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New Cloud Computing Network Architecture Directed At Multimedia

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Abstract. Multimedia computing has caused increasing resource consumption and computational overhead. This article pays its considerable attention to cloud computing in handling multimedia applications and services effectively and efficiently. First, we present a solution to reconstruct the network architecture of multimedia field based on cloud computing to integrate multi-service platforms for the heterogeneous terminals. Then we deploy a Sub-cloud computing platform with the central-control type of Sub-cloud architecture, the distributed way to save data in the Sub-cloud and the cloud proxy server setting on the edge of Sub-cloud, to satisfy the various QoS demands of the services. Finally, Sub-cloud platform is presented, and 3D shading map on mobile phone is adopted as case studies to demonstrate the feasibility and high efficiency of the proposed Sub-cloud design.

Keywords: Cloud Computing, Multimedia, QoS, Sub-cloud, Cloud Proxy Server

1. Introduction

Along with the development of Web2.0 and Web3.0, the information of multimedia is provisioned for the general customers in the form of service. There are kinds of multimedia contents, for example video, audio, images and graphics [1].Multimedia services have become more and more abundant, such as formation, editing, searching, sharing, distributing of streaming media and other multimedia business With the rapid development of multimedia technology, a variety of new multimedia applications and services based on Internet and mobile wireless network have emerged, geographic location information service based on heterogeneous terminals especially on the car GPS and mobile phones, content-based image retrieval [2]. In order to provide more quantity and higher quality multimedia services, multimedia computing technology develops rapidly in academic field and industry field.

Cloud Computing is a new technology to provide a variety of computing and storage services through Internet, which integrates the concepts of " Infrastructure as a Service ", " Platform as a Service ", " Software as a Service " .While at the same time, multimedia services cause an urgent demand for cloud computing in consideration of giant user group, explosive data quantity and intensive computation features for multimedia services [3]. Due to different types of terminal devices have different multimedia processing capabilities, different network environments have different network characteristics, different media types have different QoS requirements, the research on the network structure and the key technology on cloud computing platform for multimedia services is imperative.

2. Network Architecture for Multimedia Field

In the future, the bandwidth of air interface will increase and the performance of mobile terminals will continue to improve. The high speed development of wireless technology will impel the mobile Internet

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provider to provide richer contents of multimedia services. “Internet + wireless” network will become the best marketing mode. We can make full use of the scale effect after reconstructing the media field network architecture based on cloud computing [4].

Fig.1 shows the multimedia field network architecture based on cloud computing. Users are able to customize mobile access rules according to the terminal type and network environment. Data management and business support platform achieve service semantic expression, service flow structure and target constraint.

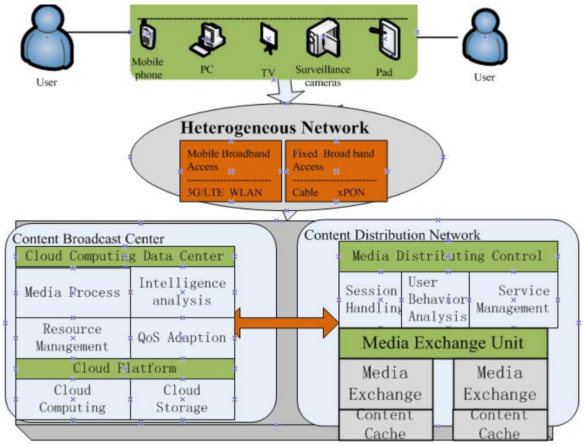

Fig.1: Multimedia field network architecture based on cloud computing

With cloud computing technology as the background, the core portion of the multimedia cloud computing network is divided into two parts: a content distribution network and a content broadcast center. The network conducts the optimization of multimedia data acquisition and network monitoring, including hardware compression encoder and data acquisition, topology routing in complex network, and interface protocols formulating for multiple equipment interaction.

Content distribution network separates control and load bearing, including a media distributing control part and a media switching unit. Media distribution control utilizes centralized setting mode, handles the main session processing and user behavior analysis. Media exchange unit uses a hierarchical and distributed deployment and saves the bandwidth of backbone network through heat content cache on the edge.

Content production and broadcasting center includes cloud computing data center and media service control system, to support storage of multimedia contents, data processing and media intelligence analysis. A cloud platform framework of decoupling mode of platform and application is deployed. Resources are taking according to needs.

The integration of business and network can be achieved through the unified content distribution network. Cloud storage and media service control technology make the service system can be extended indefinitely through cloud computing, thus realizing the integration of multimedia business. For example, through the integration of a variety of business, one user uses mobile phone to download a movie in on-line payment mode, another user can vod the movie through the Set Top Box in different time and place. Multimedia services of “on-demand access, on-demand extending” are provided for users. The system can also be divided into public cloud and private cloud according to different user group to meet the different needs. Private clouds has many characteristics, such as safety and stability, strong confidentiality, easy to unified control and manage, using services at any time, a plurality of terminals access way, large capacity, easy expansion and others, while the public cloud has low construction cost, freely telescopic construction number, multipurpose, less maintenance and public network operation.

3. Cloud Computing Platform Design and Technology

Computing resource, storage efficiency, bandwidth, delay, jitter and other QoS requirements are the key factors in using cloud computing or not in the Internet and the mobile wireless network with multimedia business [5][6]. So cloud computing architecture for the multimedia services is the key link for the study of how the cloud provides QoS guarantees for multimedia traffics from a cloud platform architecture point of view, afterwards to meet various application characteristics such as stereo video, error recovery, and scalability.

3.1. Central control type of Sub-clouds computing architecture

After the design of basic network frame for multimedia cloud computing platform, how to design the software deployment, and how to realize the interaction and management of the nodes, deployment and management of the service and other functions are the key technical points.

Fig.2 shows the Sub-cloud computing architecture. Sub-cloud refers to the server group in the same geographical position, which is oriented to the heterogeneous client terminals in the same region. The media contents and media processing are pushed to the corresponding sub-clouds according to user position by the physical way to reduce delay and provide QoS guarantees.

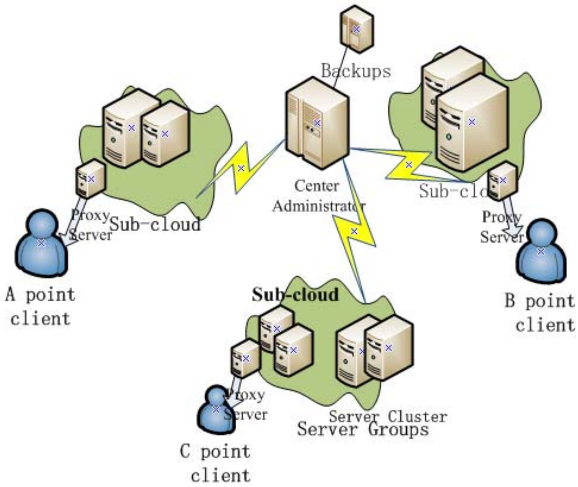

Fig. 2:Sub-cloud computing architecture

The management between sub-clouds uses the centralized management mode by a center administrator. Center administrator is responsible for the maintenance of all users' information and content location related information, to complete service publishing, searching, location and management and to implement services and resource sharing and flexible expansion effectively. It is designed for the paroxysm type business and the complex and ever-changing business model. The first inspired node is the DNS server in the Sub-cloud topology discovery. The network nodes discovery and the entire network topology formation are established by the Kademlia protocol. The center administrator manages service running status, records nodes which have already deployed service and manages the nodes. The load balance targeted at services enables the efficiency of service publishing, searching, positioning, and management. Center administrator has multiple backups to solve the problem of a single point failure.

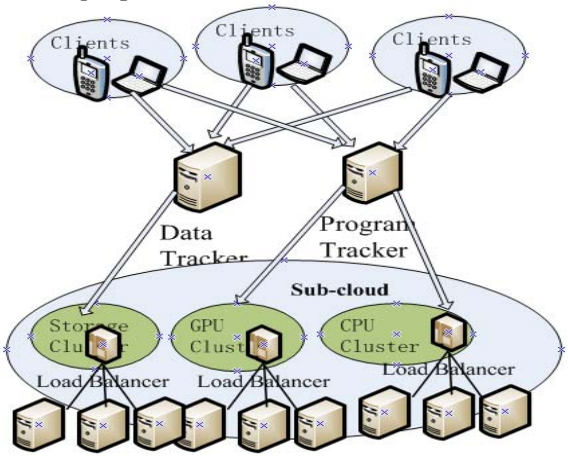

Fig.3: Parallel distribution multimedia computing

3.2 Each Sub-cloud saves all the content data in a distributed way

Internal server groups in the Sub-cloud have been logically divided into different server clusters according to the type of the servers, such as storage servers, CPU servers, GPU servers. Similar multimedia services will be pushed to the same server cluster according to multimedia type. We assign a unique key value relevant to the data for the data trackers; complete the service procedures for management of service nodes, resources, and storage. The service requests of clients are positioned to the right computing nodes. The service provider will deploy the new service applications on the entrances of the Sub-clouds. Any node can perform this function. This procedure introduces more convenient and targeted interfaces for the deployment of service applications. Users no longer need to frequently update applications.

Fig.3 shows how each server cluster uses distributed parallel processing model. The multimedia processing program will be sent to the media server load balancer, which processes distributed arrangement of media tasks, and parallel media computing to ensure the QoS requirements such as the computing resources, storage efficiency for multimedia tasks. One user's task is assigned to N servers for parallel computing, while a plurality of users' tasks are completed in parallel too. After the completion of the tasks, the results will be sent back to the clients [7].

3.3. The proxy server is arranged on the edge of Sub-cloud

The adaptations are set for heterogeneous terminals [8]. Mobile media computing is partly operated on proxy server to meet the QoS requirements of saving terminal power, bandwidth, computation storage resources; proxy server completes transform coding and media adaptation for different multimedia types; proxy server also supports multimedia hotspot caching. A caching interface is deployed on the services of multimedia cloud computing, to improve the quality of services through the point of perception of specific content services.

This architecture can provide rental services of multimedia cloud computing system, the public cloud access services toward the general public and information operation services based on huge data, such as analysis and retrieval.

4. Platform Building, Simulation Experiment and Conclusions

Experimental results verify the effectiveness of the platform design and the key technologies.

Sub-cloud has been formed with the server cluster of 60 nodes. Platform protocols towards nodes and services have been accomplished. Operations, such as querying DNS, joining node, deploying services are conducted. We can view the Tracker information during the process. Thus a basic Sub-cloud platform is constituted.

The computational task of mobile phone 3D shading map is selected to verify the validity of the platform. 3D shading map application is to generate 3D effect chart with continuous correlation plane images in the mobile phone. This process needs format conversion, feature extraction, dimension tension and reconstruction of the original images. The earlier proposal is to conduct all or most of the computation locally on the mobile terminals, while the long running time and unsatisfied effect cause poor user experience, thanks to the weak computing capacity and energy limitations of the mobile phone.

10 original images of 20KB size are used to generate 100 3D images in each experiment. As shown in Tab.1, average rendering time for generating multitude results is shorter than local computing. Transmission delay is shorter than ordinary cloud platform. This is because that the Sub-cloud platform configures the distributed parallel computing server cluster, and also that the terminal is closer to the Sub-cloud platform.

Tab.1 Results contrast of platforms to complete the 3D UI shading map

	Average computing time	Average upload time	Average download time	Average rendering time
Mobile terminal	--	--	--	8.96s
Normal cloud platform	0.59s	2.81s	2.61s	0.09s
Sub-cloud platform	0.09s	2.57s	2.35s	0.09s

6 original pictures are stored in Sub-cloud. Caching proxy server is deployed outside the gateway. 3D rendering requests are transmitted for the same set of images under the network environment of GRPS and WCDMA. From the experimental results, as is shown in Tab.2, the computational time is greatly shortened when using cache proxy server, which is shorter when under WCDMA network environment than the GPRS. It turns out that the proxy works better in broadband wireless access mode.

Tab.2 Results contrast of Cache proxy

	Average download time(s)		Initial storage space(s)
	WCDMA	GPRS	
No cache proxy	4.28	12.22	6.6
Cache proxy	2.92	10.64	1.4

In the multimedia applications, large and complex multimedia tasks are transferred to CPU cluster or GPU cluster in the cloud server group to compute, and then the results are sent back to the terminals. This can save computing time, reduces the hardware requirements for terminals; nearer Sub-clouds to the terminals can help shorten the time of transmission; the proxy server setting on the edge of the Sub-clouds can improve the efficiency of cloud platform, saving bandwidth and computing resources under the satisfaction of network bandwidth conditions.

5. Discussion and Future Work

Multimedia cloud computing has clear market demands and potential economic benefits. Network monitoring camera producing multimedia data in PB's, which requires storage and later retrieval operation; high-definition requirements for digital TV, for example the data processing of the data conversion to H.264 standards; video service on the Internet, they will all rely on the multimedia cloud computing.

Cloud computing technology development and multimedia service development are complementary, mutual influence and mutual development. Cloud computing technology will promote the multimedia service varied and graceful, and widespread use of multimedia application will arouse the innovation of cloud computing technology.

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