THE OPENSOURCE CLUSTER LAB FOR Pacemaker

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DAY 1

What is the High Availability.

The Linux Distribution(RHEL, CentOS/, Rocky and SuSE)
High Availability System for Linux
INTRODUCE

INSTALLATION AND BASIC COMMAND

Virtual Machine
Quick View to basic command

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DAY 2

INSTALL PACEMAKER

INSTALL PACEMAKER

ISCSI SETUP

CLUSTER SETUP

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DAY 3

BUILD AND CONFIGURE SERVICE

ISCSI

NFS

GFS2

WWW

TOMCAT

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DAY 4

BUILD AND CONFIGURE SERVICE

ISCSI

NFS

GFS2

WWW

TOMCAT

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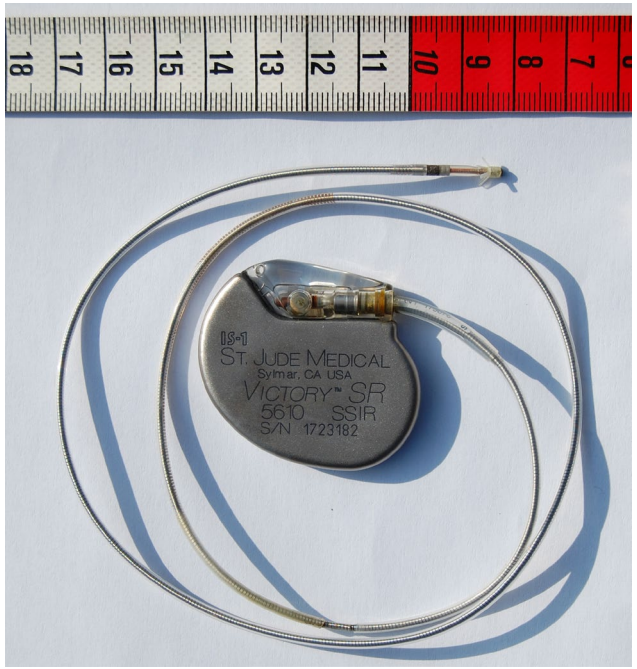
INTRODUCE

PACEMAKER

Pacemaker works like a real pacemaker. Of course, based on Software and Operating system.

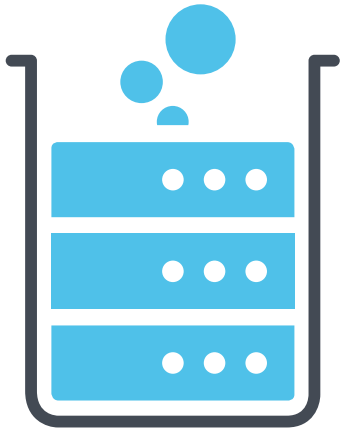
Pacemaker for Service and Operating System.



PACEMAKER

The Pacemaker doing like these.

- Health check to Linux resource and service(systemD)
- Fail-Over and Service take over between host to host
- Small and Lager scale High Availability support



BACKGROUND

- The oldest and most well-known open-community HA project - providi ng sophisticated fail over and restart capabilities for Linux
- In existence since 1998; ~ 30k mission-critical clusters in production sin ce 1999
- Active, open development community led by IBM and Novell
- Wide variety of industries; applications supported

BACKGROUND

- Shipped with most Linux distributions (all but Red Hat)
- No special hardware requirements; no kernel dependencies, all user sp ace
- All releases tested by automated test suite

Corosync

Corosync Cluster Engine. Group communication System with additional features for implementing high availability within applications.

****MOST CORE COMPOMENT**

https://clusterlabs.org/corosync.html

- Pacemaker
- DRBD
- ScanCore

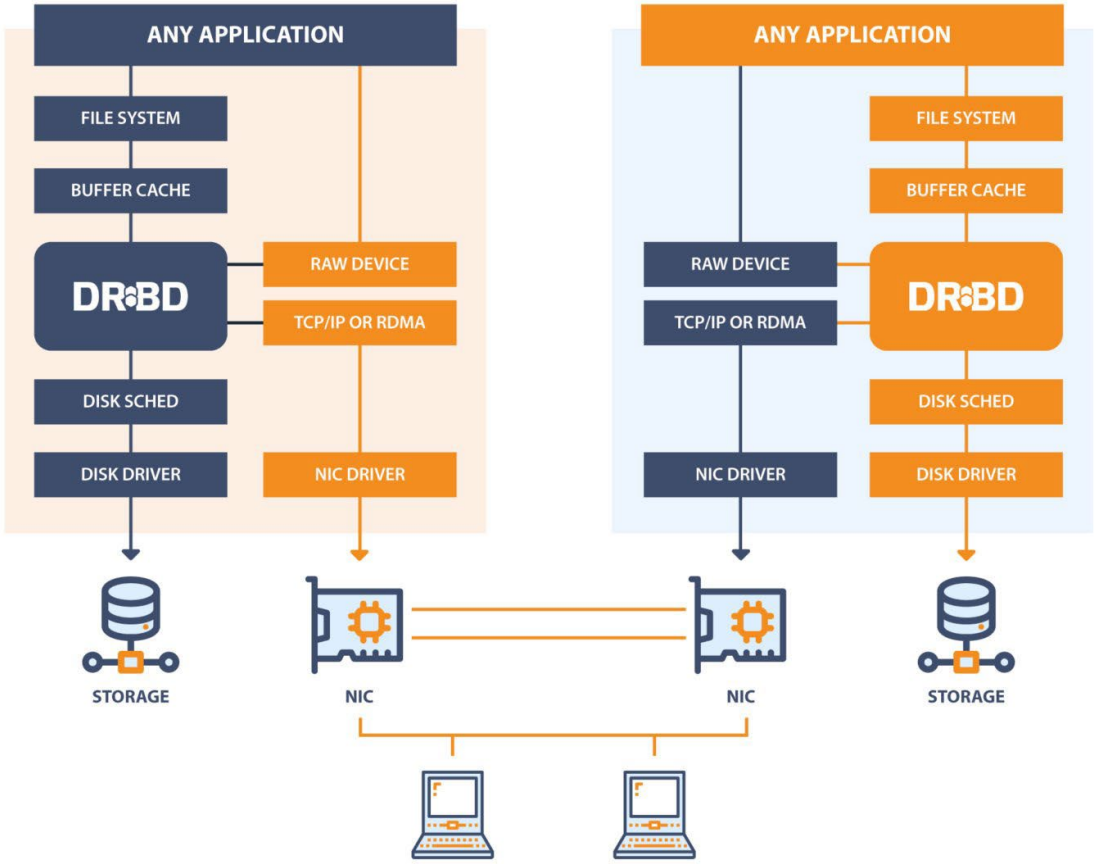
DRBD is Distribute Replicated Storage System. This is helping and implemented as kernel driver, several userspace management application and shell script.

In the Pacemaker, recently adopted this component in Pacemaker system.

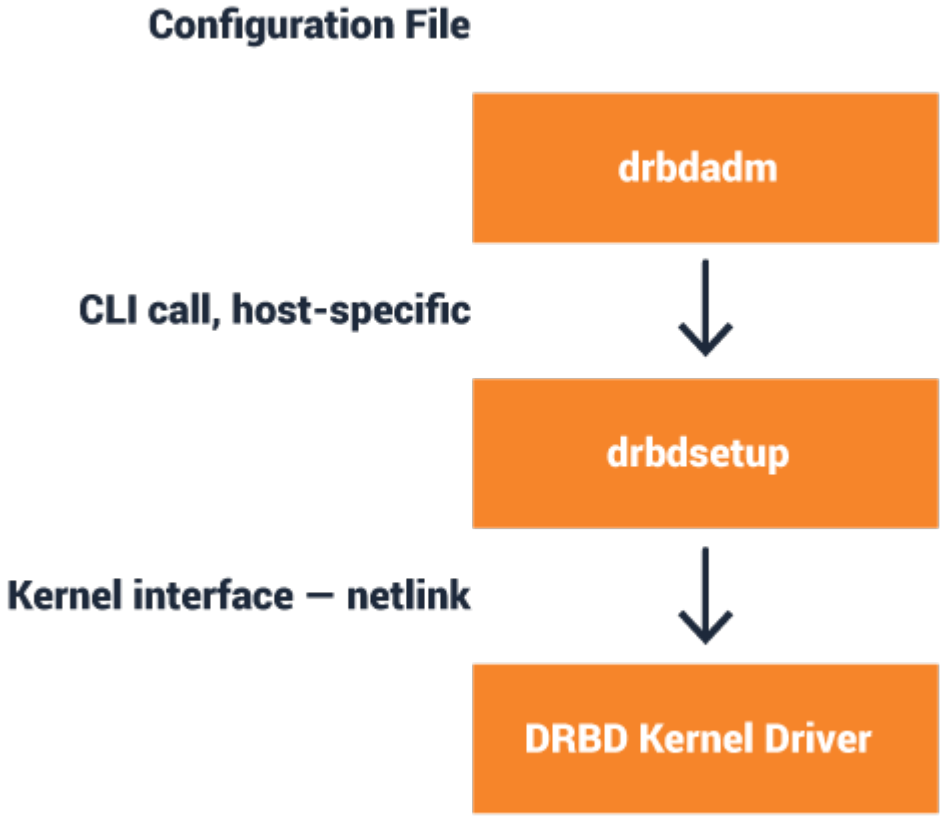
https://linbit.com/drbd/

But, Don't need to use the DRBD cli command in the Pacemaker.

DRBD


ANY APPLICATION
FILE SYSTEM
BUFFER CACHE
DRBD
RAW DEVICE
TCP/IP OR RDMA
DISK SCHED
DISK DRIVER
NIC DRIVER
ANY APPLICATION
FILE SYSTEM
BUFFER CACHE
RAW DEVICE
TCP/IP OR RDMA
DRBD
DISK SCHED
NIC DRIVER
DISK DRIVER
STORAGE
NIC
NIC
STORAGE

DRBD


Configuration File
drbdadm
CLI call, host-specific
drbdsetup
Kernel interface — netlink
DRBD Kernel Driver

ScanCore

ScanCore is at its core, "decision engine". This component will check to node below condition.

- Over heating
- Loss of input power
- Node Health
- Scan Agents

If you want to know more detail, Please visit this web site.

https://www.alteeve.com/w/ScanCore

PACEMAKER

Features

The ClusterLabs stack, incorporating Corosync and Pacemaker defines an Open Source, High Availability cluster offering suitable for both small and large deployments.

- Detection and recovery of machine and application-level failures
- Supports practically any redundancy configuration
- Supports both quorate and resource-driven clusters
- Configurable strategies for dealing with quorum loss (when multiple machines fail)
- Supports application startup/shutdown ordering, without requiring the applications to run on the same node
- Supports applications that must or must not run on the same node
- Supports applications which need to be active on multiple nodes
- Supports applications with dual roles (promoted and unpromoted)

- Provably correct response to any failure or cluster state. The cluster's response to any stimuli can be tested offline *before* the condition exists

PACEMAKER

Components

A Pacemaker stack is built on five core components:

- libQB - core services (logging, IPC, etc)
- Corosync - Membership, messaging and quorum
- Resource agents - A collection of scripts that interact with the underlying services managed by the cluster
- Fencing agents - A collection of scripts that interact with network power switches and SAN devices to isolate cluster members
- Pacemaker itself

We describe each of these in more detail as well as other optional components such as CLIs and GUIs.

"The definitive open-source high-availability stack for the Linux platform builds upon the Pacemaker cluster resource manager."
-- LINUX Journal, "Ahead of the Pack: the Pacemaker High-Availability Stack"

PACEMAKER

Background

Pacemaker has been around since 2004 and is primarily a collaborative effort between Red Hat and SUSE, however we also receive considerable help and support from the folks at LinBit and the community in general.

Corosync also began life in 2004 but was then part of the OpenAIS project. It is primarily a Red Hat initiative, with considerable help and support from the folks in the community.

The core ClusterLabs team is made up of full-time developers from Australia, Austria, Canada, China, Czech Repulic, England, Germany, Sweden and the USA. Contributions to the code or documentation are always welcome.

The ClusterLabs stack ships with most modern enterprise distributions and has been deployed in many critical environments including Deutsche Flugsicherung GmbH (DFS) which uses Pacemaker to ensure its air traffic control systems are always available.

RGMAN VS PACEMAKER

Under RHEL/CentOS 7

Only Support Resource Manager(RGMAN or CMAN)

Over RHLE/CentOS 7

Use able to be Pacemaker

RGMAN VS PACEMAKER

	rgmanager	Pacemaker
Resource Configuration Management	Manual	Automatic
Resource Management Model	Resource Group	Resource-Dependency, Resource Group
Dependency Models	Colocation, Start-After	User-defined
Event Handling Model	Distributed or Centralized	Centralized
Command-Line Interface Management	Status, Control	Status, Control, Administration
Fencing Model	Assumed	Flexible
Multi-State Resources	No	Yes
Event Scripts	Yes	No
Maximum Node Count	16	16

RGMAN VS PACEMAKER

Exclusive Services	Yes	Yes
Failover Domains	Yes	Yes
Resource Exclusion	No	Yes
Time-Based Resource Control	No	Yes
Resource Attribute Inheritance	Yes	Yes
Shared Resources	Yes	Yes
Cloned Resources	No	Yes
Resource Agent APIs	OCF, SysV	OCF, SysV

RGMAN VS PACEMAKER

Resource Freezing	Yes	Yes
Requires Quorum	Yes	Configurable
Requires DLM	Yes	No
Multi-Partition Resource Management	No	Yes
Non-root Administration	No	Yes

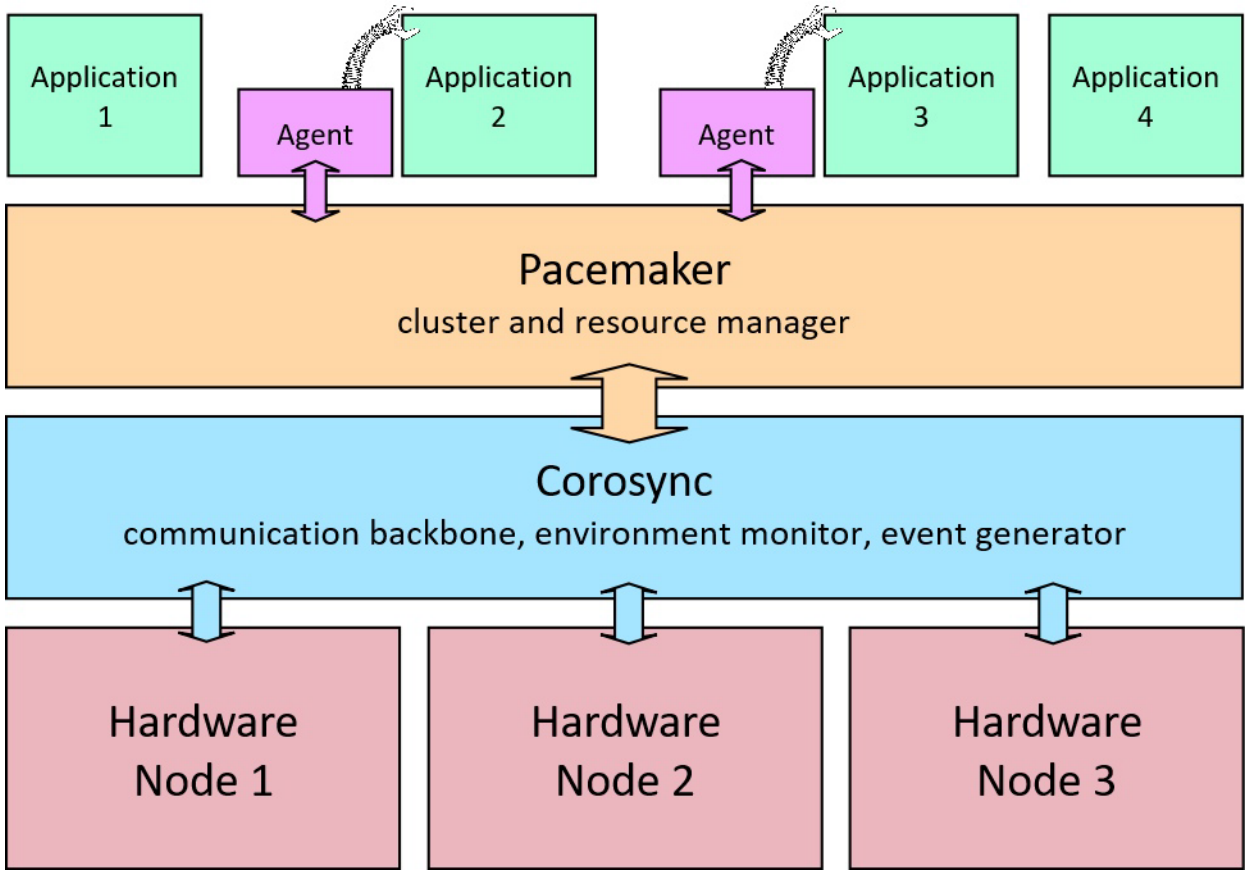
THE AGENT

Pacemaker and RGMAN can use OCF Resource Agents.

The OCF Resource Agent can not cover all of the agents features in this training.

http://www.linux-ha.org/doc/dev-guides/ra-dev-guide.html

THE AGENT


Application 1
Agent
Application 2
Agent
Application 3
Application 4
Pacemaker
cluster and resource manager
Corosync
communication backbone, environment monitor, event generator
Hardware Node 1
Hardware Node 2
Hardware Node 3

THE AGENT

- H/A, It cannot achieve 100% availability.
- A good HA Cluster systems adds a "9" to your base availability.
  - 99->99.9, 99.9 -> 99.99 something like this.
- Don't get and drag the complexity into your cluster
  - Most of time, You will fail the design and High Availability Architecture.

THE NINES THORY

99.9999% IN 30SEC

99.999% IN 5MIN

99.99% IN 52 MIN

99.9% IN 9 HOUR

99% IN 3.5 DAY

DR VS HA

DR(DISASTER RECOVERY)

1. FAILOVER IS EXPENSIVE
2. FAILOVER TIMES OFTEN MEASURED IN HOURS
3. UNRELIABLE INTER-NODE COMMUNICATION ASSUMED
4. TOO MUCH COMPLEX AND COMPLICATED DESGIN WITH CLUSTER AND NODES

DR VS HA

HA(HIGH AVAILABILITY)

- FAILOVER IS CHEAP
- FAILOVER TIMES MEASURED IN SECONDS
- RELIABLE INTER-NODE COMMUNICATION
- SIMPLE AND WELL DISGIN WITH CLUSTER AND NODES THROUGH AGENT

SINGLE POINTS OF FAILURE

SPOFs

Good

H/A design eliminates or remove of single point of failure.

Bad

H/A design is entire system or service can not communicate between nodes.

FENCING

If the resource is going failure, The fencing guarantees integrity of service

STONITH

Shoot the Other Node in the Head

SCSI RELEASE/LOCK AND RESERVE

LVM2, GFS2 or NFS things

SCSI CHANNEL

iSCSI, Fiber Channel things

CAPABILITIES

- Supports n-node clusters – where 'n' <= something like 16
- Can use serial, UDP bcast, mcast, ucast comm.
- Fails over on node failure, or on service failure
- Fails over on loss of IP connectivity, or arbitrary criteria
- Active/Passive or full Active/Active
- Built-in resource monitoring
- Support for the OCF resource standard

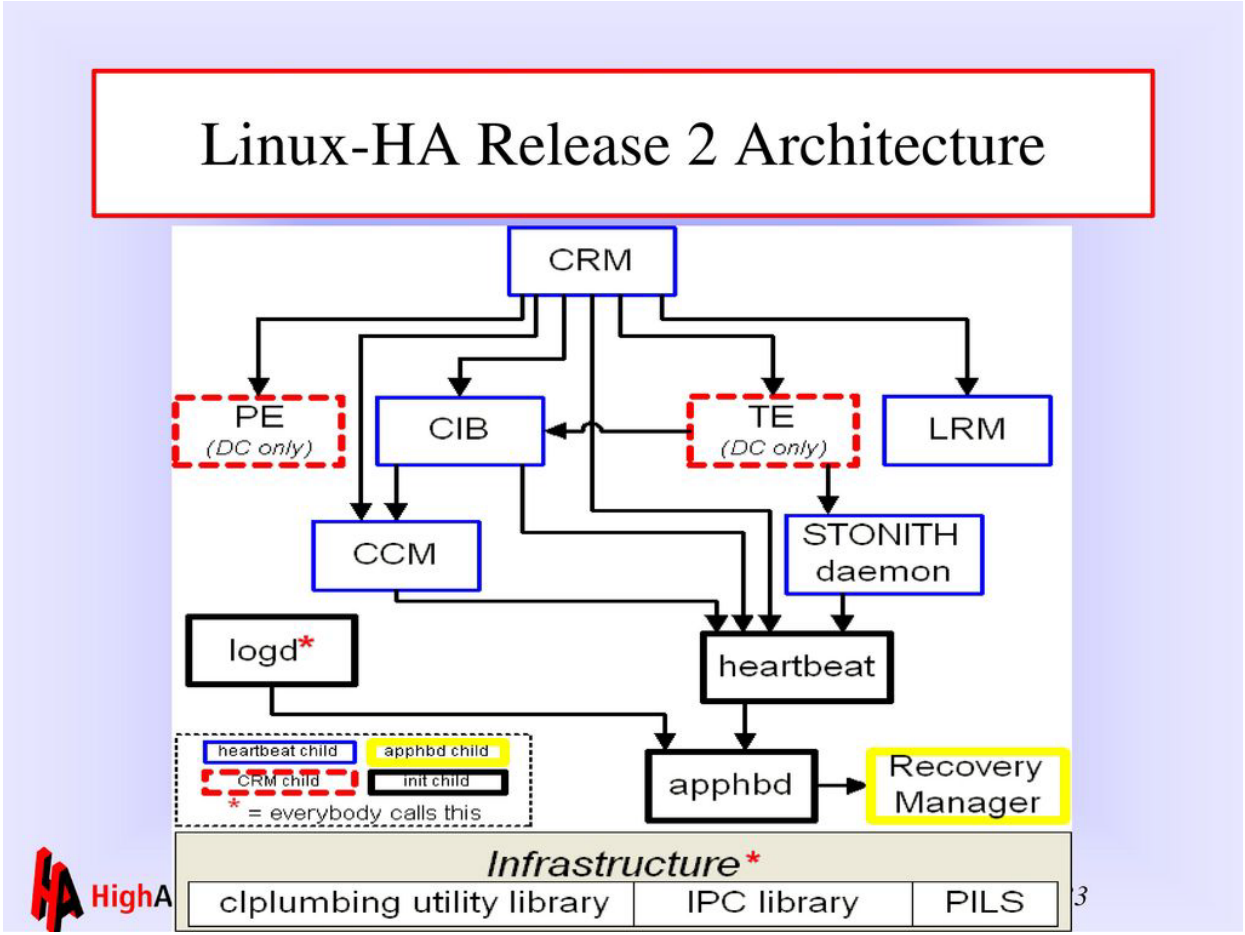
CAPABILITIES

- Sophisticated dependency model with rich constraint support (resources, groups, incarnations, master/slave) (needed for SAP)
- XML-based resource configuration
- Configuration and monitoring GUI
- Support for OCFS cluster filesystem
- Multi-state (master/slave) resource suppot

CAPABILITIES

- NODE
- RESOURCE
- RESOURCE AGENT
- DC(DESIGNATED COORDINATOR), MASTER NODE
- STONITH
- SPLIT BRAIN
- QUORUM

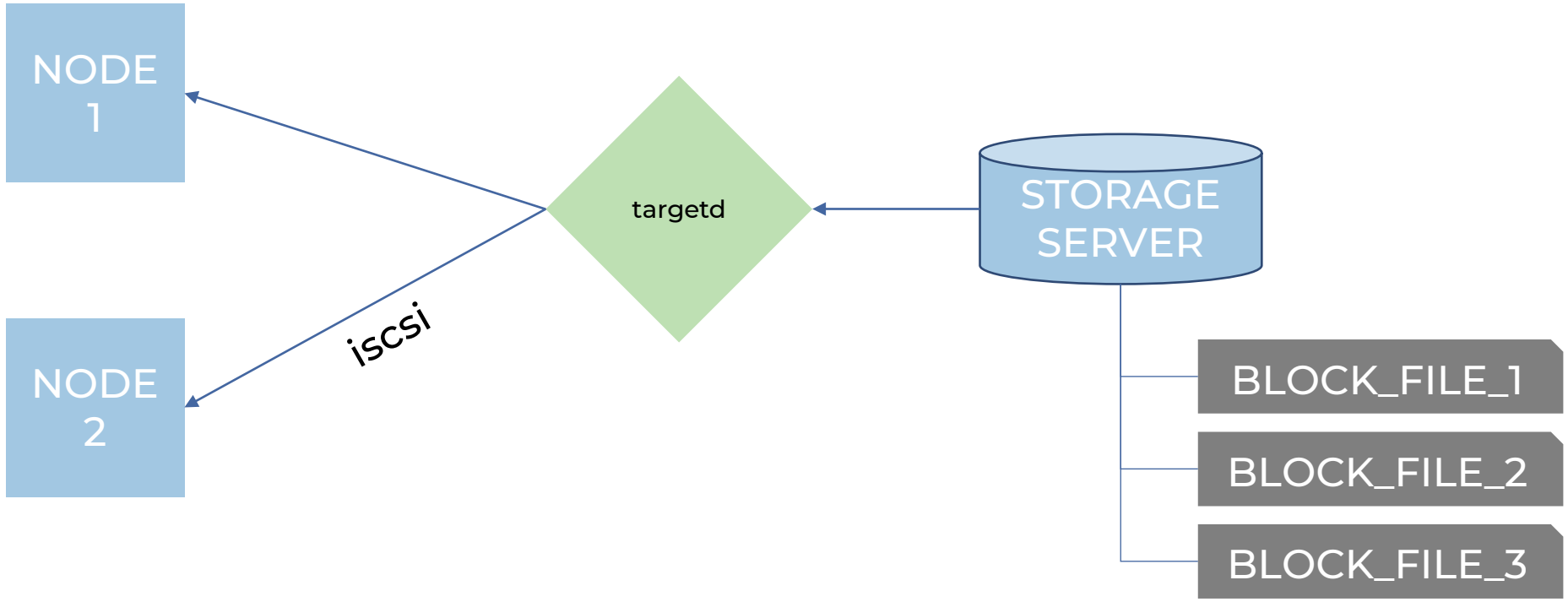
CAPABILITIES



LAB SETUP

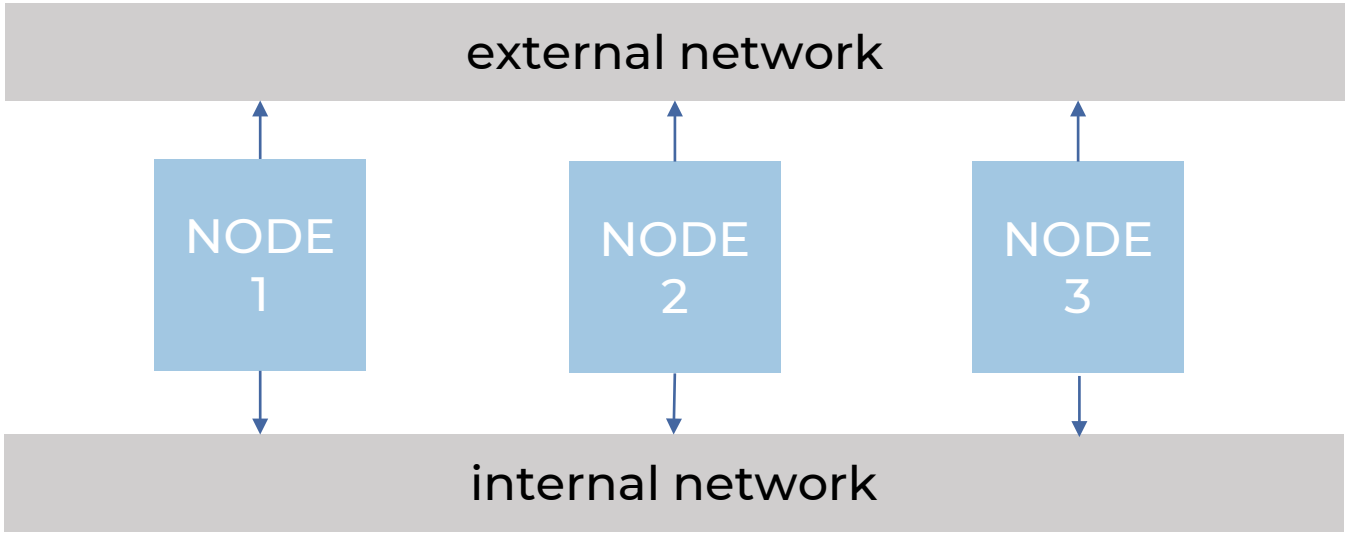
- INSTALL LINUX FOR HOST COMPUTER
- LIBVIRTD AND VIRSH COMMAND
- BUILD UP VIRTUAL MACHINE FOR PoC

LAB DESIGN


NODE 1
NODE 2
iscsi
targetd
STORAGE SERVER
BLOCK_FILE_1
BLOCK_FILE_2
BLOCK_FILE_3

FUNDAMENTAL

LAB DESIGN



We need those are packages for the lab.

- libvirtd
- virsh
- virt-builder

And Maybe need to install for VirtualBMC(IPMI protocol)

- virtualbmc

LAB

```
# dnf install libvirt libvirt-devel python3-devel
gcc -y
# pip3 install virtualbmc
```

LAB

```
# dnf groupinstall "Virtualization Host" -y
# dnf install libguestfs-tools-c -y
# virt-builder --list

# virsh net-list
# cat <<EOF> internal-network.xml
```

LAB

```
<network>
  <name>internal</name>
  <bridge name='virbr10' stp='on' delay='0'/>
  <mac address='52:54:00:91:24:b8'/>
  <domain name='internal'/>
  <ip address="192.168.90.1" netmask="255.255.255.0">
    <dhcp>
      <range start="192.168.90.2" end="192.168.90.254"/>
    </dhcp>
  </ip>
</network>
EOF
```

LAB

```
# virsh define --file
# virsh net-list
```

LAB

```
# virt-builder --size 10G --format qcow2 -o --root-password
password:centos /var/lib/libvirtd/images/node1.qcow2 centosstream-8

# virt-builder --size 10G --format qcow2 -o --root-password
password:centos /var/lib/libvirtd/images/node2.qcow2 centosstream-8

# virt-builder --size 30G --format qcow2 -o --root-password
password:centos /var/lib/libvirtd/images/node3.qcow2 centosstream-8
```

LAB

```
# dnf install virt-install -y

# virt-install --memory 4096 --cpu host-passthrough --vcpu 2 -n node1 \
--disk /var/lib/libvirtd/images/node1.qcow2,cache=none,bus=virtio \
-w network=default,model=virtio -w network=internal,model=virtio \
--graphics none --autostart --noautoconsole --import

# virt-install --memory 4096 --cpu host-passthrough --vcpu 2 -n node2 \
--disk /var/lib/libvirtd/images/node2.qcow2,cache=none,bus=virtio \
-w network=default,model=virtio -w network=internal,model=virtio \
--graphics none --autostart --noautoconsole --import
```

LAB

```
# virt-install --memory 4096 --cpu host-passthrough --vcpu 2 -n node3 \
--disk /var/lib/libvirtd/images/node3.qcow2,cache=none,bus=virtio \
-w network=default,model=virtio -w network=internal,model=virtio \
--graphics none --autostart --noautoconsole --import

# virsh console node1
# virsh console node2
# virsh console node3

# virsh domifaddr node1

# ssh root@<IP>
```

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PACEMAKER INSTALLATION

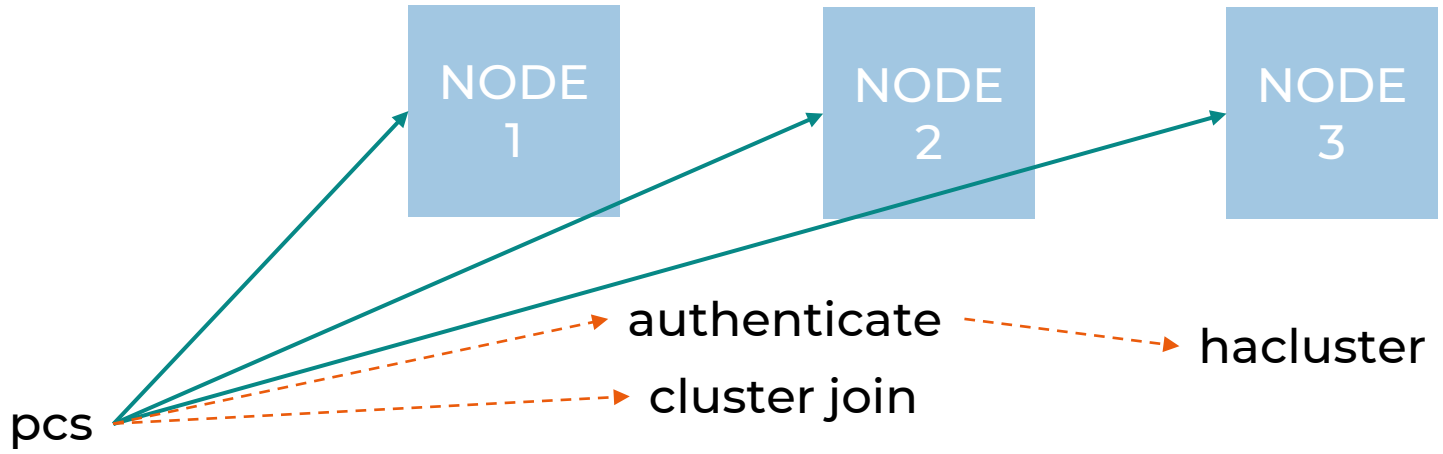
- LINUX CONFIGURE AND INSTALLATION
- ISCSI TARGET SERVER CONFIGURATION

PCS

before start this lab, we have to make a snapshot for all virtual machines.

```
# virsh snapshot-create as --domain node1 --name node1-pcs-setup
# virsh snapshot-create-as --domain node2 --name node2-pcs-setup
# virsh snapshot-create-as --domain node3 --name node3-pcs-setup

# virsh snapshot-list node1

# virsh snapshot-revert --domain node1 --snapshotname node1-pcs-setup --
running
```

PCS


NODE 1
NODE 2
NODE 3
authenticate
hacluster
cluster join
pcs

PCS

need to set a hostname to each of node.

```
# hostnamectl set-hostname nodeX.example.com
```

Here no have a DNS server. /etc/hosts configure to the A recode instead DNS.

```
# cat <<EOF>> /etc/hosts
192.168.90.110 node1.example.com node1
192.168.90.120 node2.example.com node2
192.168.90.130 node3.example.com node3 storage
EOF
```

Make a SSH Private and Public key for access to nodes without password

```
# ssh-keygen -t rsa -N'' -f ~/.ssh/id_rsa
# dnf install sshpass -y
```

PCS

Before install to Pacemaker, we have to update whole nodes as latest packages. Then install to pacemaker package.

```
# cat <<EOF> ~/.ssh/config
StrictHostKeyChecking=no
EOF

# for i in node{1..3} ; do sshpass -pcentos ssh root@$i 'dnf update -y' ; done
# for i in node{1..3} ; do sshpass -pcentos scp /etc/hosts root@$i.example.com:/etc/hosts ; done

# for i in node{1..3} ; do sshpass -p centos ssh root@$i 'dnf --enablerepo=ha -y install pacemaker pcs
' ; done
# for i in node{1..3} ; do sshpass -p centos ssh root@$i 'dnf install firewalld && systemctl enable --
now firewalld' ; done
```

PCS

```
# for i in {1..3} ; do sshpass -p centos ssh root@node${i} 'firewall-cmd --add-service=high-availability && firewall-cmd --runtime-to-permanent' ; done

# for i in {1..3} ; do sshpass -p centos ssh root@node$i 'echo centos | passwd --stdin hacluster' && systemctl enable --now pcs.service ; done

# ping node1 -c3
# ping node2 -c3
# ping node3 -c3
```

PCS(node1)

```
# pcs host auth -u ha_cluster_lab -p centos node1.example.com node2.example.com
node3.example.com
# pcs cluster setup ha_cluster_lab node1.example.com node2.example.com node3.example.com

# pcs cluster start --all
# pcs cluster enable --all
# pcs cluster status

# pcs status corosync
# pcs cluster stop --all
# pcs cluster destroy --all

# ss -npltu | grep -i corosync
```

PACEMAKER

DO SELF LAB

ROLL BACK VIRTUAL MACHINE AND REINSTALL TO THE PACEMAKER CLUSTER

FUNDAMENTAL

- PACEMAKER RESOURCE
- BASIC COMMANDS

ACL

Access Control List, This is will be disabled as default value. Pacemaker uses **"root"** or **"hacluster"** group with user account for modification CIB information.

If you want to use normal user as Pacemaker grained of authorization, use to the **ACLs**.

CIB: Cluster Information Base. The CIB file is normally configured by XML.

ACL

```
# adduser rouser
# echo centos | passwd --stdin rouser
# usermod -aG haclient rouser
# pcs acl enable
# pcs acl role create read-only description="Read only access to
cluster" read xpath /cib
# pcs acl user create rouser read-only
# pcs acl
# pcs client local-auth
```

ALERT

alert

Pacemaker can support alert agents via script.
"/usr/share/pacemaker/alerts" in the location have a sample alert agents.

ALTER

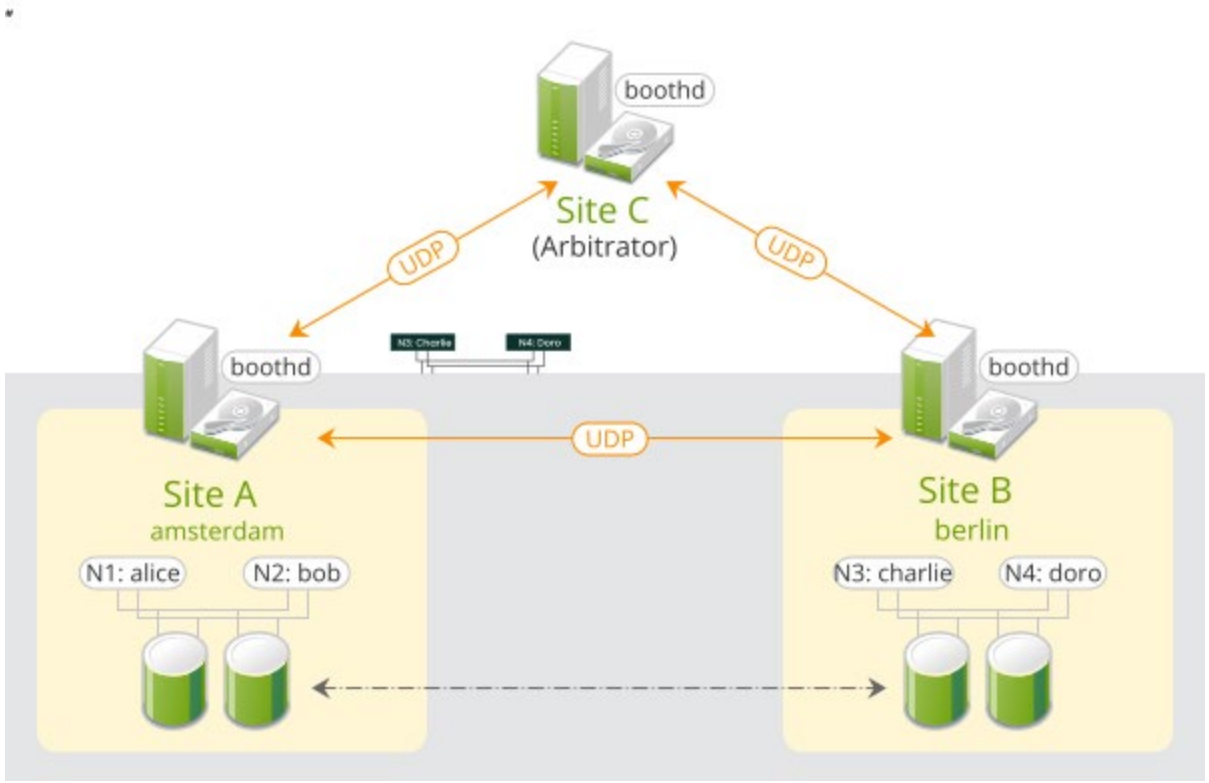
```
# install --mode=0755 /usr/share/pacemaker/alerts/alert_file.sh.sample
/var/lib/pacemaker/alert_file.sh
# touch /var/log/pcmk_alert_file.log
# chown hacluster:haclient /var/log/pcmk_alert_file.log
# chmod 600 /var/log/pcmk_alert_file.log
# pcs alert create id=alert_file description="Log events to a file."
path=/var/lib/pacemaker/alert_file.sh
# pcs alert recipient add alert_file id=my-alert_logfile
value=/var/log/pcmk_alert_file.log

# pcs alert
```

booth

Different place and cluster are in two site, the arbitrator cluster(or overlay cluster) is managed by the booth cluster. So, In Simple way, the booth cluster role is "Arbitrator"

In this training not cover this part.

BOOTH



https://documentation.suse.com/sle-ha/12-SP4/single-html/SLE-HA-geo-guide/index.html

client

Different place and cluster are in two site, the arbitrator cluster(or overlay cluster) is managed by the booth cluster.

So, In Simple way, the booth cluster role is "Arbitrator"

client

Different place and cluster are in two site, the arbitrator cluster(or overlay cluster) is managed by the booth cluster.

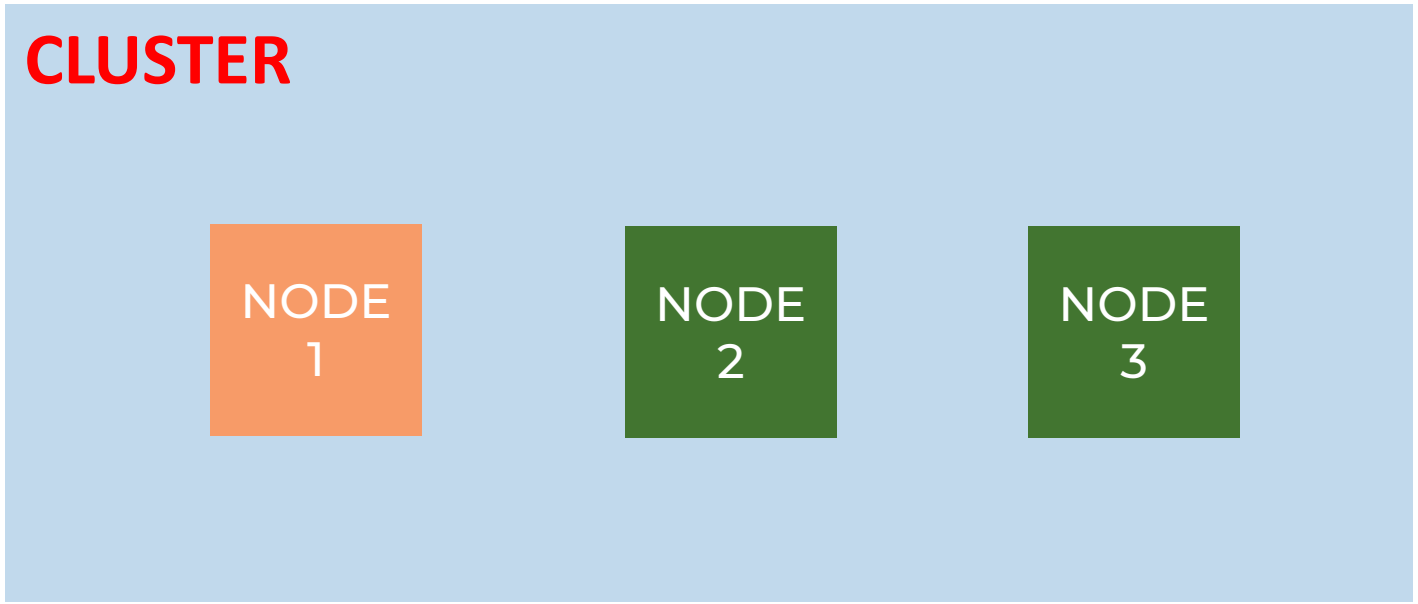
So, In Simple way, the booth cluster role is "Arbitrator"

CLUSTER

cluster

The cluster is group of nodes. In the pacemaker needs at least two nodes in the cluster.

CLUSTER



CLUSTER COMMAND

```
# pcs cluster status
# pcs cluster config
# pcs cluster auth
# pcs cluster enable
# pcs cluster start
```

CONFIG/COMMAND

config

Shows the cluster all configuration about resource, stonith, fence and OCF agent configuration.

```
# pcs config
```

CONSTRAINT

constraint

Set to location for the cluster resource. You can determine the behavior of a resource in a cluster by configuration.

location

The location is a node. A resource run the location node by configure.

order

Order is constraint determines the order in which a resources run in ordering.

COLOATION

colocation

colocation is where resource will locate or placed relative to other resource

dr

This is Disaster recovery for a high availability cluster when primary cluster is not available. This feature can use RHEL/CentOS 8 version.

DR COMMAND

```
# pcs host auth -uhacluster -phacluster node1.example.com
node2.example.com node3.example.com node4.example.com
# pcs cluster setup node1.example.com node2.example.com
node3.example.com node4.example.com
# pcs cluster setup DRsite node3.example.com node4.example.com --start
# pcs dr set-recovery-site node3.example.com
# pcs dr config
# pcs dr status
```

HOST

host

In the cluster concept, the cluster have a node at least one. Pacemaker can add a host by 'pcs host' command. Each host need to authenticate with 'hacluster' user account.

NODE

node

node is minimum element for cluster. the cluster have at least one node.
the node will have resource, constraint with resource group and order.

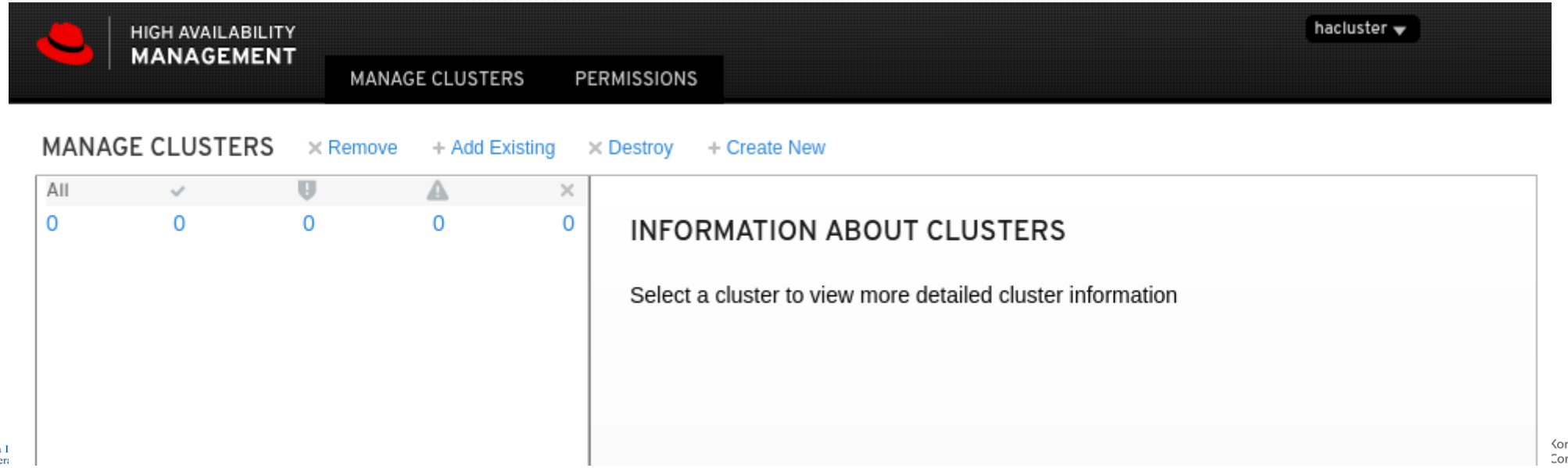
NODE COMMAND

```
# pcs cluster status
# pcs node standby node1.example.com
# pcs cluster status
```

PCSD

pcsd

pcs is Pacemaker configuration daemon for GUI and remote cli. The web GUI web administrator page access via 2224/TPC port.



PROPERTY

property

The property is configuration to cluster value such as corosync, quorum values. Cluster properties control how the cluster behavior with property value.

PROPERTY COMMAND

```
# pcs property
Cluster Properties:
 cluster-infrastructure: corosync
 cluster-name: ha_cluster_lab
 dc-version: 2.1.5-5.el8-a3f44794f94
 have-watchdog: false
 no-quorum-policy: freeze
# pcs property set maintenance-mode=true
```

PROPERTY COMMAND

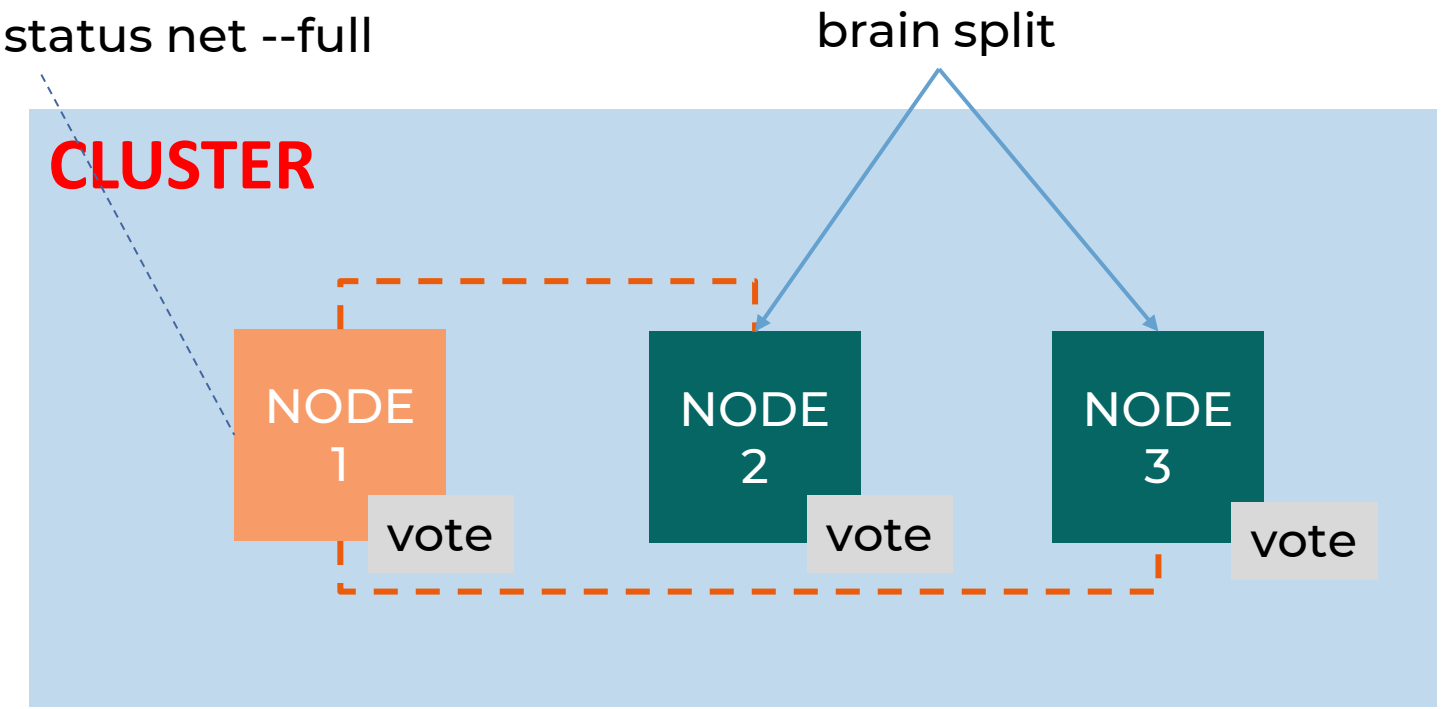
```
# pcs property
Cluster Properties:
 cluster-infrastructure: corosync
 cluster-name: ha_cluster_lab
 dc-version: 2.1.5-5.el8-a3f44794f94
 have-watchdog: false
 maintenance-mode: true
 no-quorum-policy: freeze
```

qdevice

"qdevice" is **"quorum device".** this is not device and agent. It's third-party arbitration device for the cluster. Normally a quorum device is recommended for clusters with an even number of nodes. But, when the cluster is going to be two-node cluster status, the quorum device is better for survive in split-brain situation.

QDEVICE

pcs qdevice status net --full



QDEVICE COMMAND

Install these packages form High Availability repository.

```
nodeX# dnf --enablerepo=ha install corosync-qdevice
nodeX# dnf --enablerepo=ha install pcs corosync-qnetd

node1# yum install pcs corosync-qnetd
node1# systemctl enable --now pcsd.service
node1# pcs qdevice setup model net --enable --start

node1# pcs qdevice status net --full
node1# firewall-cmd --permanent --add-service=high-availability
node2# pcs cluster auth qdevice
```

QDEVICE COMMAND

```
node2# pcs quorum config
node2# pcs quorum status
node2# pcs quorum device add model net host=qdevice
algorithm=ffsplit
node2# pcs quorum config
node2# pcs quorum status
node2# pcs quorum device status
node2# pcs qdevice status net --full
```

QDEVICE COMMAND

```
node2# pcs qdevice start net
node2# pcs qdeivce stop net
node2# pcs qdevice enable net
node2# pcs qdevice disable net
node2# pcs qdevice kill net
```

QDEVICE COMMAND

```
node2# pcs quorum device update model algorithm=lms
node2# pcs quorum device remove
node2# pcs quorum device status
node2# pcs qdevice destroy net
```

QUORUM

- quorum

- The quorum is voting system for cluster nodes.

- Every cluster nodes has a vote for vote-quorum system. If some resources or nodes can't vote the object will be fencing and detached from system.

QUORUM COMMAND

```
node2# pcs quorum status
Quorum information
------------------
Date:             Sun Feb 26 02:09:16 2023
Quorum provider:  corosync_votequorum
Nodes:            2
Node ID:          1
Ring ID:          1.40
Quorate:          Yes
```

QUORUM COMMAND

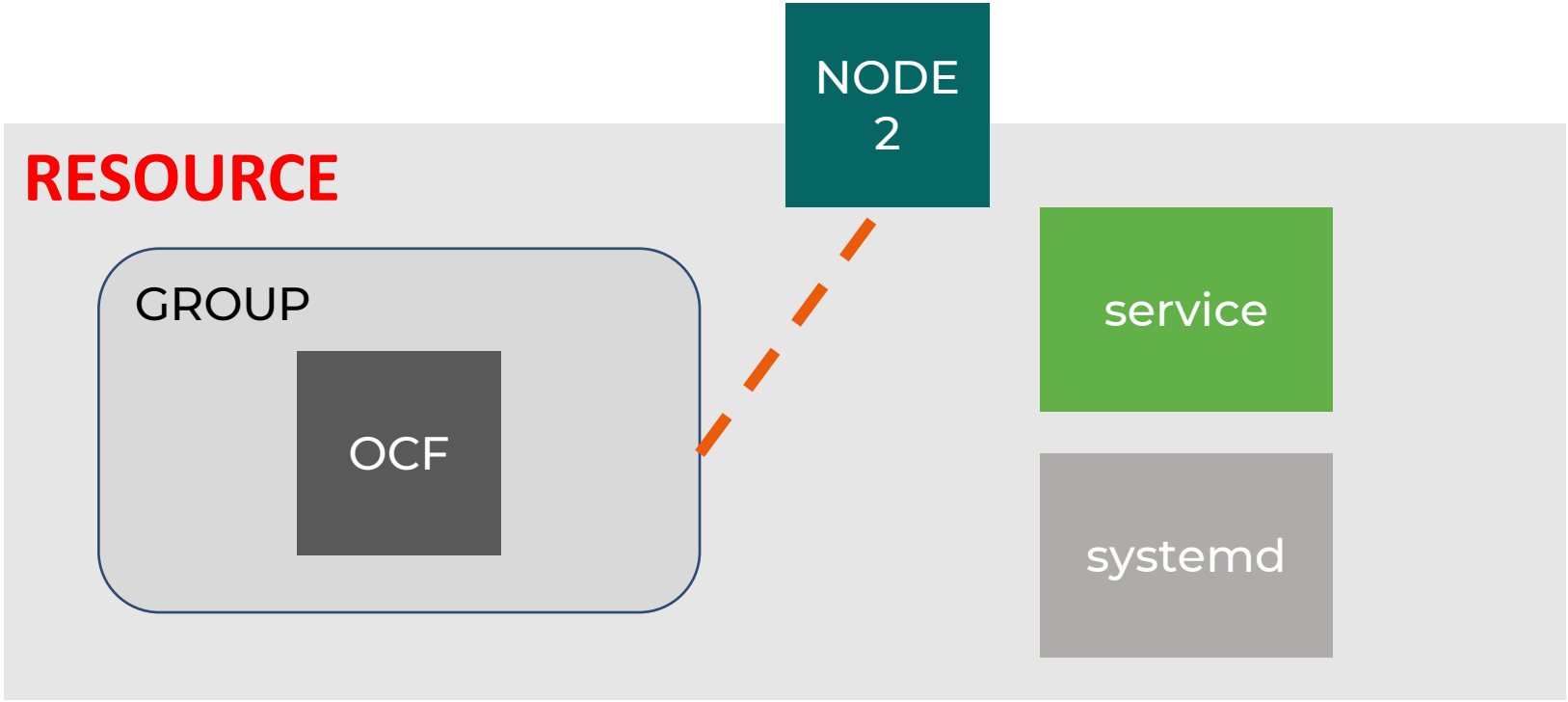
```
Votequorum information
----------------------
Expected votes:   2
Highest expected: 2
Total votes:      2
Quorum:           1
Flags:            2Node Quorate WaitForAll

Membership information
----------------------
    Nodeid      Votes    Qdevice Name
         1          1         NR node2.example.com (local)
         2          1         NR node3.example.com
```

resource

The resource is a service managed by Peacemaker. The resource is kind of agent for standardized interface for managing the service. This allows Pacemaker to be agnostic the services it manages.

We don't need to understand about the service works behind of resource agent.

RESOURCE



RESOURCE

The resources have a classes below these.

- **OCF**
- LSB
- **system**
- Upstart(deprecated)
- **Service**
- Fencing
- Nagios

The Open Cluster Framework

The Open Cluster Framework (OCF) Resource Agent API is a ClusterLabs standard for managing services. It is the most preferred since it is specifically designed for use in a Pacemaker cluster.

The Open Cluster Framework

OCF agents are scripts that support a variety of actions including start, stop, and monitor. They may accept parameters, making them more flexible than other classes. The number and purpose of parameters is left to the agent, which advertises them via the meta-data action.

Unlike other classes, OCF agents have a provider as well as a class and type.

systemd

Most Linux distributions use Systemd for system initialization and service management. Unit files specify how to manage services and are usually provided by the distribution.

Pacemaker can manage systemd services. Simply create a resource with systemd as the resource class and the unit file name as the resource type. Do not run systemctl enable on the unit.

Linux Standard Base

LSB resource agents, also known as SysV-style, are scripts that provide start, stop, and status actions for a service.

They are provided by some operating system distributions. If a full path is not given, they are assumed to be located in a directory specified when your Pacemaker software was built (usually /etc/init.d).

In order to be used with Pacemaker, they must conform to the LSB specification as it relates to init scripts.

STONITH

The Stonith class is used for managing fencing devices, discussed later in Fencing.

STATUS

The status command will show the cluster state. The status collect from **pcsd, corosync** and agent information.

STATUS COMMAND

```
# pcs status
# pcs resource status <NAME>
# pcs status nodes
```

stonith

"**S**hoot **t**he **o**ther **n**ode **i**n **t**he **h**ead" aka fencing. The Stonith for protests your date from being corrupted by rogue nodes.

The command example will not work correctly.

COMMAND

```
node2# pcs stonith list
node2# dnf search fence-agents-all
node2# dnf install fence-agents-ipmilan
node2# pcs stonith describe fence_ipmilan
node2# pcs stonith create ipmi-fence-node1 fence_ipmilan
pcmk_host_list="node1" ipaddr="10.0.0.1" login="xxx" passwd="xxx"
lanplus=1  power_wait=4
```

COMMAND

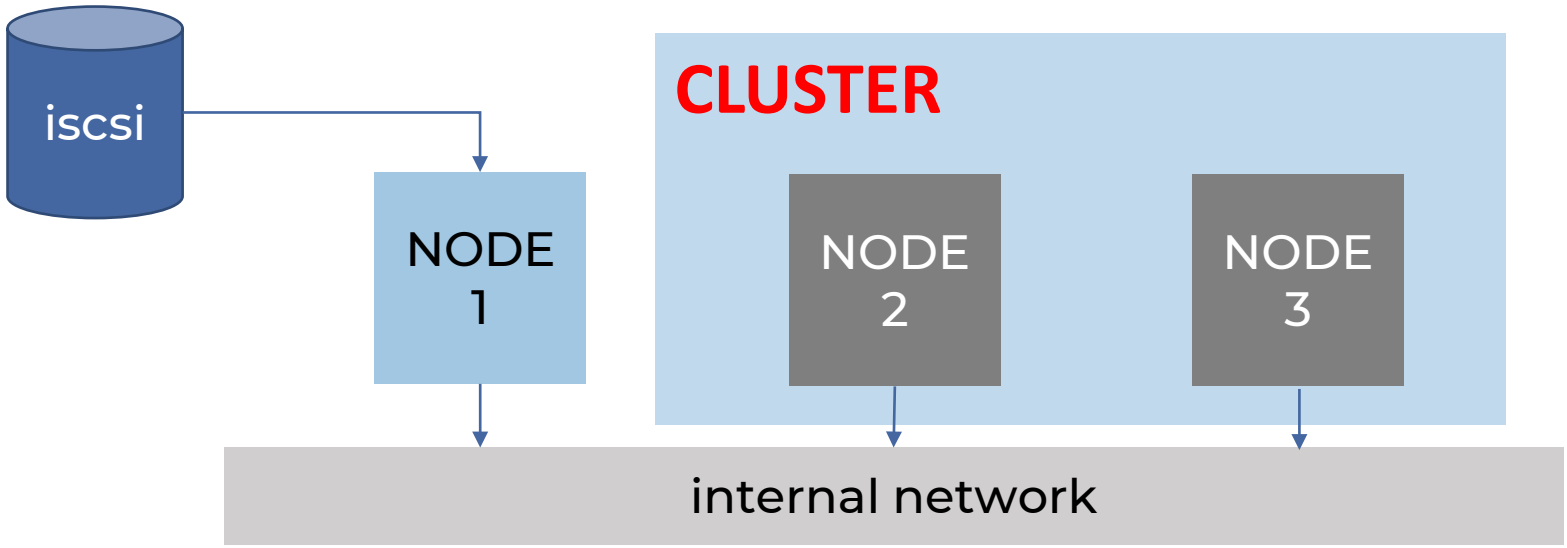
```
# pcs -f stonith_cfg stonith
# pcs -f stonith_cfg property set stonith-enabled=true
# pcs -f stonith_cfg property
# pcs cluster stop node2
# stonith_admin --reboot node2
```

ISCSI

- CONFIG TO TARGETD SERVER
- FILEIO BLOCKS SETUP

ISCSI

LAB DESIGN



STORAGE(TARGET SERVER, node3)

```
node1# dnf install targetd
node1# systemctl enable --now target
node1# firewall-cmd --add-service=iscsi-target

node1# dnf install iscsi-initiator-utils -y

node1# mkdir -p /var/lib/iscsi_disks

node1# targetcli backstores/fileio create iscsi
/var/lib/iscsi_disks/iscsi_disk.img 2G
node1# targetcli backstores/fileio create nfs /var/lib/iscsi_disks/nfs_disk.img
2G
node1# targetcli backstores/fileio create gfs2
/var/lib/iscsi_disks/gfs2_disk.img 2G
```

STORAGE(TARGET SERVER, node3)

```
node1# targetcli iscsi/ create iqn.2023-02.com.example:blocks

node1# targetcli iscsi/iqn.2023-02.com.example:blocks/tpg1/luns/ create
/backstores/fileio/iscsi/
node1# targetcli iscsi/iqn.2023-02.com.example:blocks/tpg1/luns/ create
/backstores/fileio/nfs/
node1# targetcli iscsi/iqn.2023-02.com.example:blocks/tpg1/luns/ create
/backstores/fileio/gfs2/

node1# targetcli iscsi/iqn.2023-02.com.example:blocks/tpg1/acls/ create iqn.2023-
02.com.example.com:node1.init
node1# targetcli iscsi/iqn.2023-02.com.example:blocks/tpg1/acls/ create iqn.2023-
02.com.example.com:node2.init
```

STORAGE(TARGET SERVER, node3)

```
node1# targetcli iscsi/iqn.2023-
02.com.example:blocks/tpg1/acls/iqn.2023-02.com.example.com:node1.init
set auth userid=username
node1# targetcli iscsi/iqn.2023-
02.com.example:blocks/tpg1/acls/iqn.2023-02.com.example.com:node1.init
set auth password=username

node1# targetcli iscsi/iqn.2023-
02.com.example:blocks/tpg1/acls/iqn.2023-02.com.example.com:node2.init
set auth userid=username
node1# targetcli iscsi/iqn.2023-
02.com.example:blocks/tpg1/acls/iqn.2023-02.com.example.com:node2.init
set auth password=password
```

ISCSI

STORAGE(TARGET SERVER, node3)

```
# iscsadm -m discoverydb -t sendtargets -p 192.168.100.130
# iscsadm -m node --login
# iscsadm -m session --debug 3
# iscsadm -m session --rescan
```

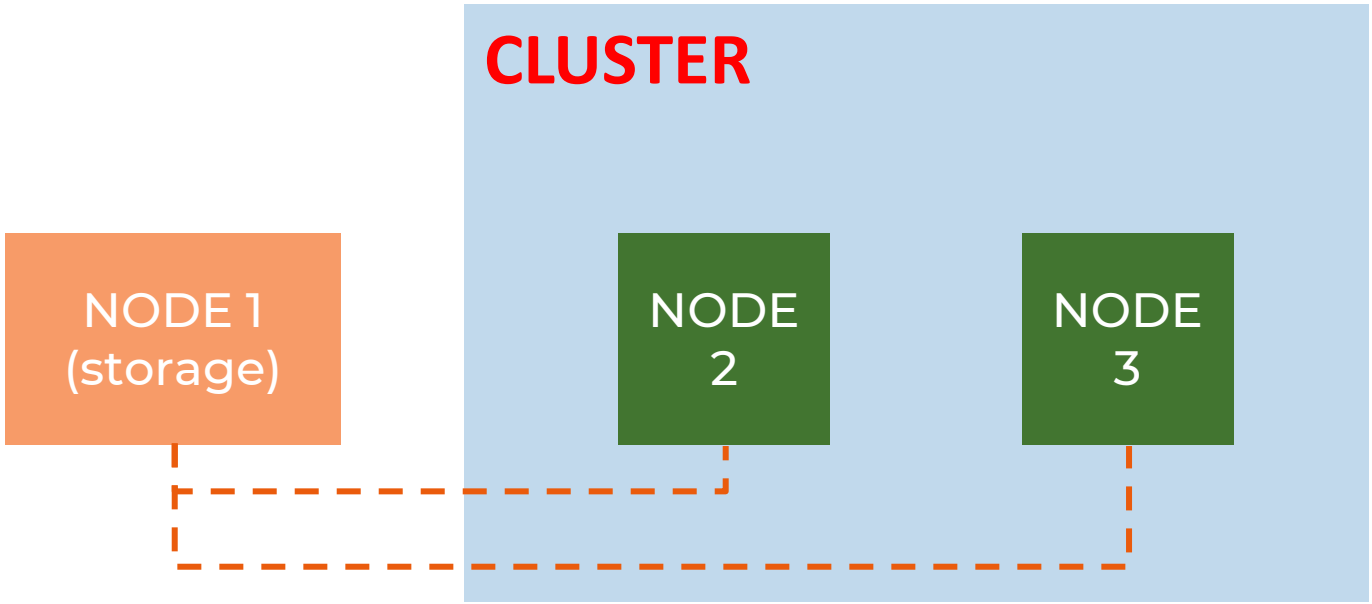
DO SELF LAB

ROLL BACK VIRTUAL MACHINE AND REINSTALL TO THE PACEMAKER CLUSTER

PACEMAKER CLUSTER

- CLUSTER CREATE
- CLUSTER VERIFY

CLUSTER



CLUSTER

```
node2/3# dnf --enablerepo=ha -y install pacemaker pcs
node2/3# systemctl enable --now pcsd
node2/3# echo centos | passwd --stdin hacluster

node2/3# firewall-cmd --add-service=high-availability --permanent
node2/3# firewall-cmd --reload

node2# pcs host auth -u hacluster -p centos node1.example.com node2.example.com
node2# pcs cluster setup ha_cluster_lab node1.example.com node2.example.com
node2# pcs cluster start --all
node2# pcs cluster enable --all
node2# pcs cluster status
node2# pcs status corosync
```

CLUSTER

```
node2# dnf --enablerepo=ha -y install fence-agents-scsi
node2# ls /dev/disk/by-id

node2# pcs stonith create scsi-shooter fence_scsi pcmk_host_list="node1.example.com node2.
example.com" devices=/dev/disk/by-id/wwn-<ID> meta provides=unfencing
node2# pcs stonith config scsi-shooter
node2# pcs status

node3# pcs status
node3# pcs stonith fence node2.example.com
node3# pcs status

node2# reboot
```

PACEMAKER

DO SELF LAB

ROLL BACK VIRTUAL MACHINE AND REINSTALL TO THE PACEMAKER CLUSTER

KOICA Korea International Cooperation Agency

KISCA Korea Information Systems Consulting & Audit Co., Ltd.

LVM

- CLUSTER LVM2

LVM

```
node2/3# vi /etc/lvm/lvm.conf
system_id_source = "uname"

node2# parted --script /dev/sda "mklabel msdos"
node2# parted --script /dev/sda "mkpart primary 0% 100%"
node2# parted --script /dev/sda "set 1 lvm on"

node2# pvcreate /dev/sda1
node2# vgcreate vg_ha_iscsi /dev/sda1
node2# vgs -o+systemid
node2# lvcreate -l 100%FREE -n lv_ha_iscsi vg_ha_iscsi
```

LVM

```
node2# mkfs.xfs /dev/vg_ha_iscsi/lv_ha_iscsi
node2# vgchange vg_ha _iscsi -an

node2# lvm pvscan --cache --activate ay
node2# pcs resource create lvm_ha_iscsi ocf:hearbeat:LVM-ac
tivate vg_name=vg_ha_iscsi vg_access_mode=system_id --group
ha_iscsi_group

node2# pcs status
```

PACEMAKER

DO SELF LAB

ROLL BACK VIRTUAL MACHINE AND REINSTALL TO THE PACEMAKER CLUSTER

NFS

- Title Name Title Name Title Name
- Title Name Title Name Title Name

NFS

```
node2/3# firewall-cmd --add-service=nfs --permanent
node2/3# firewall-cmd --add-service={nfs3,mountd,rpc-bind} --permanent
node2/3# firewall-cmd --reload

node2/3# mkdir -p /home/nfs-share
node2# pcs resource create nfs_share_iscsi ocf:heartbeat:Filesystem device=/dev/vg_ha_iscs
i/lv_ha_iscsi directory=/home/nfs-share fstype=xfs --group ha_iscsi_group

node2# pcs status
node2# mount | grep /home/nfs-share

node2# pcs resource create nfs_daemon ocf:heartbeat:nfsserver nfs_shared_infodir=/home/nfs
-share/nfsinfo nfs_no_notify=true --group ha_iscsi_group

node2# pcs resource create nfs_vip ocf:heartbeat:IPaddr2 ip=192.168.100.250 nic=eth1 cidr_
netmask=24 --group ha_iscsi_group
```

NFS

```
node2# pcs resource create nfs_notify ocf:heartbeat:nfsnotify source_host=192.168.100.250
--group ha_iscsi_group

node2# mkdir -p /home/nfs-share/nfs-root/share01
node2# pcs resource create nfs_root ocf:heartbeat:exportfs clientspec=192.168.100.0/255.25
5.255.0 options=rw,sync,no_root_squash directory=/home/nfs-share/nfs-root fsid=0 --group h
a_iscsi_group
node1 # pcs resource create nfs_share01 ocf:heartbeat:exportfs clientspec=192.168.100.0/25
5.255.255.0 options=rw,sync,no_root_squash directory=/home/nfs-share/nfs-root/share01 fsid
=1 --group ha_iscsi_group

node2 # pcs status
node2 # showmount -e

node2/3 # mkdir -p /mnt/test_nfs
node2/3 # mount 192.168.100.250:/home/nfs-share/nfs-root/share01 /mnt
```

WWW

- APACHE
- TOMCAT

WWW

```
node1 # dnf install httpd -y
node1 # vi /etc/httpd/conf.d/server-status.conf
<Location /server-status>
    SetHandler server-status
    Require local
</Location>

node1 # vi /etc/logrotate.d/httpd
node1 # firewall-cmd --add-service={http,https} --permanent && firewall-cmd --runtime-to-p
ermanent
node1 # mkdir -p /mnt/html
node1 # mount /dev/vg_ha_iscsi/lv_ha_iscsi /mnt/html
node1 # echo "Hello World" > /mnt/html/index.html && umount /mnt/html/

node1 # pcs resource create httpd_fs ocf:heartbeat:Filesystem device=/dev/vg_ha_iscsi/lv_h
a_iscsi directory=/var/www fstype=xfs --group ha_group_iscsi
```

APACHE

WWW

```
node1 # pcs resource create httpd_vip ocf:heartbeat:IPaddr2 ip=192.168.1
00.240 cidr_netmask=24 --group ha_group_iscsi

node1 # pcs resource create website ocf:heartbeat:apache configfile=/etc
/httpd/conf/httpd.conf statusurl=http://127.0.0.1/server-status --group
ha_group

node1 # pcs status

node2 # restorecon -RFvvv /var/www/
node2 # curl http://192.168.100.240/index.html
```

MIDDLEWARE

A

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GFS2

- Title Name Title Name Title Name
- Title Name Title Name Title Name

COMMAND

```
node2# dnf --enablerepo=ha -y install lvm2-lockd gfs2-utils
dlm
node2/3# vi /etc/lvm/lvm.conf
use_lvmlockd = 1
node2/3# systemctl enable --now dlm lvmlockd lvmlocks
node2# pcs property set no-quorum-policy=freeze
node2# pcs resource create dlm ocf:pacemaker:controld op mo
nitor interval=30s on-fail=fence --group locking
```

COMMAND

```
node2# pcs resource clone locking interleave=true
node2# pcs resource create lvmlockdd ocf:heartbeat:lvmlockd
op monitor interval=30s on-fail=fence --group locking
node2# pcs status
```

GFS

COMMAND

```
node2# parted --script /dev/sdb "mklabel gpt"
node2# parted --script /dev/sdb "mkpart primary 0% 100%"
node2# parted --script /dev/sdb "set 1 lvm on"

node2# pvcreate /dev/sdb1
node2# vgcreate --shared vg_gfs2 /dev/sdb1

node2# vgs
node2# vgchance --lock-start vg_gfs2
node2# lvcreate -l 100%FREE -n lv_gfs2 vg_gfs2
```

GFS

COMMAND

```
node2# mkfs.gfs2 -j2 -p lock_dlm -t ha_cluster_lab:gfs2 /dev/vg_gfs2/lv_
gfs2
node2# pcs resource create shared_lv ocf:heartbeat:LVM-activate lvname=l
v_gfs2 vgname=vg_gfs2 activation_mode=shared vg_access_mode=lvmlockd --g
roup shared_vg
node2# pcs resource clone shared_vg interleave=true
node2# pcs constraint order start locking-clone then shared_vg-clone
```

GFS

```
node2# pcs constraint colocation add shared_vg-clone with locking-clone
node2# pcs resource create shared_fs ocf:heartbeat:Filesystem device="/d
ev/vg_gfs2/lv_gfs2" directory="/home/gfs2-share" fstype="gfs2" options=n
oatime op monitor interval=10s on-fail=fence --group shared_vg
node2# pcs status
node2# mount | grep gfs2-share
node3# mount | grep gfs2-share
```