/broadcast network convergence in next generation mobile networks," Comput. Netw., vol. 52, pp. 228–247, January 2008.
[9] DVB-H, http://www.dvb-h.org/.
[10] K. Chorianopoulos and G. Lekakos, "Introduction to social tv: Enhancing the shared experience with interactive tv," International Journal of Human- Computer Interaction, vol. 24, no. 2, pp. 113–120, 2008.
[11] M. Chuah, "Reality instant messaging: injecting a dose of reality into online chat," in CHI '03 extended abstracts on Human factors in computing systems, ser. CHI EA '03, 2003, pp. 926–927.
[12] R. Schatz, S. Wagner, S. Egger, and N. Jordan, "Mobile TV becomes Social - Integrating Content with Communications," in Proc. of ITI, 2007.
[13] R. Schatz and S. Egger, "Social Interaction Features for Mobile TV Services," in Proc. of 2008 IEEE International Symposium on Broadband Multimedia Systems and Broadcasting, 2008.
[14] J. Flinn and M. Satyanarayanan, "Energy-aware adaptation for mobile applications," in Proceedings of the seventeenth ACM symposium on Operating systems principles, ser. SOSP '99, 1999, pp. 48–63.