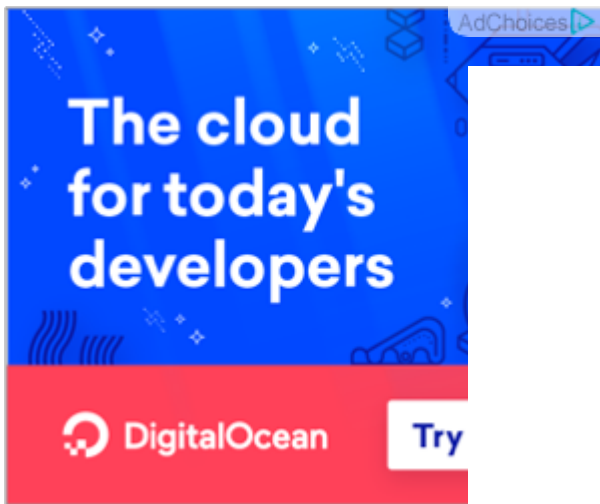# GEEKPEEK.net

# Linux Cluster Part 2 – Adding and Deleting Cluster Resources

October 10, 2013, 15:49        19 Comments



This is the second part of my "Linux Cluster" posts:

**Linux Cluster Part 1 – Install Corosync and Pacemaker on CentOS 6** – Learn how to install Corosync and Pacemaker on CentOS 6

**Linux Cluster Part 2 – Adding and Deleting Cluster Resources** – Learn how to add and delete Linux Cluster Resources and how to use CRM Shell

**Linux Cluster Part 3 – Manage Cluster Nodes and Resources** – Learn how to manage Linux Cluster Nodes (maintenance mode, standby mode, …) and Linux Cluster Resources (resource constraints – order, colocation, …)
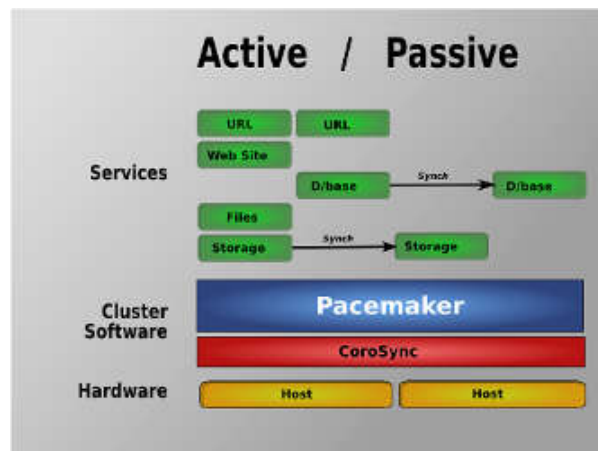


Linux Cluster Resources

## 1. CRM Shell

CRM Shell is a command line interface to configure and manage Pacemaker. The CRM Shell should be

installed on all your nodes, you can install it from HA-Clustering Repository. Add the following lines to "*/etc/yum.repos.d/ha-clustering.repo*" file:

```
[haclustering]
name=HA Clustering
baseurl=http://download.opensuse.org/repositories/network:/ha-
clustering:/Stable/CentOS_CentOS-6/
enabled=1
gpgcheck=0
```

Once installed we can run "*crm*" command from linux command line and manage our Pacemaker instance. Below is an example of running "*crm help*" command. If you want help on additional "*crm*" commands run for example "*crm cib help* ":

```
[root@foo1 ~]# crm help

This is crm shell, a Pacemaker command line interface.

Available commands:

    cib              manage shadow CIBs
    resource         resources management
    configure        CRM cluster configuration
    node             nodes management
    options          user preferences
    history          CRM cluster history
    site             Geo-cluster support
    ra               resource agents information center
    status           show cluster status
    help,?           show help (help topics for list of topics)
    end,cd,up        go back one level
```

```
     quit,bye,exit      exit the program
```

- View Linux Cluster Status

```
[root@foo1 ~]# crm status
Last updated: Mon Oct  7 13:41:11 2013
Last change: Mon Oct  7 13:41:08 2013 via crm_attribute on
foo1.geekpeek.net
Stack: classic openais (with plugin)
Current DC: foo1.geekpeek.net - partition with quorum
Version: 1.1.9-2.6-2db99f1
2 Nodes configured, 2 expected votes
0 Resources configured.


Online: [ foo1.geekpeek.net foo2.geekpeek.net ]
```

- View Linux Cluster Configuration

```
[root@foo1 ~]# crm configure show
node foo1.geekpeek.net
node foo2.geekpeek.net
property $id="cib-bootstrap-options"
    dc-version="1.1.9-2.6-2db99f1"
    cluster-infrastructure="classic openais (with plugin)"
    expected-quorum-votes="2"
```

# 2. Adding Cluster Resources

Every cluster resource is defined by a Resource Agent. Resource Agents must provide Linux Cluster with a complete resource status and availability at any time! The most important and most used Resource Agent

classes are:

- **LSB (Linux Standard Base)** – These are common cluster resource agents found in /etc/init.d directory (init scripts).
- **OCF (Open Cluster Framework)** – These are actually extended LSB cluster resource agents and usually support additional parameters

From this we can presume it is always better to use OCF (if available) over LSB Resource Agents since OCF support additional configuration parameters and are optimized for Cluster Resources.

We can **check for available Resource Agents** by running the "crm ra list" and the desired resource agent:

```
[root@foo1 ~]# crm ra list lsb
auditd          blk-availability  corosync       corosync-notifyd
crond           halt              ip6tables      iptables
iscsi           iscsid
killall         logd              lvm2-lvmetad   lvm2-monitor
mdmonitor       multipathd        netconsole     netfs
network         nfs
nfslock         pacemaker         postfix        quota_nld
rdisc           restorecond       rpcbind        rpcgssd
rpcidmapd       rpcsvcgssd
rsyslog         sandbox           saslauthd      single
sshd            udev-post         winbind

[root@foo1 ~]# crm ra list ocf
ASEHAagent.sh      AoEtarget        AudibleAlarm
CTDB               ClusterMon       Delay
Dummy              EvmsSCC          Evmsd
Filesystem         HealthCPU        HealthSMART
ICP                IPaddr           IPaddr2
IPsrcaddr          IPv6addr         LVM
LinuxSCSI          MailTo           ManageRAID
```

```
ManageVE            NodeUtilization     Pure-FTPd
Raid1               Route               SAPDatabase
SAPInstance         SendArp             ServeRAID
SphinxSearchDaemon  Squid               Stateful
SysInfo             SystemHealth        VIPArip
VirtualDomain       WAS                 WAS6
WinPopup            Xen                 Xinetd
anything            apache              apache.sh
asterisk            clusterfs.sh        conntrackd
controld            db2                 dhcpd
drbd                drbd.sh             eDir88
ethmonitor          exportfs            fio
fs.sh               iSCSILogicalUnit    iSCSITarget
ids                 ip.sh               iscsi
jboss               ldirectord          lvm.sh
lvm_by_lv.sh        lvm_by_vg.sh        lxc
mysql               mysql-proxy         mysql.sh
named               named.sh            netfs.sh
nfsclient.sh        nfsexport.sh        nfsserver
nfsserver.sh        nginx               o2cb
ocf-shellfuncs      openldap.sh         oracle
oracledb.sh         orainstance.sh      oralistener.sh
oralsnr             pgsql               ping
pingd               portblock           postfix         postgres-
8.sh        pound               proftpd             remote
rsyncd              rsyslog
samba.sh            script.sh           scsi2reservation
service.sh          sfex                slapd
smb.sh              svclib_nfslock      symlink
syslog-ng           tomcat              tomcat-5.sh     tomcat-
6.sh        varnish             vm.sh               vmware
zabbixserver
```

We **configure cluster resources** with "*crm configure primitive*" command following by a *Resource Name, Resource Agent* and *Additional Parameters* (example):

```
crm configure primitive resourcename resourceagent parameters
```

We can see **HELP and additional Resource Agent parameters** by running "*crm ra meta*" command following by a *resource name* (example):

```
[root@foo1 ~]# crm ra meta IPaddr2
```

**Before we start adding Resources to our Cluster we need to disable STONITH (Shoot The Other Node In The Head)** – since we are not using it in our configuration:

```
[root@foo1 ~]# crm configure property stonith-enabled=false
```

We can **check the Linux Cluster configuration** by running "*crm configure show*" command:

```
[root@foo1 ~]# crm configure show
node foo1.geekpeek.net
node foo2.geekpeek.net
property $id="cib-bootstrap-options"
    dc-version="1.1.9-2.6-2db99f1"
    cluster-infrastructure="classic openais (with plugin)"
    expected-quorum-votes="2"
    stonith-enabled="false"
```

..to confirm STONITH was disabled!

○ Adding IP Address Resource

Let's add **IP address** resource to our Linux Cluster. The information we need to configure IP address is:

**Cluster Resource Name:** ClusterIP

**Resource Agent:** ocf:heartbeat:IPaddr2 (get this info with "crm ra meta IPaddr2")

**IP address:** 192.168.1.150

**Netmask:** 24

**Monitor interval:** 30 seconds (get this info with "crm ra meta IPaddr2")

**Run the following command** on a Linux Cluster node to configure ClusterIP resource:

```
[root@foo1 ~]# crm configure primitive ClusterIP ocf:heartbeat:IPaddr2
params ip=192.168.1.150 cidr_netmask="24" op monitor interval="30s"
```

**Check Cluster Configuration** with:

```
[root@foo1 ~]# crm configure show
node foo1.geekpeek.net
node foo2.geekpeek.net
primitive ClusterIP ocf:heartbeat:IPaddr2
    params ip="192.168.61.150" cidr_netmask="24"
    op monitor interval="30s"
property $id="cib-bootstrap-options"
    dc-version="1.1.9-2.6-2db99f1"
    cluster-infrastructure="classic openais (with plugin)"
    expected-quorum-votes="2"
    stonith-enabled="false"
    last-lrm-refresh="1381240623"
```

**Check Cluster Status** with:

```
[root@foo1 ~]# crm status
```

```
Last updated: Tue Oct  8 15:59:19 2013

Last change: Tue Oct  8 15:58:11 2013 via cibadmin on foo1.geekpeek.net

Stack: classic openais (with plugin)

Current DC: foo1.geekpeek.net - partition with quorum

Version: 1.1.9-2.6-2db99f1

2 Nodes configured, 2 expected votes

1 Resources configured.


Online: [ foo1.geekpeek.net foo2.geekpeek.net ]


 ClusterIP    (ocf::heartbeat:IPaddr2):    Started foo1.geekpeek.net
```

As we can see a new resource called **ClusterIP is configured in the Cluster and started on foo1.geekpeek.net node**.

- Adding Apache (httpd) Resource

Next resource is an **Apache Web Server.** Prior to Apache Cluster Resource Configuration, **httpd package must be installed** and configured on **both nodes!** The information we need to configure Apache Web Server is:

**Cluster Resource Name:** Apache

**Resource Agent:** ocf:heartbeat:apache (get this info with "crm ra meta apache")

**Configuration file location:** /etc/httpd/conf/httpd.conf

**Monitor interval:** 30 seconds (get this info with "crm ra meta apache")

**Start timeout:** 40 seconds (get this info with "crm ra meta apache")

**Stop timeout:** 60 seconds (get this info with "crm ra meta apache")


**Run the following command** on a Linux Cluster node to configure Apache resource:


```
[root@foo1 ~]# crm configure primitive Apache ocf:heartbeat:apache
```

```
params configfile=/etc/httpd/conf/httpd.conf op monitor interval="30s"
op start timeout="40s" op stop timeout="60s"
```

**Check Cluster Configuration** with:

```
[root@foo1 ~]# crm configure show
node foo1.geekpeek.net
node foo2.geekpeek.net
primitive Apache ocf:heartbeat:apache
    params configfile="/etc/httpd/conf/httpd.conf"
    op monitor interval="30s"
    op start timeout="40s" interval="0"
    op stop timeout="60s" interval="0"
    meta target-role="Started"
primitive ClusterIP ocf:heartbeat:IPaddr2
    params ip="192.168.61.150" cidr_netmask="24"
    op monitor interval="30s"
property $id="cib-bootstrap-options"
    dc-version="1.1.9-2.6-2db99f1"
    cluster-infrastructure="classic openais (with plugin)"
    expected-quorum-votes="2"
    stonith-enabled="false"
    last-lrm-refresh="1381240623"
```

**Check Cluster Status** with:

```
[root@foo1 ~]# crm status
Last updated: Thu Oct 10 11:13:59 2013
Last change: Thu Oct 10 11:07:38 2013 via cibadmin on foo1.geekpeek.net
Stack: classic openais (with plugin)
Current DC: foo1.geekpeek.net - partition with quorum
Version: 1.1.9-2.6-2db99f1
2 Nodes configured, 2 expected votes
2 Resources configured
```

```
2 Resources configured:


Online: [ foo1.geekpeek.net foo2.geekpeek.net ]


 ClusterIP    (ocf::heartbeat:IPaddr2):    Started foo1.geekpeek.net
 Apache     (ocf::heartbeat:apache):    Started foo2.geekpeek.net
```

As we can see **both Cluster Resources (Apache and ClusterIP) are configured and started** – ClusterIP is started on foo1.geekpeek.net Cluster node and Apache is started on foo2.geekpeek.net node.

Apache and ClusterIP are at the moment running on different Cluster nodes but we will fix this later,  setting Resource Constraints like: colocation (colocating resources), order (order in which resources start and stop), …

**Resource Constraints will be explained in detail in the next "Linux Cluster Part 3" post!**

# 3. Deleting Cluster Resources

We can **delete** the configured Cluster Resources with "*crm configure delete*" command following by a *Resource Name* we want to delete (example:)

```
crm configure delete resourcename
```

**We must always stop the Cluster Resource prior to deleting it!!**

We can stop the Resource by running "*crm resource stop*" command following by a *Resource Name* we want to stop.

**Cluster Resource and Cluster Node management will be explained in detail in the next "Linux Cluster Part 3" post!**

We can **check the Linux Cluster configuration** by running "*crm configure show*" command and see, if the Cluster Resource was successfully removed from Cluster Configuration.

- Deleting Apache (httpd) Resource

Let's **stop and delete** our **Apache** Cluster Resource configured in the steps above:

```
[root@foo1 ~]# crm resource stop Apache
[root@foo1 ~]# crm configure delete Apache
```

**Check Cluster Configuration** with:

```
[root@foo1 ~]# crm configure show
node foo1.geekpeek.net
node foo2.geekpeek.net
primitive ClusterIP ocf:heartbeat:IPaddr2
    params ip="192.168.61.150" cidr_netmask="24"
    op monitor interval="30s"
property $id="cib-bootstrap-options"
    dc-version="1.1.9-2.6-2db99f1"
    cluster-infrastructure="classic openais (with plugin)"
    expected-quorum-votes="2"
    stonith-enabled="false"
    last-lrm-refresh="1381240623"
```

… to confirm **Apache** resource was **deleted** from Cluster Configuration.

- Deleting IP Address Resource

Next let's **stop and delete ClusterIP** Resource:

```
[root@foo1 ~]# crm resource stop ClusterIP
[root@foo1 ~]# crm configure delete ClusterIP
```

**Check Cluster Configuration** with:

```
[root@foo1 ~]# crm configure show
node foo1.geekpeek.net
node foo2.geekpeek.net
property $id="cib-bootstrap-options"
    dc-version="1.1.9-2.6-2db99f1"
    cluster-infrastructure="classic openais (with plugin)"
    expected-quorum-votes="2"
    stonith-enabled="false"
    last-lrm-refresh="1381240623"
```

… to confirm the **ClusterIP** Resource was **deleted** from our Cluster Configuration.

Be sure to read the nex post **Linux Cluster Part 3 – Manage Cluster Nodes and Resources (COMMING SOON!)**.

Here's my latest book about High Availability on CentOS Linux
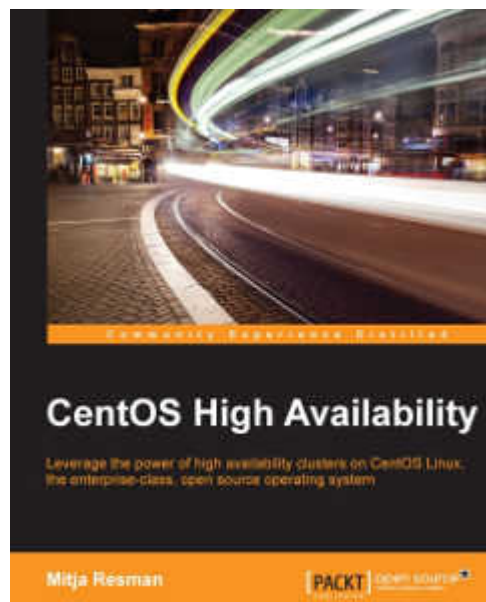
Tagged with:     centos6     cluster     corosync     pacemaker

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**Goi** • 5 years ago
Hi Mitch,

I'm following your 3 part tutorial on
setting up a HA system with 2 nodes, both running CentOS 6.5, and
connected via ethernet to a router.

I successfully
installed corosync, pacemaker, crmsh, cman and httpd. Both machines are
able to ping each other via hostname and IP address.

However, when I get to steps 6/7 of Part 1, I encountered a problem.

"service corosync start" was successful.

"service pacemaker start" shows the following error message:
Starting cman... Corosync Cluster Engine is already running
[FAILED]

If I stop corosync and start pacemaker, it completes successfully, and this is what I did.

I then moved on to Part 2 of your guide, all the way up to adding of Apache as a resource. No
errors there.

Here's my "crm configure show" output:
node node01
node node02
primitive Apache apache \
params configfile="/etc/httpd/conf/httpd.conf" \
op monitor interval=30s \
op start timeout=40s interval=0 \
op stop timeout=60s interval=0
primitive ClusterIP IPaddr2 \
params ip=192.168.1.110 cidr_netmask=24 \
op monitor interval=30s

property cib-bootstrap-options: \
dc-version=1.1.10-14.el6_5.3-368c726 \
cluster-infrastructure=cman \
stonith-enabled=false \
no-quorum-policy=ignore
rsc_defaults rsc_defaults-options: \
migration-threshold=1

And here's the error message with "crm status"
Last updated: Wed Oct 15 17:38:16 2014
Last change: Wed Oct 15 17:00:44 2014 via cibadmin on node02
Stack: cman
Current DC: node02 - partition WITHOUT quorum
Version: 1.1.10-14.el6_5.3-368c726
2 Nodes configured
2 Resources configured

Online: [ node02 ]
OFFLINE: [ node01 ]

ClusterIP (ocf::heartbeat:IPaddr2): Started node02

Failed actions:

Apache_start_0 on node02 'unknown error' (1): call=44, status=complete,
last-rc-change='Wed Oct 15 17:00:45 2014', queued=2185ms, exec=0ms

Seems
like Apache isn't able to start properly. Do you know what might be
wrong? I did not configure Apache at all. I simply installed it and left
it as that.

Any help would be appreciated, thanks!
∧ | ∨ • Reply • Share ›

**Muhammad Asim** • 5 years ago
Hi MITCh

Thanks for your above very good document i have one question

primitive Apache ocf:heartbeat:apache

in above line what is meaning of heartbeat

and its necessary the resource name always like below example (p_fs_mysql) or it is just a name
primitive p_fs_mysql ocf:heartbeat:Filesystem params
device="/dev/drbd0" directory="/var/lib/mysql_drbd" fstype="ext4"
∧ | ∨ • Reply • Share ›

**Mitch** ⇌ Muhammad Asim • 5 years ago

Mitch ↱ Muhammad Asim · 5 years ago

Hi Muhammad! To answer your questions "heartbeat" is a resource agent. Read more here http://www.linux-ha.org/wik... and p_fs_mysql is just a name you give a resource. Regards, Mitch

∧ | ∨ · Reply · Share ›

**phyo** · 6 years ago

I faced a problem. After adding Apache and when I check the status with crm status, it show me this error:

[root@centos01 ~]# crm status
Last updated: Tue Nov 26 17:43:49 2013
Last change: Tue Nov 26 17:43:15 2013 via cibadmin on centos01.nagios.local
Stack: classic openais (with plugin)
Current DC: centos01.nagios.local - partition with quorum
Version: 1.1.10-1.el6_4.4-368c726
2 Nodes configured, 2 expected votes
2 Resources configured

Online: [ centos01.nagios.local centos02.nagios.local ]

ClusterIP (ocf::heartbeat:IPaddr2): Started centos01.nagios.local

Failed actions:
Apache_start_0 on centos01.nagios.local 'unknown error' (1): call=54, status=complete, last-rc-change='Tue Nov 26 17:43:20 2013', queued=2447ms, exec=0ms
Apache_start_0 on centos02.nagios.local 'unknown error' (1): call=48, status=complete, last-rc-change='Tue Nov 26 17:43:17 2013', queued=2427ms, exec=1ms
[root@centos01 ~]#
HTTPD service on both servers is running.
Thanks.

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**Mitch** ↱ phyo · 6 years ago

Please send me output of "crm configure show" on info@geekpeek.net and i will help you solve your problem.

Regards,
Mitch

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**ALI** · 6 years ago

please help me i am getting the following error configuring Apache:

[root@node03 ~]# crm status
Last updated: Mon Nov 25 17:32:56 2013
Last change: Mon Nov 25 16:07:44 2013 via cibadmin on node03.cluster.com
Stack: classic openais (with plugin)
Current DC: node03.cluster.com - partition with quorum

Version: 1.1.10-1.el6_4.4-368c726
2 Nodes configured, 2 expected votes
2 Resources configured

Online: [ node03.cluster.com node04.cluster.com ]

ClusterIP (ocf::heartbeat:IPaddr2): Started node03.cluster.com

Failed actions:
Apache_start_0 on node03.cluster.com 'unknown error' (1): call=22, status=complete, last-rc-
change='Mon Nov 25 17:31:06 2013', queued=2590ms, exec=0ms
Apache_start_0 on node04.cluster.com 'unknown error' (1): call=13, status=complete, last-rc-
change='Mon Nov 25 17:31:00 2013', queued=4094ms, exec=0ms

˄  │  ˅  •  Reply  •  Share ›

**Mitch** ➜ ALI • 6 years ago
Hello Ali! You sem to have some problem with Apache start as you can see in the Failed
actions info. I would suggest you try to start Apache manually on each node and see if it
starts. If it doesnt, check Apache log for errors. What does your Apache cluster
configuration look like? ..and Apache configuration? Did you bind it to your Cluster IP? Do
you see errors in Apache log?

Regards,
Mitch

˄  │  ˅  •  Reply  •  Share ›

**Ali** ➜ Mitch • 6 years ago
Dear Mitch,
thank you very much for the reply, as advised above i have manually started httpd on
both the nodes but i am still getting the same error. i am using Centos version 6.4 the
Apache configuration is default i didnt change any thing and i have copy paste the
command for the Apache resource and after initiating crm status command i am
getting the following error again:

crm status
Last updated: Tue Nov 26 15:21:47 2013
Last change: Tue Nov 26 15:10:28 2013 via cibadmin on node04.cluster.com
Stack: classic openais (with plugin)
Current DC: node04.cluster.com - partition with quorum
Version: 1.1.10-1.el6_4.4-368c726
2 Nodes configured, 2 expected votes
2 Resources configured

Online: [ node03.cluster.com node04.cluster.com ]

ClusterIP (ocf::heartbeat:IPaddr2): Started node03.cluster.com

Failed actions:
Apache_start_0 on node03.cluster.com 'unknown error' (1): call=22

Apache_start_0 on node03.cluster.com 'unknown error' (1): call=22,
status=complete, last-rc-change='Tue Nov 26 15:10:35 2013', queued=2571ms,
exec=0ms
Apache_start_0 on node04.cluster.com 'unknown error' (1): call=16,
status=complete, last-rc-change='Tue Nov 26 15:10:32 2013', queued=2505ms,
exec=0ms

please also note that i am able to display Apache test page through the both node IP
and the floating IP.

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**Mitch** ➜ Ali • 6 years ago

I would also ask you to send me the output of "crm configure show" on
info@geekpeek.net and i will help you solve your problem.

Regards,
Mitch

∧ | ∨ • Reply • Share ›

**David** • 6 years ago

Great document ! I'm not sure to understand why it's necessary to disable stonith and also why yuo
don't enable it after ?

Sorry for this stupid question ...

∧ | ∨ • Reply • Share ›

**Mitch** ➜ David • 6 years ago

Hello David! You are welcome to ask anything and i will try to give you answers :)
STONITH is Shoot The Other Node In The Head - this means you have to set up some kind
of solution to kill "the other node". We can implement STONITH with solutions like UPS,
PDU, Lights-out,... If using virtualization we can even write scripts to kill the virtual
machine... Since we did not implement no such solutions we can not use it, there fore we
disabled STONITH. You can read more here http://clusterlabs.org/doc/... and here
http://www.linux-ha.org/wik....

I hope this answered your question.

Regards,
Mitch

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**ben** ➜ Mitch • 6 years ago

Hi - great tutorial so far. Just a comment on STONITH:

If you are doing a two node cluster you should definitely have stonith a.k.a. a quorum
disk. This is one strength of pacemaker/openais (default on SLES). Centos/Redhat 6
default cluster also gives you option for quorum disk but configuring it is tedious work
to the point where when I was trying to figure out how to put it together most of the

google responses on Centos/Redhat was to just forget the cluster disk. In the event of failover/split-brain let them do a fence-race (?!!). That is really kludgy. I ended up grinding it out with Centos/Redhat in figuring out how to do quorum disk. In SLES (Pacemaker/openais) it is MUCH easier and in a two-node cluster to avoid split-brain it is a must to have that third vote.

∧  |  ∨  •  Reply  •  Share ›

**ben** ➜ ben • 6 years ago

I had to combine about 8 to 10 resource in my research for sles11 cluster buiding. My final steps are here (including stonith config)

http://geekswing.com/geek/b...

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**ben** ➜ ben • 5 years ago

Hi Mitch - Thanks :) For some reason I cannot reply to your comment below so I'm replying back to mine. I might have misspoke because I only used the cluster software which came integrated with the OS. For SLES that meant pacemaker/openais. For CentOS it's cman/luci/ricci. For SLES/pacemaker/openais it is definitely easy to add the quorum disk. For CentOS/cman/luci/ricci it takes a lot of work. If you'd like I'd be happy to send you the .pdf I wrote up on SLES (and then when I have it finished, CentOS) so you can have a looksie :). Cheers!

∧  |  ∨  •  Reply  •  Share ›

**Mitch** ➜ ben • 6 years ago

Wau Ben! Really appreciate your input on this topic and agree with you completely! For physical servers it would probably be more optimal to use UPS, PDU or Lights out but you can't use that in virtual environments. Since i have not yet tested out SBD it is definitely time to do so in the near future. Thanks for the info and thumbs up for GeekSwing.Com and your research! If i have some problems setting it up i might send you an email :) Regards, Mitch

∧  |  ∨  •  Reply  •  Share ›

**Eran** • 6 years ago

Thanks! Definitely the best Linux HA cookbook Iv'e read!

∧  |  ∨  •  Reply  •  Share ›

**Mitch** ➜ Eran • 6 years ago

That is really nice to hear, thanks Fran!

Regards,
Mitch

∧  |  ∨  •  Reply  •  Share ›

**Pol** • 6 years ago

Cool! Very thanks!
I wait part 3
thanks

Pol

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**Mitch** ➜ Pol • 6 years ago

Thanks for your support Pol! Part 3 comming up soon!

Regards,
Mitch

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### Install PostgreSQL 9.3 on CentOS 6

2 comments • 5 years ago

Avatar **Mitch** — Hi Naveen and thanks for your question! I decided to write all how to's with iptables and selinux disabled. Managing iptables and selinux

### Order OnePlus 2 – No Invites or Wait Time

### Android – How To Unpack Rikomagic Firmware

3 comments • 5 years ago

Avatar **Shiv** — how to start customizing official Rikomagic Firmware so stay tuned? pls post this.

### Extend SNMP – Run bash scripts via SNMP