



This are notes for my LXC workshop, in state of flux

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## Cgroups

- <http://www.kernel.org/doc/Documentation/cgroups/cgroups.txt>
- <http://www.webupd8.org/2010/11/alternative-to-200-lines-kernel-patch.html>
- [http://docs.redhat.com/docs/en-US/Red\\_Hat\\_Enterprise\\_Linux/6/html/Resource\\_Management\\_Guid](http://docs.redhat.com/docs/en-US/Red_Hat_Enterprise_Linux/6/html/Resource_Management_Guid)
- Resource allocation using cgroups <http://blip.tv/file/4773168>

## Systemd

- systemd, beyond init <http://www.youtube.com/watch?v=TyMLi8QF6sw>

launchd alternative, similar to inetd, but for unix sockets (mostly)

# LXC

Virtual Servers and Checkpoint/Restart in Mainstream Linux  
<http://lxc.sourceforge.net/doc/sigops/appcr.pdf>

- you don't have hardware virtualization (netbooks, anyone?)
  - ◆ <http://lxc.teegra.net/>
  - ◆ <http://en.gentoo-wiki.com/wiki/LXC>
  - ◆ <http://sysadvent.blogspot.com/2010/12/day-1-linux-containers-lxc.html>
- Amazon EC2
  - ◆ <http://www.phenona.com/blog/using-lxc-linux-containers-in-amazon-ec2/>
- Running X
  - ◆ [http://blog.ikibiki.org/2011/04/05/Running\\_X\\_from\\_LXC/](http://blog.ikibiki.org/2011/04/05/Running_X_from_LXC/)
- LVM integration
  - ◆ <http://s3hh.wordpress.com/2011/03/30/one-more-lxc-clone-update/>

## LXC inside KVM for testing

- [http://sysadmin-cookbook.rot13.org/#lxc\\_kvm](http://sysadmin-cookbook.rot13.org/#lxc_kvm)

## setup KVM LXC test machine

- <http://www.landley.net/lxc/01-setup.html>

### Step 1: Create a root filesystem for the KVM system.

- [http://sysadmin-cookbook.rot13.org/#01\\_create\\_kvm\\_root\\_sh](http://sysadmin-cookbook.rot13.org/#01_create_kvm_root_sh) 3m12.426s

### Step 2: Build a kernel for KVM, with container support.

- [http://sysadmin-cookbook.rot13.org/#02\\_build\\_kvm\\_kernel\\_sh](http://sysadmin-cookbook.rot13.org/#02_build_kvm_kernel_sh) 8m22.248s

### Step 3: Boot the result under QEMU or KVM

- [http://sysadmin-cookbook.rot13.org/#03\\_boot\\_kvm\\_sh](http://sysadmin-cookbook.rot13.org/#03_boot_kvm_sh)

### Step 4: ssh into the KVM instance.

```
ssh root@127.0.0.1 -p 9876
```

### Step 5: Set up a simple busybox-based container under the KVM system.

```
wget http://busybox.net/downloads/binaries/latest/busybox-i686 -O busybox
chmod +x busybox
echo -e "lxc.utsname = container\nlxc.network.type = empty" > container.conf
PATH=$(pwd):$PATH lxc-create -f container.conf -t busybox -n container
```

## Step 6: Launch the container

```
lxc-start -n container

# console is broken, so start another

lxc-console -n container
```

## Step 7: Stop the container, and the KVM system.

```
lxc-stop -n container

# remove container
lxc-destroy -n container
```

## Setup networking

- <http://www.landley.net/lxc/02-networking.html>

### Step 1: Add a TAP interface to the Laptop.

```
# FIXME change username
tunctl -u dpavlin -t kvm0
ifconfig kvm0 192.168.254.1 netmask 255.255.255.0
echo 1 > /proc/sys/net/ipv4/ip_forward

# iptables -t nat -A POSTROUTING -o eth0 -j MASQUERADE
```

### Step 2: Launch KVM with two ethernet interfaces.

```
kvm -m 1024 -kernel ../01-setup/linux-2.6.*/arch/x86/boot/bzImage -no-reboot \
-hda ../01-setup/squeeze.ext3 -append "root=/dev/hda rw panic=1" \
-net nic,model=e1000 -net user -redir tcp:9876::22 \
-net nic,model=e1000 -net tap,ifname=kvm0,script=no
```

### Step 3: Set up a new container in the KVM system.

```
root@kvm:~# cat > busybox.conf << EOF
lxc.utsname = busybox
lxc.network.type = phys
lxc.network.flags = up
lxc.network.link = eth1
#lxc.network.name = eth0
EOF

PATH=$(pwd):$PATH lxc-create -f busybox.conf -t busybox -n busybox
lxc-start -n busybox
```

```
root@kvm:~# lxc-console -n busybox

ifconfig eth1 192.168.254.2 netmask 255.255.255.0
route add default gw 192.168.254.1
```

## Step 4: Fun with routing.

On host, bring up loopback alias in KVM network:

```
dpavlin@x200:~$ sudo ifconfig lo:1 10.0.2.200 netmask 255.255.255.0
```

busybox container can reach it, while KVM can't !

## network hints

### prepare host machine

#### macvlan

- aliased IP at eth level
- new device with own mac **with** offloading
- can't communicate with other containers or host (< 2.6.33)

```
lxc.network.type=macvlan
lxc.network.link=eth0
lxc.network.flags=up
```

```
ip link add link <phys> name <vif> address <mac address> type macvlan mode
(bridge|vepa|private)
```

```
ip link add link bond200 name bond200:0 address 00:aa:bb:cc:dd:ee type macvlan mode bridge
```

```
ip -d show link bond200:0
```

```
lxc.network.type = macvlan
lxc.network.macvlan.mode = bridge
lxc.network.flags = up
lxc.network.link = bond200
lxc.network.name = eth7
lxc.network.mtu = 1500
lxc.network.ipv4 = 192.168.90.11/24
lxc.network.hwaddr = 4a:49:43:49:79:0B
```

#### veth

```
sudo apt-get install bridge-utils dnsmasq
```

```
# setup hints
```

```
sysctl -w net.ipv4.ip_forward=1
```

```
iptables -t nat -A POSTROUTING -o wlan0 -j SNAT --to-source=WLAN0_IP
```

```
# or for nat
```

```
iptables -t nat -A POSTROUTING -o wlan0 -j MASQUERADE
```

```
lxc.network.type=veth  
lxc.network.link=br0  
lxc.network.flags=up
```

#### 1. name inside container

```
lxc.network.name = eth0.12  
lxc.network.mtu = 1500  
lxc.network.ipv4 = 10.60.0.12/23  
lxc.network.hwaddr = AC:DE:48:00:00:0C
```

#### 1. name host interface for bridge

```
lxc.network.veth.pair = veth12
```

## host-only bridge

```
$ cat /etc/network/interfaces
```

```
auto br0  
iface br0 inet static  
    bridge_ports dummy0  
    bridge_maxwait 0  
    address 172.16.16.1  
    netmask 255.255.255.0
```

## pseudo-random mac?

[http://en.wikipedia.org/wiki/Mac\\_address](http://en.wikipedia.org/wiki/Mac_address)

```
x2:xx:xx:xx:xx:xx  
x6:xx:xx:xx:xx:xx  
xA:xx:xx:xx:xx:xx  
xE:xx:xx:xx:xx:xx
```

```
IP=192.168.0.50 # container nic IP
```

```
HA=printf "02:00:%x:%x:%x:%x" ${IP//./ } # generate a MAC from the IP
```

## slow network?

```
/usr/sbin/ethtool -K br0 sg off  
/usr/sbin/ethtool -K br0 tso off
```

## phys

kernel > 2.6.35

```
lxc.network.type=phys  
lxc.network.link=eth1  
lxc.network.name=eth1
```

## limit container resources

### cpuset.cpus

```
echo 1 > /cgroup/<name>/cpuset.cpus # 2nd CPU!
```

```
echo 1,2,3 > /cgroup/<name>/cpuset.cpus
```

```
echo 0-7 > /cgroup/<name>/cpuset.cpus
```

```
lxc-execute -n foo -s lxc.cgroup.cpuset.cpus="1,2,3" myforks
```

### cpu.shares

```
lxc-execute -n foo -s lxc.cgroup.cpu.shares=1 /bin/bash
```

```
lxc-execute -n bar -s /bin/bash
```

```
while $(true); do echo -n . ; done
```

```
lxc-cgroup -n foo cpu.shares=1024
```

### memory

```
lxc.cgroup.memory.limit_in_bytes = 256M  
lxc.cgroup.memory.memsw.limit_in_bytes = 1G
```

### disk

#### usage

standard Linux tools:

- LVM
- quota (it can be bypassed if the container runs with CAP\_SYS\_ADMIN and/or CAP\_SYS\_RESOURCE capabilities)

#### limit disk bandwidth using cgroup blkio

- <http://www.mjmwired.net/kernel/Documentation/cgroups/blkio-controller.txt>

Required kernel configuration

```
CONFIG_BLK_CGROUP=y
CONFIG_CFQ_GROUP_IOSCHED=y
CONFIG_BLK_DEV_THROTTLING=y
```

## create containers for test

```
#!/bin/sh -xe

lxc-ls | xargs -i sh -c "lxc-stop -n {} ; lxc-destroy -n {}"

echo "lxc.network.type = empty" > blkio.conf

PATH=$(pwd):$PATH lxc-create -f blkio.conf -t busybox -n disk1
PATH=$(pwd):$PATH lxc-create -f blkio.conf -t busybox -n disk2
PATH=$(pwd):$PATH lxc-create -f blkio.conf -t busybox -n disk3

lxc-ls | xargs -i dd if=/dev/zero of=/var/lib/lxc/{}/rootfs/tmp/zero bs=1M count=100

cat > /tmp/speed.sh <<EOF
#!/bin/sh
while true ; do
    sync ; echo 3 > /proc/sys/vm/drop_caches
    dd if=/tmp/zero of=/dev/null 2>&1
done | grep MB
EOF

chmod +x /tmp/speed.sh

lxc-ls | xargs -i cp /tmp/speed.sh /var/lib/lxc/{}/rootfs/tmp/speed.sh

lxc-ls | xargs -i lxc-start -d -n {}
```

## login into each container and run test

```
root@kvm:~# lxc-console -n disk1

Type <Ctrl+a q> to exit the console

disk1 login: root
~ # /tmp/speed.sh
104857600 bytes (100.0MB) copied, 0.958453 seconds, 104.3MB/s
```

## Test limits (be careful not to enter 1000, you might oops kernel!)

```
root@kvm:~# echo 100 > /mnt/cgroup/disk1/blkio.weight
root@kvm:~# echo 200 > /mnt/cgroup/disk2/blkio.weight
root@kvm:~# echo 500 > /mnt/cgroup/disk3/blkio.weight

root@kvm:~# cat /mnt/cgroup/disk?/blkio.weight
100
200
500
```

## Limit /dev/hda to 1Mb/s read

```
root@kvm:~# ls -al /dev/hda
```



```
brw-rw---- 1 root disk 3, 0 May 15 00:10 /dev/hda
```

```
root@kvm:~# echo "3:0 1048576" > /mnt/cgroup/disk1/blkio.throttle.read_bps_device
```

## network

- [http://vger.kernel.org/netconf2009\\_slides/Network%20Control%20Group%20Whitepaper.odt](http://vger.kernel.org/netconf2009_slides/Network%20Control%20Group%20Whitepaper.odt)

```
# mkdir -p /dev/cgroup
# mount -t cgroup net_cls -o net_cls /dev/cgroup
# mkdir /dev/cgroup/A
# mkdir /dev/cgroup/B

# cd /dev/cgroup
# echo 0x1001 > A/net_cls.classid # 10:1
# echo 0x1002 > B/net_cls.classid # 10:2

# tc qdisc add dev eth0 root handle 10: htb

# tc class add dev eth0 parent 10: classid 10:1 htb rate 40mbit
# tc class add dev eth0 parent 10: classid 10:2 htb rate 30mbit

# tc filter add dev eth0 parent 10: protocol ip prio 10 handle 1: cgroup
```

## LXC commands

### lxc-create

```
/usr/lib/lxc/templates/
```

```
export MIRROR=http://192.168.1.20:3142/ftp.debian.org
export SUITE=lenny
```

```
cat > /tmp/lenny.conf
lxc.network.type=veth
lxc.network.link=br0
lxc.network.flags=up
```

1. <ctrl+d>

```
t61p:~# lxc-create -n lenny -t debian -f /tmp/lenny.conf
```

### lxc-execute

application container (shares filesystem!)

```
lxc-ssh
```

```
lxc-execute -n foo -s lxc.utsname=foo /bin/bash
lxc-execute -n bar -s lxc.utsname=bar /bin/bash
```

## lxc-attach

Needs kernel patch

```
lxc-attach n=0 /usr/sbin/tcpdump -i eth0
```

## devices

<http://lwn.net/Articles/273208/>

```
lxc.cgroup.devices.allow = <type> <major>:<minor> <perm>
```

<type> : b (block), c (char), etc ...

<major> : major number

<minor> : minor number (wildcard is accepted)

<perms> : r (read), w (write), m (mapping)

## monitoring

### htop

```
htop - cgroups > r192
```

```
t61p:/tmp# apt-get source htop
```

```
t61p:/tmp# apt-get build-dep htop
```

```
t61p:/tmp# dpkg-source -x htop_0.9-2.dsc
```

```
t61p:/tmp# cd htop-0.9/
```

```
t61p:/tmp/htop-0.9# DEB_BUILD_OPTIONS="--enable-cgroup" fakeroot debian/rules binary
```

1. sigh, no work, patch debian/rules to add --enable-cgroup

```
t61p:/tmp/htop-0.9# fakeroot debian/rules binary
```

```
t61p:/tmp/htop-0.9# dpkg -i ../htop_0.9-2_i386.deb
```

## procf

<http://lxc.sourceforge.net/download/procfs/procfs.tar.gz> (fuse, defunct)

<http://www.tinola.com/lxc/> (somewhat newer)

## debugging

```
lxc-start --logpriority=TRACE -o /tmp/trace.log --name my_container
```

(must have redirect to file!)

## kernel patches

<http://lxc.sourceforge.net/patches/linux/>

# Are we in container?

on host:

```
dpavlin@stage:~$ cat /proc/$$/cgroup
1:net_cls,freezer,devices,cpuacct,cpu,ns,cpuset:/
```

inside container:

```
dpavlin@narada:~$ cat /proc/$$/cgroup
1:net_cls,freezer,devices,cpuacct,cpu,ns,cpuset:/narada
```

## 32-bit guest on 64-bit kernel

(lxc >= 0.7.3)

lxc.arch=x86

## Container tweaks

### udev

echo udev hold | dpkg --set-selections

### nfs

kernel doesn't have nfs namespaces yet, use user-space nfs servers:

- <http://unfs3.sourceforge.net>
- <http://sourceforge.net/apps/trac/nfs-ganesha>

### chromium

- <http://www.chromium.org/chromium-os/chromiumos-design-docs/system-hardening>
- <http://git.chromium.org/gitweb/?p=chromiumos/platform/minijail.git;a=summary>

### pam

- <http://pam-netns.sourceforge.net/>

pam\_netns allows to setup a private network namespace for every user session (comparable with pam\_namespace for filesystem namespaces). This is especially useful on multiseat environments.

### X-server

- <http://box.matto.nl/lxcxserver.html> (Xnest example)
- <https://launchpad.net/arkose> - Arkose - Desktop Application Sandboxing (using aufs2)

## Virtual PCI network cards

- [http://docs.redhat.com/docs/en-US/Red\\_Hat\\_Enterprise\\_Linux/6/html/Virtualization/sect-Para-virtual](http://docs.redhat.com/docs/en-US/Red_Hat_Enterprise_Linux/6/html/Virtualization/sect-Para-virtual)

### don't delete files

`dpkg-divert --rename /etc/init/theinitfile.conf`

`.pre`