Implementation of Mobile Video/Voice over IP and Access Control on Cloud Computing

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Abstract

The objective of this study is to realize a real-time video/voice over IP (VVoIP) applications that has implemented by a Hadoop cloud computing and it is denoted CLC-IHU. It really outperforms the previous P2P connected VVoIP (called SCTP-IHU) due to the easy-to-use and high-performance video phone call. User does not need to know what is a real IP used to ring a video phone call to the receiver. Next based on client/server architecture users employ web interface to achieve VVoIP connection with thin clients where the seamless handoff delay between base stations is in average 1.631 sec under mobile wireless environment. Therefore video phone call adopts an easy TCP connection instead of the complicated PR-SCTP protocol because of web interface not supported by PR-SCTP. Moreover, CLC-TCP scheme reduces computation load and power consumption dramatically for thin clients. In order to verify the effectiveness and efficiency in access control for preventing illegal intrusions from the outside of the cloud, the rapid facial recognition and fingerprint identification via Hadoop cloud computing has been done successfully within 2.2 seconds to cross-examine the subject identity exactly.

Keywords: Hadoop Cloud Computing; Thin Client; VVoIP; PR-SCTP; SCTP-IHU; CLC-IHU

1. Introduction

It is well-known that audio stream transmitted are through Real-Time Transport Protocol (RTP) [1] relying on UDP, which provides no loss recovery (unreliable). Using TCP rather than UDP, it may cause long delay to get obsolete data at receiver side. In the previous work [2], VVoIP is constructed in ARM-based embedded platform rather than the earlier project implemented on x86 PC [3] for the purpose of the use of mobile video phone call operated on P2P connection [4]. In order to tackle three crucial problems: head-of-line blocking, handover interruption, and non-real-time transmission, we have adopted PR-SCTP protocol [5] instead of TCP. However, the computation load for real-time video phone call is so big and has caused ARM-based embedded platform [6] no longer with power-saving. Moreover, VVoIP need to know their respective IP address between two mobile devices before P2P connection.

In order to resolve the problems as mentioned above, this study is to realize a real-time video/voice over IP (VVoIP) applications that has implemented by a Hadoop cloud computing and it is denoted CLC-IHU. Next based on client/server architecture users employ web interface to achieve VVoIP connection with thin clients and video phone call adopts an easy TCP connection instead of the complicated PR-SCTP protocol because of web interface not supported by PR-SCTP. User does not need to know what is a real IP used to ring a video phone call. In addition, cloud computing server has been protected by the access control according to the mechanism of authentication, authorization, and accounting (AAA) [7]. Hadoop cloud computing [8] together with access control by employing the rapid identification of face and fingerprint has been realized in order for preventing illegal intrusions from the outside of the cloud. Here, we use the standard J2ME [9] environment for embedded devices, where JamVM [10] virtual machine is employed to achieve J2ME environment and GNU Classpath [11] is used as the Java Class Libraries.

2. Cloud computing and VoIP applications

Cloud computing is an emerging and increasingly popular computing paradigm, which provides the users massive computing, storage, and software resources on demand. How to program efficient distributed parallel applications is complex and difficult. How to dispatch a large scale task executed in cloud computing environments is challenging as well.

Currently on the market the most popular cloud computing services are divided into public clouds, private clouds, community/open clouds, and hybrid clouds, where Goggle App Eng [12], Amazon Web Services [13], Microsoft Azure [14] - the public cloud; IBM Blue Cloud [15] - the private cloud; Open Nebula [16], Eucalyptus [17], Yahoo Hadoop [18] and the NCDM Sector/Sphere [19] - open cloud; IBM Blue Cloud [15] - hybrid cloud.

Two famous companies related to IP phone via cloud computing are voice over IP in a Cloud, IIS 2009 [20] and VoIP in cloud computing, Skpye in 2010 [21]. In Taiwan, Chunghwa Telecom provides Hicloud with two services: CaaS and StaaS [22], Innovative DigiTech-Enabled Applications & Services Institute at III [23] gives public cloud computing services, National Center for cloud computing at NARL delivers training courses for cloud computing [24], and Cloud computing Center for Mobile Application at ITRI contributes the efforts in Container Computer, Cloud OS, and Application [25].

3. Video/voice over IP on cloud computing

In this study, the VVoIP application program does not need to be installed inside mobile devices. It has been set up in the Hadoop cloud computing server [26] [27] so that web interface is applicable to run and browse video phone call between cloud computing server and thin clients as shown in Fig. 1. Therefore, instead of complicate PR-SCTP protocol a simple and easy control transmission protocol TCP is employed in such a client/server structure rather than P2P connection as we did before. Video/voice streaming over IP can be implemented in such a bidirectional connection between thin-client type of Linux or WinCE embedded platforms. Users do not need to get both actual IPs in advance; instead they get into Hadoop cloud computing server to catch VVoIP service directly for initiating video phone call connection and cloud computing will be looking for the other side to accomplish phone call link between two client sites.

4. Method and procedure

4.1. Deploying Hadoop cloud computing

Once a Hadoop cloud computing server has been established in server site, we have to test the functionality of cloud computing in Hadoop system as shown in Fig. 2, 3, and 4. In order to setup a programming environment for Python or Java, an Eclipse IDE [28] is applied to develop the application program (AP) at local site. It is noted that please remember to install Java JDK [29] before you setup an Eclipse IDE in local site. If AP has been done and is waiting for dispatching itself to Hadoop cloud computing server, we deploy this AP via the path of LAN or WiFi. Finally we take a look at HBase in Hadoop server to make sure that the cloud computing is ready for the task.

4.2. Establishing thin client

In terms of thin client, JamVM is treated as the framework of programming development; however the virtual machine JamVM has no way to perform the drawing even through their core directly, and thus it must call other graphics library to achieve the drawing performance. Here some options we have are available, for example, GTK+DirectFB, GTK+X11, QT/Embedded [30]. As shown in Fig. 5, this study has chosen QT/Embedded framework instead of GTK series, in such a way that achieves GUI interface functions. In Fig. 6, no matter SWT or AWT in JamVM they apply Java Native Interface (JNI) [31] to communicate C- written graphics library. Afterward QT/Embedded gets through the kernel driver to activate graphic function as shown in Fig. 7.

4.3. Installing access control system

Cloud computing here can perform rapid fingerprint identification [32] and facial recognition [33] in order to fulfill the access control system [34]. We will see whether or not a quick response to client is confirmed. The access control system is shown in Fig. 8.

4.4. Implementing VVoIP at Hadoop with web interface

(1) According to a open source IHU (a voice over IP application program), we have established a video/voice over IP application program implemented on Linux system to realize VVoIP over two PCs as shown in Fig. 9.

(2) Activating a database in a cloud computing server to record the necessitated information like account, IP address and so on.

(3) Constructing the web services in order to connect a database in Hadoop cloud computing server for implementing the VVoIP applications, user account and login, as shown in Figs. 10 and 11.

(4) Transplanting the video/voice over IP application program into cloud computing server incorporation with web interface and database.

5. Experimental Results and Discussions

A client/server scheme of VVoIP application running on Hadoop cloud computing will be denoted CLC-IHU in the following experiments, as shown in Figs. 12, 13, and 14, and discussions. Two remarkable benchmarks for the performance comparison of access security are revealed in FACE ID2 [35] and ZKS-F20 [36] where Equal Error Rate (EER), for the processes on facial recognition and fingerprint verification, and Response Time are two most concerned measures in the control of access security. As listed in Table 1, the comparison of performance with three models, FACE ID2, ZKS-F20, and CLC-IHU, is consequently shown that the method we proposed here outperforms the other alternatives due to fast response and low misclassification rate in access security.

In comparison to the previous work as shown in Fig. 15, the result of the experiment on VVoIP at Hadoop cloud computing, as shown in Fig. 16, is really to highly improve the network traffic for video/audio streaming, and easy-to-use TCP/IP protocol instead of PR-SCTP. A well-known benchmark for QoS measures is USHA scheme [37] where low latency and low packet loss are two most critical design issues in USHA scheme. As a result, the comparison of QoS with three models, USHA, SCTP-IHU, and CLC-IHU, as listed in Table 2 is shown that the approach we proposed here is good enough to realize a real-time on-line video phone call between embedded platforms. In addition, we also emphasizes that real-time streaming multimedia with cloud computing scheme to achieve the least losses of transmitted packets, below 2% on average for video streaming, which is acceptable for four types of handoff. This result show the head-of-line blocking and handoff interruption can be resolved somehow by fast re-connection and parallel computation. According to the specification for mini2440 [38], ARM-based embedded platform, it is noticed that the power consumption is really reduced dramatically in mobile device when we adopt cloud computing scheme, CLC-TCP, for a real-time on-line video phone call.

In the application of VVoIP running in Hadoop cloud computing, the handoff delay time can achieve less than 1.7 sec as shown in Table 2. In order to verify the effectiveness and efficiency in access control for preventing illegal intrusions from the outside of the cloud, the rapid face recognition and fingerprint identification in Hadoop cloud computing has been done successfully within 2.2 seconds, as shown in Table 1, to exactly cross-examine the subject identity. As a result the proposed approach outperforms the other alternatives due to fast response and low misclassification rate like EER in access control.

6. Conclusions

In the previous work, VVoIP application program must be installed in mobile devices. In this study we have devoted to deploy the VVoIP applications to a Hadoop cloud computing server together with access control implementation of rapid facial and fingerprint identifications so that user can utilize web interface to interact with VVoIP services through the connection between thin client and cloud computing server. This client/server scheme reduces dramatically the computation load and power consumption for thin clients since the computation task of VVoIP is served in cloud computing server. We do not get the actual IP for each other before VVoIP connection. A simple and easy control transmission protocol TCP is applicable, instead of the complicated PR-SCTP, to implements the real-tome on-line video phone call for both clients. We have concluded that the approach we proposed here achieves a better performance and efficiency than the previous works.

7. Acknowledgement

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8. References

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Table 1. The Performance Comparison of Access Security

Performance	FACE ID2	ZKS F20	CLC-IHU
Equal Error Rate (EER)	<0.1%	<0.01%	<0.01%
Response Time	<5.5 sec	<3.7 sec	<2.2 sec

Table 2. The QoS Comparison of VVoIP

Performance	USHA	SCTP-IHU	CLC-IHU
Handoff Delay	2.5 sec	1.865 sec	1.631 sec
Power Consumption at Thin Client	—	11.7mAV ∫ 10.53mAV	7.02mAV ∫ 6.318mAV

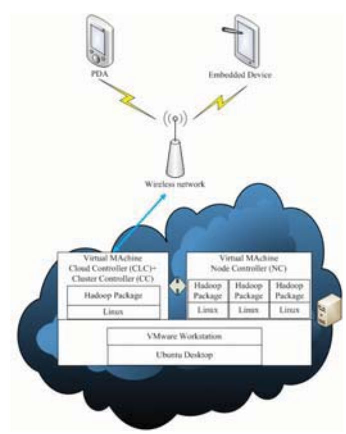


Fig. 1. Hadoop cloud computing server linked to mobile devices over WiFi.

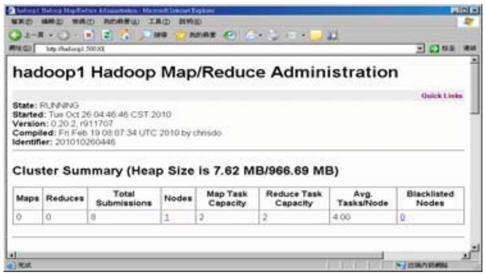


Fig. 2. Testing Hadoop Administration Interface at http://hadoop1:50030.

Fig. 3. Testing Task Tracker Status at http://hadoop1:50060.

Fig. 4. Testing HDFS Status at http://hadoop1:50070.

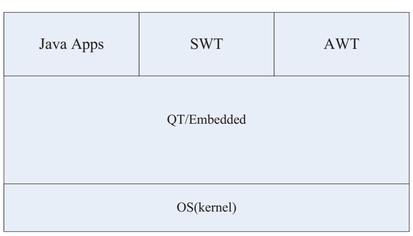


Fig. 5. Terminal node with QT/Embedded.

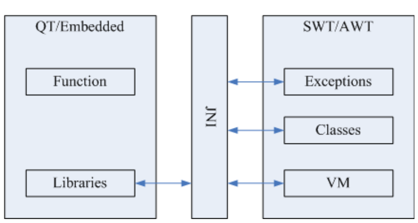


Fig. 6. Communication between SWT/AWT and QT/Embedded.

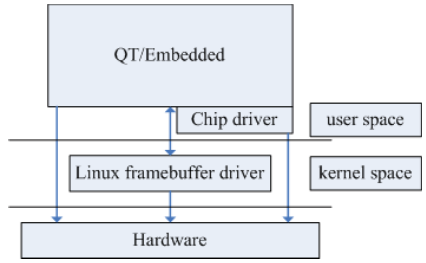
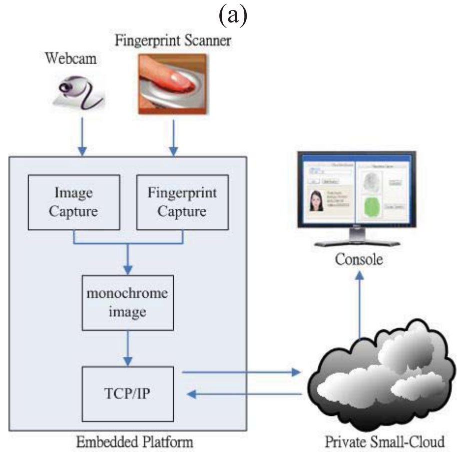


Fig. 7. QT/embedded communicates with the Linux Framebuffer.

(a)



(b)

Fig. 8. Architecture of access control.

Fig. 9. VVoIP implementation between two PCs via P2P connection.

Fig. 10. Web registration at Hadoop cloud computing server before launching VVoIP application.

Fig. 11. Web login interface at Hadoop cloud computing server before launching VVoIP application.

Fig. 12. Binarization processing automatically running in a program.

Fig. 13. Processing fingerprint features to reduce the amount of information.

Fig. 14. Information sent to the cloud and cloud displays the results of recognition on the consol.

Fig. 15. VVoIP over two PCs via P2P connection.

(a) on-line user A

(b) on-line user B

Fig. 16. CLC-IHU implementing VVoIP over two Linux mobile devices (mini2440).