Distributed Big Video Processing

[1]Tai-Won Um, [2]Jinsul Kim, [3]Hyun-Woo Lee
[1, First Author] *Dept. of Information and Communication Engineering, Chosun University, Korea (Rep. of), twum@chosun.ac.kr*
[*2,Corresponding Author] *School of Electrical, Electronic Communication and Computer Engineering , Chonnam National University, Korea (Rep. of), jsworld@jnu.ac.kr*
[3] *Electronics and Telecommunications Research Institute, Korea (Rep. of), hwlee@etri.re.kr*

Abstract This paper proposes a distributed big video processing architecture that is able to efficiently store and process video content with diverse service needs. This architecture provides a foundation for various future media services and can realize many new services to the consumers.

Keywords*: Distributed video processing, Big data engine, Big video service, Multimedia*

1. Introduction

Internet-based multimedia services such as IPTV, personal broadcasting and video surveillance are increasing rapidly, and in the near future, people will always be connected on their media services surrounding with a number of interactive and perceptive display devices and people are able to stream and share high-quality live video in customized ways at any time and any place. It will lead to the generation of enormous amount of video content, and these video contents need to be stored, processed, transcoded or shared to users through various types of user devices.

As the number of video content increases and as the video resolution scales up to UHD/3D, it becomes more difficult to store and process it. Furthermore, the processing and storage capabilities provided by a single node are generally limited, so that constructing and maintaining the enormous video content cause high buildup and maintenance cost.

How to efficiently store, process and utilize large amount of video content is quite a big challenge for multimedia service providers and research communities. In order to deal with such vast amounts of video content, advanced computing capabilities are required along with video processing methods that can be used in various applications.

Since there is still no feasible and effective processing architecture for real-time big video services, it needs innovative research to deal with the problems. This paper presents design of a cloud-based big video processing architecture to meet the diverse service needs.

2. Related Works

MapReduce is one of the most popular programming models for the batch processing of big data, and Hadoop [1] is a kind of open source software to provide a system for large and computationally intensive distributed processing. On the other hand, Apache Spark [2] support real-time processing of streaming data based on distributed in-memory storage. There have been some researches that focus on video processing by using big data technologies. Liu et al. [3] proposed a distributed cloud platform for storing and managing massive video data based on the integration of Hadoop. In [4], Zhang et al showed a video-processing framework combines batch processing and stream processing to reveal knowledge hidden in video data.

3. Requirements of Cloud-based Distributed Video Processing

In this clause, we present system requirements to design a cloud-based distributed video processing system.

Major web portal or video service providers with requirements for multiple media processing normally maintain many separate, single-purposed computing clusters. This cannot aggregate workloads from different systems and is incapable of handling burst usage in one system. This is even worse for resource utilization and cost efficiency.

The main requirements of the cloud-based distributed video processing are to support multiple video processing models while guaranteeing both strong performance isolation and high resource utilization. This is challenging for several reasons [5]. First, different video processing service models have diverse processing workflows and provisioning models. Second, multiplexed by such a hybrid video

processing workloads, the resource requirements become highly dynamic in both spatial and temporal dimensions. Maintaining high utilization while satisfying fair sharing and service requirements for multiple video processing services is a demanding task. Researches in efficient use of cloud computing technology in the context of video processing service are necessary. Also, high efficient video transmission structure needs to be developed to support the distributed video processing system.

4. Proposed Architecture

The proposed architecture, named MediaCloud, addresses these requirements by providing a unified interface to dynamically negotiate the resource allocation and to instantiate service components as shown in Fig. 1. A video processing service is a platform as a service (PaaS) instance, and it utilizes the unified interface to access the resources. A centralized system-wide MediaCloud Resource Arbitrator (MRA) is responsible to allocate resources in aggregation. When a new video processing service is registered with MediaCloud, it is subscribed by MRA, and the MRA might dynamically shrink the video processing task to each Service-level Resource Controller (SRC) which consumes the set of resources and performs service-specific task scheduling. Moreover, it relies on a Network Resource Manager (NRM) to reach out its control into the datacenter network, based on the Software-Defined Network (SDN) capability.

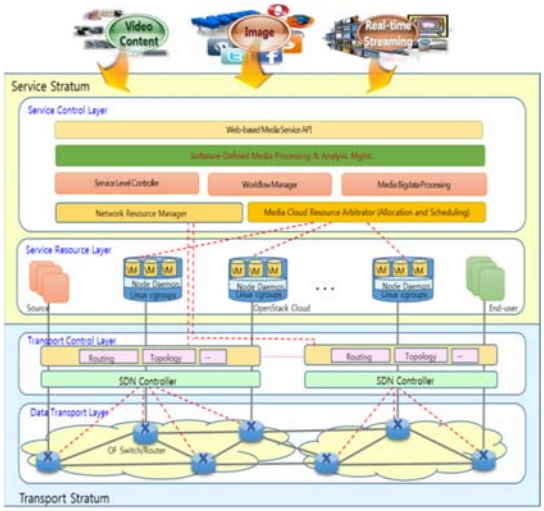

Figure 1. Architecture of distributed big video processing system based on cloud computing

The main design goal of MediaCloud is to enable fine-grained resource multiplexing among different video processing service models to fully utilize the cloud resources.

By referring [5], the design of MediaCloud uses a unified video processing abstraction to encapsulate different types of video service. The resource associated with each video processing task can be dynamically inflated or deflated.

5. Conclusion

Processing and storage capabilities provided by a single node are generally limited, so that constructing and maintaining the enormous video content cause high buildup and maintenance cost. The proposed architecture can be used to build a scalable video processing system handling diverse service needs.

The introduction of the big video processing architecture opens a new way to build a large scale media service platform, which provide scalable and high-speed video encoding, transcoding, decoding, etc. which also addresses the issue of dynamically scaling media cloud resource and Quality of Service (QoS requirements.

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