

Simple Application of GlusterFs: Distributed file system for Academics

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Abstract— Glusterfs is scalable distributed file system implemented in C language. Glusterfs is best example to learn about distributed file system for students. Glusterfs is software based distributed file system, and As it is open source any one can use and extend its features. Its architecture is very simple to learn. It can be installed on commodity hardware that is personal computers. Glusterfs doesnot uses concept of metadata to store information about files stored on server. Client intelligence bases DHT algorithm is used in glusterfs which is alternative for metadata storage as client with the help of DHT, can calculate files address and access files easily. Concept of bricks and volumes isolates different users data on cluster of file system. Glusterfs can be useful for academic student to learn about distributed file system. Cluster can be implemented to store students data and utilized and demonstrated use of distributed file system.

Keywords— Distributed File System; GlusterFs; Academics

I. INTRODUCTION

It is for sure, students in academic learn about Distributed file system only in books. Apart from theory concept, candidate are not getting proper understanding of practical of distributed file system. Distributed file system means users data is stored in distributed manner and user feels local file as his or her local system and user is also unaware of names used to store that files on back end. Application of such files are in big system and distributed in nature such as railway reservation system. Only this much basic understanding is clear to every student. There are many companies in market who has implemented distributed file system such as Apache HDFS hadoop distributed file system, Googles GFS google file system, BeeGFS, MooseFS,Lustre, Cept, Glusterfs [1]. Students in academic needs clear practical understanding of Distributed file system which is not getting anywhere. In this paper author is described Glusterfs file system and its simple application for academic students. Actually glusterfs has many application in storage systems of big data, media storage, pictures storage companies, streaming data storage, education systems[]. Section 2 is all about glusterfs and its architecture study. Section 3 installation guide of glusterfs and section 4 is proposed small application of glusterfs file system section 5 concludes this tutorial paper.

II. STUDY OF SYSTEM ARCHITECTURE

Glusterfs system architecture simple to understand and is a powerful network or cluster file system written in user space which uses FUSE to hook itself with virtual file

system [2] layer. Glusterfs file system architecture is layered. So that features can be added and removed. Glusterfs file system works on ext3, ext4, xfs.etc.to store data. Glusterfs can scale out to petabyte of data to store with single mount point. System architecture is as shown in figure.

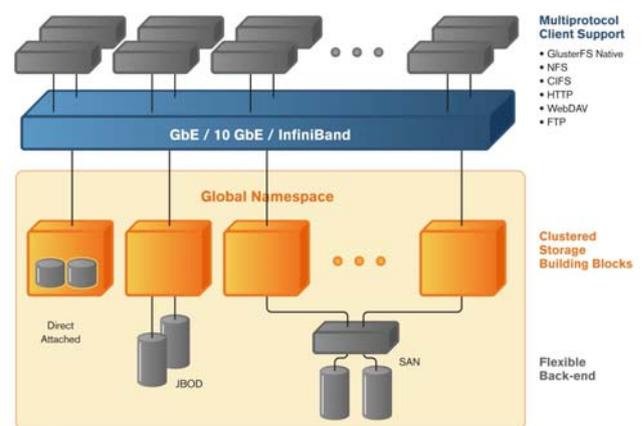


Fig 1: System Architecture

In above fig 1 GbE, 10 GbE or infiniband is network used in cluster file system to connect nodes in cluster (Server pool). All connected nodes also called server pool in which any one single node can be referred as main server node to create server pool and can be used further to mount server on client. User can use Glusterfs native protocol or any of NFS, CFS,HTTP, FTP to connect with server pool and access global memory space. Following are glusterfs storage cluster components described as

A. GlusterFs server storage pool

Glusterfs storage server pool is created of storage nodes to create single global namespace.Trusted storage pool (cluster is collection of Storage servers).Trusted storage pool is formed by invitation – Probe a new member from the cluster and not vice versa. Logical partition for all data and management operations. Membership information used for determining quorum. Members can dynamically added and removed from the pool. Probing node is is glusterfs means adding node to trusted storage pool. Probing is done from selected node as main server node as described above paragraph. Probed node can be detached from storage pool.

B. GlusterFs storage client

Client can any system which is able to connect with linux file system with any of NFS, CFS, HTTP, FTP protocols.

C. Fuse

With FUSE it is possible to implement a fully functional filesystem in a userspace program. Features include: [8]

- Simple library API
- Simple installation (no need to patch or recompile the kernel)
- Secure implementation
- Userspace - kernel interface is very efficient
- Usable by non privileged users
- Runs on Linux kernels 2.4.X and 2.6.X
- Has proven very stable over time

Internal structure of glusterfs contains following elements.

1. Brick: Brick is the small unit of storage on glusterfs. Each brick is of same size. A brick is combination of a node and an export directory[]. For example hostname:/directory each brick inherits limit of the underlying file system. There is no limit on number of bricks on each node.
2. Volume: Volume is made up of collection of all bricks from all nodes in cluster. Volume can be different types [4]. Following are different types of volumes.
 - a. Distributed: Volume is said to be distributed if files are stored in distributed manner. All files of same user stored on different nodes in cluster.
 - b. Striped: Striped volume is concept where there is single node with RAID array of disk. In that case single file can be broken into chunks and chunks are placed on different Disk of same computer. In case of glusterfs single file is broken and placed onto different nodes that is striped.
 - c. Replication: Replication means single file can be cloned and placed on multiple nodes so that can be helped on server crashed other copy is available to the user to access.
 - d. Replicated distributed: Generally this requires more memory but most of users prefer this kind of file systems volume because it provides more availability and faster access to user.

D. Mathematical Model

In this section glusterfs file systems rough mathematical model is described. In this case, file name with file path is key of hashing function, after hashing integer number is generated which is address in global namespace.

$$H : F \rightarrow GA$$

This is hashing function, F is file name with path and GA is global address. H is hashing function. F is set of all possible file with file path.

$$F = \{f_1, f_2, f_3, \dots, f_n\}$$

GA is set of all possible address from global address space.

$$GA = \{a_1, a_2, \dots, a_n\}$$

H is hash function which take input as hash key that is fi and generate ai.

Hence we can write mathematically as $H: F \rightarrow GA$.

Later on this GA is compared with different range of address corresponding to each node. And file is stored or searched on that particular node in cluster.

Example:

File : /exp/abc.txt

After hashing say 100 address generated. Suppose we have 4 nodes in cluster. Each node having following range of address space.

Node 1: 1 – 200

Node 2: 201- 400

Node 3: 401 – 600

Node 4: 601 – 800

Then /exp/abc.txt file is stored on node 1. In this way hashing is worked to allocate files in DFS.

III. INSTALLATION GUIDELINES

In this section some installation and cluster preparation guide lines are provided. Any user can simply refer and prepare cluster using glusterfs file system. It is very easy if you are familiar with linux operating system as glusterfs is

only installed on linux based operating system. Glusterfs supports for redhat. CentOS, Fedora. Ubuntu flavors of linux operating system. In this chapter we are going to demonstrate it on Ubuntu 14.04 version of linux operating system

A. Prerequisite

First of all get information about how much minimum storage space is required to store customers data. Also make sure you are going to create more than that requirement. Decide how many nodes you want to be in your cluster storage. According to requirement use that much capacity of disk on each node. Select Ubuntu operating system of Linux. You can use other if your are familiar with but you need to refer glusterfs.org for more detail or corresponding commands to build the system. Following table shows detail requirements for creating 2 TB capacity of cluster. You also need static IP for this because if you are using DHCP it will give you error once ip get changed.

Follow the steps to install glusterfs or refer [5] documents provided by glusterfs. It is very helpful if you are subscribing developer and user mailing because you will get daily status from that mail and queries posted by users like you and the solution posted by developer and expert team

Once you get atleast 2 ubuntu system, or using virtual box you can install two instances on ubuntu on your windows or linux and you can start exploring glusterfs file system. For easy and error free installation please give similar name of user in both nodes. Hostname can be different and change hosts file settings for ip address using `sudo gedit /etc/hosts` command. After this basic settings you can start installation.

1. Install python software libraries.
2. Install glusterfs ppa
3. Update system
4. Install glusterfs file server using command.
5. Configure server flush firewall settings and Add settings as per configuration.
6. Install similler setup on all other nodes you want in cluster.
7. After installation configure fire wall as steps 5.
8. Select one node as main point of your cluster and probe to all other nodes from that node.
9. After success probe check peer status [status of your server pool]
10. After ready cluster server pool you can start creating volumes and mounting as per guidelines.

Glusterfs file system volume needs to start before using or mounting at client system.

Commands in detail you will get on [6] glusterfs users guide. After successful mounting volume on client machine you can create file in your mounted folder on client then you will come to know how distributed file system works. How DHT algorithms works in distributed file system.

IV. APPLICATION OF GLUSTERS IN ACADEMICS

Glusterfs is now becoming stable. Also more customers are attracted towards it. Customer are trying to use glusterfs to store their online generated data on web server. So Glusterfs has many application in storage of large data specifically created on media sites, education domain to store erp data, business domain to store and maintain replicated and backup data storage. It is also used in cloud systems to provide storage service to their customer. Zuckerman says he's using GlusterFS with storing media for Picture Marketing. "Brand ambassadors use our mobile apps to take pictures and videos at events and upload them to our online platform. After processing the uploads our system stores the media in a GlusterFS cluster. From there it is served to event attendees through custom web sites made specifically for the events." In this section we are going to describe small application project of glusterfs which will be effective and using commodity hardware least cost project for any education institute to maintain students work, faculties work in fault tolerant, distributed and replicated manner.

System architecture is shown in figure below.

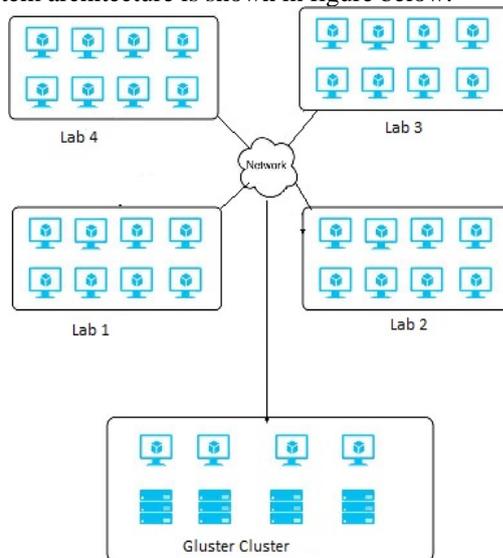


Fig 2. Application of Glusterfs for Academic LAB

Glusterfs cluster is created for an educational institute for example Engineering college. In Engineering college specially in computer department, Students practical are not maintained or backed up. All data are stored on personal computer, after some day systems will done format and then data may get loss. So no student or any teacher get their data from the lab after one year or semester. To solve this storage problem we can set distributed storage cluster using glusterfs on which there will created on volume for each student. This volume can be mounted to those student at the time of login on that machine.

Steps to use storage system

Environment will be as shown in above system architecture. Student login application will be installed on each machine. Before creating any files on machine student will get one message that do want to keep it on server? Then if yes then that file will be migrated to folder which is mounted to glusterfs storage server. This folder will be mounted on login to application. Every user has to following steps.

Step 1. User need to login on Storage Login App after login to computer. Then One local folder is mounter to server.

Step 2. Local folder mounted to server will fetch all files from server. Then user can able to access his all files which he has created and stored in previous session.

Step 3. If user is creating files, He will get one message, that do you want to store this file on server?

If yes then files are stored in local folder. This files get stored on fluster server. Once user logout to his application all file from local folder will flushed. Files always get stored on server.

Step 4. User can access any computer with his files. From any Lab. Hence this application of glusterfs is very much useful to manage student as well as teachers practical and documents.

V. CONCLUSION

Glusterfs is very light weight and easy to learn system to demonstrate concept of distributed file system. Also it can be used by research student to implement projects on distributed file system. Glusterfs is open source, scalable distributed file system can be deployed on commodity hardware.

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