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Review On Cloud Computing Application In P2P Video Streaming

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Abstract

Cloud computing has been introduced as a solution to several problems of the traditional web-based e-learning system, such as a limited storage, a high infrastructure maintenance costs and a low interoperability among the component of web-based e-learning system. However, the cloud computing system performance may deteriorate with increasing number of users and become worse when many users access the video streaming from the cloud system. This is due to the centralized architecture of the cloud computing that can generate network traffic congestion and bottleneck in the cloud servers. Peer-to-peer (P2P) architecture has been proposed to overcome this problem. Using P2P, all nodes in the cloud system can act as servers as well as clients at the same time for reducing the congestion and bottleneck of the system. Currently, there are few reviews on P2P video streaming although intensive studies have been done on the development of the system. With this condition, identifying and understanding the development of P2P video streaming will be expensive, time consuming and physically exhausting. The objective of this paper is to review the latest development of P2P video streaming based on cloud computing. A narrative review method has been used as the methodology for investigating the P2P video streaming' articles from 2009 to 2014. The outcomes of this research shows that 90% of cloud based e-learning integrate with P2P when it's involving streaming video.

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1. Introduction

Cloud based e-learning system are commonly used to replace the traditional client-server technology of e-learning**.** Learning through e-learning is not something new as most universities have utilized it as an interactive teaching and learning tool. E-learning can be categorized as an interactive teaching and learning because it includes numerous types of media that deliver text, audio, images, animation, and streaming video[14].However, the e-learning also have several disadvantages. Most universities have their own e-learning system which mostly developed based on open source solution and stored in a server. These can lead to low scalability as the repositories keep growing in a limited space as it is stored in the server. In addition, cost of implementing e-learning is also high as it includes infrastructure, architecture and hardware and software. Hence, cloud computing is introduced to overcome this issues.

Is it a must to change to cloud? Based on previous research made by other researchers, there are valid reasons to move to the cloud computing [9]:

• Reduced cost: Cloud computing reduce the capital cost (CapEx) and operating Expense (OpEx) resources are needed on the basis of pay per use.

• Refined usage of personnel: In cloud computing, the users focus on delivering values rather than maintaining hardware and software.

• Robust scalability: Cloud computing allows to have immediate scaling, either increase or decrease, at any time for feature commitment.

However, as many user access to the server, centralized computing architecture will produce bottlenecks, which will affect the quality of cloud computing services and cause inconvenience to users. Bottlenecks in the available upload bandwidth, both at the media source and inside the overlay network, may limit the quality of service (QoS) experienced by users.

Google is one of the centralized cloud computing provider [4,10,12]. Its system divides all node of system into three roles which are client, master and chunk server. Client is the applications access interface, Master is a node that act as a manager which stores metadata of the system and control of the management of entire system. While Chunk server is used to store data in file format. The size of Google File System depends on chunk server. Bottleneck of the whole system will happen due to increasing number of chunk server or the number of client accessing Master [26]. Thus, the big problem actually came from the Master server of cloud computing.

The current technology of e-learning takes benefit from P2P network to boost up the service of e-learning to its users as potential solution for the bottleneck problem is assisting the P2P streaming network by a cloud computing infrastructure to guarantee a minimum level of QoS.Peer-to-peer (P2P) live streaming is becoming an increasingly popular technology, with a large number of academic [1],[2], [3], [5], [16] and commercial [17], [19] products being designed and deployed. Therefore, P2P networks which integrated with cloud were developed by researchers to achieved efficient usage of the network resources and also improved user experience in terms of bandwidth, delay and jitter. This research focussed more in cloud P2P video streaming in two different scenarios which are live streaming and video on demand which only reviewed latest paper from 2009 until 2013.

The problems have been discussed so far leave important questions unanswered as follows:

i) How to analyse the paper comprehensively?
ii) What are the technology have been used to develop cloud based e-learning?
iii) Is cloud based e-learning integrate with P2P system makes a better solution?

This research covers all issue of the aforementioned problems. This paper is written to analyse the characteristic of traditional e-learning, cloud based e-learning and cloud based e-learning integrate with P2P system.

Rest of the paper is organized as follows, in section 2, we will describe some theory of traditional e-learning. In section 3, we describe about the characteristics of cloud based e-learning. In section 4, the description about P2P video streaming and in section 5 of this paper, there is an explanation about the implementation of technology works with P2P. Section 6 discusses the related works of implementation of cloud computing application in P2P video streaming and Section 7 is conclusion and future work.

2. Theory of Traditional E-learning

Nowadays, e-learning has been used as electronical tool that support teaching and learning. E-learning is the computer and network-enabled transfer of skills and knowledge. Its applications and processes include Web-based learning, computer-based learning, virtual education opportunities and digital collaboration.

Lecturers can upload notes, assignment and even quizzes into e-learning and students can access to e-learning to get the materials that they have been provided. If students have question to be asked, they can interact with lecturers and peers using forum and private messages. Hence, students can learn through notes and interact with lecturers and peers to help them solving their problem in certain subjects.

3. Theory of Cloud based E-learning

Cloud computing has been introduced years ago to solve the problem of cost, limited storage and interoperability of e-learning. The term “cloud computing” was first used in 1996 to describe a computing model where all desktop applications live on the cloud. Unfortunately, during that time, the technology to deploy cloud computing were not readily available. The cloud computing model was reintroduced in 2006. (Van Ommerenet al., 2009) stated that the response to this technology is fairly accepted at the beginning and changed when the Internet giants like amazon.com, google.com, microsoft.com, and IBM started using this computational model and further offer this facility to other web users[7]. Since then, various services, software and storage based on cloud computing have been implemented.

Based on previous research made by other researchers, The valid reasons are cloud computing can reduce cost of capital cost (CapEx) and operating Expense (OpEx) resources which needed on the basis of pay per use. Besides, cloud computing also capable in immediate increase or decrease scaling at any time which make cloud has robust scalability. Thus, cloud computing integrate with traditional e-learning to overcome the limited storage problem. E-learning cloud is a migration of cloud computing technology in the field of e-learning, infrastructure, including all the necessary hardware and software computing resources included in e-learning. After these computing resources are virtualized, they can be afforded in the form of services for educational institutions, students and businesses to rent computing resources. E-learning cloud architecture is shown in Fig. 1 [2].

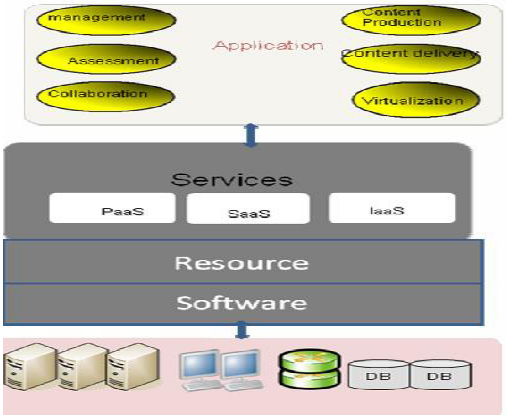

Fig.1. E-learning Cloud Architecture

In addition, cloud solutions can be used to support cooperative learning and socially oriented theories of learning,

using computer technologies to support collaborative methods of instruction [21]. Cloud computing offers many benefits to e-learning solutions by providing the infrastructure, platform and educational services directly through cloud providers and by using virtualization, centralized data storage and facilities for data access monitoring [14] in order to ensure success in e-learning, universities use metrics systems adapted to measure the effectiveness of e-learning solutions based on the cloud.

Within the cloud [23], learners can select the learning content according to their needs, customize learning resources, and arrange learning progress. The effective support of cloud service mainly lied in two aspects. On the one hand, cloud service can help build personal learning environment, centralize management and control the basic elements of personal learning environments, e.g. text, audio, video.

But, as many users access the server, centralized computing architecture will produce bottlenecks. This will affect the quality of cloud computing services. It can cause inconvenience to users as they want to stream the video at the same time.

4. P2P Video Streaming

Peer-to-Peer (P2P) file downloading and streaming applications have recently attracted a large number of users on the Internet. Currently, several P2P video streaming systems have been deployed to reduce server cost where they can be classified into two categories: live and on-demand streaming systems. The live streaming systems disseminate live video contents to all the peers in real time while on-demand video (VoD) streaming system enable peers to enjoy the flexibility of watching a video [18].

For live streaming, Quality of Service (QoS) means high playback continuity and short playback delay. Quality of Service (QoS) provides the ability to specify parameters on multiple queues for increased throughput and better performance of differentiated wireless traffic like Voice-over-IP (VoIP), other types of audio, video, and streaming media, as well as traditional IP data over the Access Point. Existing approaches for live P2P streaming can be generally divided into two categories: treebased and mesh-based approaches. Although these two categories have their own advantages and disadvantages, recently research [5] indicates that the mesh-based approach consistently exhibits a superior performance over the tree-based approach when providing live P2P streaming services.

Video-on-demand service (VoD) allows users to watch any point of video at any time. Compared with live streaming, VoD offers more flexibility and convenience to user. VoD has been identified as the key feature to attract consumers to IPTV service. In VoD service, although a large number of users may be watching the same video, they are asyhnchronous to each other and different users are watching different portions of the same video at any given moment as the playbacks of the same video clip on different users are not synchronized[20].

5. Implementation of Technology

According to establishing topology methods and resource location methods, the P2P system is divided into the categories: centralized way, broadcast, hybrid method, DHT method [17]. Due to the issues upcoming from streaming video over cloud, several researchers propose P2P architecture model that integrate with other technologies as follows.

5.1. DHT Technology

In the P2P network which located according to DHT where the network topology is established according to DHT. First, each node is first assigned a unique identification (ID) and keywords (KEY) is used to represent resource information stored in the node. Through Hash function, KEY can be converted into Hash Value, H(key). When information is released, Tuple Group(KEY,ID) is released to an identicated node. When the resources is located, Tuple Group(KEY,ID) is at the node which likely same with H(key). This method eventually avoid bottlenecks from occur at the central server as the flooding search with distributed structure [6,7,13]. Currently the model based on DHT mainly have CAN[12] and Tapestry[13] system proposed by the research group of UC Berkeley, CHORD[14] system proposed by Massachusetts Institute of Technology and Pastry system proposed by Microsoft Research and Rice University.

5.2. SVC Technology

Due to dynamically changes in the P2P network, such as the joining and leaving of peers, video streaming over cloud cause limitations in the upload bandwidth and client did not receive smooth video stream. Thus, there exists a need to develop an appropriate and stable video delivery platform that supports live video streaming in all kinds of online multimedia devices which is SVC. Scalable video coding (SVC) is one solution to the problems posed by the characteristics of modern video transmission systems. Video applications such as streaming, conferencing, surveillance, broadcast and storage can benefit from SVC technology. By implementing SVC technology, video can be streamed via different quality either low or high.

6. Implementation of Cloud Computing Application in P2P Video Streaming

The network overcomes the bottleneck of the centralized network, makes the communication between nodes more directly and helps to improve the capability of mutual cooperation. P2P network has much characteristic such as decentralization, scalability, robustness, high performance or price ratio, privacy policy and load balancing[25]. Due to this aforementioned problem, several researchers propose a P2P architecture model that change Master server into central P2P network [11,12,26].Central P2P network is consist of multiple Master and Chunk server into Side P2P network that consist a lot of Chunk server. Central P2P network can overcome the bottleneck problem with the help of DHT technology.

In the context of media streaming over cloud, delay and jitter also has becoming the common issues. To provide better Qos of multimedia services, (Wenwu Zhu et.al, 2011) propose media-edge Cloud architecture (MEC). MEC integrate with P2P technology to aid with distributed media data storage and computation. Its composed of storage, central processing unit (CPU),and graphics processors unit(GPU) clusters. The MEC will stores, processes and transmits media data at the edge, hence achieving shorter delay.

(Hong-Yi Chang et. Al, 2012) proposed Cloud-based P2P Live Video Streaming or known as CloudPP that use public cloud servers as peers integrate with Scalable Video Coding(SVC) technology. As they notice there were two problems occur when streaming video over cloud. First, the cloud provider is not responsible for the expansion and distribution of video stream. The cloud servers will act as SVC extractor and online client join or leave algorithms were also implemented to efficiently serve all client requests which enable very large number of clients to receive live video stream which can reduce delay in receiving the video. However, (Korpeglu Erdinc et.al, 2013) claimed that CloudPP[7] were fewer emphasized in delay compared to multipoint real-time user interactive applications and they could tolerate streaming delay up to ten seconds. As the authors propose a hybrid Cloud-P2P architecture, Dragonfly that is specifically developed to support different kinds of large scale multipoint streaming applications. Dragonfly proposed a novel 2-tier edge cloud middle layer of architecture. It is called 2-tier edge because it combines P2P cloud and traditional cloud source providers such as Amazon, Google, and IBM. This layer able to provide additional network resources in preventing bandwidth bottleneck and delay occur.

For peer-to-peer video-on-demand system [20,24], when the number of users online extents at certain scale, it will significantly affecting the bandwidth and speediness of response server when the number of online user extents certain scale. Since cloud computing makes distributed processing easier, it is an alternative to dedicated servers to overcome the challenges by dynamically composing and optimizing the needed service at reduced costs. As proposed by (Yu Wu et.al, 2011), they formulate two optimization problems for cloud provisioning which located in cloud infrastructure which include virtual machine provisioning and storage rental. Then, they also proposed a dynamic cloud resource provisioning algorithm which using the derived capacities and instantaneous network statistics as inputs, can effectively support VoD streaming with low cloud utilization cost

7. Conclusion and Future Work

In this paper, we discussed about the characteristic of traditional e-learning, cloud based e-learning and reviewed cloud computing application of p2p video streaming. Cloud computing has the advantages of high reliability, high scalability, on-demand service, large scale operation, low maintenance costs and also virtualization. However, as many user access to the server, centralized computing architecture will produce bottlenecks, which will affect the

quality of cloud computing services and cause inconvenience to users. With the aid of P2P system, issues arising when streaming video over cloud can be overcome in term of bottleneck, bandwidth, delay and jitter. In the future work, we will emphasize algorithms applied in the cloud computing application in video streaming.

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