

# **Boot + Root + Raid + Lilo : Software Raid mini-HOWTO**

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# Boot + Root + Raid + Lilo : Software Raid mini-HOWTO

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*This document provides a cookbook for setting up root raid using the 0.90 raidtools for bootable raid mounted on root using standard LILO. Also covered is the conversion of a conventional disk to a raid1 or raid5 mirror set without the loss of data on the original disk.*

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## 1. Introduction

### 1.1 Acknowledgements

The essence of the information I've put together here was originally provided by Harald Nordgård-Hansen <[hnh@bukharin.hiof.no](mailto:hnh@bukharin.hiof.no)> and posted to the raid mail list in a lilo.conf file with commentary by Martin Bene <[mb@sime.com](mailto:mb@sime.com)>. Many thanks for your contribution. I've tried to put this information and the helpful work of many others who contribute to the raid mail list and linux raid project into a **COOKBOOK** form, including many examples from real systems so that bootable root raid is easy to set up and understand. One section is devoted to the conversion of a standard single drive system to RAID. The key to the conversion, in my humble opinion, is the understanding of bootable root raid.

### 1.2 Bugs

Yes, I'm sure there are some. If you'd be good enough to report them, I will correct the document. ;-)

### 1.3 Copyright Notice

This document is GNU copyleft by Michael Robinton [Michael@BizSystems.com](mailto:Michael@BizSystems.com).

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## 2. What you need BEFORE YOU START

The packages you need and the documentation that answers the most common questions about setting up and running raid are listed below. Please review them thoroughly.

## 2.1 Required Packages

You need to obtain the most recent versions of these packages.

- a linux kernel that supports raid, initrd

I used [linux-2.2.14](#) from kernel.org

- <ftp://ftp.kernel.org/pub/linux/daemons/raid/alpha/> the most recent tools and patch that adds support for modern raid1/4/5

I used <http://people.redhat.com/mingo/raid-patches/>

## 2.2 Where to get Up-to-date copies of this document.

Click here to browse the [author's latest version](#) of this document. Corrections and suggestions welcome!

Boot Root Raid + LILO HOWTO

Available in LaTeX (for DVI and PostScript), plain text, and HTML.

<http://www.linuxdoc.org/HOWTO/Boot+Root+Raid+LILO.html>

Available in SGML and HTML.

<ftp.bizsystems.net/pub/raid/>

## 2.3 Documentation -- Recommended Reading

If you plan on using raid1/5 over raid0, please read:

`/usr/src/linux/Documentation/initrd.txt`

as well as the documentation and man pages that accompany the raidtools set.

and..... [Software-RAID-HOWTO.html](#)

## 2.4 RAID resources

Mailing lists can be joined at:

- This one seems quiet: [majordomo@nuclecu.unam.mx](mailto:majordomo@nuclecu.unam.mx) *send a message to* **subscribe raiddev**  
send mail to: [raiddev@nuclecu.unam.mx](mailto:raiddev@nuclecu.unam.mx)
- Raid development: [majordomo@vger.rutgers.edu](mailto:majordomo@vger.rutgers.edu) *send a message to* **subscribe linux-raid**  
send mail to: [linux-raid@vger.rutgers.edu](mailto:linux-raid@vger.rutgers.edu) (*this seems to be the most active list*)

### 3. Bootable Raid

I'm not going to cover the fundamentals of setting up raid0/1/5 on Linux, that is covered in detail elsewhere. The problem I will address is setting up raid on root and making it bootable with **standard** LILO. The documentation that comes with the LILO sources (not the man pages) and with the raidtools-0.90, covers the details of booting and boot parameters as well as general raid setup - respectively.

There are two scenarios which are covered here. Set up of bootable root raid and the conversion of an existing non-raid system to bootable root raid without data loss.

#### 3.1 Booting RAID 1 with standard LILO

To make the boot information redundant and easy to maintain, set up a small RAID1 and mount it on the **/boot** directory of your system disk. LILO does not know about device 0x9?? and can not find the information at boot time because the raid sub system is not active then. As a simple work around, you can pass LILO the geometry information of the drive(s) and from that, LILO can determine the position of the information needed to load the kernel even though it is on the RAID1 partition. This is because the RAID1 partition is the same as a standard partition but with a raid super-block written at the end. The boot raid set should fall with the first 1024 mbytes of the disk drive. In theory the start of the raid partition could fall anywhere in the 1024 megs, but in practice I was unable to get it to work unless the boot-raid started at the first block of the set. This is probably because of something dumb that I did, but it was not worth following up at the time. Since then I've simply set up all my systems with the boot-raid set as the first partition. I have root raid system configurations with bootable RAID1 mounted on **/boot** with root raid sets as follows: RAID1, RAID5, RAID10 & RAID1-10 ( 1 mirror + 1 raid0 set). The last has a very peculiar lilo file pair since none of the disk geometries are the same, however, the principals are the same for the initial boot process. The RAID10 and RAID1-10 root mounts require the use of *initrd* to mount root after the boot process has taken place. See the appendices for the configuration files for all of these example systems.

A conventional LILO config file stripped down looks like this:

```
# lilo.conf - assumes drive less than 1024
boot = /dev/hda
delay = 40                # extra, but nice
vga = normal              # not normally needed
image = /bzImage
root = /dev/hda1
read-only
label = Linux
```

A raid LILO config file pair would look like this:

```
# lilo.conf.hda - primary ide master
disk=/dev/md0
bios=0x80
sectors=63
heads=16
cylinders=39770
partition=/dev/md1
start=63
boot=/dev/hda
map=/boot/map
install=/boot/boot.b
image=/boot/bzImage
root=/dev/md0
```

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```
    read-only
    label=LinuxRaid

# -----

# lilo.conf.hdc - secondary ide master
    disk=/dev/md0
    bios=0x80          # see note below
    sectors=63
    heads=16
    cylinders=39770
    partition=/dev/md1
    start=63
    boot=/dev/hdc      # this is the other disk
    map=/boot/map
    install=/boot/boot.b
    image=/boot/bzImage
    root=/dev/md0
    read-only
    label=LinuxRaid
```

# BIOS=line -- if your bios is smart enough (most are not) to detect that that the first disk is missing or failed and will automatically boot from the second disk, then **bios=81** would be the appropriate entry here. This is more common with SCSI bios than IDE bios. I simply plan on relocating the drive so it will replace the dead drive C: in the event of failure of the primary boot drive.

The geometry information for the drive can be obtained from fdisk with the command:

```
fdisk -ul (little L)
fdisk -ul /dev/hda
```

```
Disk /dev/hda: 16 heads, 63 sectors, 39770 cylinders
Units = sectors of 1 * 512 bytes
```

Device	Boot	Start	End	Blocks	Id	System
/dev/hda1		63	33263	16600+	fd	Linux raid autodetect
/dev/hda2		33264	443519	205128	82	Linux swap
/dev/hda3		443520	40088159	19822320	fd	Linux raid autodetect

\* note the listing of the START of each partition

## 3.2 Detailed explanation of lilo.conf for raid boot

The raid lilo.conf file above, commented in detail for each entry.

```
# lilo.conf.hda - primary ide master
#   the location of the /boot directory that will be
#   designated below as containing the kernel, map, etc...
#   note that this is NOT the actual partition containing
#   the boot image and info, but rather the device
#   that logically contains this directory.
#   in this example, /dev/md1 is mounted on /dev/md0/boot
    disk=/dev/md0

#   tell LILO which bios device to use for boot, i.e. C: drive
    bios=0x80

#   tell LILO the geometry of the device
#   this is usually but not always the "logical"
```

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```
# geometry. Check the /proc file system or watch
# the boot messages when the kernel probes for the drive
#
sectors=63
heads=16
cylinders=39770

# this is a dummy entry to make LILO happy so it
# will recognize the raid set 0x9?? and then find
# the START of the boot sector. To really see
# what this was for, read the documentation
# that comes with the LILO source distribution.
# This parameter "must" be different than the
# disk= entry above. It can be any other mdx
# device, used or unused and need not be the one
# that contains the /boot information
#
partition=/dev/md1

# the first sector of the partition containing /boot information
start=63

# the real device that LILO will write the boot information to
boot=/dev/hda

# logically where LILO will put the boot information
map=/boot/map
install=/boot/boot.b

# logically where lilo will find the kernel image
image=/boot/bzImage

# standard stuff after this
# root may be a raid1/4/5 device
root=/dev/md0
read-only
label=LinuxRaid
```

## 4. Upgrading from non-raid to RAID1/4/5

Upgrading a non-raid system to raid is fairly easy and consists of several discrete steps described below. The description is for a system with a boot partition, root partition and swap partition.

OLD disk in the existing system:

```
/dev/hda1    boot, may be dos+lodlin or lilo
/dev/hda2    root
/dev/hda3    swap
```

We will add an additional disk and convert the entire system to RAID1. You could easily add several disks and make a RAID5 set instead using the same procedure.

### 4.1 Step 1 - prepare a new kernel

Download a clean kernel, raidtools-0.90 (or the most recent version), and the kernel patch to upgrade the kernel to 0.90 raid.

Compile and install the raidtools and READ the documentation.

Compile and install the kernel to support all the flavors (0/1/4/5 ?) of raid that you will be using. Make sure to specify autostart of raid devices in the kernel configuration. Test that the kernel boots properly and examine /proc/mdstat to see that the raid flavors you will use are supported by the new kernel.

## 4.2 Step 2 - set up raidtab for your new raid.

The new disk will be added to an additional IDE controller as the master device, thus becoming /dev/hdc

```
/dev/hdc1    16megs -- more than enough for several kernel images
/dev/hdc2    most of the disk
/dev/hdc3    some more swap space, if needed. otherwise add to hdc2
```

Change the partition types for /dev/hdc1 and /dev/hdc2 to "fd" for raid-autostart.

Using the **failed-disk** parameter, create a raidtab for the desired RAID1 configuration. The failed disk must be the last entry in the table.

```
# example raidtab
# md0 is the root array
raiddev      /dev/md0
raid-level   1
nr-raid-disks 2
chunk-size   32
# Spare disks for hot reconstruction
nr-spare-disks 0
persistent-superblock 1
device       /dev/hdc2
raid-disk    0
# this is our old disk, mark as failed for now
device       /dev/hda2
failed-disk  1

# md1 is the /boot array
raiddev      /dev/md1
raid-level   1
nr-raid-disks 2
chunk-size   32
# Spare disks for hot reconstruction
nr-spare-disks 0
persistent-superblock 1
device       /dev/hdc1
raid-disk    0
# boot is marked failed as well
device       /dev/hda1
failed-disk  1
```

## 4.3 Create, format, and configure RAID

Create the md devices with the commands:

```
mkraid /dev/md0
mkraid /dev/md1
```



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The raid devices should be created and start. Examination of `/proc/mdstat` should show the raid personalities in the kernel and the raid devices running.

Format the boot and root devices with:

```
mke2fs /dev/md0
mke2fs /dev/md1
```

Mount the new root device somewhere handy and create the `/boot` directory and mount the boot partition.

```
mount /dev/md0 /mnt
mkdir /mnt/boot
mount /dev/md1 /mnt/boot
```

### 4.4 Copy the current OS to the new raid device

This is pretty straightforward.

```
cd /
# set up a batch file to do this
cp -a /bin /mnt
cp -a /dev /mnt
cp -a /etc /mnt
cp -a (all directories except /mnt, /proc, and nsf mounts) /mnt
```

This operation can be tricky if you have mounted or linked other disks to your root file system. The example above assumes a very simple system, you may have to modify the procedure somewhat.

### 4.5 Test your new RAID

Make a boot floppy and rdev the kernel.

```
dd if=kernal.image of=/dev/fd0 bs=2k
rdev /dev/fd0 /dev/md0
rdev -r /dev/fd0 0
rdev -R /dev/fd0 1
```

Modify the `fstab` on the RAID device to reflect the new mount points as follows:

```
/dev/md0      /          ext2    defaults    1 1
/dev/md1      /boot      ext2    defaults    1 1
```

Dismount the raid devices and boot the new file system to see that all works correctly.

```
umount /mnt/boot
umount /mnt
raidstop /dev/md0
raidstop /dev/md1
shutdown -r now
```

Your RAID system should now be up and running in degraded mode with a floppy boot disk. Carefully check that you transferred everything to the new raid system. If you mess up here without a backup, **YOU ARE DEAD!**

If something did not work, reboot your old system and go back and fix things up until you successfully complete this step.

## 4.6 Integrate old disk into raid array

Success in the previous step means that the raid array is now operational, but without redundancy. We must now re-partition the old drive(s) to fit into the new raid array. Remember that if the geometries are not the same, the partition size on the old drive must be the same or larger than the raid partitions or they can not be added to the raid set.

Re-partition the old drive as required. Example:

```
/dev/hda1    same or larger than /dev/hdc1
/dev/hda2    same or larger than /dev/hdc2
/dev/hda3    anything left over for swap or whatever...
```

Change the **failed-disk** parameter in the raidtab to **raid-disk** and hot add the new (old) disk partitions to the raid array.

```
raidhotadd /dev/md1 /dev/hda1
raidhotadd /dev/md0 /dev/hda2
```

Examining `/proc/mdstat` should show one or more of the raid devices reconstructing the data for the new partitions. After a minute or two... or so, the raid arrays should be fully synchronized (this could take a while for a large partition).

Using the procedure described in the first sections of this document, set up bootable raid on the new raid pair. Hang on to that boot floppy while setting up and testing this last step.

## 5. Appendix A. - example raidtab

RAID1 example described in the first sections of this document

```
df
Filesystem          1k-blocks      Used Available Use% Mounted on
/dev/md0             19510780    1763188  16756484  10% /
/dev/md1              15860         984     14051    7% /boot

# -----

fdisk -ul /dev/hda

Disk /dev/hda: 16 heads, 63 sectors, 39770 cylinders
Units = sectors of 1 * 512 bytes

   Device Boot      Start         End      Blocks   Id  System
/dev/hda1            63         33263     16600+   fd  Linux raid autodetect
/dev/hda2          33264     443519     205128   83  Linux native
/dev/hda3          443520    40088159    19822320   fd  Linux raid autodetect

# -----

fdisk -ul /dev/hdc

Disk /dev/hdc: 16 heads, 63 sectors, 39770 cylinders
```

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Units = sectors of 1 \* 512 bytes

Device	Boot	Start	End	Blocks	Id	System
/dev/hdc1		63	33263	16600+	fd	Linux raid autodetect
/dev/hdc2		33264	443519	205128	82	Linux swap
/dev/hdc3		443520	40088159	19822320	fd	Linux raid autodetect

```
# -----  
  
# md0 is the root array, about 20 gigs  
raiddev          /dev/md0  
raid-level       1  
nr-raid-disks   2  
chunk-size      32  
# Spare disks for hot reconstruction  
nr-spare-disks  0  
persistent-superblock 1  
device          /dev/hda3  
raid-disk       0  
device          /dev/hdc3  
raid-disk       1  
  
# md1 is the /boot array, about 16 megs  
raiddev          /dev/md1  
raid-level       1  
nr-raid-disks   2  
chunk-size      32  
# Spare disks for hot reconstruction  
nr-spare-disks  0  
persistent-superblock 1  
device          /dev/hda1  
raid-disk       0  
device          /dev/hdc1  
raid-disk       1
```

```
# -----  
  
# GLOBAL SECTION  
# device containing /boot directory  
disk=/dev/md0  
# geometry  
  bios=0x80  
  sectors=63  
  heads=16  
  cylinders=39770  
# dummy  
  partition=/dev/md1  
# start of device "disk" above  
  start=63
```

```
boot=/dev/hda  
map=/boot/map  
install=/boot/boot.b
```

```
image=/boot/bzImage  
root=/dev/md0  
label=LinuxRaid  
read-only
```

```
# -----  
  
# GLOBAL SECTION
```

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```
# device containing /boot directory
disk=/dev/md0
# geometry
  bios=0x80
  sectors=63
  heads=16
  cylinders=39770
# dummy
  partition=/dev/md1
# start of device "disk" above
  start=63
```

```
boot=/dev/hdc
map=/boot/map
install=/boot/boot.b
```

```
image=/boot/bzImage
root=/dev/md0
label=LinuxRaid
read-only
```

## 6. Appendix B. - SCSI reference implementation RAID5

### 4 disk SCSI RAID5

```
df
Filesystem          1k-blocks      Used Available Use% Mounted on
/dev/md0             11753770    2146076   9000678   19% /
/dev/md1              15739         885     14042    6% /boot
```

```
# -----
```

```
fdisk -ul /dev/sda
```

```
Disk /dev/sda: 64 heads, 32 sectors, 4095 cylinders
Units = sectors of 1 * 512 bytes
```

Device	Boot	Start	End	Blocks	Id	System
/dev/sda1		32	32767	16368	fd	Linux raid autodetect
/dev/sda2		32768	292863	130048	5	Extended
/dev/sda3		292864	8386559	4046848	fd	Linux raid autodetect
/dev/sda5		32800	260095	113648	82	Linux swap
/dev/sda6		260128	292863	16368	83	Linux native - test

```
# -----
```

```
fdisk -ul /dev/sdb
```

```
Disk /dev/sdb: 64 heads, 32 sectors, 4095 cylinders
Units = sectors of 1 * 512 bytes
```

Device	Boot	Start	End	Blocks	Id	System
/dev/sdb1		32	32767	16368	fd	Linux raid autodetect
/dev/sdb2		32768	292863	130048	5	Extended
/dev/sdb3		292864	8386559	4046848	fd	Linux raid autodetect
/dev/sdb5		32800	260095	113648	82	Linux swap
/dev/sdb6		260128	292863	16368	83	Linux native - test

```
# -----
```

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```
# fdisk -ul /dev/sdc

Disk /dev/sdc: 64 heads, 32 sectors, 4095 cylinders
Units = sectors of 1 * 512 bytes

   Device Boot      Start         End      Blocks   Id  System
/dev/sdc2             32       292863    146416     5   Extended
/dev/sdc3          292864    8386559   4046848    fd   Linux raid autodetect
/dev/sdc5             64       260095    130016    83   Linux native - development
/dev/sdc6          260128       292863     16368    83   Linux native - test

# -----

fdisk -ul /dev/sdd

Disk /dev/sdd: 64 heads, 32 sectors, 4095 cylinders
Units = sectors of 1 * 512 bytes

   Device Boot      Start         End      Blocks   Id  System
/dev/sdd2             32       292863    146416     5   Extended
/dev/sdd3          292864    8386559   4046848    fd   Linux raid autodetect
/dev/sdd5             64       260095    130016    83   Linux native - development
/dev/sdd6          260128       292863     16368    83   Linux native - test

# -----

# raidtab
#
raiddev /dev/md0
    raid-level      5
    nr-raid-disks   4
    persistent-superblock 1
    chunk-size      32

# Spare disks for hot reconstruction
    nr-spare-disks  0
    device           /dev/sda3
    raid-disk        0
    device           /dev/sdb3
    raid-disk        1
    device           /dev/sdc3
    raid-disk        2
    device           /dev/sdd3
    raid-disk        3

# boot partition
#
raiddev /dev/md1
    raid-level      1
    nr-raid-disks   2
    persistent-superblock 1
    chunk-size      32

# Spare disks for hot reconstruction
    nr-spare-disks  0
    device           /dev/sda1
    raid-disk        0
    device           /dev/sdb1
    raid-disk        1

# -----
```

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```
# cat lilo.conf.sda
# GLOBAL SECTION
# device containing /boot directory
disk=/dev/md0
# geometry
  bios=0x80
  sectors=32
  heads=64
  cylinders=4095
# dummy
  partition=/dev/md1
# start of device "disk" above
  start=32

boot=/dev/sda
map=/boot/map
install=/boot/boot.b

image=/boot/bzImage
root=/dev/md0
label=LinuxRaid
read-only
```

```
# -----
# cat lilo.conf.sdb
# GLOBAL SECTION
# device containing /boot directory
disk=/dev/md0
# geometry
  bios=0x80
  sectors=32
  heads=64
  cylinders=4095
# dummy
  partition=/dev/md1
# start of device "disk" above
  start=32

boot=/dev/sdb
map=/boot/map
install=/boot/boot.b

image=/boot/bzImage
root=/dev/md0
label=LinuxRaid
read-only
```

## 7. Appendix C. - ide RAID10 with initrd

RAID1 over striped RAID0 pair.... the disks in the RAID0 sets are not quite the same size, but close enough.

```
/dev/md0 is the /boot partition and is autostarted by the kernel
/dev/md1 and /dev/md3 are the two RAID0 sets autostarted by the kernel
/dev/md2 is the root partition and is started by initrd
```

```
df
Filesystem          1k-blocks      Used Available Use% Mounted on
/dev/md2             118531         76485      35925   68% /
/dev/md0              1917           1361         457    75% /boot
```

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```
# -----  
  
fdisk -ul /dev/hda  
  
Disk /dev/hda: 4 heads, 46 sectors, 903 cylinders  
Units = sectors of 1 * 512 bytes  
  
    Device Boot      Start         End      Blocks   Id  System  
/dev/hda1          46          4231       2093    fd  Linux raid autodetect  
/dev/hda2         4232       166151       80960    fd  Linux raid autodetect  
  
# -----  
  
fdisk -ul /dev/hdb  
  
Disk /dev/hdb: 5 heads, 17 sectors, 981 cylinders  
Units = sectors of 1 * 512 bytes  
  
    Device Boot      Start         End      Blocks   Id  System  
/dev/hdb1          17        83384       41684    fd  Linux raid autodetect  
  
# -----  
  
fdisk -ul /dev/hdc  
  
Disk /dev/hdc: 7 heads, 17 sectors, 1024 cylinders  
Units = sectors of 1 * 512 bytes  
  
    Device Boot      Start         End      Blocks   Id  System  
/dev/hdc1          17        84013      41998+    fd  Linux raid autodetect  
/dev/hdc2         84014       121855       18921    82  Linux swap  
  
# -----  
  
fdisk -ul /dev/hdd  
  
Disk /dev/hdd: 4 heads, 46 sectors, 903 cylinders  
Units = sectors of 1 * 512 bytes  
  
    Device Boot      Start         End      Blocks   Id  System  
/dev/hdd1          46          4231       2093    fd  Linux raid autodetect  
/dev/hdd2         4232       166151       80960    fd  Linux raid autodetect  
  
# -----  
  
# raidtab  
#  
raiddev /dev/md0  
    raid-level      1  
    nr-raid-disks   2  
    persistent-superblock  1  
    chunk-size      8  
    device          /dev/hda1  
    raid-disk       0  
    device          /dev/hdd1  
    raid-disk       1  
  
raiddev /dev/md1  
    raid-level      0  
    nr-raid-disks   2  
    persistent-superblock  1  
    chunk-size      8
```

## Boot + Root + Raid + Lilo : Software Raid mini-HOWTO

```
device          /dev/hdd2
raid-disk       0
device          /dev/hdb1
raid-disk       1

raiddev /dev/md2
raid-level      1
nr-raid-disks   2
persistent-superblock  1
chunk-size      8
device          /dev/md1
raid-disk       0
device          /dev/md3
raid-disk       1

raiddev /dev/md3
raid-level      0
nr-raid-disks   2
persistent-superblock  1
chunk-size      8
device          /dev/hda2
raid-disk       0
device          /dev/hdc1
raid-disk       1

# -----

contents of linuxrc

cat linuxrc
#!/bin/sh
# ver 1.02 2-22-00
#
##### really BEGIN 'linuxrc' #####
#
# mount the proc file system
/bin/mount /proc

# start raid 1 made of raid 0's
/bin/raidstart /dev/md2

# tell the console what's happening
/bin/cat /proc/mdstat

# Everything is fine, let the kernel mount /dev/md2
# tell the kernel to switch to /dev/md2 as the /root device
# The 0x900 value is the device number calculated by:
# 256*major_device_number + minor_device number
echo "/dev/md2 mounted on root"
echo 0x902>/proc/sys/kernel/real-root-dev

# umount /proc to deallocate initrd device ram space
/bin/umount /proc
exit

# -----

contents of initrd

./bin/ash
./bin/echo
./bin/raidstart
```



```
./bin/mount
./bin/umount
./bin/cat
./bin/sh
./dev/tty1
./dev/md0
./dev/md1
./dev/md2
./dev/md3
./dev/md4
./dev/console
./dev/hda
./dev/hda1
./dev/hda2
./dev/hda3
./dev/hdb
./dev/hdb1
./dev/hdb2
./dev/hdb3
./dev/hdc
./dev/hdc1
./dev/hdc2
./dev/hdc3
./dev/hdd
./dev/hdd1
./dev/hdd2
./dev/hdd3
./dev/initrd
./dev/ram0
./dev/ram1
./dev/ram2
./dev/ram3
./dev/ram4
./dev/ram5
./dev/ram6
./dev/ram7
./etc/raidtab
./etc/fstab
./lib/ld-2.1.2.so
./lib/ld-linux.so.1
./lib/ld-linux.so.1.9.9
./lib/ld-linux.so.2
./lib/ld.so
./lib/libc-2.1.2.so
./lib/libc.so.6
./linuxrc
./proc
```

## 8. Appendix D. - ide RAID1-10 with initrd

This is a system made up of an assortment of odds and ends. The root mounted raid device is comprised of a RAID1 made up of one RAID0 array from odd sized disks and a larger regular disk partition. Examination of the lilo.conf files may give you better insight into the reasoning behind the various parameters.

```
/dev/md0 is the /boot partition and is autostarted by the kernel
/dev/md1 is one half of the mirror set for md2, autostarted by kernel
/dev/hda3 is the other half of the mirror set for md2
/dev/md2 is the RAID1 /dev/md1 + /dev/hda3, started by initrd
```

df

## Boot + Root + Raid + Lilo : Software Raid mini-HOWTO

```
Filesystem          1k-blocks      Used Available Use% Mounted on
/dev/md2             138381         74421      56815   57% /
/dev/md0             2011           1360         549    71% /boot

# -----

fdisk -ul /dev/hda

Disk /dev/hda: 8 heads, 46 sectors, 903 cylinders
Units = sectors of 1 * 512 bytes

   Device Boot      Start         End      Blocks   Id  System
/dev/hda1          46           4415        2185     fd  Linux raid autodetect
/dev/hda2          4416          43423       19504     82  Linux swap
/dev/hda3          43424          332303    144440     83  Linux native

# -----

fdisk -ul /dev/hdc

Disk /dev/hdc: 8 heads, 39 sectors, 762 cylinders
Units = sectors of 1 * 512 bytes

   Device Boot      Start         End      Blocks   Id  System
/dev/hdc1          39           4367       2164+     fd  Linux raid autodetect
/dev/hdc2          4368          70199       32916     82  Linux swap
/dev/hdc3          70200         237743     83772     fd  Linux raid autodetect

# -----

fdisk -ul /dev/hdd

Disk /dev/hdd: 4 heads, 39 sectors, 762 cylinders
Units = sectors of 1 * 512 bytes

   Device Boot      Start         End      Blocks   Id  System
/dev/hdd1          39          118871     59416+     fd  Linux raid autodetect

# -----

# raidtab
#
raiddev /dev/md0
    raid-level      1
    nr-raid-disks   2
    persistent-superblock  1
    chunk-size      8
    device           /dev/hdc1
    raid-disk        1
    device           /dev/hda1
    raid-disk        0

raiddev /dev/md1
    raid-level      0
    nr-raid-disks   2
    persistent-superblock  1
    chunk-size      8
    device           /dev/hdc3
    raid-disk        0
    device           /dev/hdd1
    raid-disk        1
```

## Boot + Root + Raid + Lilo : Software Raid mini-HOWTO

```
raiddev /dev/md2
    raid-level      1
    nr-raid-disks   2
    persistent-superblock  1
    chunk-size      8
    device           /dev/md1
    raid-disk        1
    device           /dev/hda3
    raid-disk        0

# -----

    cat linuxrc
#!/bin/sh
# ver 1.02 2-22-00
#
##### really BEGIN 'linuxrc' #####
#
# mount the proc file system
/bin/mount /proc

# autostart /boot partition and raid0
/bin/raidstart /dev/md2

# tell the console what's happening
/bin/cat /proc/mdstat

# Everything is fine, let the kernel mount /dev/md2
# tell the kernel to switch to /dev/md2 as the /root device
# The 0x900 value is the device number calculated by:
# 256*major_device_number + minor_device number
echo "/dev/md2 mounted on root"
echo 0x902>/proc/sys/kernel/real-root-dev

# umount /proc to deallocate initrd device ram space
/bin/umount /proc
exit

# -----

contents of initrd.gz

./bin
./bin/ash
./bin/echo
./bin/raidstart
./bin/mount
./bin/umount
./bin/cat
./bin/sh
./dev/tty1
./dev/md0
./dev/md1
./dev/md2
./dev/md3
./dev/console
./dev/hda
./dev/hda1
./dev/hda2
./dev/hda3
./dev/hdc
./dev/hdc1
```

## Boot + Root + Raid + Lilo : Software Raid mini-HOWTO

```
./dev/hdc2
./dev/hdc3
./dev/hdd
./dev/hdd1
./dev/hdd2
./dev/hdd3
./dev/initrd
./dev/ram0
./dev/ram1
./dev/ram2
./dev/ram3
./dev/ram4
./dev/ram5
./dev/ram6
./dev/ram7
./etc/raidtab
./etc/fstab
./lib/ld-2.1.2.so
./lib/ld-linux.so.1
./lib/ld-linux.so.1.9.9
./lib/ld-linux.so.2
./lib/ld.so
./lib/libc-2.1.2.so
./lib/libc.so.6
./linuxrc
./proc

# -----

cat lilo.conf.hda
# GLOBAL SECTION
# device containing /boot directory
disk=/dev/md2
# geometry
  bios=0x80
  cylinders=903
  heads=8
  sectors=46
# geometry for 2nd disk
# bios will be the same because it will have to be moved to hda
# cylinders=762
# heads=8
# sectors=39

# dummy
  partition=/dev/md0
# start of device "disk" above
  start=46
# second device
# start=39

# seem to have some trouble with 2.2.14 recognizing the right IRQ
  append = "ide1=0x170,0x376,12 ether=10,0x300,eth0 ether=5,0x320,eth1"

boot=/dev/hda
map=/boot/map
install=/boot/boot.b

initrd=/boot/initrd.gz

image=/boot/zImage
root=/dev/md2
```

## Boot + Root + Raid + Lilo : Software Raid mini-HOWTO

```
label=LinuxRaid
read-only

# -----

cat lilo.conf.hdc
# GLOBAL SECTION
# device containing /boot directory
disk=/dev/md2
# geometry
  bios=0x80
# cylinders=903
# heads=8
# sectors=46
# geometry for 2nd disk
# bios will be the same because it will have to be moved to hda
  cylinders=762
  heads=8
  sectors=39

# dummy
  partition=/dev/md0
# start of device "disk" above
# start=46
# second device
  start=39

# seem to have some trouble with 2.2.14 recognizing the right IRQ
  append = "ide1=0x170,0x376,12 ether=10,0x300,eth0 ether=5,0x320,eth1"

boot=/dev/hdc
map=/boot/map
install=/boot/boot.b

initrd=/boot/initrd.gz

image=/boot/zImage
root=/dev/md2
label=LinuxRaid
read-only
```