



USB pen drive boot using Fedora 9 (115)

Build a bootable USB pen drive with a custom micro Linux distribution on it.

Requirements:

- Fedora 9 VM
<http://simms-teach.com/howtos/114-fedora-9-install.pdf>
- VMWare Server 1.05 or higher
<http://www.vmware.com/products/server/>
- USB pen drive

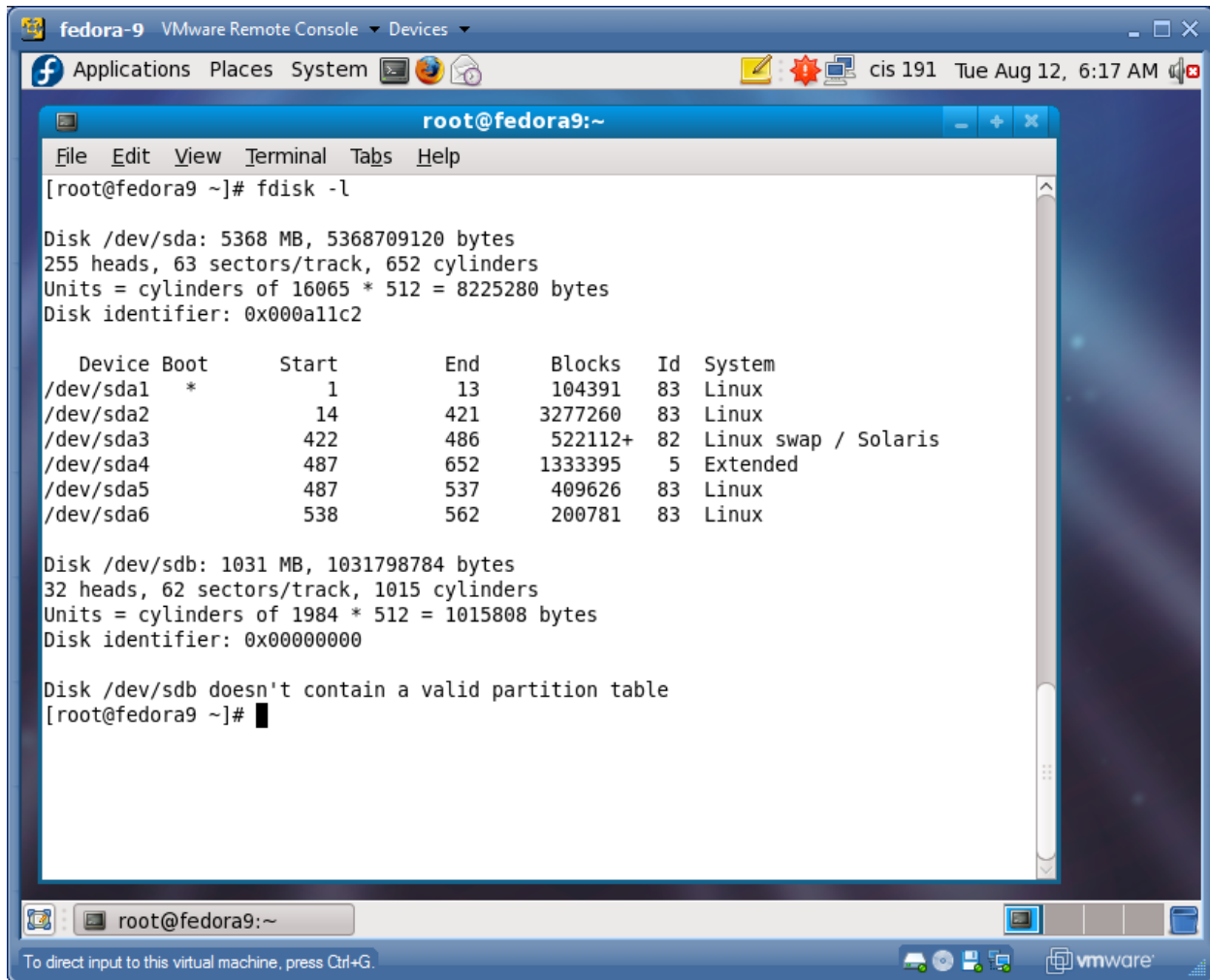
Desired USB pen drive installation:

Location	Type	Boot Code	Usage	Size
MBR		GRUB		
/dev/sdb1	Primary		/	varies

Step 1 - Add USB controller to VM if necessary:

- <http://simms-teach.com/howtos/113-add-usb-to-vm.pdf>

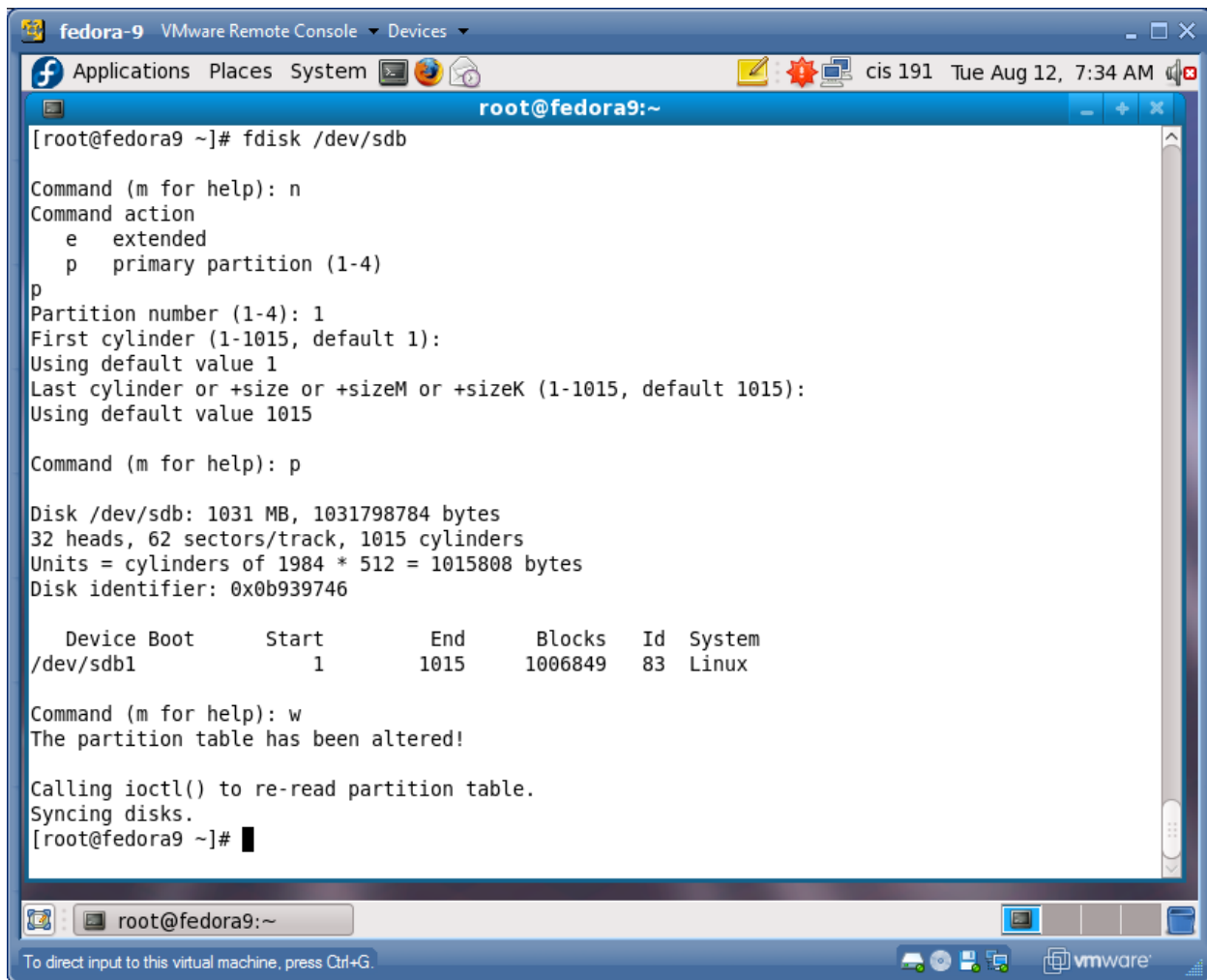
Step 2 – Partition and create root file system on USB pen drive



```
root@fedora9:~  
File Edit View Terminal Tabs Help  
[root@fedora9 ~]# fdisk -l  
  
Disk /dev/sda: 5368 MB, 5368709120 bytes  
255 heads, 63 sectors/track, 652 cylinders  
Units = cylinders of 16065 * 512 = 8225280 bytes  
Disk identifier: 0x000a11c2  
  
   Device Boot      Start         End      Blocks   Id  System  
/dev/sda1 *          1          13        104391   83  Linux  
/dev/sda2             14          421       3277260   83  Linux  
/dev/sda3            422          486       522112+   82  Linux swap / Solaris  
/dev/sda4            487          652       1333395    5  Extended  
/dev/sda5            487          537        409626   83  Linux  
/dev/sda6            538          562        200781   83  Linux  
  
Disk /dev/sdb: 1031 MB, 1031798784 bytes  
32 heads, 62 sectors/track, 1015 cylinders  
Units = cylinders of 1984 * 512 = 1015808 bytes  
Disk identifier: 0x00000000  
  
Disk /dev/sdb doesn't contain a valid partition table  
[root@fedora9 ~]#
```

- The 1GB pen drive (/dev/sdb) in this example has just been zeroed out and has no partition table.

Step 3 – Add partition to pen drive



```
[root@fedora9 ~]# fdisk /dev/sdb

Command (m for help): n
Command action
   e   extended
   p   primary partition (1-4)
p
Partition number (1-4): 1
First cylinder (1-1015, default 1):
Using default value 1
Last cylinder or +size or +sizeM or +sizeK (1-1015, default 1015):
Using default value 1015

Command (m for help): p

Disk /dev/sdb: 1031 MB, 1031798784 bytes
32 heads, 62 sectors/track, 1015 cylinders
Units = cylinders of 1984 * 512 = 1015808 bytes
Disk identifier: 0x0b939746

   Device Boot      Start         End      Blocks   Id  System
/dev/sdb1            1         1015     1006849   83   Linux

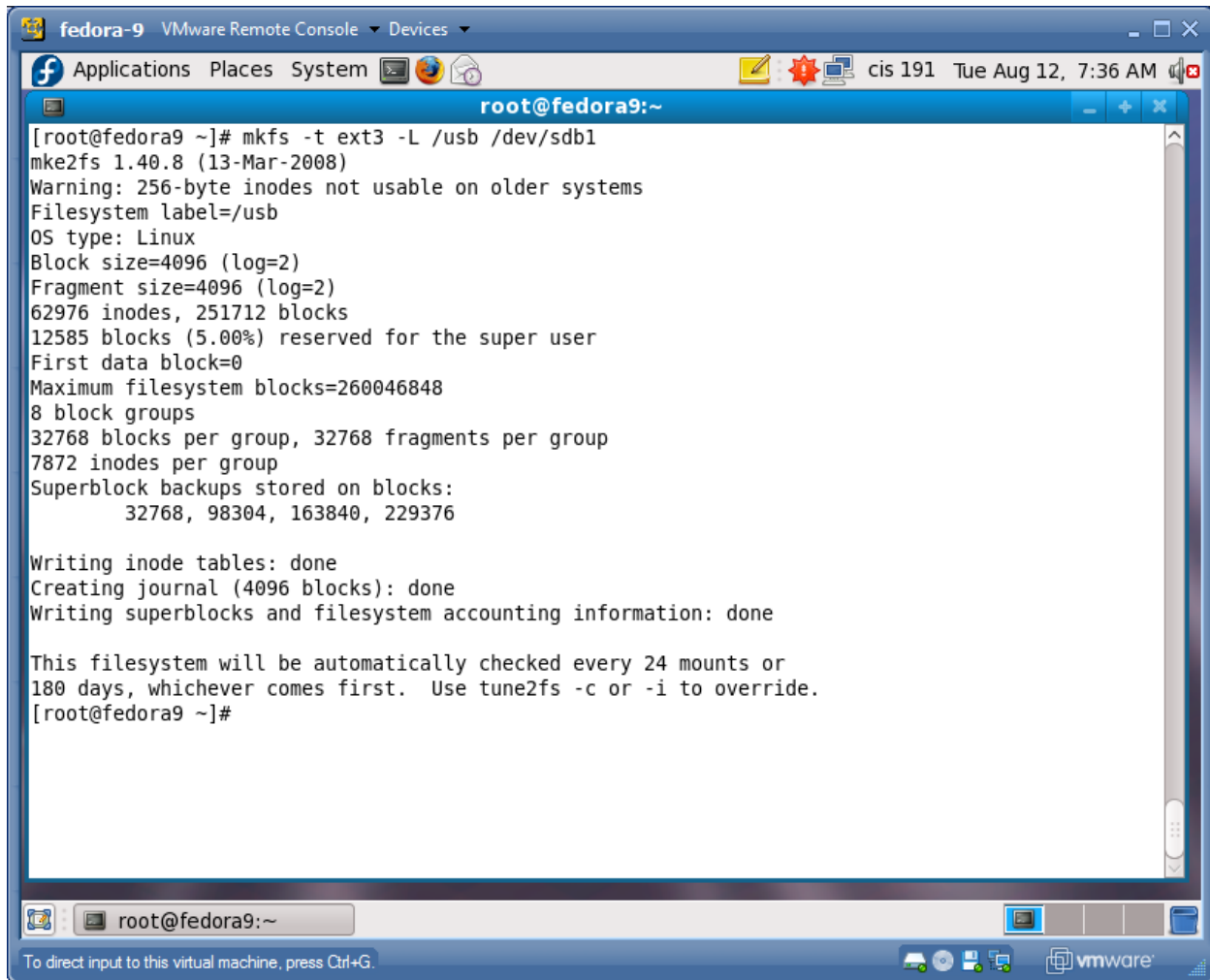
Command (m for help): w
The partition table has been altered!

Calling ioctl() to re-read partition table.
Syncing disks.
[root@fedora9 ~]#
```

The screenshot shows a terminal window in a VMware Remote Console environment. The terminal displays the execution of the `fdisk /dev/sdb` command. The user is prompted to enter a command, and they choose `n` for a new partition. They are then prompted for the partition type, choosing `p` for a primary partition. The partition number is set to 1, and the first and last cylinders are both set to their default values of 1 and 1015, respectively. The user then enters `p` to view the current partition table, which shows a single partition `/dev/sdb1` of type `Linux` (Id 83) spanning from cylinder 1 to 1015. Finally, the user enters `w` to write the changes to the disk, and the terminal confirms that the partition table has been altered and the disks are being synced.

- Use `fdisk` to add a single primary partition to the USB pen drive.

Step 4 – Lay down ext3 file system



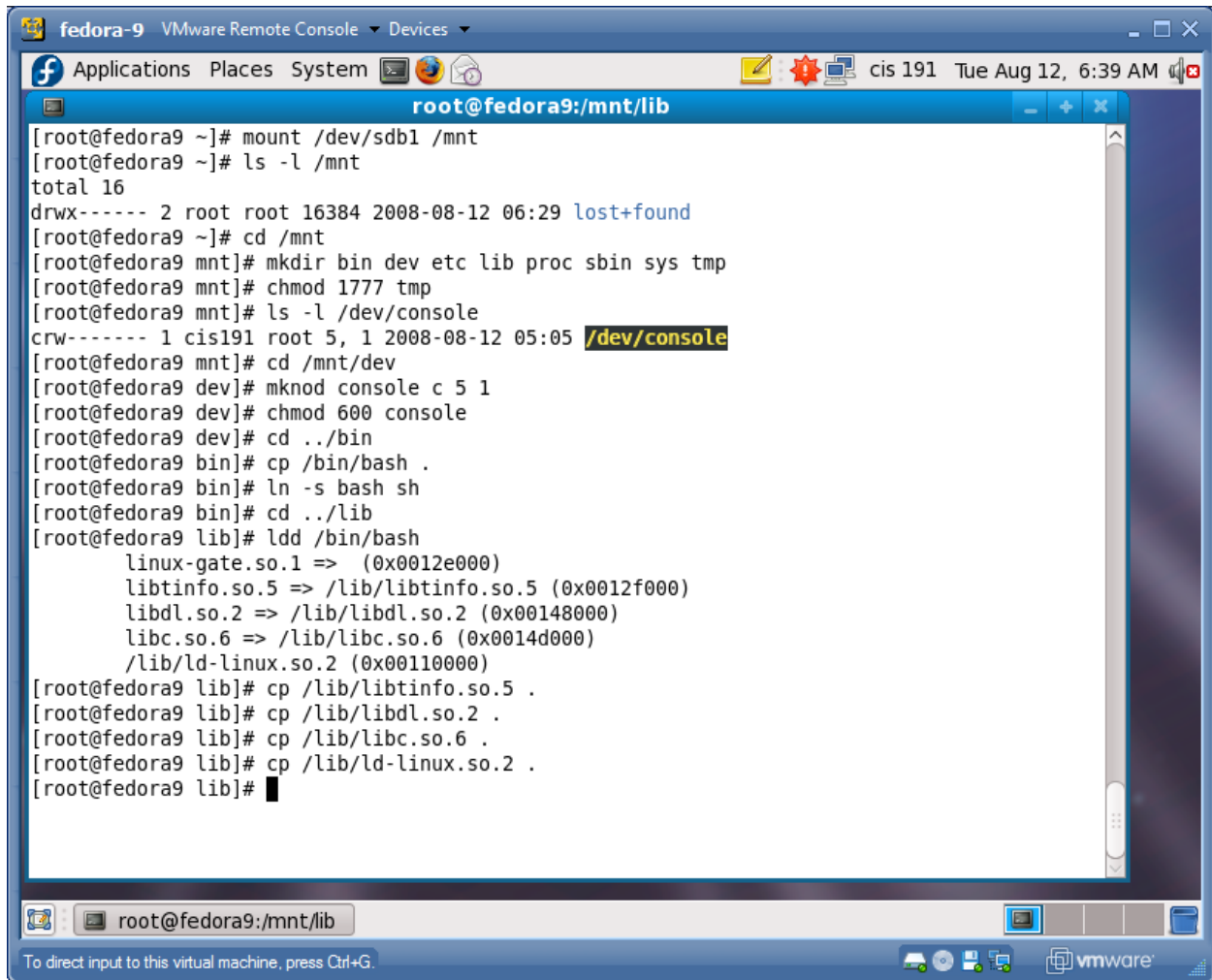
```
fedora-9 VMware Remote Console Devices
Applications Places System cis 191 Tue Aug 12, 7:36 AM
root@fedora9:~
[root@fedora9 ~]# mkfs -t ext3 -L /usb /dev/sdb1
mke2fs 1.40.8 (13-Mar-2008)
Warning: 256-byte inodes not usable on older systems
Filesystem label=/usb
OS type: Linux
Block size=4096 (log=2)
Fragment size=4096 (log=2)
62976 inodes, 251712 blocks
12585 blocks (5.00%) reserved for the super user
First data block=0
Maximum filesystem blocks=260046848
8 block groups
32768 blocks per group, 32768 fragments per group
7872 inodes per group
Superblock backups stored on blocks:
    32768, 98304, 163840, 229376

Writing inode tables: done
Creating journal (4096 blocks): done
Writing superblocks and filesystem accounting information: done

This filesystem will be automatically checked every 24 mounts or
180 days, whichever comes first. Use tune2fs -c or -i to override.
[root@fedora9 ~]#
```

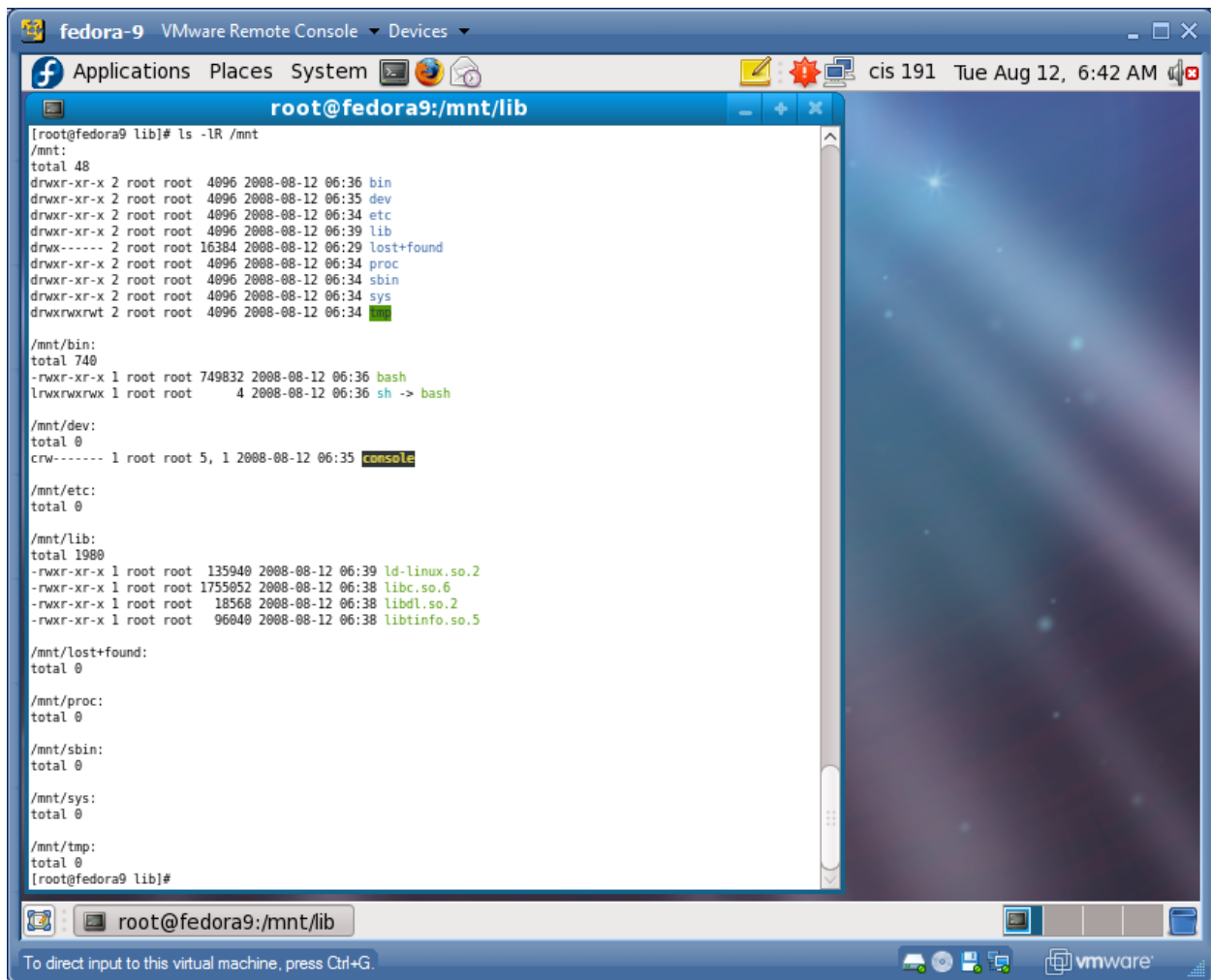
- Label the ext3 file system /usb

Step 5 – Mount and create root file system



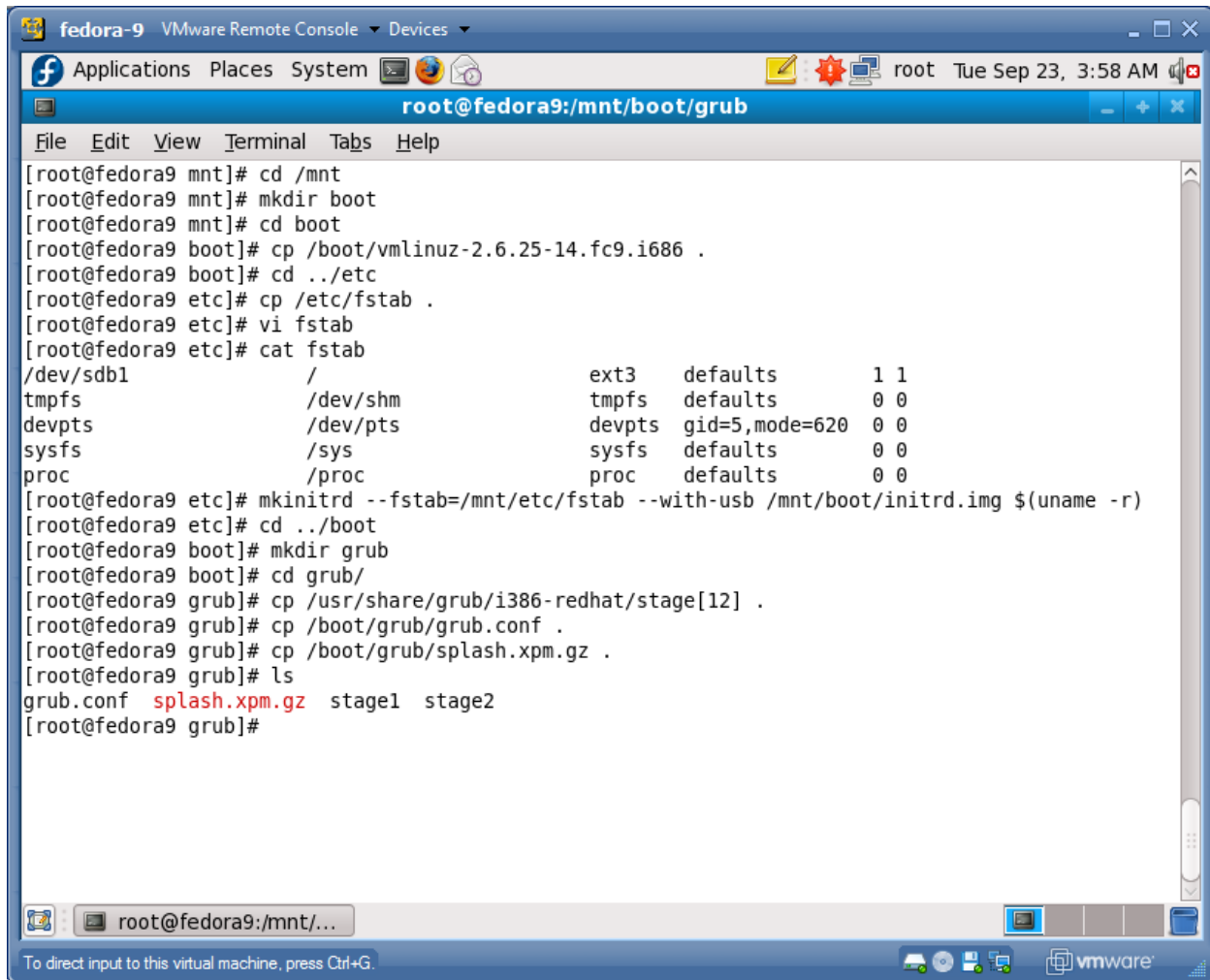
```
fedora-9 VMware Remote Console Devices
Applications Places System cis 191 Tue Aug 12, 6:39 AM
root@fedora9:/mnt/lib
[root@fedora9 ~]# mount /dev/sdb1 /mnt
[root@fedora9 ~]# ls -l /mnt
total 16
drwx----- 2 root root 16384 2008-08-12 06:29 lost+found
[root@fedora9 ~]# cd /mnt
[root@fedora9 mnt]# mkdir bin dev etc lib proc sbin sys tmp
[root@fedora9 mnt]# chmod 1777 tmp
[root@fedora9 mnt]# ls -l /dev/console
crw----- 1 cis191 root 5, 1 2008-08-12 05:05 /dev/console
[root@fedora9 mnt]# cd /mnt/dev
[root@fedora9 dev]# mknod console c 5 1
[root@fedora9 dev]# chmod 600 console
[root@fedora9 dev]# cd ../bin
[root@fedora9 bin]# cp /bin/bash .
[root@fedora9 bin]# ln -s bash sh
[root@fedora9 bin]# cd ../lib
[root@fedora9 lib]# ldd /bin/bash
linux-gate.so.1 => (0x0012e000)
libtinfo.so.5 => /lib/libtinfo.so.5 (0x0012f000)
libdl.so.2 => /lib/libdl.so.2 (0x00148000)
libc.so.6 => /lib/libc.so.6 (0x0014d000)
/lib/ld-linux.so.2 (0x00110000)
[root@fedora9 lib]# cp /lib/libtinfo.so.5 .
[root@fedora9 lib]# cp /lib/libdl.so.2 .
[root@fedora9 lib]# cp /lib/libc.so.6 .
[root@fedora9 lib]# cp /lib/ld-linux.so.2 .
[root@fedora9 lib]#
```

- Add top level directories to USB pen drive
- Add console device in dev directory
- Add a shell (bash) in bin directory.
- Create symbolic link to shell named sh in bin directory.
- Copy libraries used by the shell to lib directory.



- View and verify directories and files added.

Step 6 – Make pen drive bootable

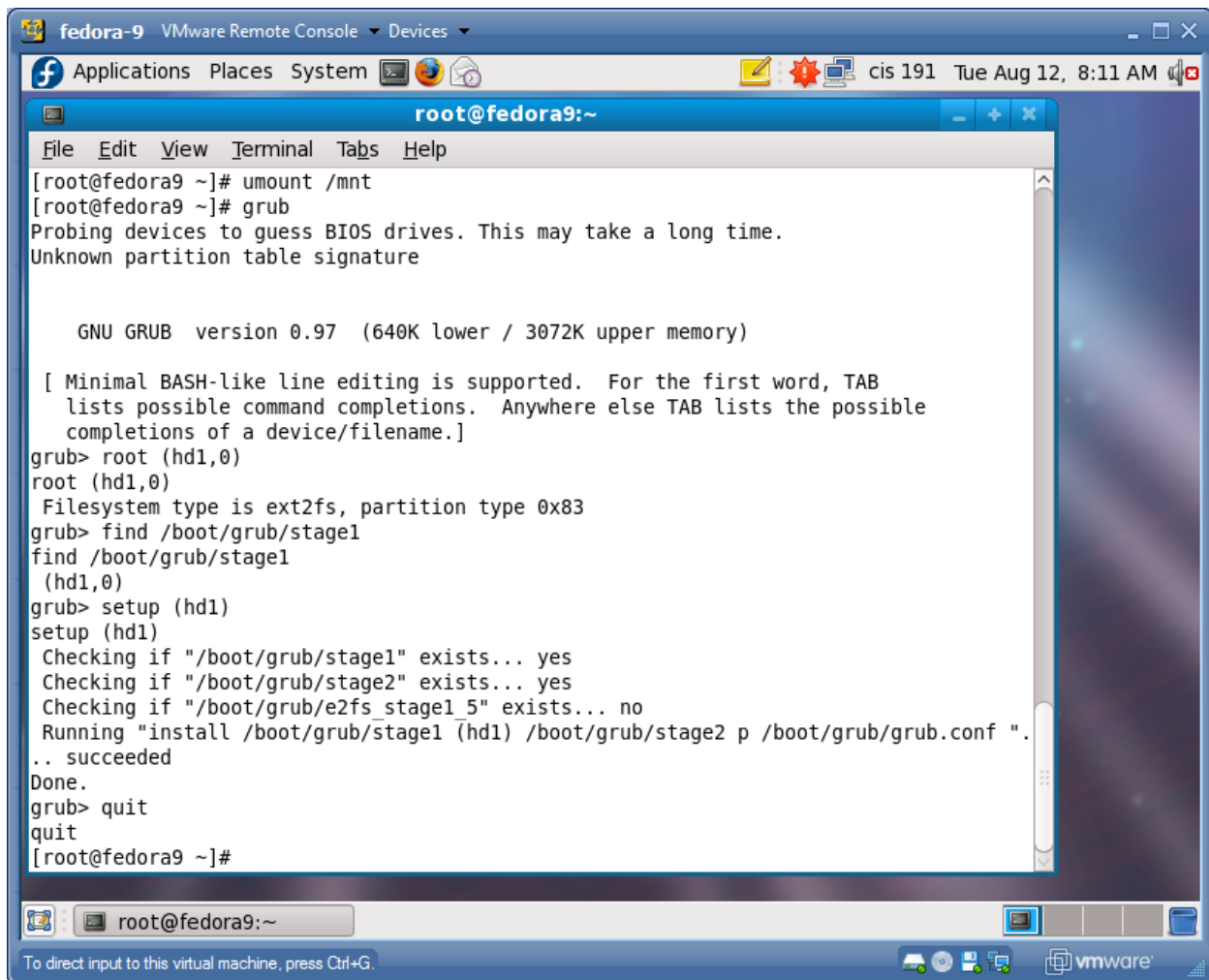


```
fedora-9 VMware Remote Console Devices
Applications Places System root Tue Sep 23, 3:58 AM
root@fedora9:/mnt/boot/grub
File Edit View Terminal Tabs Help
[root@fedora9 mnt]# cd /mnt
[root@fedora9 mnt]# mkdir boot
[root@fedora9 mnt]# cd boot
[root@fedora9 boot]# cp /boot/vmlinuz-2.6.25-14.fc9.i686 .
[root@fedora9 boot]# cd ../etc
[root@fedora9 etc]# cp /etc/fstab .
[root@fedora9 etc]# vi fstab
[root@fedora9 etc]# cat fstab
/dev/sdb1          /          ext3    defaults    1 1
tmpfs             /dev/shm   tmpfs   defaults    0 0
devpts           /dev/pts   devpts  gid=5,mode=620 0 0
sysfs            /sys       sysfs   defaults    0 0
proc             /proc      proc    defaults    0 0
[root@fedora9 etc]# mkinitrd --fstab=/mnt/etc/fstab --with-usb /mnt/boot/initrd.img $(uname -r)
[root@fedora9 etc]# cd ../boot
[root@fedora9 boot]# mkdir grub
[root@fedora9 boot]# cd grub/
[root@fedora9 grub]# cp /usr/share/grub/i386-redhat/stage[12] .
[root@fedora9 grub]# cp /boot/grub/grub.conf .
[root@fedora9 grub]# cp /boot/grub/splash.xpm.gz .
[root@fedora9 grub]# ls
grub.conf splash.xpm.gz stage1 stage2
[root@fedora9 grub]#
```

- Make boot directory on USB pen drive and add kernel to it.
- Copy fstab to etc directory on pen USB drive, then modify the new fstab for correct mount points and remove the swap partition.
- In the boot directory make an initial ramdisk image.
- Create grub directory in boot directory on USB pen drive.
- Copy grub files (use the pristine versions of stage1 and stage2) over.

```
fedora-9 VMware Remote Console Devices
Applications Places System cis 191 Tue Aug 12, 8:07 AM
root@fedora9:/mnt/boot/grub
File Edit View Terminal Tabs Help
[root@fedora9 grub]# vi grub.conf
[root@fedora9 grub]# cat grub.conf
# grub.conf generated by anaconda
#
# Note that you do not have to rerun grub after making changes to this file
# NOTICE: You have a /boot partition. This means that
#           all kernel and initrd paths are relative to /boot/, eg.
#           root (hd0,0)
#           kernel /vmlinuz-version ro root=/dev/sda2
#           initrd /initrd-version.img
#boot=/dev/sda1
default=0
timeout=15
splashimage=(hd0,0)/boot/grub/splash.xpm.gz
#hiddenmenu
title My Linux (boot from USB pen drive)
    root (hd0,0)
    kernel /boot/vmlinuz-2.6.25-14.fc9.i686 ro root=LABEL=/usb init=/bin/bash
    initrd /boot/initrd.img
[root@fedora9 grub]#
```

- Edit grub.conf on USB pen drive.
- Bump up timeout to 15 seconds.
- Comment out hiddenmenu so we can view boot.
- Customize title.
- Update root= on kernel line to /usb (our file system on USB pen drive).
- Add init=bin/bash to tell kernel that bash is the initial program to run
- Modify the name of the of the initial ramdisk image to match the one we made.
- Add /boot to paths for splash screen image, kernel and initial ramdisk image.



```
fedora-9 VMware Remote Console Devices
Applications Places System cis 191 Tue Aug 12, 8:11 AM
root@fedora9:~
File Edit View Terminal Tabs Help
[root@fedora9 ~]# umount /mnt
[root@fedora9 ~]# grub
Probing devices to guess BIOS drives. This may take a long time.
Unknown partition table signature

GNU GRUB version 0.97 (640K lower / 3072K upper memory)

[ Minimal BASH-like line editing is supported. For the first word, TAB
  lists possible command completions. Anywhere else TAB lists the possible
  completions of a device/filename.]
grub> root (hd1,0)
root (hd1,0)
Filesystem type is ext2fs, partition type 0x83
grub> find /boot/grub/stage1
find /boot/grub/stage1
(hd1,0)
grub> setup (hd1)
setup (hd1)
Checking if "/boot/grub/stage1" exists... yes
Checking if "/boot/grub/stage2" exists... yes
Checking if "/boot/grub/e2fs_stage1_5" exists... no
Running "install /boot/grub/stage1 (hd1) /boot/grub/stage2 p /boot/grub/grub.conf ".
.. succeeded
Done.
grub> quit
quit
[root@fedora9 ~]#
```

- umount USB pen drive
- Run grub utility
 - Root to USB pen drive partition (2nd drive, 1st partition).
 - Verify stage1 file is where it should be with find command.
 - Copy boot code to MBR or USB pen drive.

Step 7 – Test

- Insert your USB pen drive into a computer that can boot from USB.
- Your prompt will be bash-3.2#
- You are limited to bash built-in commands.
- Use cd command to navigate.
- Use echo * for ls (or issue alias ls='echo *')
- When done, use ctrl-alt-del or power button to reset or turn off.

USB pen drive when finished:

```
[root@fedora9 ~]# fdisk -l /dev/sdb
```

```
Disk /dev/sdb: 1031 MB, 1031798784 bytes
32 heads, 62 sectors/track, 1015 cylinders
Units = cylinders of 1984 * 512 = 1015808 bytes
Disk identifier: 0x0b939746
```

Device	Boot	Start	End	Blocks	Id	System
/dev/sdb1		1	1015	1006849	83	Linux

```
[root@fedora9 ~]#
```

```
[root@fedora9 ~]# dumpe2fs -h /dev/sdb1
```

```
dumpe2fs 1.40.8 (13-Mar-2008)
```

```
Filesystem volume name: /usb
```

```
Last mounted on: <not available>
```

```
Filesystem UUID: 4e92cdba-f081-4932-b6a0-e28aedd6d395
```

```
Filesystem magic number: 0xEF53
```

```
Filesystem revision #: 1 (dynamic)
```

```
Filesystem features: has_journal ext_attr resize_inode dir_index
```

```
filetype needs_recovery sparse_super large_file
```

```
Filesystem flags: signed_directory_hash
```

```
Default mount options: (none)
```

```
Filesystem state: clean
```

```
Errors behavior: Continue
```

```
Filesystem OS type: Linux
```

```
Inode count: 62976
```

```
Block count: 251712
```

```
Reserved block count: 12585
```

```
Free blocks: 241427
```

```
Free inodes: 62941
```

```
First block: 0
```

```
Block size: 4096
```

```
Fragment size: 4096
```

```
Reserved GDT blocks: 61
```

```
Blocks per group: 32768
```

```
Fragments per group: 32768
```

```
Inodes per group: 7872
```

```
Inode blocks per group: 492
```

```
Filesystem created: Tue Aug 12 07:35:44 2008
```

```
Last mount time: Tue Aug 12 08:00:33 2008
```

```
Last write time: Tue Aug 12 08:00:33 2008
```

```
Mount count: 2
```

```
Maximum mount count: 24
```

```
Last checked: Tue Aug 12 07:35:44 2008
```

```
Check interval: 15552000 (6 months)
```

```
Next check after: Sun Feb 8 06:35:44 2009
```

```
Reserved blocks uid: 0 (user root)
```

```
Reserved blocks gid: 0 (group root)
```

```
First inode: 11
```

```
Inode size: 256
```

```
Journal inode: 8
```

```
Default directory hash: tea
```

```
Directory Hash Seed: 0213de55-a866-4393-8882-9eefdda3761f
```

```
Journal backup: inode blocks
```

```
Journal size: 16M
```

```
[root@fedora9 ~]# mount /dev/sdb1 /mnt
[root@fedora9 ~]# ls -lR /mnt
/mnt:
total 52
drwxr-xr-x 2 root root 4096 2008-08-12 06:36 bin
drwxr-xr-x 3 root root 4096 2008-08-12 06:51 boot
drwxr-xr-x 2 root root 4096 2008-08-12 06:35 dev
drwxr-xr-x 2 root root 4096 2008-08-12 06:48 etc
drwxr-xr-x 2 root root 4096 2008-08-12 06:39 lib
drwx----- 2 root root 16384 2008-08-12 06:29 lost+found
drwxr-xr-x 2 root root 4096 2008-08-12 06:34 proc
drwxr-xr-x 2 root root 4096 2008-08-12 06:34 sbin
drwxr-xr-x 2 root root 4096 2008-08-12 06:34 sys
drwxrwxrwt 2 root root 4096 2008-08-12 06:34 tmp

/mnt/bin:
total 740
-rwxr-xr-x 1 root root 749832 2008-08-12 06:36 bash
lrwxrwxrwx 1 root root 4 2008-08-12 07:37 sh -> bash

/mnt/boot:
total 4688
drwxr-xr-x 2 root root 4096 2008-08-12 07:12 grub
-rw----- 1 root root 2698221 2008-08-12 06:50 initrd.img
-rwxr-xr-x 1 root root 2088288 2008-08-12 06:48 vmlinuz-2.6.25-14.fc9.i686

/mnt/boot/grub:
total 192
-rw----- 1 root root 593 2008-08-12 07:12 grub.conf
-rw-r--r-- 1 root root 66003 2008-08-12 06:52 splash.xpm.gz
-rw-r--r-- 1 root root 512 2008-08-12 06:51 stage1
-rw-r--r-- 1 root root 110532 2008-08-12 06:51 stage2

/mnt/dev:
total 0
crw----- 1 root root 5, 1 2008-08-12 06:35 console

/mnt/etc:
total 4
-rw-r--r-- 1 root root 774 2008-08-12 06:48 fstab

/mnt/lib:
total 1980
-rwxr-xr-x 1 root root 135940 2008-08-12 06:39 ld-linux.so.2
-rwxr-xr-x 1 root root 1755052 2008-08-12 06:38 libc.so.6
-rwxr-xr-x 1 root root 18568 2008-08-12 06:38 libdl.so.2
-rwxr-xr-x 1 root root 96040 2008-08-12 06:38 libtinfo.so.5

/mnt/lost+found:
total 0

/mnt/proc:
total 0

/mnt/sbin:
total 0
```

```
/mnt/sys:  
total 0
```

```
/mnt/tmp:  
total 0  
[root@fedora9 ~]#
```