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IERI Procedia 2 (2012) 742 – 747

Procedia IERI

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2012 International Conference on Future Computer Supported Education

Mass Data Storage and Management Solution Based on Cloud Computing

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Abstract

In view of the current video data storage surge in demand, mass data storage problem must be paid more attention. Cloud computing techniques provide effective way to solve the problem. According to Hadoop technology in cloud computing, this paper puts forward the mass data storage architecture. Combining with the actual demand, the paper proposes the media resources storage solution. Through the practical applications, this solution can be overcome current storage method is insufficient, and is able to improve the efficiency of the storage.

Selection and peer review under responsibility of Information Engineering Research Institute

Keywords: Cloud Computing; Mass Data; Virtualization Storage; Hadoop; MapReduce;

1. Problem analysis

With the surge in global information and the network technology continuing to mature, large scale data storage has to be paid more and more attention. The problems faced mainly include the following aspects:

- The cost of storing data continues to rise. It requirements data storage and computing should adopt cheap cluster environments to reduce the cost.
- Users make much more demands of security in data storage. Key data is the foundation of normal operation. Once encounter data disaster, the overall work will be paralyzed, and bring huge loss. ▪

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2212-6678
doi:10.1016/j.ieri.2012.06.164

Traditional centralized management y can't satisfy the requirement, and it roughly experienced four stages: file system management, the file system and database mixed management, relational database combined with spatial database engine management, and object-relational database management (ORDB).

The common characteristic of these methods are based on the centralized management strategy. Because of the flaw of the individual node equipment, these methods have many restrictions in management of large scale (TB level even above PB level) video data storage. For instance, user always feel data inquiring is time-consuming, data storage ability is limited, and read process is low efficiency. Therefore we need new management manner to meet the demand of mass data storage problem. The practice shows that the traditional video data processing methods and management strategy already can't meet the increasing requirements, the urgent need to study the new processing method and strategy. Cloud computing as an emerging model of business computing, can provide almost unlimited storage capacity, and computing power. It is an effective means that adopting the cloud computing applications to solve the problem in mass data management. Storage solution which based on cloud computing is a kind of dynamic and web-based solutions. Users can through the generic and easy protocols and application programming interface (API) to access the storage targets in internet. This new solution is good for end users. Cloud storage can provide service for users to easily increase storage capacity, and users do not need to buy or install any storage equipment. Storage solution based on cloud computing is the hot spot in the mass data storage study field.

2. Cloud related technology

The Cloud technology is a kind of computing model; it is the development from distributed processing, parallel processing and grid computing. Cloud computing regards the computer on the network as a virtual resource pool. It will gather all the computing resources, and use specific software to achieve the automatic resource management. This method make all kinds of computing resources work together and it makes huge amounts of data processing possible. Hadoop technology is the core of cloud computing. It has broad prospect of application.

Hadoop is a distributed computing framework of the Apache open source organization. It is also the most well-known OSS (Open Source Software) with cloud computing. It can run the application program in large clusters which is composed of cheap hardware equipment. Hadoop provides a group of reliable interfaces for application, thus to build up a high reliability and good scalability of the distributed system.

The core of Hadoop is made up of three:

HDFS (Hadoop Distributed File System), MapReduce distributed computing model and Hbase (Hadoop Database), as shown in figure 1.

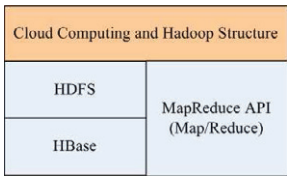

Fig.1. Structure of Hadoop

HDFS can be deployed on cheap hardware, it can store huge amounts of data (up to TB even PB grade), in high fault tolerance and reliable ways. It can be well combined with MapReduce computing model, provides the high throughput data access for the application. HDFS is suitable for data intensive applications.

MapReduce is large data distributed computing model, it is famous for its simplicity and usability when running distributed applications in large clusters. The MapReduce of Hadoop is open source realization of Google's MapReduce. MapReduce is a simplified parallel computing model. It is composed of Map and

Reduce, those respectively in charging of the task decomposition and the results summary. Based on the model, the writing of the distributed video program became very simple. Users don't even need the experience of parallel development, can easily develop distributed parallel programs, and complete the mass data calculation.

HBase is an open source distributed database, it is based on column of storage model. HBase is constructed over the HDFS storage systems, which are distributed, the column-faced. It is used for real-time reading and writing, and large data set random access.

For the mass of video data, HDFS system can provide sub-layer physical platform for data storage, to provide functions such as load balancing and redundancy storage; The MapReduce in Hadoop can easily process the plenty of parallelized video data; for many types of the data format, HBase can provide a unified management to store large-scale video data. The cloud computing technology with the help of these technologies integration can realize the distributed computing, parallel computing and storage. Therefore, it can achieve good dealing with large data ability.

3. Solution design

3.1. General framework

Compared with the traditional storage technology, cloud computing storage solution is not only hardware, but a complex system with multiple parts. This system bases on storage equipment; it provides users services such as business accessing and data storage through some application software. Based on Hadoop technology, we design the general framework of the mass data storage, as shown in figure 2.

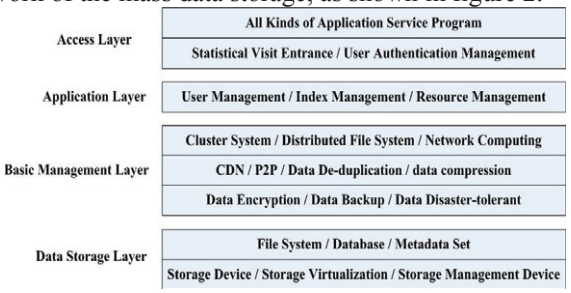

Fig.2. the framework of storage solution

The whole framework is composed of four parts: storage layer offering physical storage, basic management layer providing data processing and storage, application layer and access layer to provide application service.

The bottom is storage layer; its main function is to provide mass data of physical storage. This layer provides basic network environment, physical storage resources and logical storage resources for the storage system. The storage layer includes storage device (disk array, CD library and tape library), storage management equipment, data logical storage system (the file system, database and meta-data sets), etc. This layer can link many different storage devices together within the system by the way of internet, fibre channel network and wan. Through the unified management system of storage equipment, the storage layer can realize the logic storage virtualization management, multilink redundancy management, as well as the hardware equipment condition monitoring and fault maintenance.

Basic management is the core of the system; it mainly realizes the data processing and storage.

In basic management layer, through the use of cluster, distributed file system and grid computing technology, many kinds of storage equipment can Collaborate, including storage monitoring, scheduling, copy management, etc.

In basic management layer, different kinds of storage equipment can provide users the same kind of service. By this way, the system improves the data access performance, and ensures that many users can also use data at the same time.

In addition, the layer can also ensure the data security and stability by the means of data backup, data encryption, and data disaster tolerant technology.

The application layer is responsible for providing various kinds of service, mainly including User Management, Index Management, and Resource Management, etc.

The application layer takes some functions packaging. Developer can develop a suitable application layer according to their own business types, thus provide user different application services.

For example, the storage management platform, IPTV systems, video monitoring application platform, network hard disk reference platform, and the remote data backup application platform, are different user application services.

In the top is access layer.

It displays different kinds of application services interfaces which is generally WEB browser. Users make request to the storage system in this layer.

Any authorized user can access the data through the Application Layer, if he can connect the Internet terminal equipment, such as PC, mobile phones, and mobile multimedia equipment. They can access the data in any time, anyplace to satisfy the requirement of information.

3.2. Function Modules

From the function perspective, the whole cloud storage system can be divided into seven major modules: management module of physical storage device, virtualization storage management module, management module of network connection device, resource management module, storage management module, backup management module and the I/O management module.

Physical storage device management module can be used in cloud storage system to monitor the physical device, real-time collect and control all the operation information, and ensure the different device can be connected to collaboration.

Virtualization storage management module is the key of cloud storage system. It manages the great logic resources pool in the base of physical device integration.

Network device management module can be used transfer the task to other device when some device can not work or it is focus on access in the cloud storage system. By this way, we can ensure the reliability of the cloud storage service.

Resource management module can reasonably allocate resources in the storage system. According the users' requirement, it can automatically look up available resources to answer the request of application.

The storage management module takes request switch according the information in the meta-data index when users request to access data from API. Virtualization storage of the module will transfer the data access request to different storage device to achieve the unified access to isomerism database.

Backup management module is indispensable for cloud storage. Data is centralized stored in cloud data center. And cloud data center is aggregated by large amounts of servers and storage device. So equipment failure rate is obviously increasing. So backup management module ensures the security of data, and provides consistent service.

The I/O management module can allocates the server resources to provide real-time uninterrupted service.

3.3. Data processing mechanism

According to the mass data properties, with Hadoop technology of cloud computing, we make the analysis about the data processing mechanism of mass data storage, as shown in figure 3.

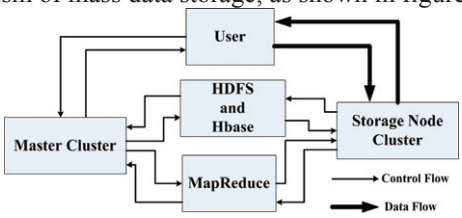

Fig.3. Data processing system

In the figure above, the chief service control cluster equivalent to the controller, it is mainly responsible for receiving application request and answering the request. Storage node is constructed by large disk array system or mass data storage cluster. It equals the memory to deal with data accessing procedure. HDFS, MapReduce and Hbase used to store or deploy data to each compute node.

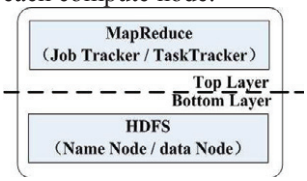

Fig.4. Hadoop structure model

As shown in the figure 4, Hadoop follows the masterslave model from the top-layer perspective. HDFS which is masterslave distributed file system and MapReduce which is masterslave parallel data processing model constitute the Hadoop foundation framework.

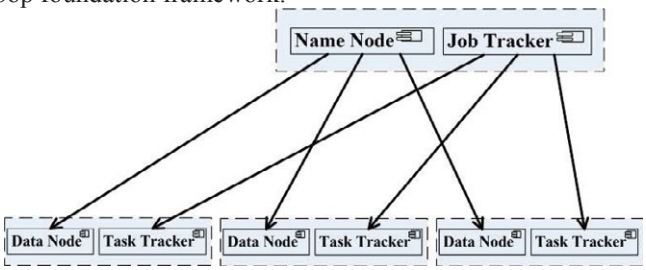

Fig.5. Detailed Hadoop structure model

In the figure 5, HDFS is composed of NameNode as master node and a number of DataNode as child nodes. The metadata of file system is stored in NameNode, including the file system namespace and other information. NameNode provides the mapping of the file systems, and is responsible for the management of the file storage and other services. The actual data stored in DataNode, the client application through the NameNode gets metadata, then directly establish data access connections with DataNode.

The Map/Reduce in Hadoop also has masterslave architecture. Similar to master node NameNode in HDFS, Hadoop main program on the Map/Reduce is called the JobTracker. It is responsible for the whole Map/Reduce control work.

JobTracker needs to read the information of file blocks, so all of them are usually in the same node with NameNode. JobTracker is responsible for creating to a child node, that is, affiliate task of Task Tracker directly finishes data processing in the child nodes and complete transfer from computing to storage.

TaskTracker will report the state and complete information to JobTracker.

The master server in Hadoop (named Job Tracker), is used for scheduling and management of other computer (Task Tracker), Job Tracker can run in each computer of cluster.

Task Tracker is responsible for the task. It must be running in Data Node which is also the computing node.

Job Tracker distributes Map task and Reduce Task to idle Task Tracker, letting these tasks run simultaneously, and responsible for monitoring the running situation of the Task.

If one of Task Tracker is out of order, Job Tracker will redirect the task to other idle Task Tracker to run.

Users don't directly read HDFS or Hbase to access data, so as to avoid system congestion caused by a lot of read operation.

Users send information to master cluster through the Hadoop framework, then directly interact with storage node to access data.

4. Application

The storage solution is designed for the internal digital media resources management of Higher education. Combining the demand of resources storage, we consider the following aspects.

In the storage layer, we choose virtualization storage devices to connect all kinds of resources which are distributed and heterogeneous on the physical location through the high-speed network. By this way, we can realize the unified centralized storage management, eliminate Information Island, and realize the resource sharing.

In management layer, we establish a remote data backup and disaster tolerant system to ensure that when local major disasters occurred, using remote backup or remote tolerant system for a rapid recovery; we can reduce the losses, and make sure the data security.

In the application layer, we develop digital media resources storage and management platform. The platform can mainly realize many functions, such as user management, the workflow management ,the big file upload in the web, resources storage management, resources classification and retrieval etc.

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