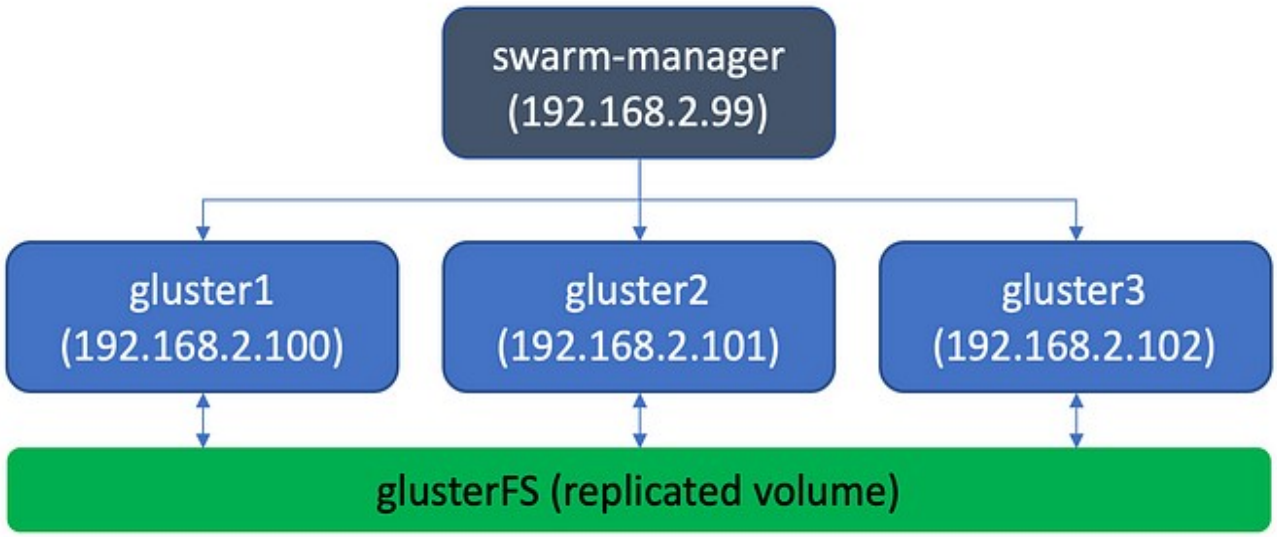
Source : https://medium.com/running-a-software-factory/setup-3-node-high-availability-cluster-with-glusterfs-and-docker-swarm-b4ff80c6b5c3

Setup Highly Available applications with Docker Swarm and Gluster



Docker Swarm cluster with shared glusterFS replicated volume for HA

A good design pattern for highly available applications is to deploy the application as a container on a Docker Swarm cluster with persistent storage provided by GlusterFS. GlusterFS is a fast shared filesystem that can keep the container volume in sync between multiple VMs running the Docker Swarm cluster. This pattern ensures high availability for your containerised application. In the event a VM dies, Docker Swarm will spin up the container on another VM. GlusterFS will ensure the container has access to the same data when it comes up.

In this tutorial, we'll look at setting up GlusterFS on 3 VMs and create a replicated volume with a replication factor of 3. Later we'll install Docker Swarm over these three VMs. Goal is to use GlusterFS to provide persistent storage to your application container, and docker swarm for high availability.

1. Plan and setup the infrastructure

For the setup, first we'll need three Ubuntu Gluster VMs, each with 2 disks attached. We'll use the first disk to run the OS, and the second as the GlusterFS replicated volume. Create three VMs with two disks. In my case, my VMs had the root volume on `/dev/vda` and the second disk on `/dev/vdc`. Create three VMs and let's assume the private IPs of these VMs are `192.168.2.100, 192.168.2.101, 192.168.2.102`, and their hostnames are `gluster1, gluster2, gluster3`.

Note: All commands are being executed as `root` user (hence the # at the beginning)

```
# lsblk

NAME   MAJ:MIN RM SIZE RO TYPE MOUNTPOINT

vda    253:0    0  30G  0 disk

└─vda1 253:1    0  30G  0 part /

vdb    253:16   0  64M  0 disk
```

```
vdc    253:32   0  10G  0 disk
```

Update the /etc/hosts files on each VM to reflect the private IPs of each VM. This is important for GlusterFS, and you may encounter bugs or issues if you give private IPs directly to Gluster volumes. After editing the files should look like:

```
(gluster1)# cat /etc/hosts

127.0.0.1       localhost

192.168.2.100   gluster1

192.168.2.101   gluster2

192.168.2.102   gluster3(gluster2)# cat /etc/hosts

127.0.0.1       localhost

192.168.2.100   gluster1

192.168.2.101   gluster2

192.168.2.102   gluster3(gluster3)# cat /etc/hosts

127.0.0.1       localhost
```

```
192.168.2.100   gluster1


192.168.2.101   gluster2


192.168.2.102   gluster3
```

Format the disks with xfs filesystem on each VM in case you haven't already. You can also use ext4 if you prefer.

```
# mkfs.xfs /dev/vdc
```

2. Create directories for GlusterFS storage

Setup the glusterFS directories where the gluster "bricks" will reside. Better to name them differently so it's easy to identify on which node the replicated volumes reside. Also add an entry to your /etc/fstab file on each VM so that our brick gets mounted when the operating system boots or restarts.

```
(gluster1)# mkdir -p /gluster/bricks/1


(gluster1)# echo '/dev/vdc /gluster/bricks/1 xfs defaults 0 0'
>> /etc/fstab


(gluster1)# mount -a


(gluster1)# mkdir /gluster/bricks/1/brick(gluster2)# mkdir -p
/gluster/bricks/2
```

```
(gluster2)# echo '/dev/vdc /gluster/bricks/2 xfs defaults 0 0'
>> /etc/fstab


(gluster2)# mount -a


(gluster2)# mkdir /gluster/bricks/2/brick(gluster3)# mkdir -p
/gluster/bricks/3


(gluster3)# echo '/dev/vdc /gluster/bricks/3 xfs defaults 0 0'
>> /etc/fstab


(gluster3)# mount -a


(gluster3)# mkdir /gluster/bricks/3/brick
```

3. Install GlusterFS

Install GlusterFS on all VMs by executing following commands on each VM:

```
# apt-get -y update && apt-get -y upgrade


# apt-get install -y software-properties-common


# add-apt-repository ppa:gluster/glusterfs-6 && apt-get update #
Use the latest glusterFS version instead of 6, which was the
latest at the time of writing this tutorial
```

```
# apt-get install -y glusterfs-server


# systemctl enable glusterd # automatically start glusterfs on
boot


# systemctl start glusterd # start glusterfs right now


# systemctl status glusterd # Should show status active
```

4. Peer with other Gluster VMs

Now peer with other nodes from gluster1:

```
(gluster1)# gluster peer probe gluster2


peer probe: success.


(gluster1)# gluster peer probe gluster3


peer probe: success.


(gluster1)# gluster peer status


Number of Peers: 2Hostname: gluster2


Uuid: 60861905-6adc-4841-8f82-216c661f9fe2
```

```
State: Peer in Cluster (Connected)Hostname: gluster3


Uuid: 572fed90-61de-40dd-97a6-4255ed8744ce


State: Peer in Cluster (Connected)
```

5. Setup the Gluster “replicated volume”

GlusterFS has multiple volume types. For our HA architecture, we want to setup a “replicated” volume that stores the files created on each of the 3 VMs and hence the file is available to any app or container running on these VMs. Create the replicated volume named “gfs” with 3 replicas:

```
(gluster1)# gluster volume create gfs \


replica 3 \


gluster1:/gluster/bricks/1/brick \


gluster2:/gluster/bricks/2/brick \


gluster3:/gluster/bricks/3/brickvolume create: gfs: success:
please start the volume to access data(gluster1)# gluster volume
start gfs


(gluster1)# gluster volume status gfsStatus of volume: gfs
```

```
Gluster process                                 TCP Port  RDMA Port
Online  Pid

------------------------------------------------------------------
------------

Brick gluster1:/gluster/bricks/1/brick      49152     0          Y
4619

Brick gluster2:/gluster/bricks/2/brick      49152     0          Y
4504

Brick gluster3:/gluster/bricks/3/brick      49152     0          Y
4306

Self-heal Daemon on localhost               N/A       N/A        Y
4641

Self-heal Daemon on gluster2                N/A       N/A        Y
4526

Self-heal Daemon on gluster3                N/A       N/A        Y
4328Task Status of Volume gfs

------------------------------------------------------------------
------------
```

```
There are no active volume tasks(gluster1)# gluster volume info
gfsVolume Name: gfs


Type: Replicate


Volume ID: 703e46cb-a637-4620-adfa-6b292a15e0d5


Status: Started


Snapshot Count: 0


Number of Bricks: 1 x 3 = 3


Transport-type: tcp


Bricks:


Brick1: gluster1:/gluster/bricks/1/brick


Brick2: gluster2:/gluster/bricks/2/brick


Brick3: gluster3:/gluster/bricks/3/brick


Options Reconfigured:
```

```
transport.address-family: inet


nfs.disable: on


performance.client-io-threads: off
```

6. Setup security and authentication for this volume

GlusterFS will allow any clients to connect to volumes by default. However, you will need to authorize the three infra VMs running GlusterFS to connect to the GlusterFS Volumes on each node. You can do it by authorizing the private IPs of each VM to connect to the volume. This will allow replication to happen. Execute:

```
(gluster1)# gluster volume set gfs auth.allow
192.168.2.100,192.168.2.101,192.168.2.102
```

7. Mount the glusterFS volume where applications can access the files

We'll mount the volume onto `/mnt` on each VM, and also append it to our /etc/fstab file so that it mounts on boot:

```
(gluster1)# echo 'localhost:/gfs /mnt glusterfs
defaults,_netdev,backupvolfile-server=localhost 0 0' >> /etc/fstab


(gluster1)# mount.glusterfs localhost:/gfs /mnt(gluster2)# echo
'localhost:/gfs /mnt glusterfs defaults,_netdev,backupvolfile-
server=localhost 0 0' >> /etc/fstab
```

```
(gluster2)# mount.glusterfs localhost:/gfs /mnt(gluster3)# echo
'localhost:/gfs /mnt glusterfs defaults,_netdev,backupvolfile-
server=localhost 0 0' >> /etc/fstab


(gluster3)# mount.glusterfs localhost:/gfs /mnt
```

8. Verify

Verify mounted glusterfs volume:

```
# df -Th


Filesystem     Type            Size  Used Avail Use% Mounted on


udev           devtmpfs        7.9G     0  7.9G   0% /dev


tmpfs          tmpfs           1.6G   17M  1.6G   2% /run


/dev/vda1      ext4             30G  2.1G   27G   8% /


tmpfs          tmpfs           7.9G   12K  7.9G   1% /dev/shm


tmpfs          tmpfs           5.0M     0  5.0M   0% /run/lock


tmpfs          tmpfs           7.9G     0  7.9G   0%
/sys/fs/cgroup
```

```
tmpfs           tmpfs           1.6G     0  1.6G   0%
/run/user/1001



/dev/vdb        xfs              10G   33M   10G   1%
/gluster/bricks/1



localhost:/gfs fuse.glusterfs   10G  135M   10G   2% /mnt
```

The total space available on the volume comes up as 10G even though we have 3 disks of 10G each connected to GlusterFS. This is due to our replication factor of 3. Total volume size is 30G, but with a replication factor or 3 for each file only 10G is available to us.

Test GlusterFS replication:

```
(gluster1)# echo "Hello World!" | sudo tee
/mnt/test.txt(gluster2)# cat /mnt/test.txt



Hello World!(gluster3)# cat /mnt/test.txt



Hello World!
```

Part 2: Setup Docker Swarm

Now let's setup the Docker Swarm cluster with the gluster VMs (gluster1/2/3) as the workers, and a new VM (swarm-manger) as the Swarm manager. We'll use our gluster replicated volume to achieve High Availability for our stateful containerized application. We'll test with Wordpress.

All commands executed as root.

1. Setup Docker community edition on all VMs

Install docker-ce on all four VMs (swarm-manager, gluster1/2/3) using the instructions given here: https://docs.docker.com/install/linux/docker-ce/ubuntu/ (I feel it's redundant to repeat the standard instructions).

However, after the installation, please do verify if Docker is installed properly by running following command on all VMs:

```
# docker run hello-world


Unable to find image 'hello-world:latest' locally


latest: Pulling from library/hello-world


1b930d010525: Pull complete


Digest:
sha256:92695bc579f31df7a63da6922075d0666e565ceccad16b59c3374d2cf4e
8e50e


Status: Downloaded newer image for hello-world:latestHello from
Docker!


This message shows that your installation appears to be working
correctly.
```

2. Initialize Docker swarm from the swarm-manager

We'll use the swarm-manager's private IP as the "advertised address".

```
swarm-manager:~# docker swarm init --advertise-addr 192.168.2.99



Swarm initialized: current node (sz42o1yjz08t3x98aj82z33pe) is now
a manager.To add a worker to this swarm, run the following
command:docker swarm join --token SWMTKN-1-
3gi2wi4o22nyiqij3io055na7wt0201oamaegykllea0t5vi5k-
2qjld08v7ouzax6gzw15dw2ab 192.168.2.99:2377To add a manager to
this swarm, run 'docker swarm join-token manager' and follow the
instructions.
```

3. Add the three gluster VMs as swarm workers

```
gluster1:~# docker swarm join --token SWMTKN-1-
3gi2wi4o22nyiqij3io055na7wt0201oamaegykllea0t5vi5k-
2qjld08v7ouzax6gzw15dw2ab 192.168.2.99:2377



This node joined a swarm as a worker.gluster2:~# docker swarm join
--token SWMTKN-1-
3gi2wi4o22nyiqij3io055na7wt0201oamaegykllea0t5vi5k-
2qjld08v7ouzax6gzw15dw2ab 192.168.2.99:2377



This node joined a swarm as a worker.gluster3:~# docker swarm join
--token SWMTKN-1-
3gi2wi4o22nyiqij3io055na7wt0201oamaegykllea0t5vi5k-
2qjld08v7ouzax6gzw15dw2ab 192.168.2.99:2377
```

```
This node joined a swarm as a worker.swarm-manager:~# docker node
ls


ID                            HOSTNAME            STATUS
AVAILABILITY        MANAGER STATUS      ENGINE VERSION


qjmuz0n8n770ryougk2tsb37x     gluster1            Ready
Active                                    18.09.5


kcwsavrtzhvy038357p51lwl2     gluster2            Ready
Active                                    18.09.5


ifnzgpk25p27y19vslee4v74x     gluster3            Ready
Active                                    18.09.5


sz42o1yjz08t3x98aj82z33pe *   swarm-manager       Ready
Active              Leader                18.09.5
```

Part 3: Test the High Availability Setup

We'll use docker stack to setup a single container Wordpress backed by a single container of MySQL, and then test if this setup is resilient to VM failure.

1. Create replicated directories for wordpress and mysql in glusterFS

```
gluster1:~# mkdir /mnt/wp-content
```

```
gluster1:~# mkdir /mnt/mysql
```

2. Create the wordpress-stack.yml file

This stack file exposes wordpress on port 8080 on all swarm nodes, even the swarm-manager node. It mounts the directories created for wp-content and mysql as volumes on the containers.

```
swarm-manager:~# cat wordpress-stack.yml

# wordpress-stack.yml

version: '3.1'

services:  wordpress:

   image: wordpress

   restart: always

   ports:

     - 8080:80

   environment:
```

```
  WORDPRESS_DB_HOST: db

  WORDPRESS_DB_USER: exampleuser

  WORDPRESS_DB_PASSWORD: examplepass

  WORDPRESS_DB_NAME: exampledb

volumes:

  - "/mnt/wp-content:/var/www/html/wp-content"

deploy:

  placement:

    constraints: [node.role == worker]   db:

image: mysql:5.7

restart: always

environment:
```

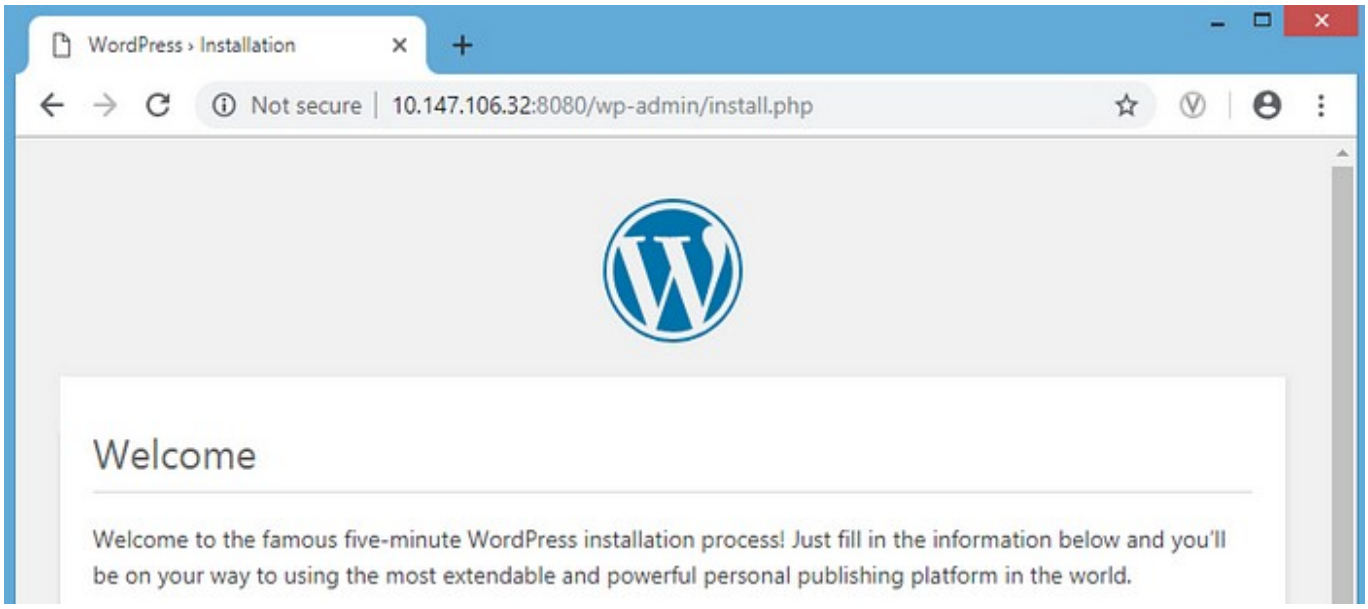
```
    MYSQL_DATABASE: exampledb

    MYSQL_USER: exampleuser

    MYSQL_PASSWORD: examplepass

    MYSQL_RANDOM_ROOT_PASSWORD: '1'

  volumes:

    - "/mnt/mysql:/var/lib/mysql"

  deploy:

    placement:

      constraints: [node.role == worker]
```

3. Use docker stack to deploy Wordpress and MySQL

```
swarm-manager:~# docker stack deploy -c wordpress-stack.yml
wordpress

Ignoring unsupported options: restartCreating network
wordpress_default
```

```
Creating service wordpress_db


Creating service wordpress_wordpressswarm-manager:~# docker stack
ps wordpress


ID                  NAME                    IMAGE
NODE                DESIRED STATE       CURRENT STATE
ERROR               PORTS


x5vvrt6ohko2        wordpress_db.1          mysql:5.7
gluster2            Running             Running 5 minutes ago


idree9r7qlxb        wordpress_wordpress.1   wordpress:latest
gluster1            Running             Running 5 minutes ago
```

Check if Wordpress is up by entering http://<any-worker-external-ip>:8080/ in the browser.



Note: 10.147.106.32 was one of my gluster worker VM's (gluster3) external IP

Go through the install process, choose an admin username and password, and create your first post.

4. Test High Availability by shutting down a VM

Check on which VM the Wordpress and MySQL containers are running. We'll shutdown each VM to understand whether HA is working properly. In my case, the Wordpress container was running on gluster1 and MySQL was running on gluster2.

```
swarm-manager:~# docker stack ps wordpress


ID                  NAME                    IMAGE
NODE                DESIRED STATE       CURRENT STATE
ERROR               PORTS


x5vvrt6ohko2        wordpress_db.1          mysql:5.7
gluster2            Running             Running 24 minutes ago


idree9r7qlxb        wordpress_wordpress.1   wordpress:latest
gluster1            Running             Running 24 minutes ago
```

Shutdown gluster1 and check what happens. You'll find that docker swarm starts a new container on a new worker VM. The website will continue to work, your data will still be stored, but you'll have to login again as the session data is lost with the previous container.

```
swarm-manager:~# docker stack ps wordpress


ID                  NAME                    IMAGE
NODE                DESIRED STATE       CURRENT STATE
ERROR               PORTS
```

```
u8s93kowj2mx        wordpress_wordpress.1   wordpress:latest
gluster3            Running             Running 3 seconds ago


x5vvrt6ohko2        wordpress_db.1          mysql:5.7
gluster2            Running             Running 28 minutes ago


idree9r7qlxb        wordpress_wordpress.1   wordpress:latest
gluster1            Shutdown            Running about a minute ago
```

Start the gluster1 VM again and let's repeat the HA test with MySQL host gluster2. Shutdown gluster2 which was running the MySQL container. After shutdown, you'll find docker swarm has scheduled MySQL on another worker VM.

```
swarm-manager:~# docker stack ps wordpress


ID                  NAME                    IMAGE
NODE                DESIRED STATE       CURRENT STATE
ERROR               PORTS


px90rs5q22ei        wordpress_db.1          mysql:5.7
gluster1            Running             Preparing 41 seconds ago


u8s93kowj2mx        wordpress_wordpress.1   wordpress:latest
gluster3            Running             Running 6 minutes ago


x5vvrt6ohko2        wordpress_db.1          mysql:5.7
gluster2            Shutdown            Running 50 seconds ago
```

```
idree9r7qlxb        wordpress_wordpress.1   wordpress:latest
gluster1            Shutdown            Shutdown 3 minutes ago
```

The website will continue to work without any data loss as the MySQL container would have found the replicated volume under the same path (/mnt/mysql).

Add the three worker VM IPs with port behind a Load Balancer (like AWS ELB) and *voilà*, A Highly Available stateful deployment on Docker Swarm using GlusterFS.