ISSN : 0974 - 7435 Volume 10 Issue 11

2014

BioTechnology

An Indian Journal

FULL PAPER

BTAIJ, 10(11), 2014 [5368-5376]

The study on magnanimous data-storage system based on cloud computing

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ABSTRACT

Cloud computing is a computing and a brand new business model, large amounts of data storage issues related to cloud computing emerged in this model. In order to better solve the storage problem of cloud computing, this paper studies on the cloud computing and storage system, focusing on analysis of the distributed computing framework of Apache open-source organization, called Hadoop. First, it focuses on the study of the storage infrastructure of HDFS file system which lays the foundation of the effective design of Hadoop; then it analyzes the programming model of Map Reduce and HBase, in order to exploring the methods of system designing; in the end, based on large amounts of models of data stored design rooted to could computing, it testing the system, and compares the system in this paper to traditional designed system in the area of CUP load and memory usage, and finds out if the effect on CPU caused by the system in this paper is in an acceptable range, this system will has a very excellent memory usage advantages in Name Node.

KEYWORDS

Cloud computing; Hadoop; System testing; CUP load; Memory usage.

INTRODUCTION

At the end of 2006, Google became the first company ever put forward the concept of "Cloud" in order to solve the storage issue of mass data in the Internet. As a calculation model for sharing resource, cloud computing has powerful information storage and processing ability which attracts relevant scholars did much research about it. This paper wants to explore a more convenient and effective system design for big data cloud computing based on the study of large amount of data storage technology.

The studies of cloud computing and storage system consist of many people's efforts. They have promoting the development of cloud computing to a certain extent. Among them are: Tuo Shouheng[1], who designed a generic architecture of cloud computing after introduce the definition and character of the now existing cloud computing; he focused on the structural model of cloud computing and its storage system, analyzed the 2 new storage technology, and in-depth analysis the development trend of cloud computing and storage[1]. Xu Xiaoyuan etc.[2], they focused on the issue of big data storage caused by the widely use of internet, based on the cloud computing, analyzed the calculate model of Hadoop framework structure and the Map Reduce and put forward the mass data storage technology based on cloud computing architecture diagram, and further analyzed the storage layer[2]. Duan Wanlong etc.[3], they studied the magnanimous data-storage system for books based on cloud computing, and analyzed the main features of modern digital libraries as well as the application situation of cloud computing technology in library data management, and proposed appropriate guidance[3].

Based on previous studies, this paper conducted research on magnanimous data-storage system under the cloud computing, in order to explore the advantages of the system in this paper compared to the traditional system.

OVERVIEW OF CLOUD COMPUTING SYSTEM AND THE STRUCTURE OF STORAGE SYSTEM

Yuan Guojun[4] once pointed out, the cloud computing is not only a calculate model but also a entirely new business model, it is the development of distributed processing, parallel processing and grid computing, or it can be say as the realization of computer concepts[4]. As the platform of cloud computing is a powerful "Cloud" net that connects a large number of concurrent network computing and services, it can take advantage of virtualization technology to expand the ability of each server, collects their resources together through cloud computing platform, and provides them supercomputing and storage capacity, as shown in Figure 1, a generic cloud computing architecture.

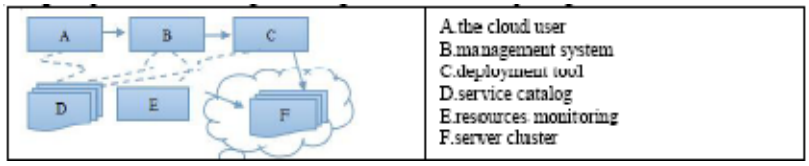

Figure 1 : A generic cloud computing architecture.

In Figure 1: the cloud user's role is to provide cloud user a interface for requesting services, users can register, log in or customized services, configure and manage the users via a Web browser; service catalog refers to the user can select or customize the service list after obtaining the appropriate permissions; the management system and deployment tools are to provide management and services, the management include the cloud user, user authorization, authentication, landing and available computing resources and services, accept the requests sent by user and forwarded to the appropriate application base on the request, scheduling resources, intelligently deploy resources and application, dynamically deploy, configure, and recovery resources; monitoring and calculating the usage of cloud computing in

order to react quickly, complete the node configuration synchronization, load balancing configuration and resource monitoring to ensure the allocation of resource would be able to fit the user; Server cluster refers to the virtual or physical server under the control of management system, responsible for the high concurrency users' request, processing large computational complexity computing, Web application services, cloud data is stored through cutting algorithm, the upload and download of big data are done through parallel way.

Wang Sehngchuan[5] pointed out, the user can choose required services through the client, the management systems will schedule the resources due to the request, then the deployment tool distributed the request and configuring Web application[5].

Tang Jian[6] pointed out; compared to the traditional storage devices, the cloud storage system is not only hardware, but a complex system composed by multi-sectorial, mainly include: Network devices, storage devices, servers, applications, company access interface, access network and client programs, etc. the core of these parts is storage device, provide the services of data storage and access to business due to user's request through some software application. Figure 2 shows us the 4 layers of cloud storage system mechanism.

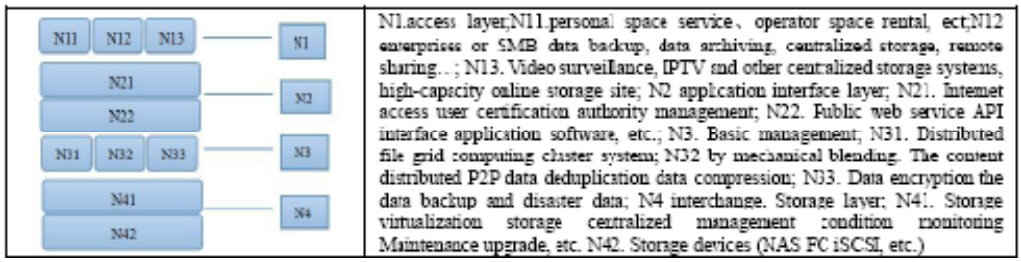

Figure 2 : Cloud storage system mechanism

Yang Liting[7] pointed out, compared to cloud computing system, cloud storage system has one more storage layer in its architectural model, what's more, in basic management cloud storage also corresponding increase a lot of data related functions, like data management and data security, etc., the 2 systems have the same access layer and application interface layer.

ARCHITECTURE ANALYSIS OF HADOOP

Chen Yong[8] pointed out, Hadoop is a distributed computing framework of Apache open-source organization, you can run the application on a large number of low-cost hardware cluster, provides a stable and reliable interface for applications, aims to build a high reliability and good scalability Distributed Systems. Beside its open-source feature, Hadoop is also scalable, economical, reliable and efficient advantages.

Hadoop is mainly composed of HDFS graphs and HBase these three parts, also it is the main component of architecture, the chapter above will focus on the analyzing of these three parts.

System Analyses of HDFS

HDFS is the abbreviation of the Hadoop distributed file system, is the storage basis of distributed computing, its design premise and the target as shown below:

(1) Hardware error should not be seen as anomaly, but normal.

(2) Batch processing for streaming data access, use batch processing instead of user interaction with the data, this way pays more attention to high throughput data access.

(3) Large data sets, the typical HDFS file size may be levels in GD terabytes even huge amounts of data, so it can support large file storage, meanwhile, if the data sets have more than 100 node number,

(4) the overall storage will provide strong enough guarantee.

Simple and consistent model of mobile computing costs are lower compared with mobile data, especially for large files, the advantage of mobile computing is even more obviously, portability across heterogeneous hardware and software platforms makes it convenient to promote the HDFS as the platform for massive data platform.

HDFS showed the name of the file system space, in the form of files, the user can storage the files by splitting them into a block of data through namespace. Liu Peng[9] pointed out that the namespace implementation of the file system is done by Name Node, the Name Node will also determine the block of data and mapped them to a specific Database node, and Data Node is responsible to the read request of file system client[9].

The architecture of HDFS file system is shown in Figure 3.

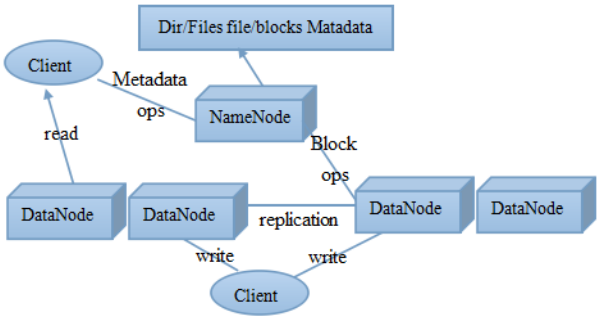

Figure 3 : The architecture of HDFS file system

As shown in Figure 3, if the client wants to access a file, first, the client needs to get the data block position list of files from the Name Node, then directly read the file's data from the Data Node, the Name Node in charge of all HDFS metadata, always has nothing to do with the transmission of the data

The Programming Model of Map Reduce

Map Reduce framework using the map and reduce, these two functions to implement the data's partition and merging, Map Reduce model has the advantages of high abstractness, this model also including the map function, the reduce function and < key, value > these three core parts.

The Map function: the Map function defined by users receives from the input data slice from < key, value >, then produce a series of intermediate < key, value > sets, Map Reduce collect each with the same intermediate key value together and then sent to Reduce function respectively.

Reduce function: Reduce function receives a set of intermediate key and its corresponding value, at the same time by the iterator to the value of the key collection provided to the user's Reduce function, the user defined Reduce function summary and output all the value. Reduce are commonly used to summarize the data, programming the massive data to get smaller data, for example: Implement a "+" operation, returns the input data and the value list.

< key, value > set : < key, value > set is consist of the data related to the task by a representative of the value and the key represents the value of the packet number these two parts, the value needs to be placed in the corresponding group to participate in the operation process. Therefore, < key, value > set can be regarded as a communication interface for programmers

Zhao Chunyan[10] pointed out that the operation of a Map Reduce include mapping and reduction these two stage, in the mapping stage, the data input by user are separately into M fragment by Map Reduce, corresponding M Map tasks, each Map's operation is the input data fragments of * < key, value >set< K2, V1 > collection, Map operation call user defined the Map function, the output of an intermediate state * < key, value > set < K2, V2 > collection, then, according to the intermediate state, a

new K2 will be ordered by the output data set, and generate a new < K2, the list (V2) > tuple, it can make all the values of the data corresponding to the same key together, finally, according to the scope of the K2 these tuples is divided into R a fragment, corresponding to the number of Reduce tasks

The principle of how Hadoop operate Map Reduce is shown in Figure 4.

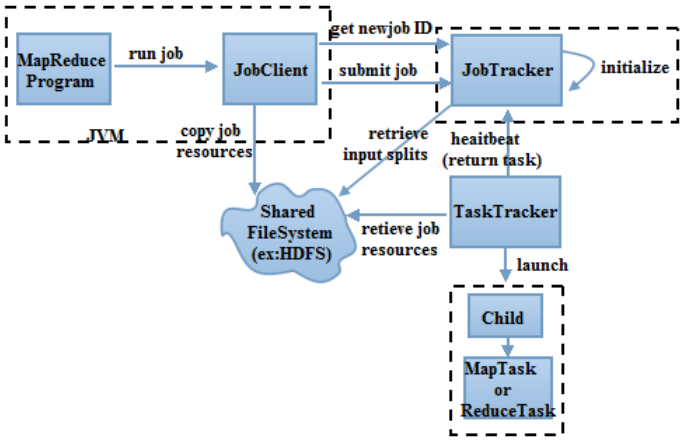

Figure 4 : The principle of how Hadoop operate Map Reduce

The Figure 4 shows that, the analysis of realization of Job Client submit Job () method to the job submission process: first, to request a new assignment job tracker ID by calling the job tracker get New Job Id (); Then, check the job output, division operations of the input, resource partitioning operations; Finally, the job is ready to perform.

The operation execution process of Map Reduce is shown in Figure 5.

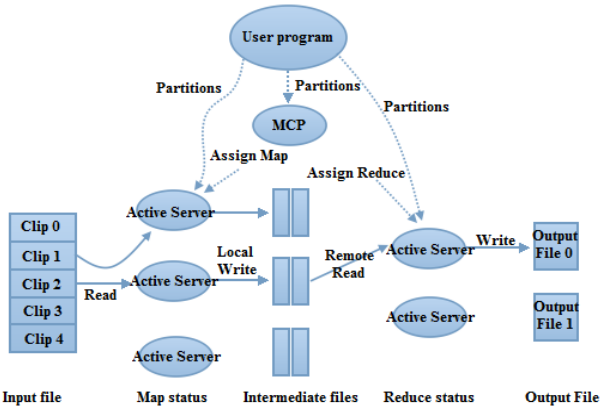

Figure 5: The operation execution process of Map Reduce

Figure 5: segmentation, first the input files are divided into M pieces by the Map Reduce function in the user's program, each piece is about 16 MB to 64 MB, then the program is copied; Assigned task is when the program has a Master programs and as a work of Master control program to allocate work units, the Master distribution Map/Reduce tasks to choose free work on board; Read is the Master machine assigned to the job, assigned a Map task, the work machine will processing input block related work, and < key, value > set will be passed to the user to specify the Map function, and the function of intermediate value are temporarily stored in memory; the Reduce machine is responsible for receiving the local writing information.

Remote reading is when the Reduce machine receives the middle position, the Master calls a remote procedure from the Map work machine on the local hardware disk read buffer in the middle of the data, Reduce machine work after reading these intermediate value, it is the same in accordance with the key to sorting, will arrange together in the same key value, use external sort to relieve the

intermediate value too complicated; Write is in accordance with each key corresponding to the displacement in the middle of the sequence of intermediate data, Reduce machine work send the keywords and the corresponding intermediate data to the user's Reduce function, after the Reduce function treatment results output to a final output file; Complete all the Map/Reduce tasks, master control program will activate the user's program.

Analysis of HBase

HBase is an open source based on the storage model of distributed database, and it is an important part of Apache Hadoop project. As shown in TABLE 1, the store logical model of HBase is the same as the Big table, tables in HBase is Bigtable

The series data lines that the users stored in the form contain the sortable keyword, an optional timestamp, and some may have data column. There are three basic types of definition in a data line, keyword, timestamp, line and column, line of keywords is a unique identifier in the table, the timestamp is the timestamp each corresponding correlation data operation, the column definitions for (< race > : < TAB >) through these two parts, a column of a data storage can be specified

You need administrator rights if you want define or modify a column family, but tags can be added at any time, in accordance with the column family, HBase data is stored on disk, a column family of all items must be the same in read/write, HBase update timestamp, the client can get some point to the latest data by the timestamp or all of the data, such as TABLE 1

TABLE 1 : View list for the logical of database

keywords	timestamp	line"contents"	line"anchor"		line"mine"
	T9		"anchor.cnnsi.com"	"CNN"	
	T8		"anchor.my.look.ca"	"CNN.com"	
"com.cnn.www"	T6	"<html>…"			"Text/html"
	T5	"<html>…"			
	T3	"<html>…"			

ANALYSIS OF MASSIVE DATA BASED ON CLOUD COMPUTING

Design philosophy

The data storage requirements are shown below:

(1) Require considerable storage capacity, and requires efficient storage process
(2) Require the data storage model and calculation can reasonable use a cluster environment
(3) Require to meet a variety of data format
(4) Require to solve a hardware failure collect the data somehow.
(5) Avoid the waste of time caused by operation error, require a high level of fault-tolerant.
(6) Require the model has good maintainability, scalability and usability.

The design philosophy of this paper is to solve the above requirements, the model of massive data storage model is shown in Figure 6.

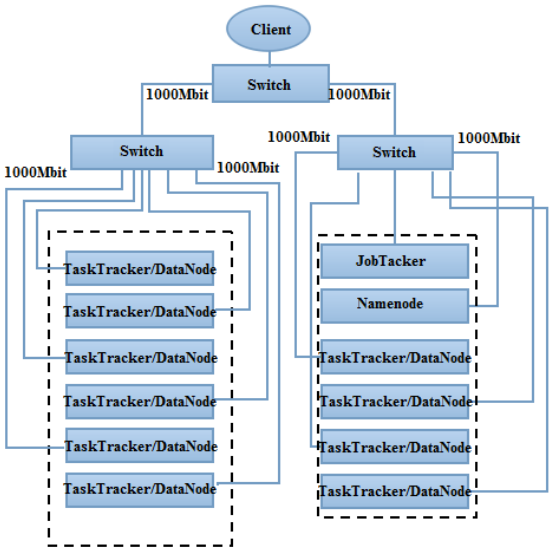

Figure 6 : Massive data storage model

As shown in Figure 5, massive data storage model has many advantages such as collect jobs in order, collect DFS in system directly, to read the NFS backup in free time, and strong resilience, when operation fail it still can perform distribution, etc.

System testing

The configuration files of Hadoop is as shown in TABLE 2

TABLE 2 : List of documents Hadoop configuration

filename	format	description
Hadoop-env.sh	Bash script	Use environment variables in operation the script for the Hadoop
Core-site.xml	Hadoop configuration XML	Core - site. such as HDFS and graphs are very common in the I/O Settings
Hdfs-site.xml	Hadoop configuration XML	HDFS daemon configuration Settings
Mapred-site.xml	Hadoop configuration XML	Map Reduce daemon configuration settings
masters	plain text	Record the operation list of the second Name Node machine
slaves	plain text	Machine list of Data Node and task tracker's record
Hadoop-metrics.properties	Java Properties	how to control Hadoop to attributes released metrics
Log4j.properties	Java Properties	The filename of system log file attributes, the Name Node audit log and task tracker log properties

In the process of system testing, first download an SSH client through the official website, and then registered an account on http://hadoop.nchc.org.tw/index.php, by this account login remote HDFS cluster file system, using this to complete the test, the command used in the process as shown in TABLE 3.

TABLE 3 : The basic command of the Hadoop list

Basic command	function	Basic command	function
start-all.sh	Start all the Hadoop environment	stop-Mapred.sh	Stop MapReduce environment
stop-all.sh	Stop all Hadoop environment	start-dfs.sh	Start HDFS environment

start-Mapred.sh	Start MapReduce environment	stop-dfs.sh	Stop HDFS environment

In this test we all together launch six Map task, using nnbench respectively test three sets of data, the test is mainly about read, write and operation of the three sets of data, analysis system's improved and the load of CPU and memory usage, the data of three tested groups are as shown in TABLE 4.

TABLE 4 : The experimental data list

group	number of documents	file size	aggregate capacity
Group 1	2000	61MB	122G
Group 2	100000	1MB	100G
Group 3	1600000	64KB	100G

The CUP load and memory usage in the traditional and system design in this paper's read operation.

TABLE 5 : The CUP load and memory usage in the traditional and system design in this paper's read operation as shown in TABLE 5.

group	(nn memory)	Nn memory	(nnCPU)	nnCPU	(execution time)	execution time
Group 1	1.4GB	0.7GB	56%	54%	0.5min	0.7 min
Group 2	1.2GB	1.1GB	77%	88%	4.0 min	5.0 min
Group 3	0.9GB	0.8GB	79%	79%	6.0 min	7.0 min

Note : (XX) refer to traditional one; XX refer to the design in this paper.

The CUP load and memory usage in the traditional and system design in this paper's write operation shown in TABLE 6.

TABLE 6 : The CUP load and memory usage in the traditional and system design in this paper's write operation

group	(nn memory)	Nn memory	(nnCPU)	nnCPU	(execution time)	execution time
Group 1	1.6GB	0.7GB	75%	84%	3.5min	4.0min
Group 2	1.3GB	0.9GB	82%	88%	4.0min	5.0min
Group 3	1.0GB	1.0GB	89%	94%	5.0mn	6.0mn

Note : (XX) refer to traditional one; XX refer to the design in this paper.

The system design in this paper Reduced memory usage of the Name Node, but caused a certain influence on the performance of the CPU compare to the traditional one.

The influence on the performance of CUP is in an acceptable range.

Reduce the use of Name Node can increase the extensibility of the whole system, improve the Name Node number of document processing overall.

For the application of large files, the reduction of Name Node memory usage is more obvious

CONCLUSION

This paper first summarizes the cloud computing system and the structure of storage system and then focused on the analysis of Hadoop's framework, mainly studied the HDFS system, Map Reduce

programming model and Hbase. Through the study of Hbase, operate the massive data storage design based on the 6 requests. The massive data storage model has many advantages such as collect jobs in order, collect DFS in system directly, to read the NFS backup in free time, and strong resilience, when operation fail it still can perform distribution, etc.

On the basis of Hadoop configuration file information and basic commands in the Hadoop interpretation, the author test the design of this paper base on the massive data storage, and compare the result with the traditional store system, and found the advantages of the system design in this paper in the usage of Name Node.

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