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Xen Cluster Management With Ganeti On Debian Etch

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Ganeti is a cluster virtualization management system based on **Xen**. In this tutorial I will explain how to create one virtual Xen machine (called an *instance*) on a cluster of two physical nodes, and how to manage and failover this instance between the two physical nodes.

This document comes without warranty of any kind! I do not issue any guarantee that this will work for you!

1 Preliminary Note

Ganeti is still in an early stage. Right now, it can be installed on Debian Etch nodes, and you can create virtual machines with it that use Debian Etch as well. Other Linux distributions should theoretically work, too, but there's no documentation yet.

In this tutorial I will use the physical nodes *node1.example.com* and *node2.example.com*:

- *node1.example.com*: IP address *192.168.0.100*; will be the master of the cluster.
- *node2.example.com*: IP address *192.168.0.101*; will be the primary node of the virtual machine (aka *instance*).

Both have a 50GB hard drive of which I use 10GB for the */* partition, 1GB for swap, and leave the rest unpartitioned so that it can be used by Ganeti (the minimum is 20GB!). Of course, you can change the partitioning to your liking, but remember about the minimum unused space.

The cluster I'm going to create will be named *cluster1.example.com*, and it will also have the IP address *192.168.0.100*.

The Xen virtual machine (called an *instance* in Ganeti speak) will be named *inst1.example.com* with the IP address *192.168.0.105*. *inst1.example.com* will be mirrored between the two physical nodes using **DRBD** - you can see this as a kind of network RAID1.

As you see, *node1.example.com* will be the cluster master, i.e. the machine from which you can control and manage the cluster, and *node2.example.com* will be the primary node of *inst1.example.com*, i.e. *inst1.example.com* will run on *node2.example.com* (with all changes on *inst1.example.com* mirrored back to *node1.example.com* with DRBD) until your fail it over to *node1.example.com* (if you want to take down *node2.example.com* for maintenance, for example). This is an active-passive configuration.

I think it's good practice to split up the roles between the two nodes, so that you don't lose the cluster master and the primary node at once should one node go down.

In my tests I was using two systems with 204MB RAM each for *node1* and *node2*. This is pretty low, and you should use considerably more RAM, especially on production systems. For my tests it was ok, though. Because of the low RAM, I restricted my Xen *dom0*s (*node1* and *node2*) to use 64MB RAM. The **Ganeti installation guide** says that 512MB are reasonable - I think 256MB should work, too. Anyway, your system must have more RAM than what you specify for *dom0* so that enough RAM is left over for the virtual machine(s).

One last thing to note is that all hostnames mentioned here should be resolvable to all hosts, which means that they must either exist in DNS, or you must put all hostnames in all */etc/hosts* files on all hosts (which is what I will do here).

Ok, let's start...

2 Installing A Base Debian System On The Physical Nodes

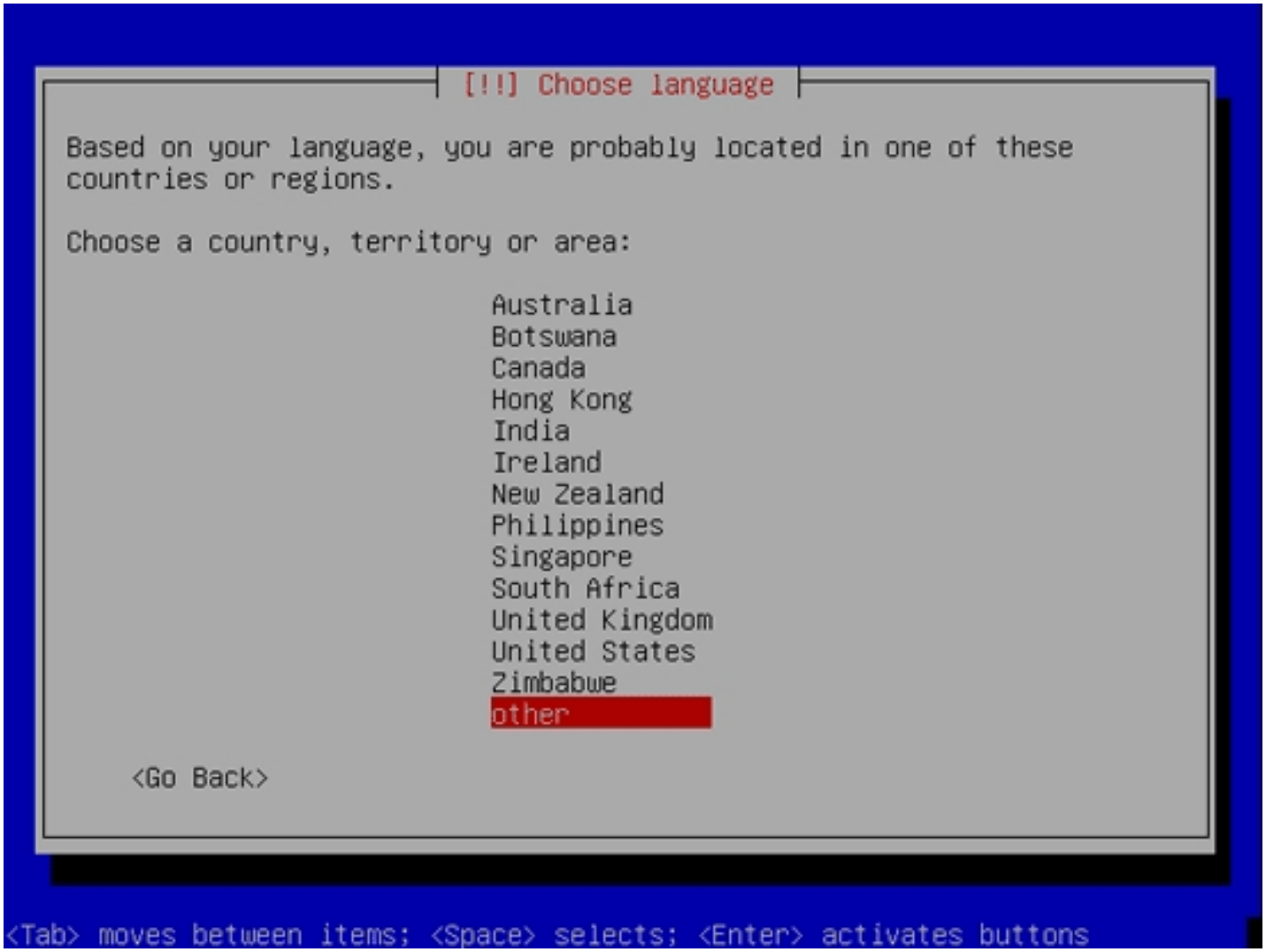
Set up a minimal Debian Etch systems on both node1 and node2:

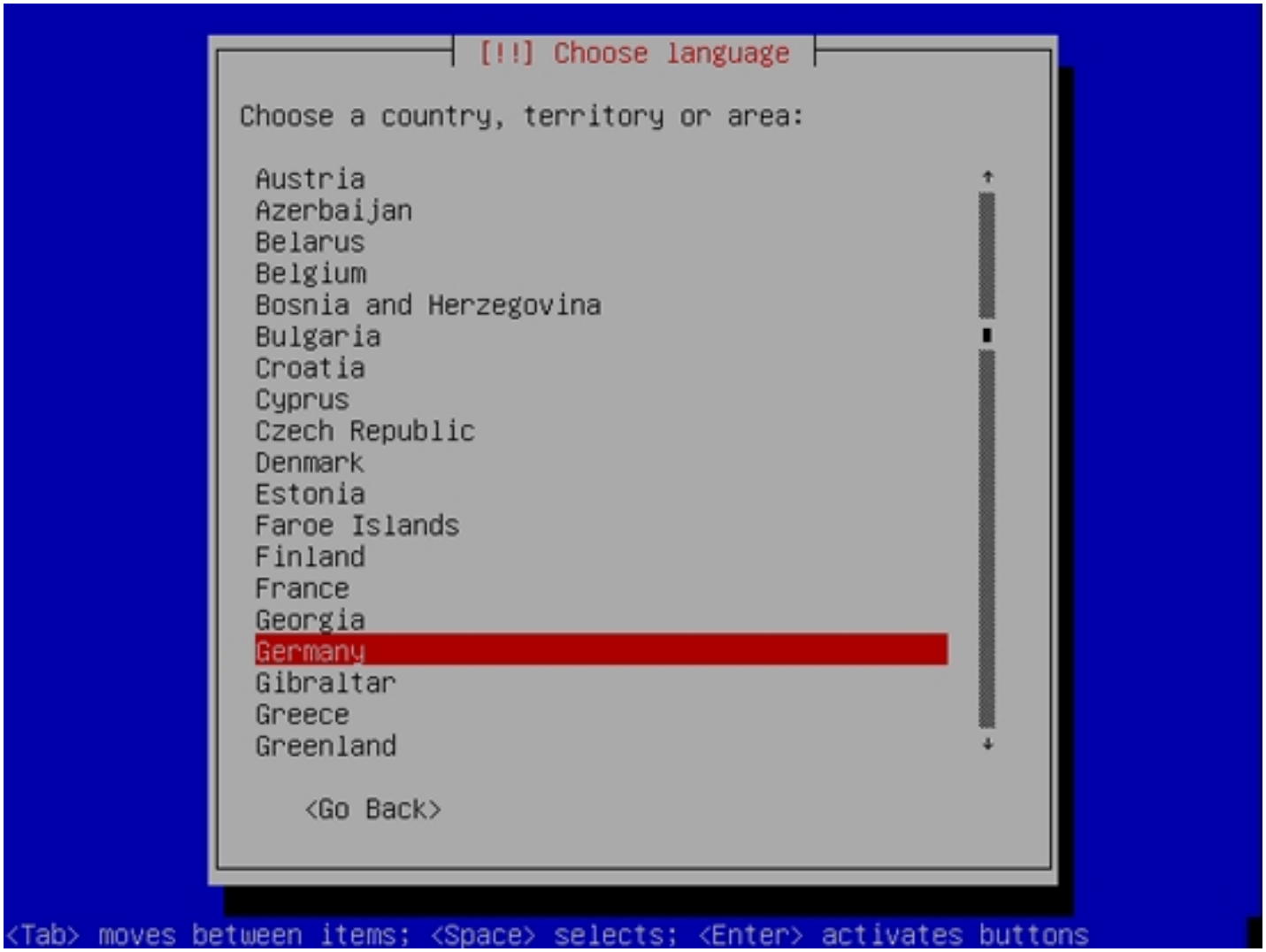
node1/node2:

Insert your **Debian Etch Netinstall CD** into your system and boot from it. Press *ENTER* to boot:

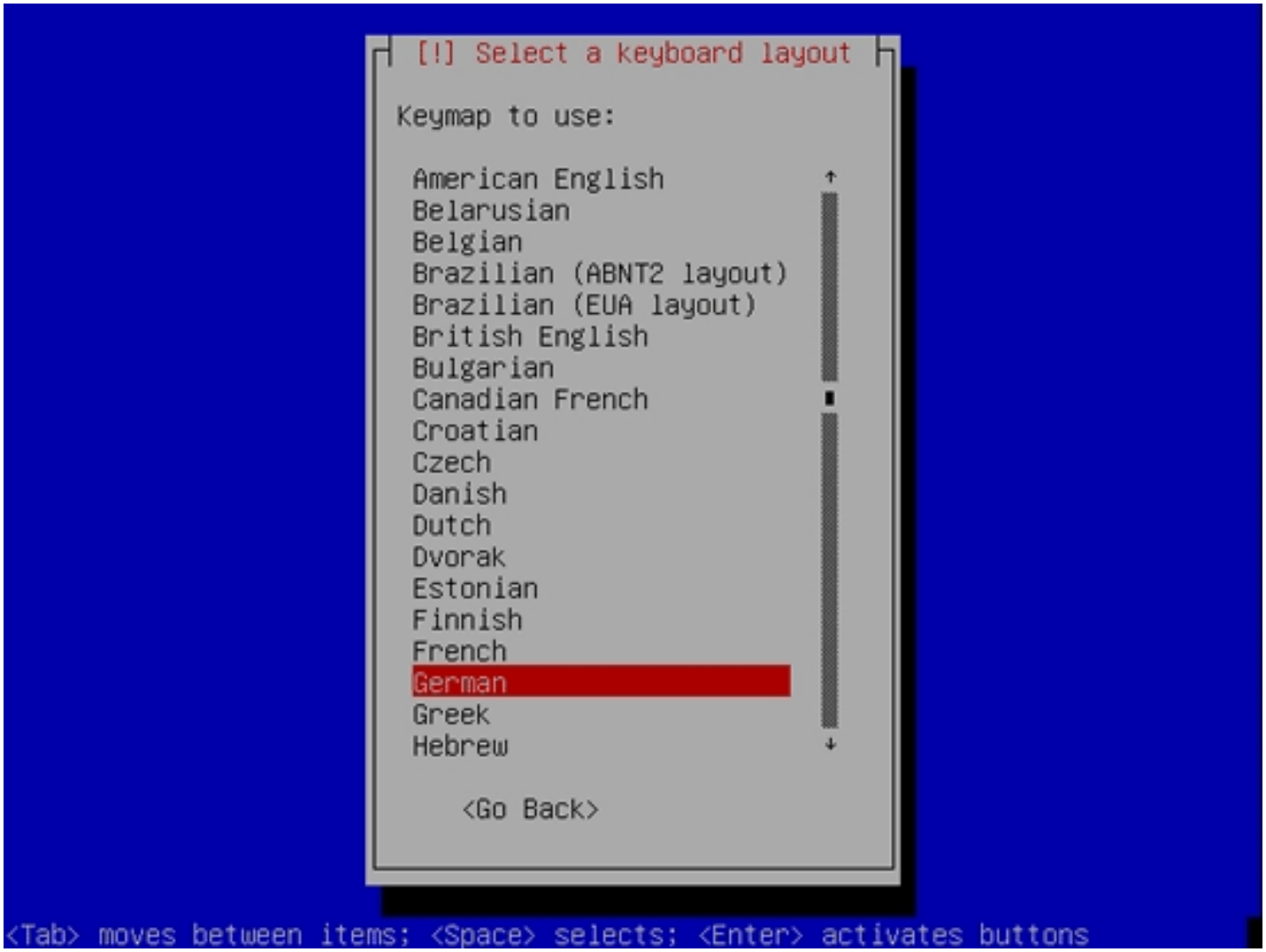
The installation starts, and first you have to choose your language:

Then select your location:

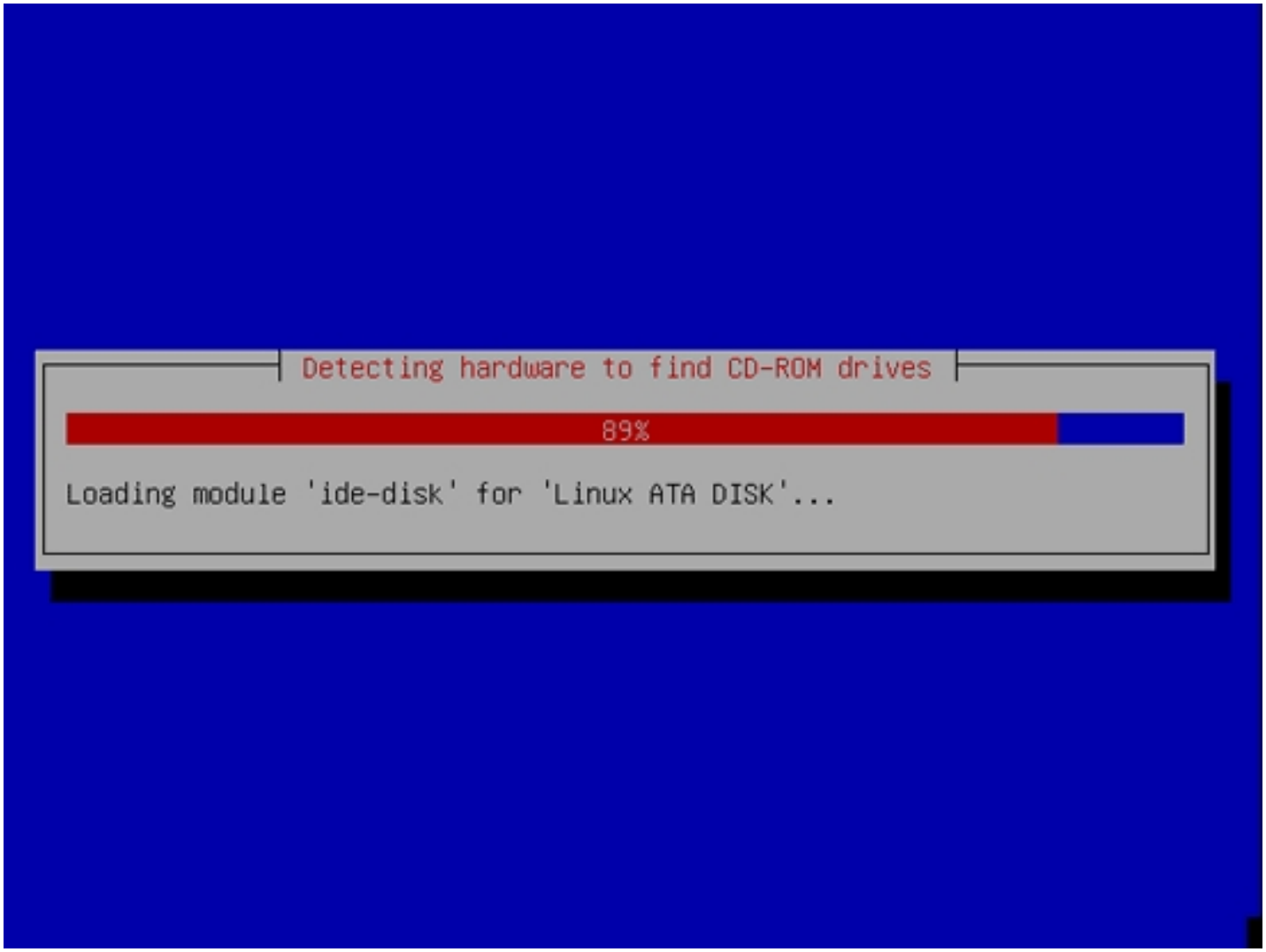




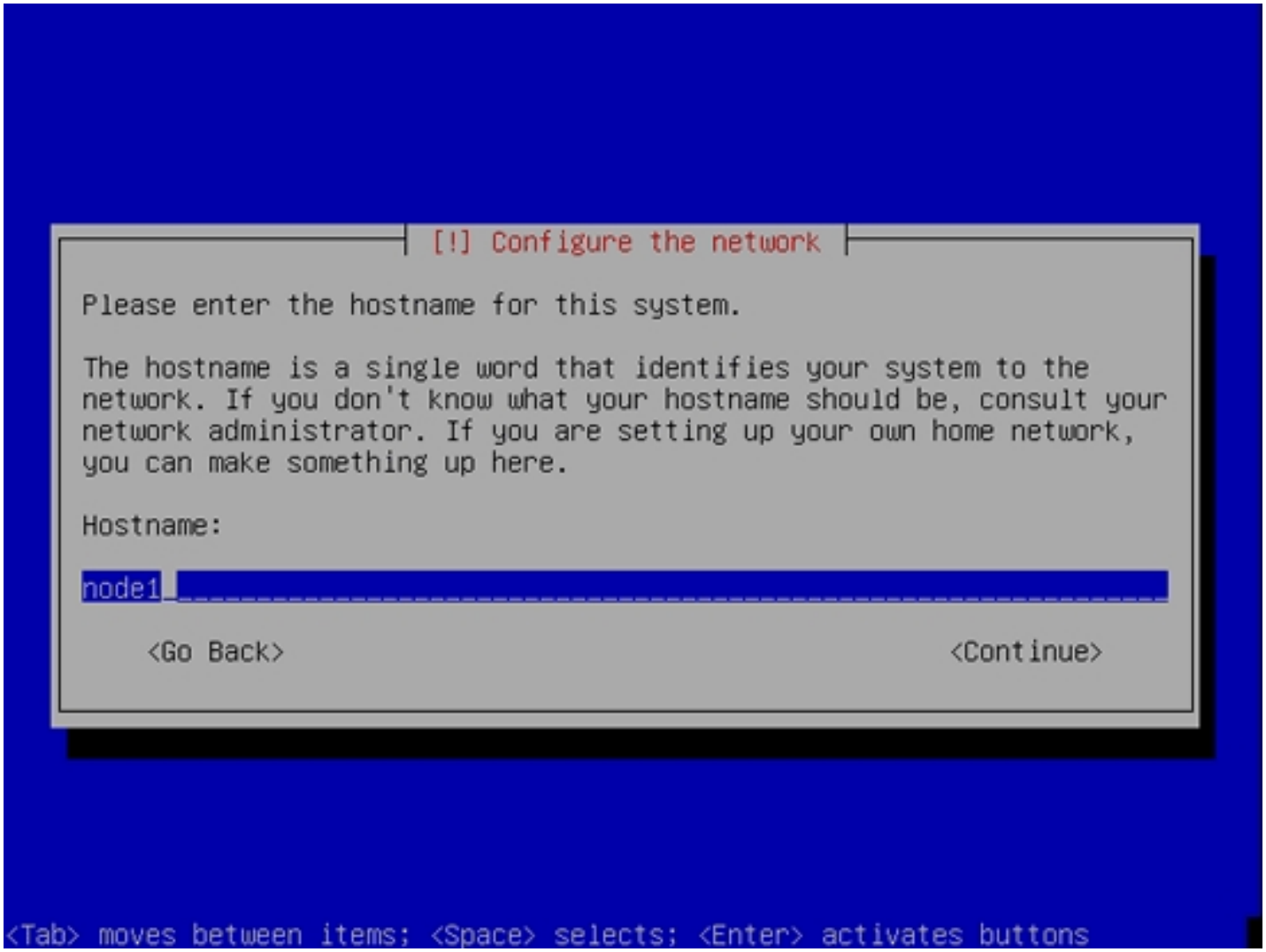
Choose a keyboard layout:



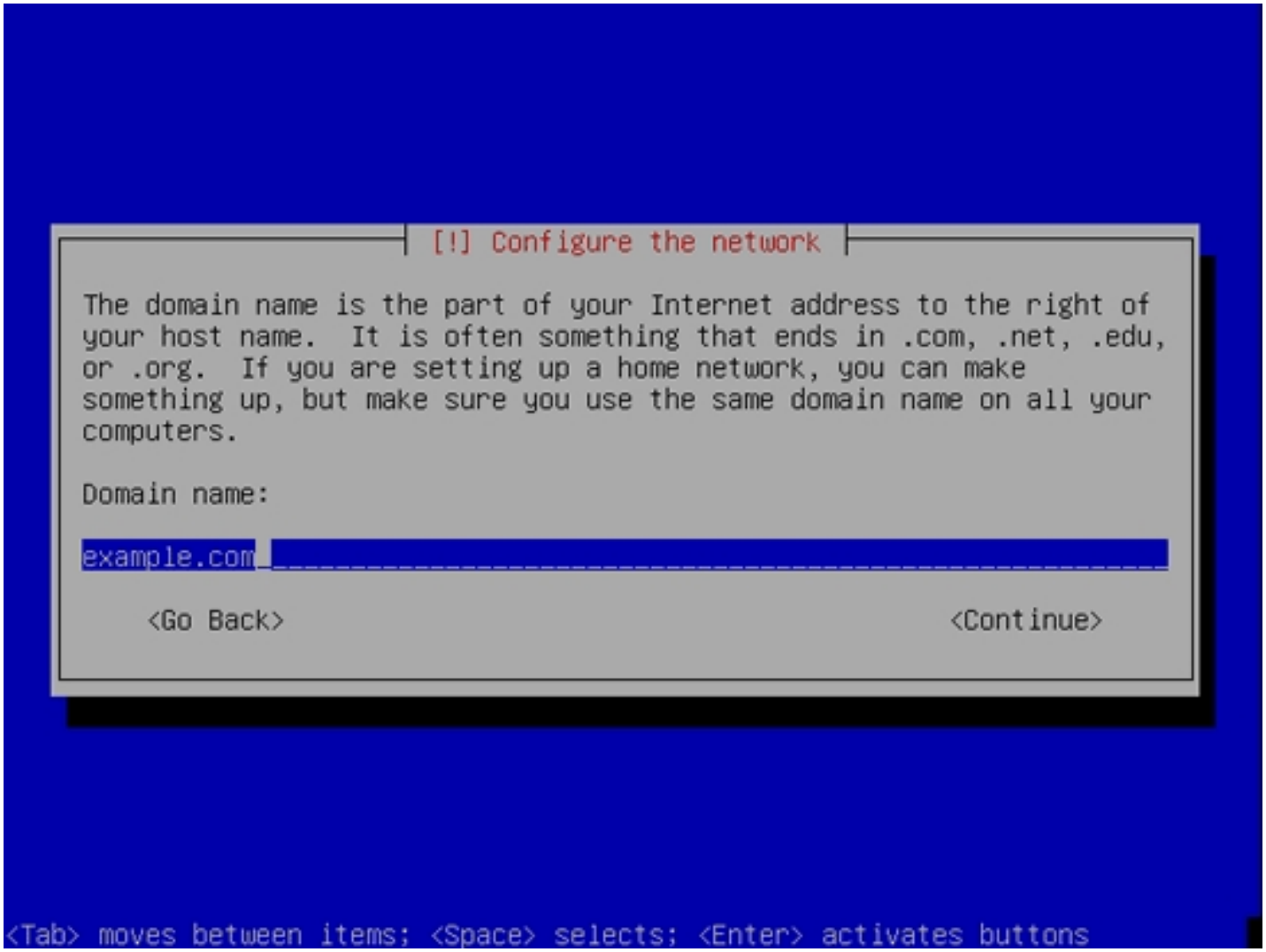
The installer checks the installation CD, your hardware, and configures the network with DHCP if there is a DHCP server in the network:



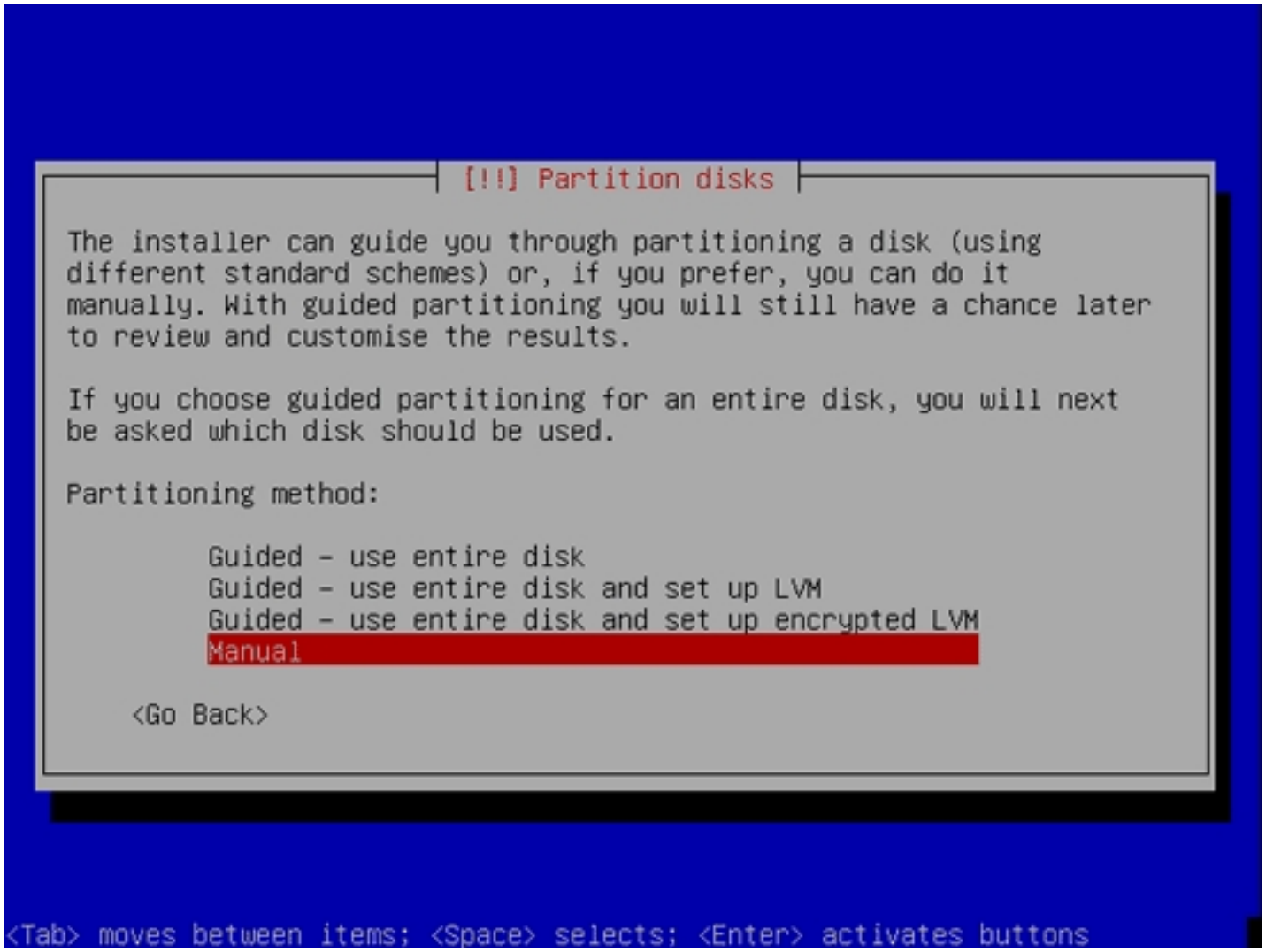
Enter the hostname. For *node1.example.com*, enter *node1*, for *node2.example.com*, enter *node2*:



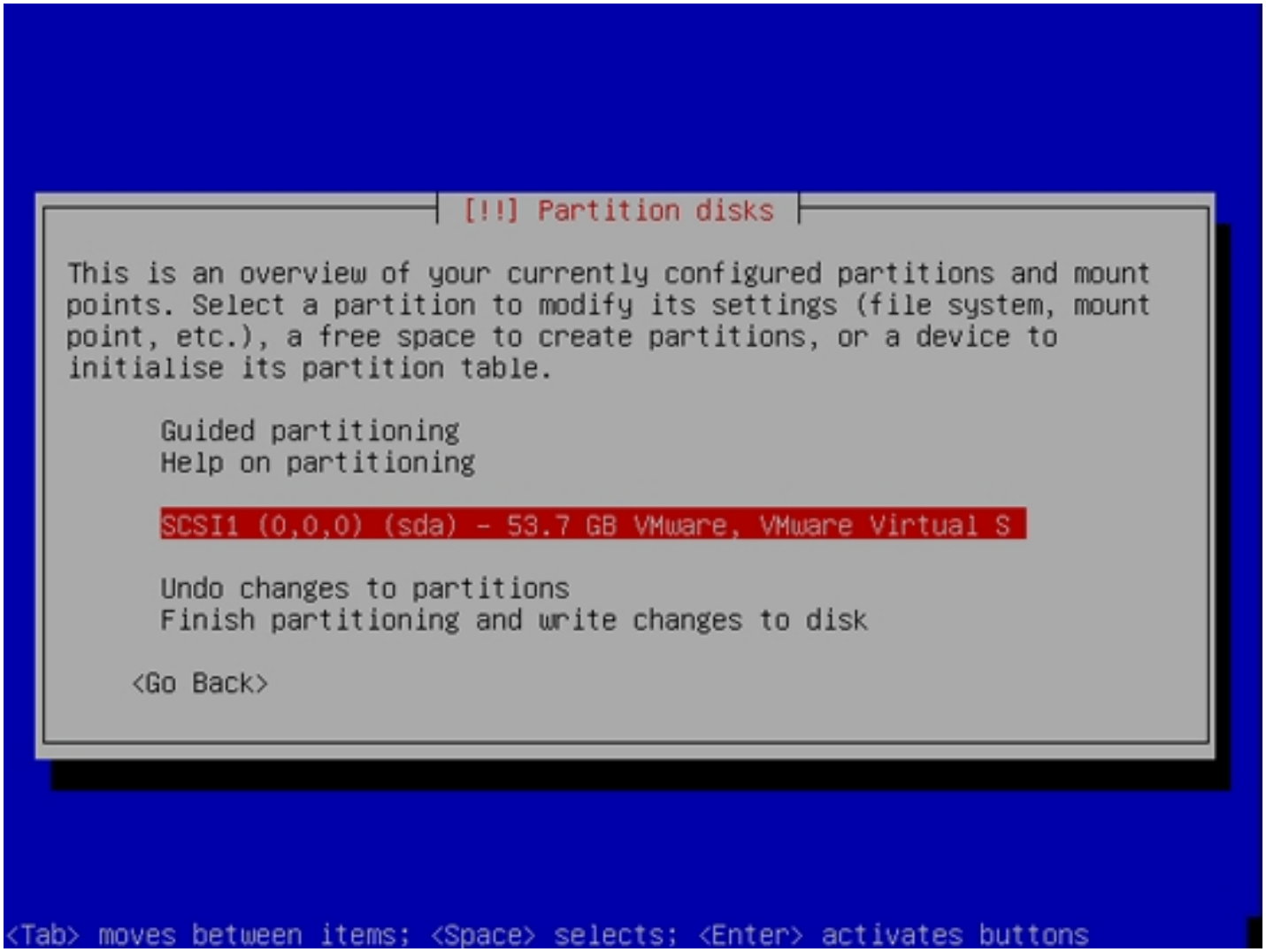
Enter your domain name. In this example, this is *example.com*:



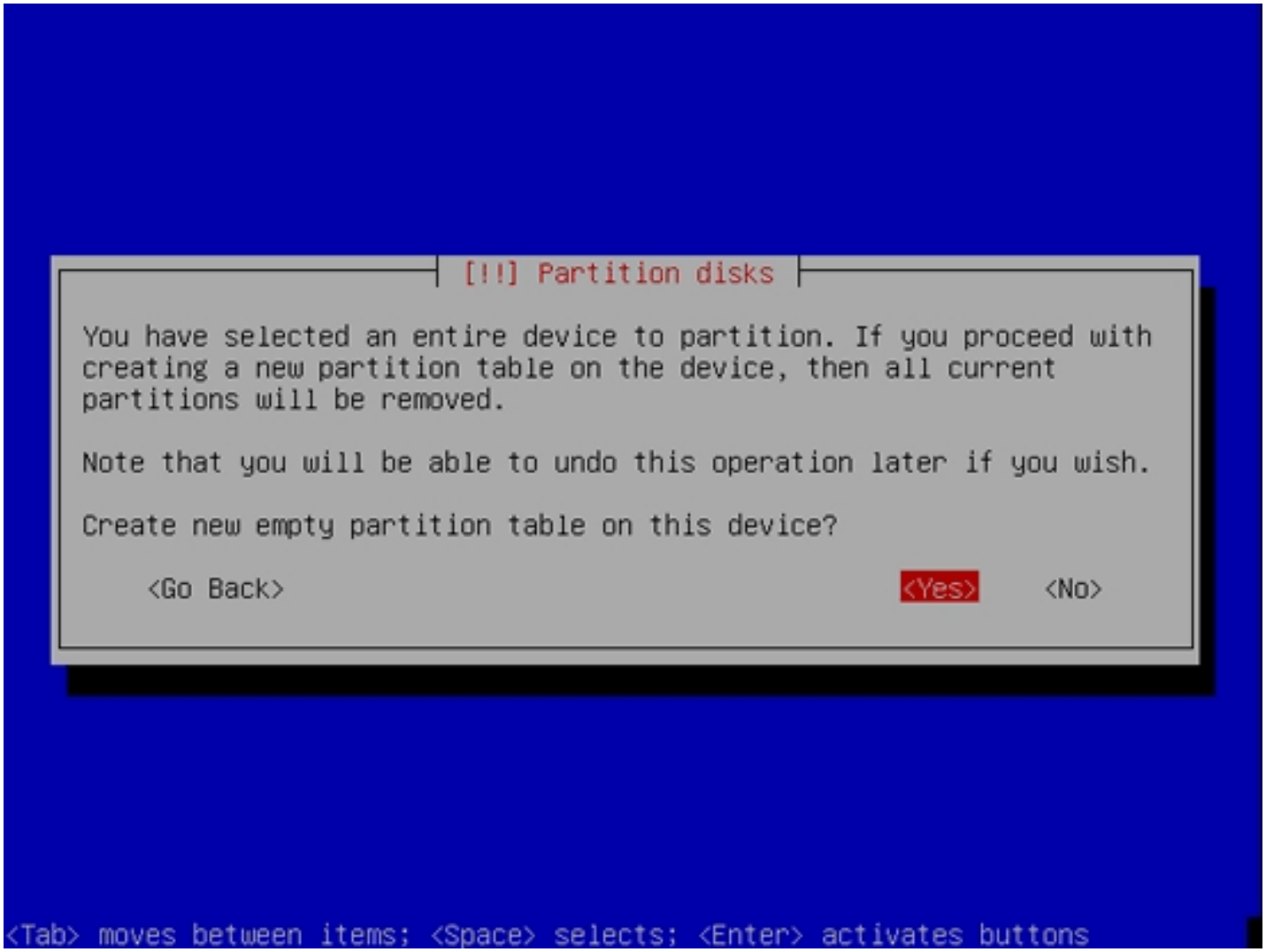
Now we have to partition the hard drive. As stated in chapter 1, I want a 10GB / partition, a 1GB swap partition, and leave the rest unpartitioned. Select *Manual* as the partitioning method:



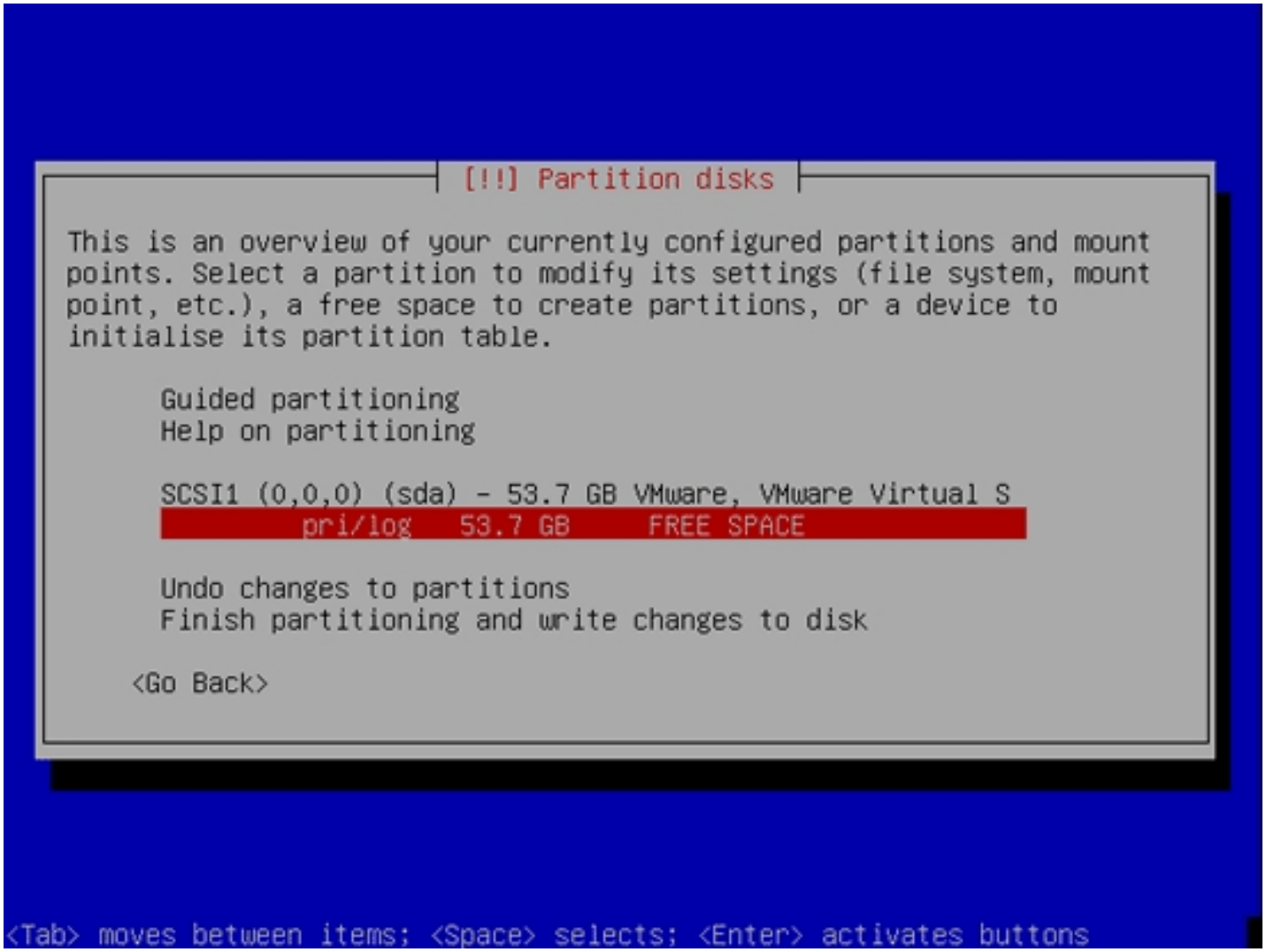
Select the hard drive:



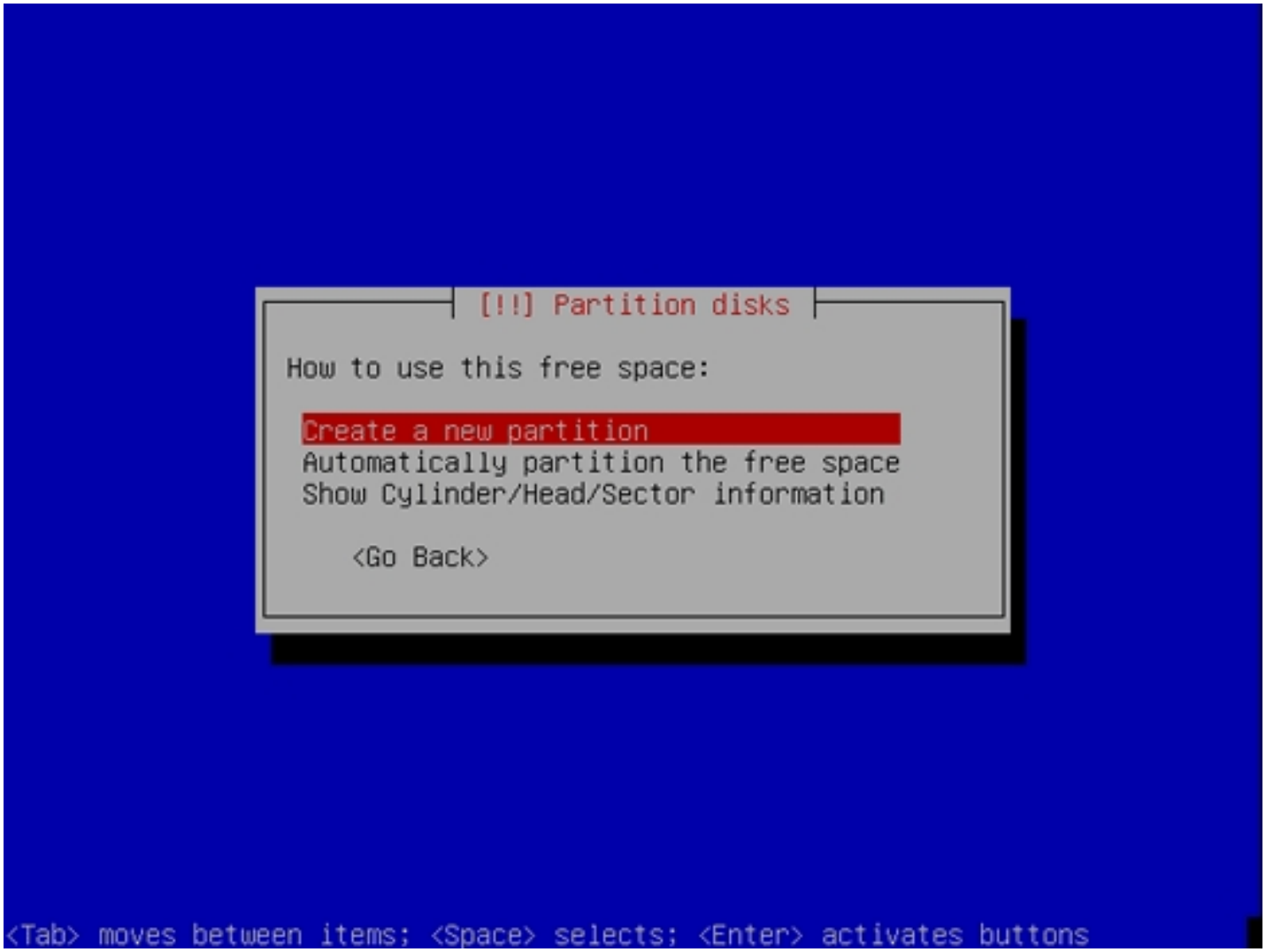
Select *Yes* when you are asked *Create new empty partition table on this device?*:



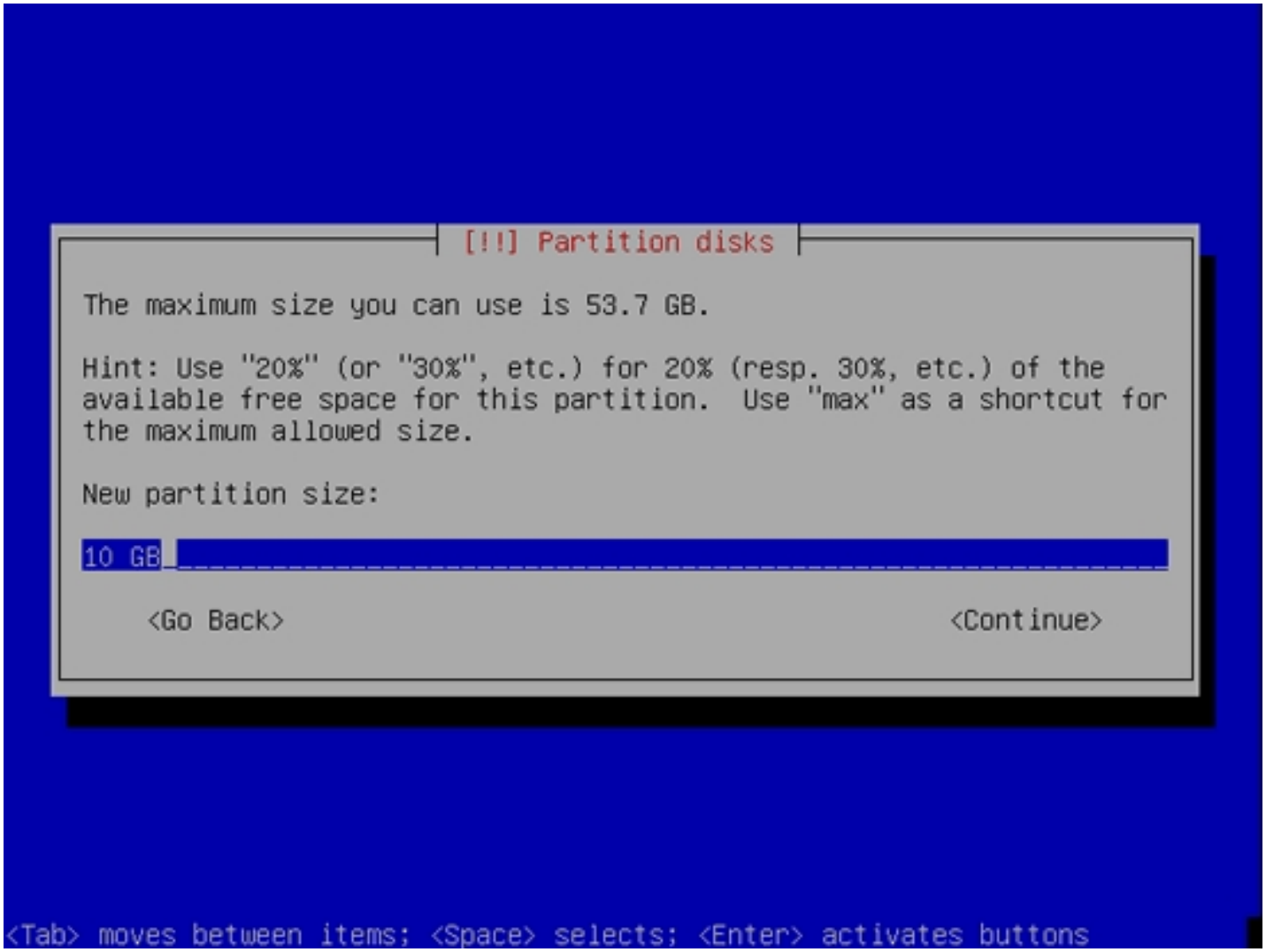
Select the free space on the hard drive:



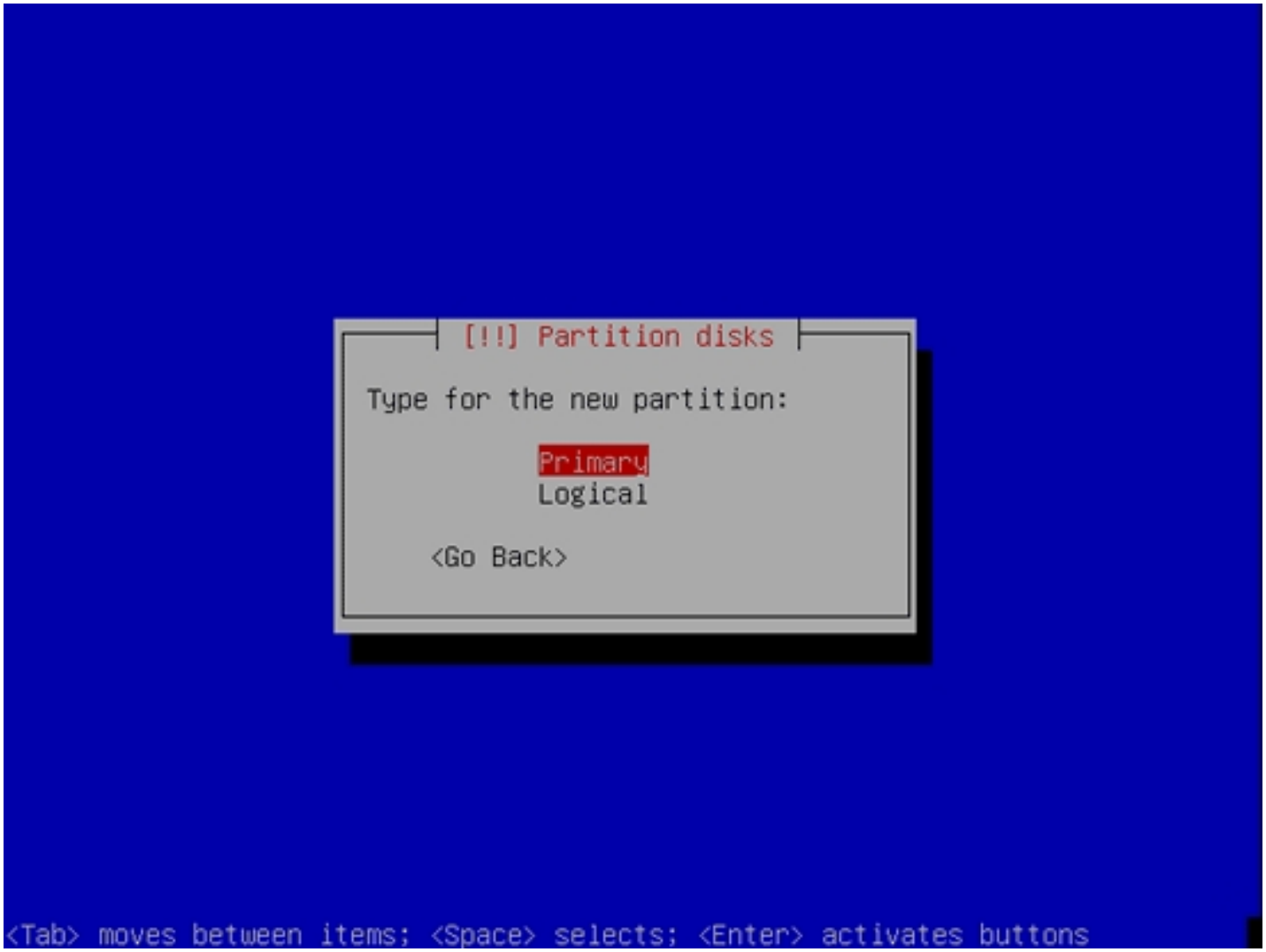
Choose *Create a new partition*:



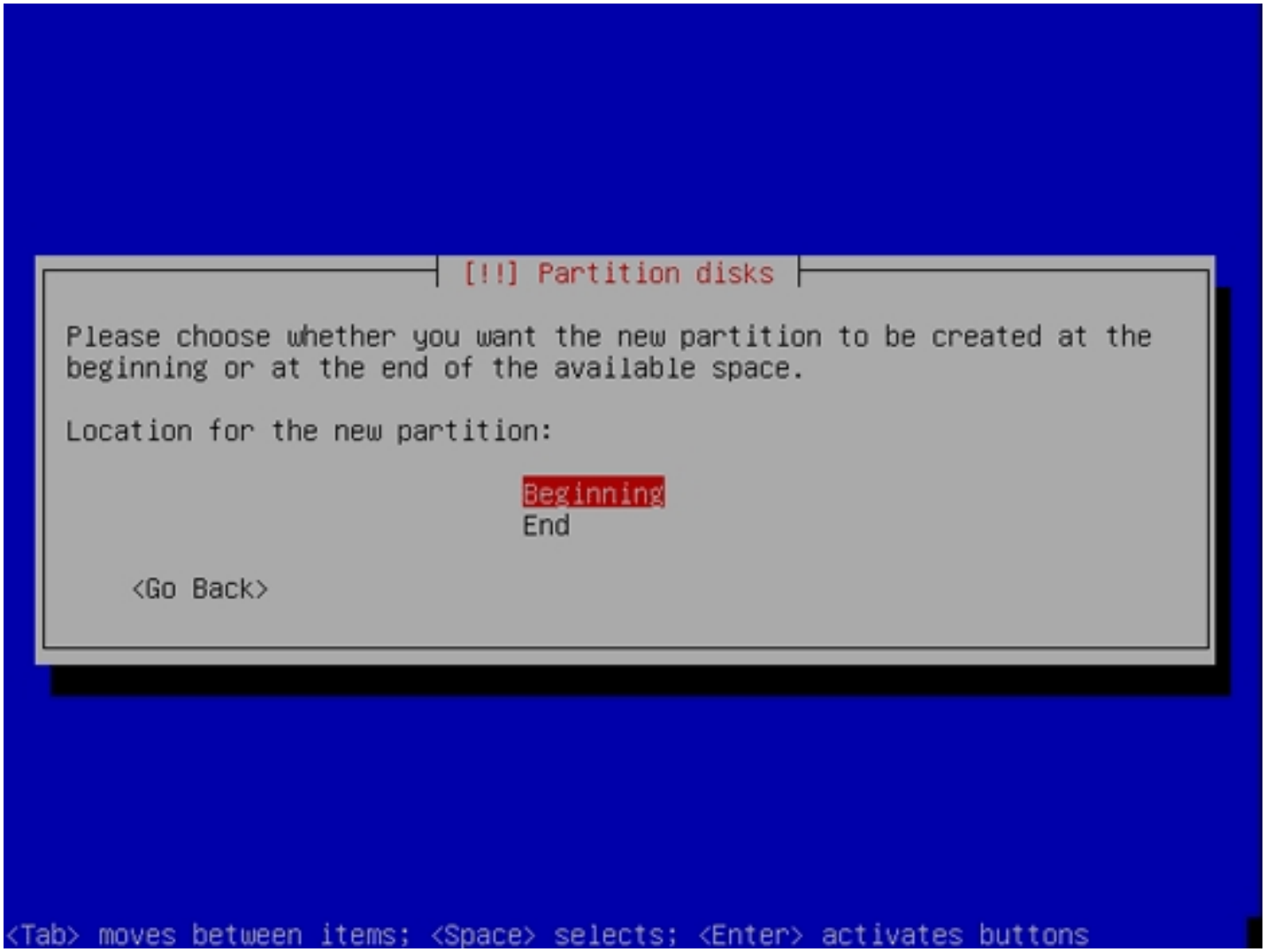
Enter 10 GB as the partition size (or whatever size you want the / partition to have):



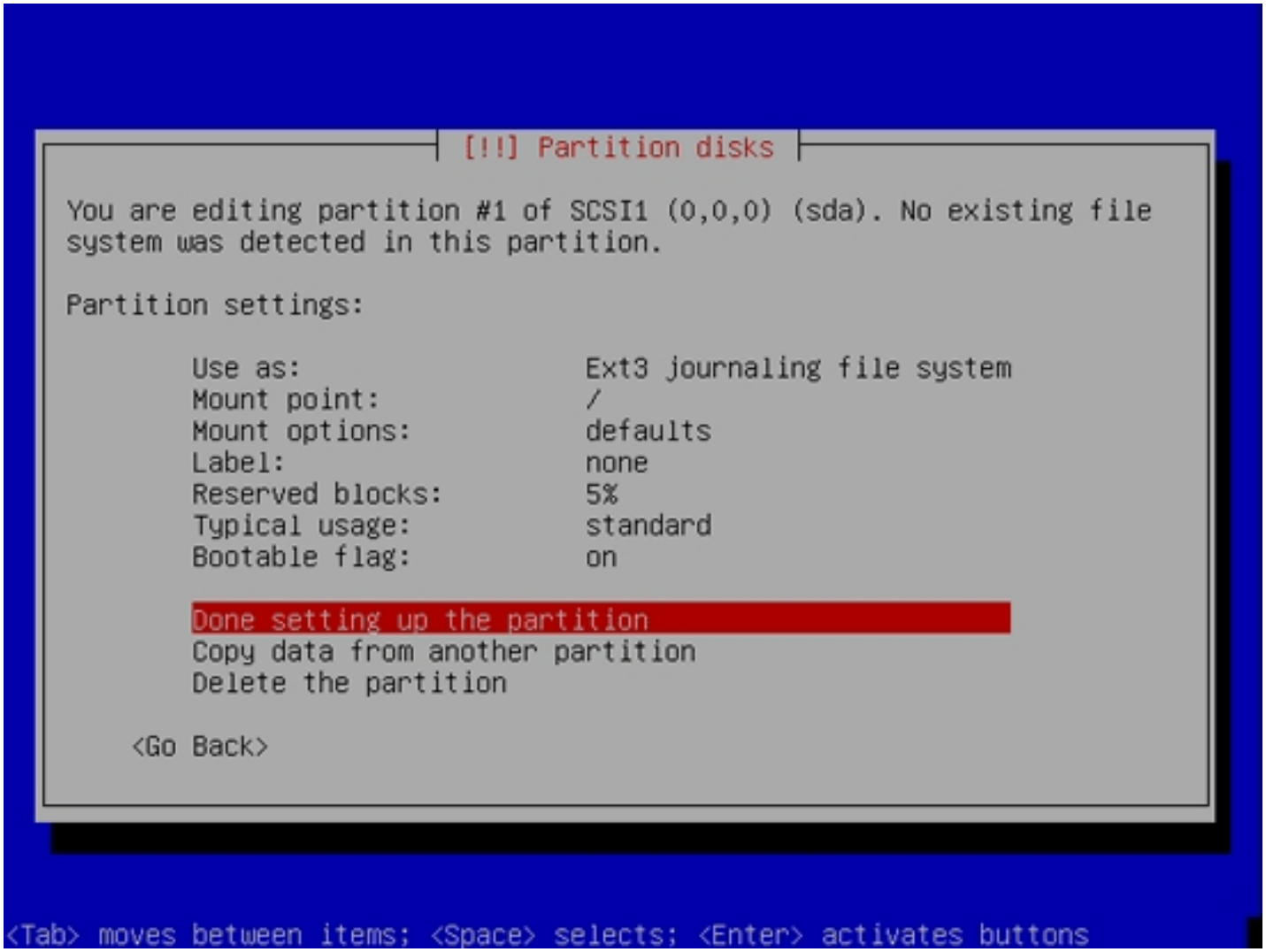
Choose *Primary* as the partition type:



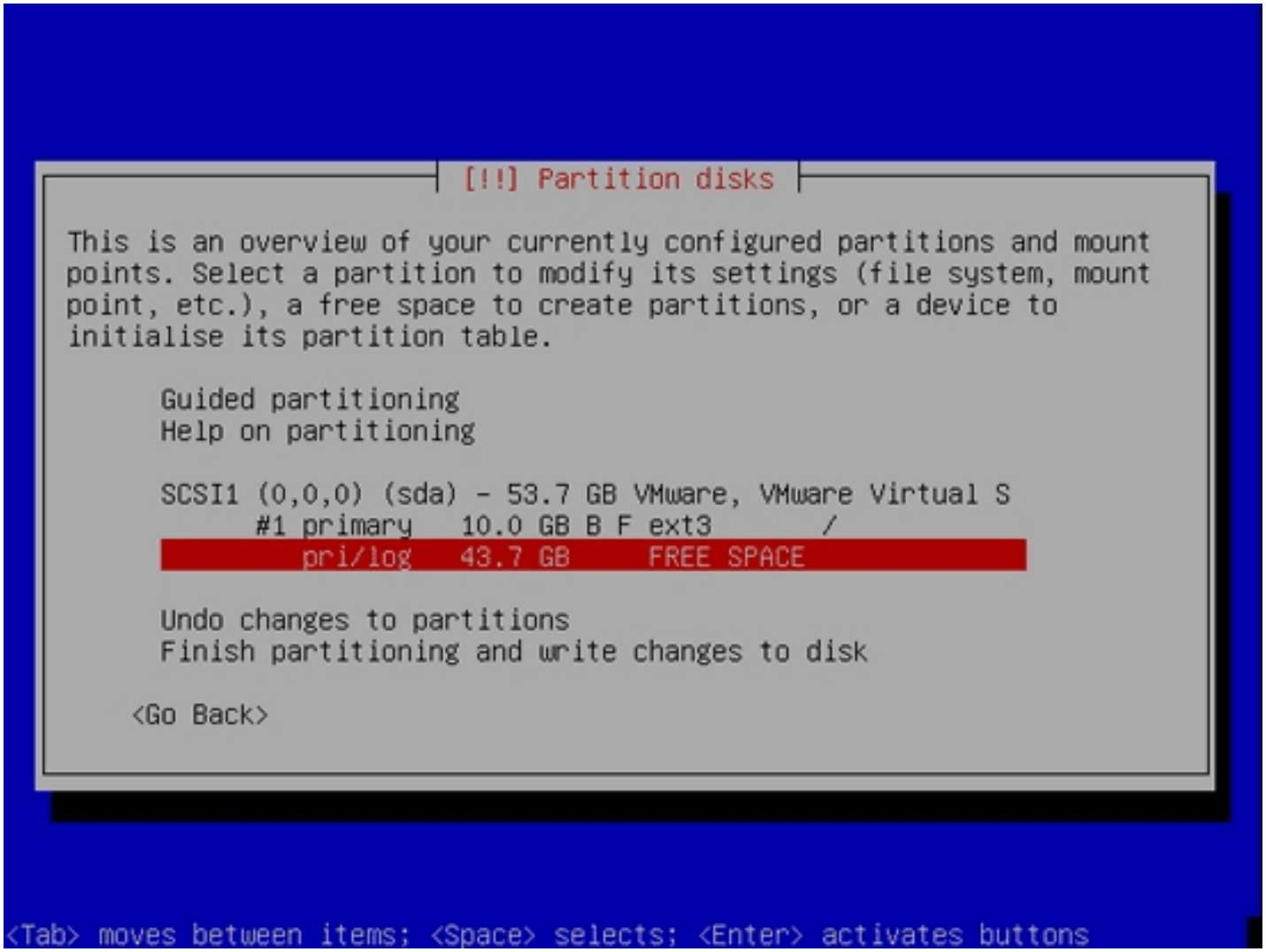
Select *Beginning*:



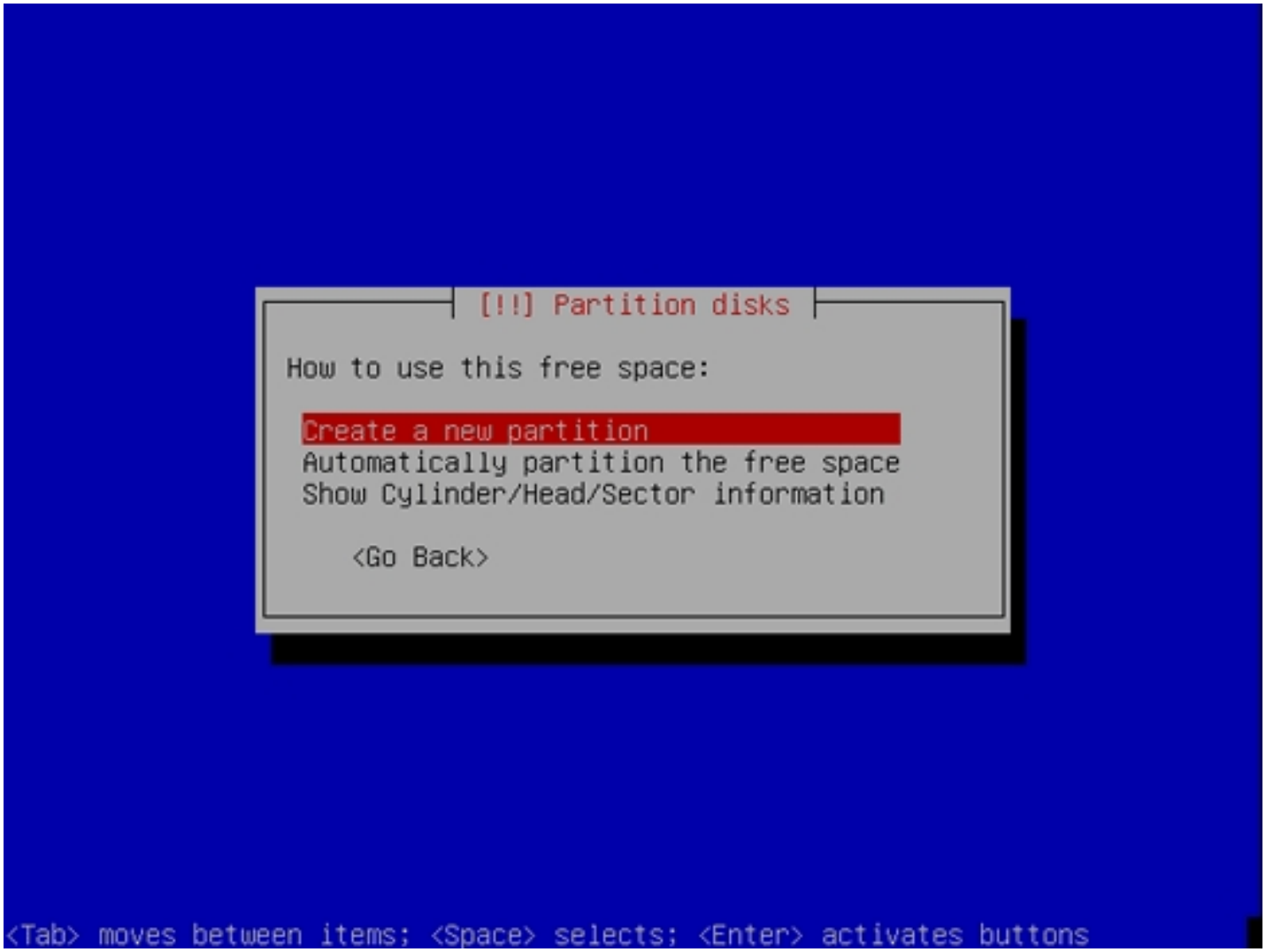
Make sure that you set the *Bootable flag* to *on*, then select *Done setting up the partition*:



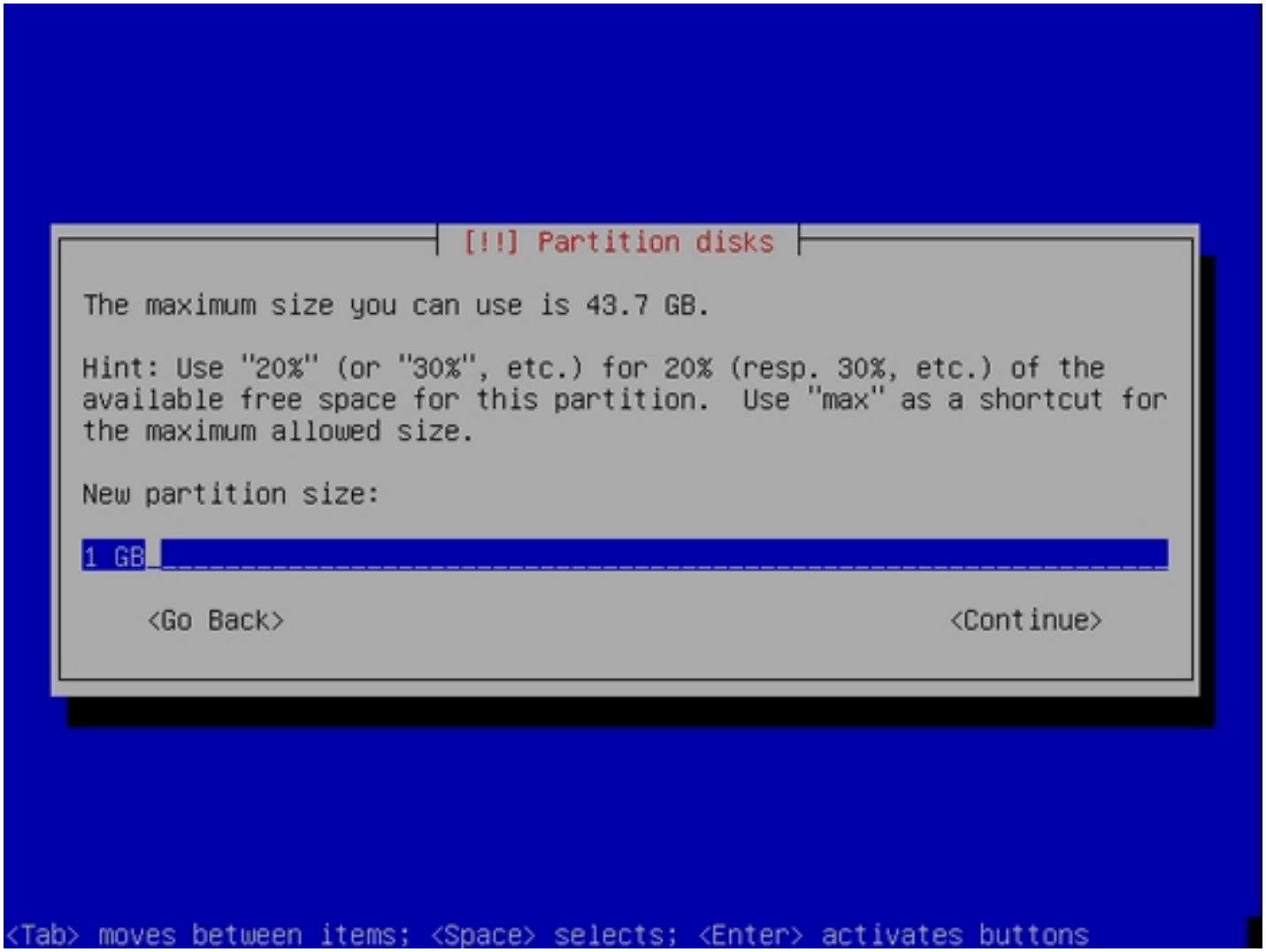
The / partition is not set up. Now let's create the swap partition. Select the free space again:



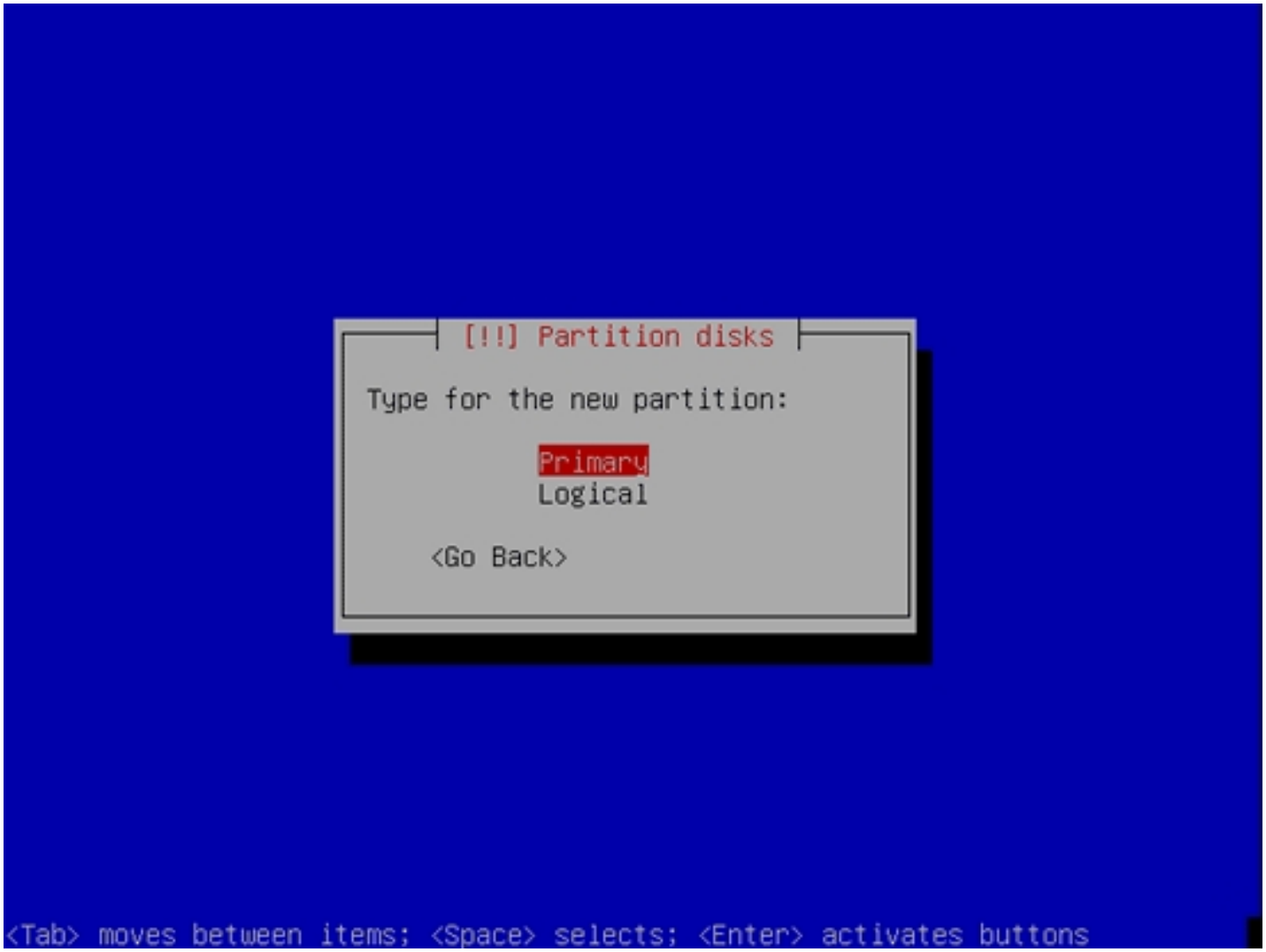
Pick *Create a new partition* again:



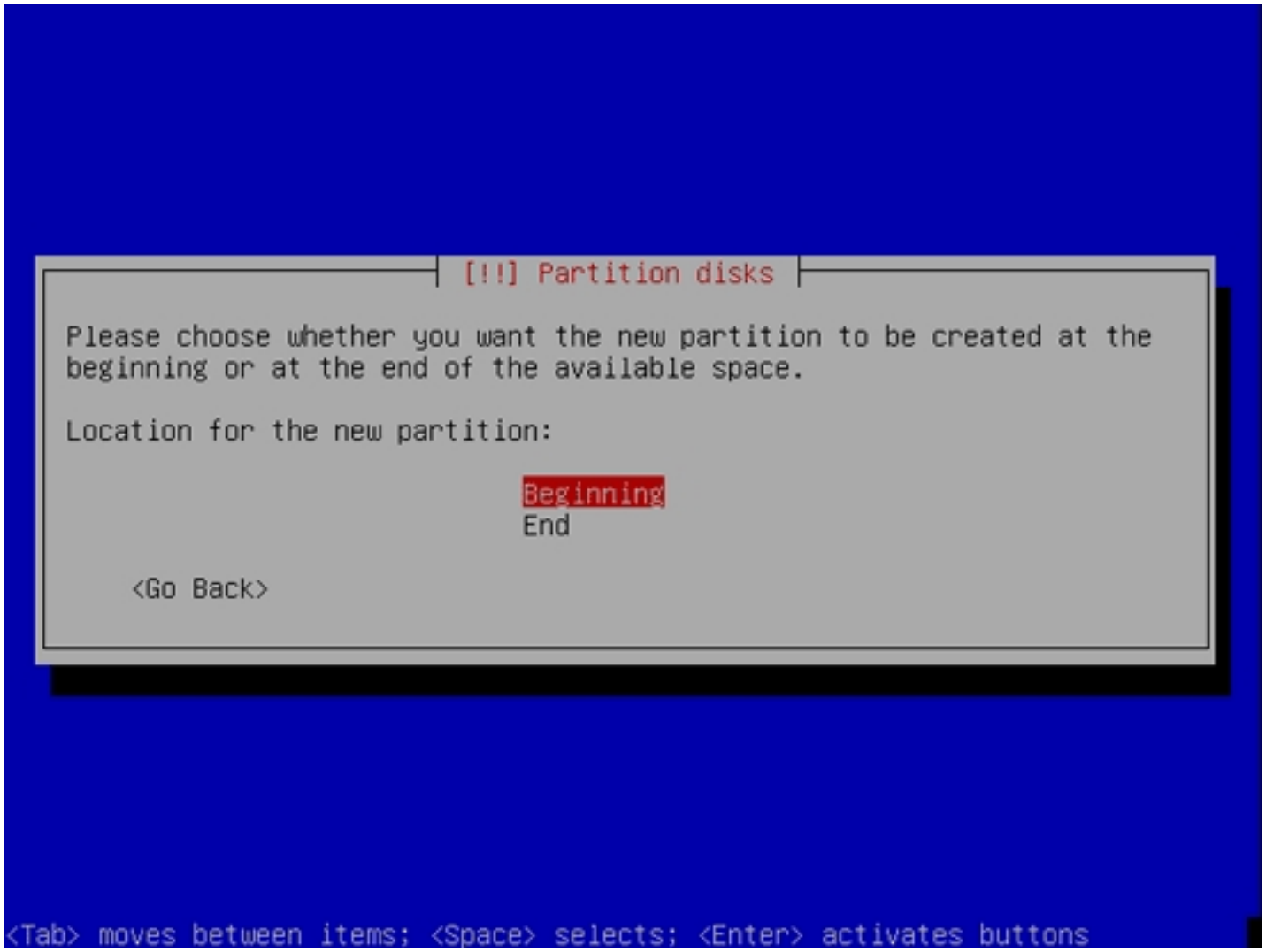
Enter 1 GB as the size of the partition (or whatever size you want the swap partition to have):



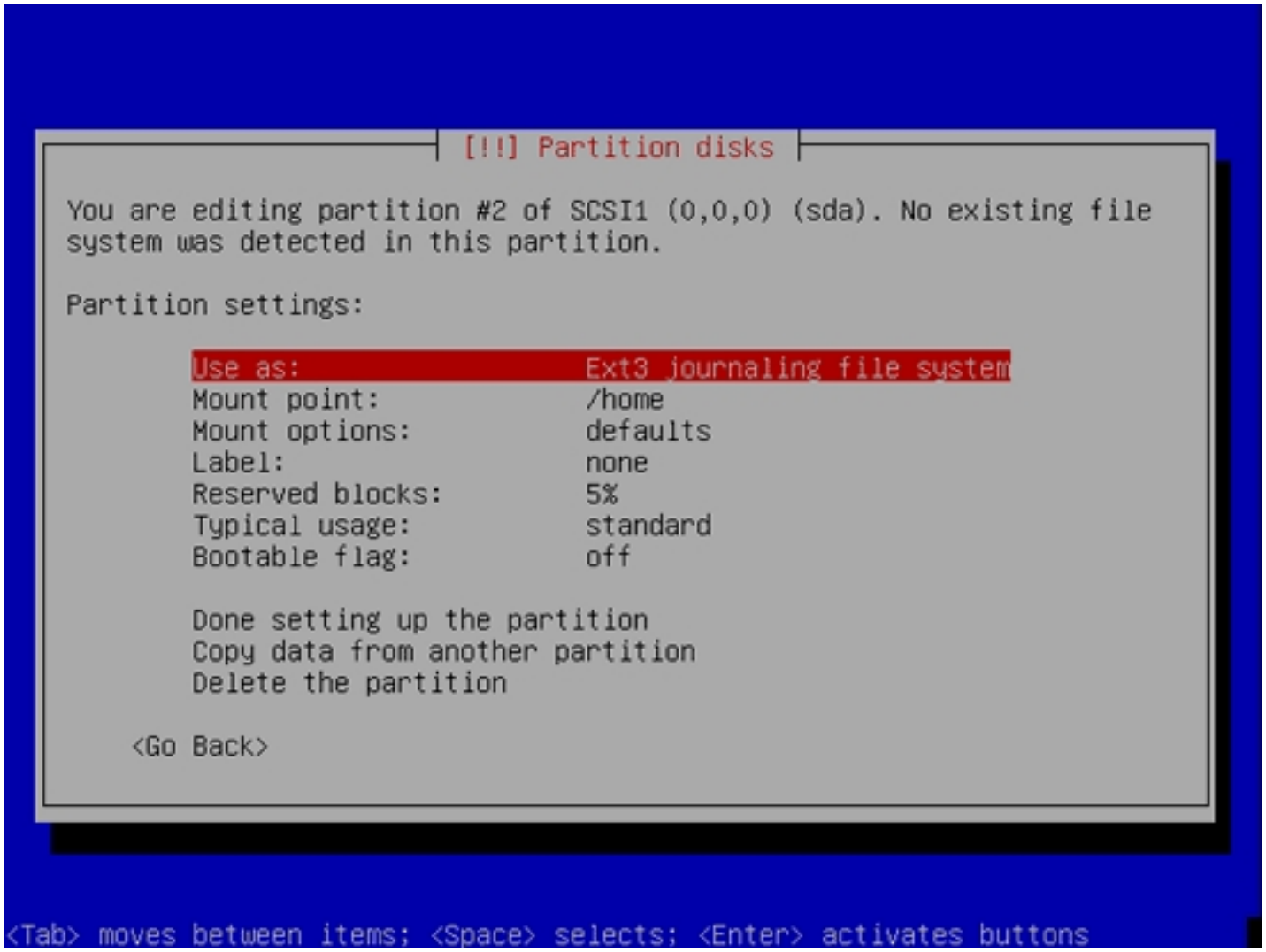
Choose *Primary*:



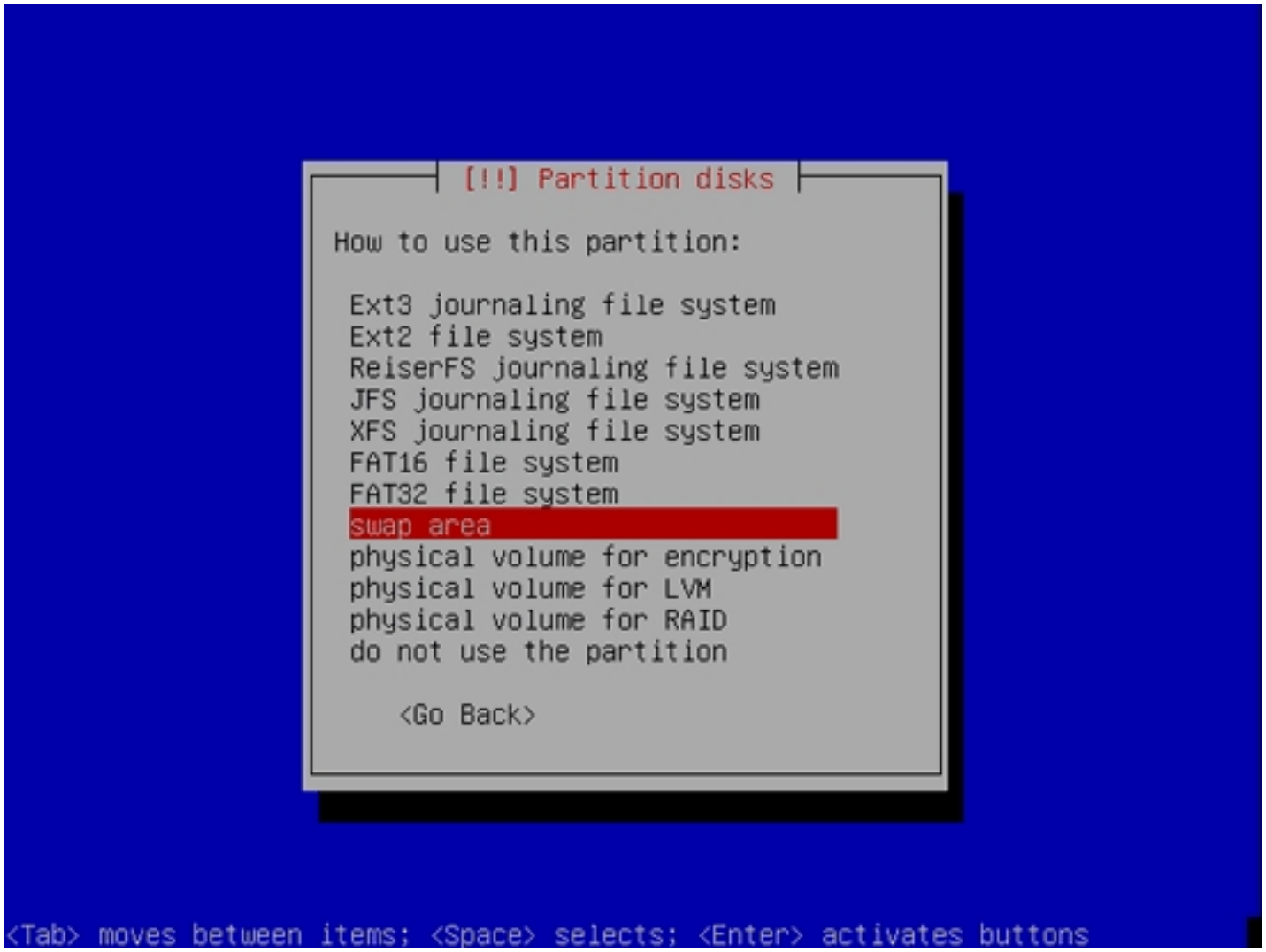
Select *Beginning*:



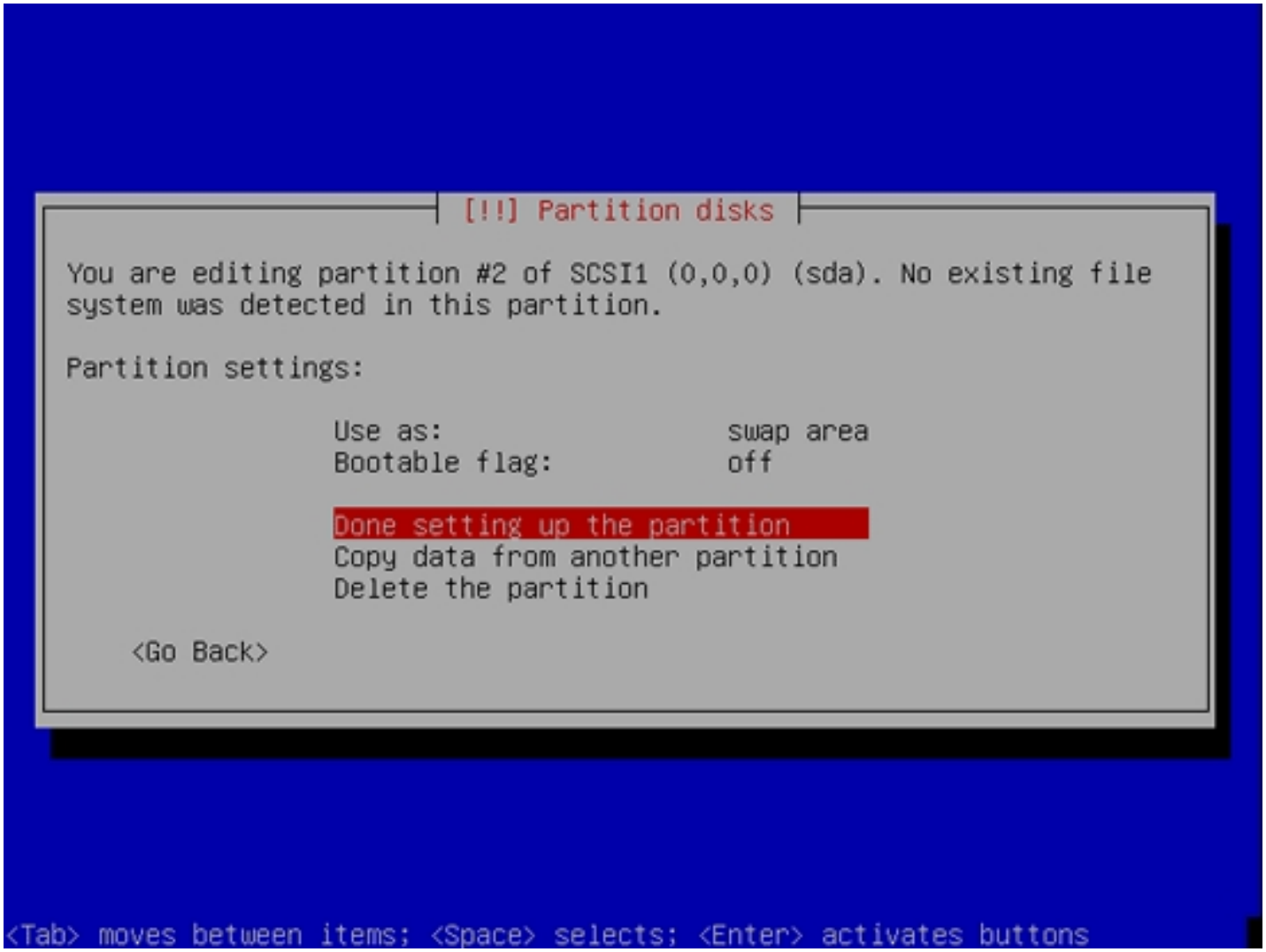
Then move to the *Use as:* row and press *ENTER*:



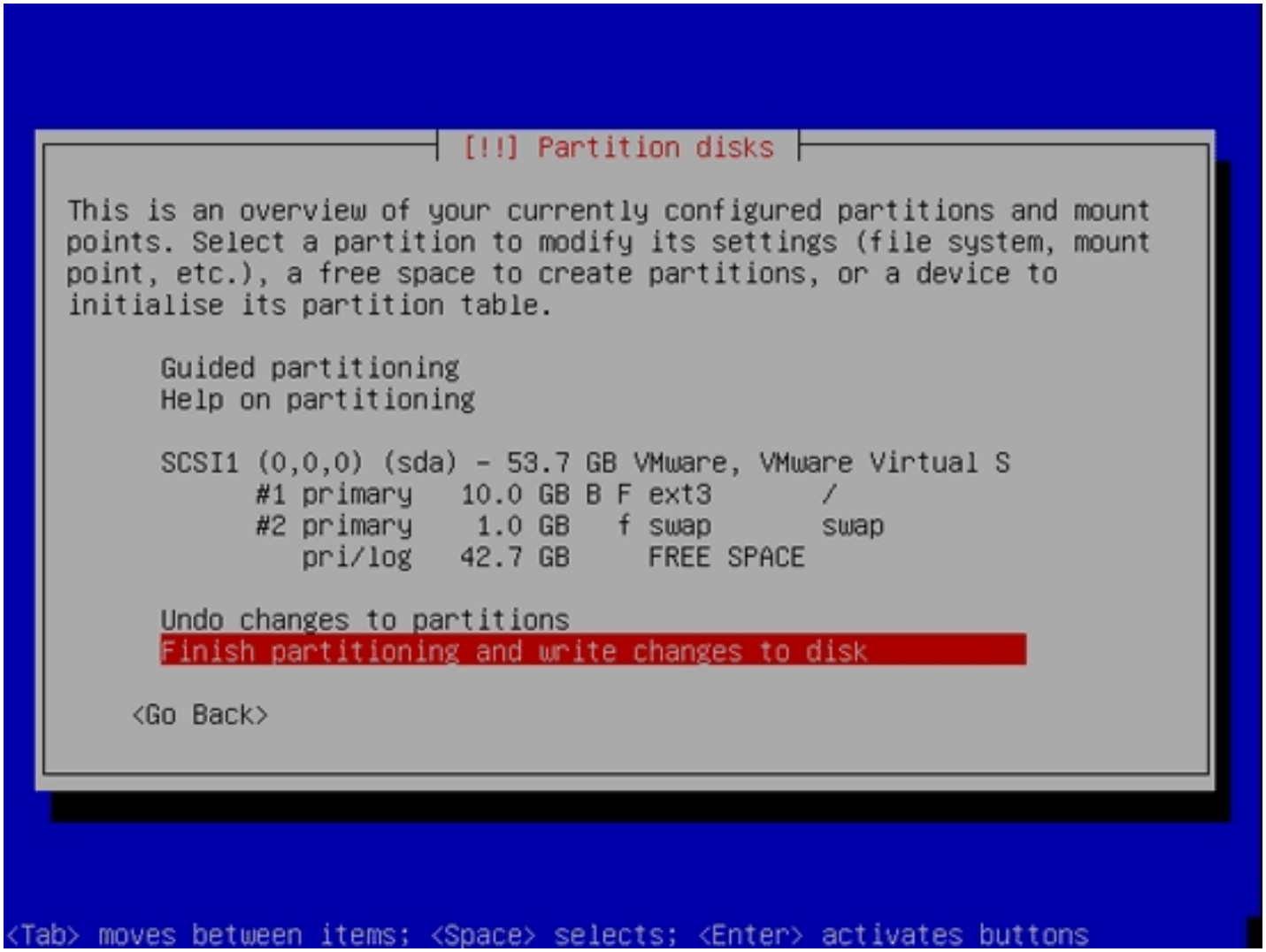
Select *swap area*:



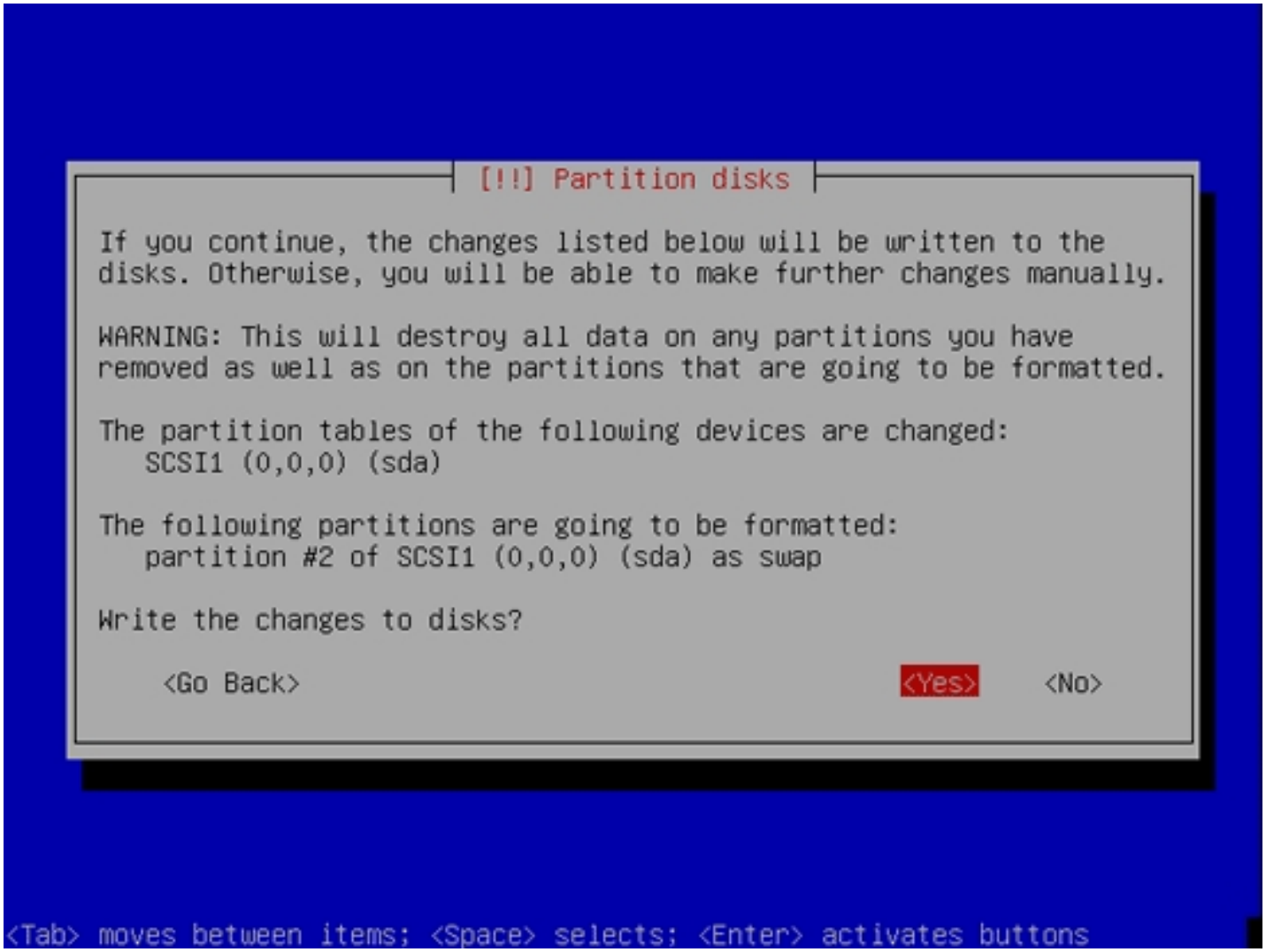
Afterwards, choose *Done setting up the partition*:



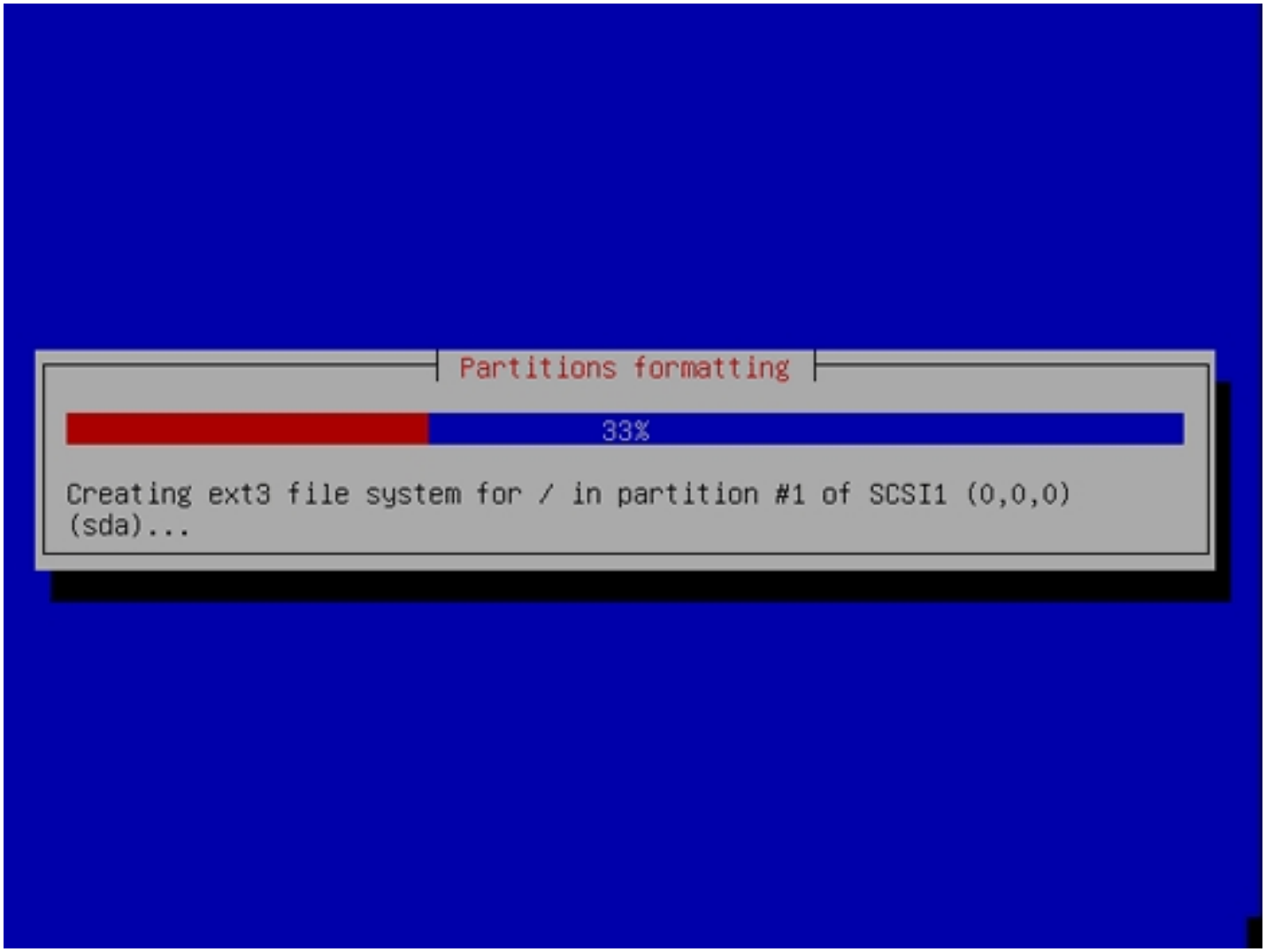
Afterwards, select *Finish partitioning and write changes to disk* (make sure that you have at least 20 GB of unpartitioned disk space):



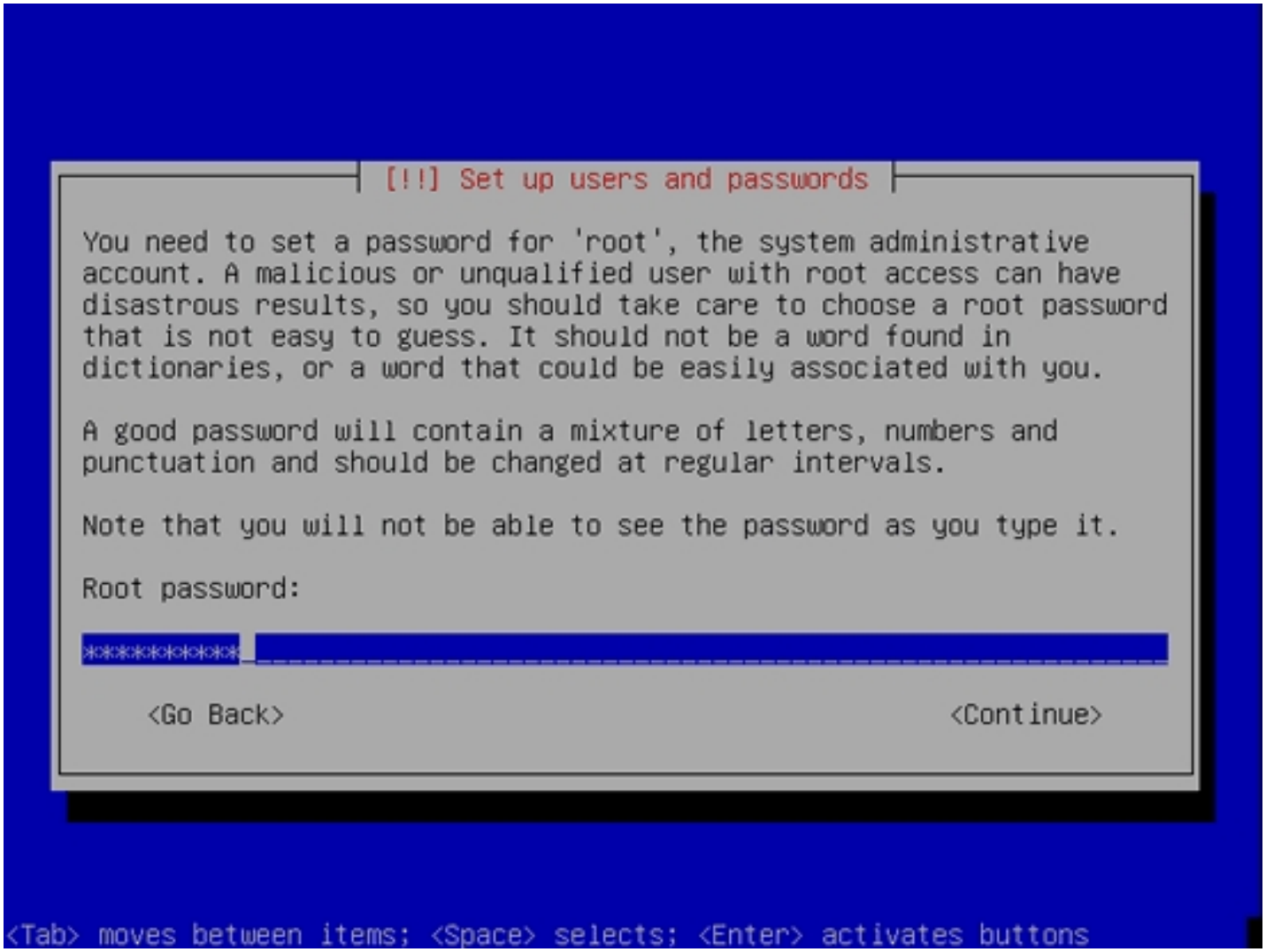
Select *Yes* when you're asked *Write changes to disks?*:



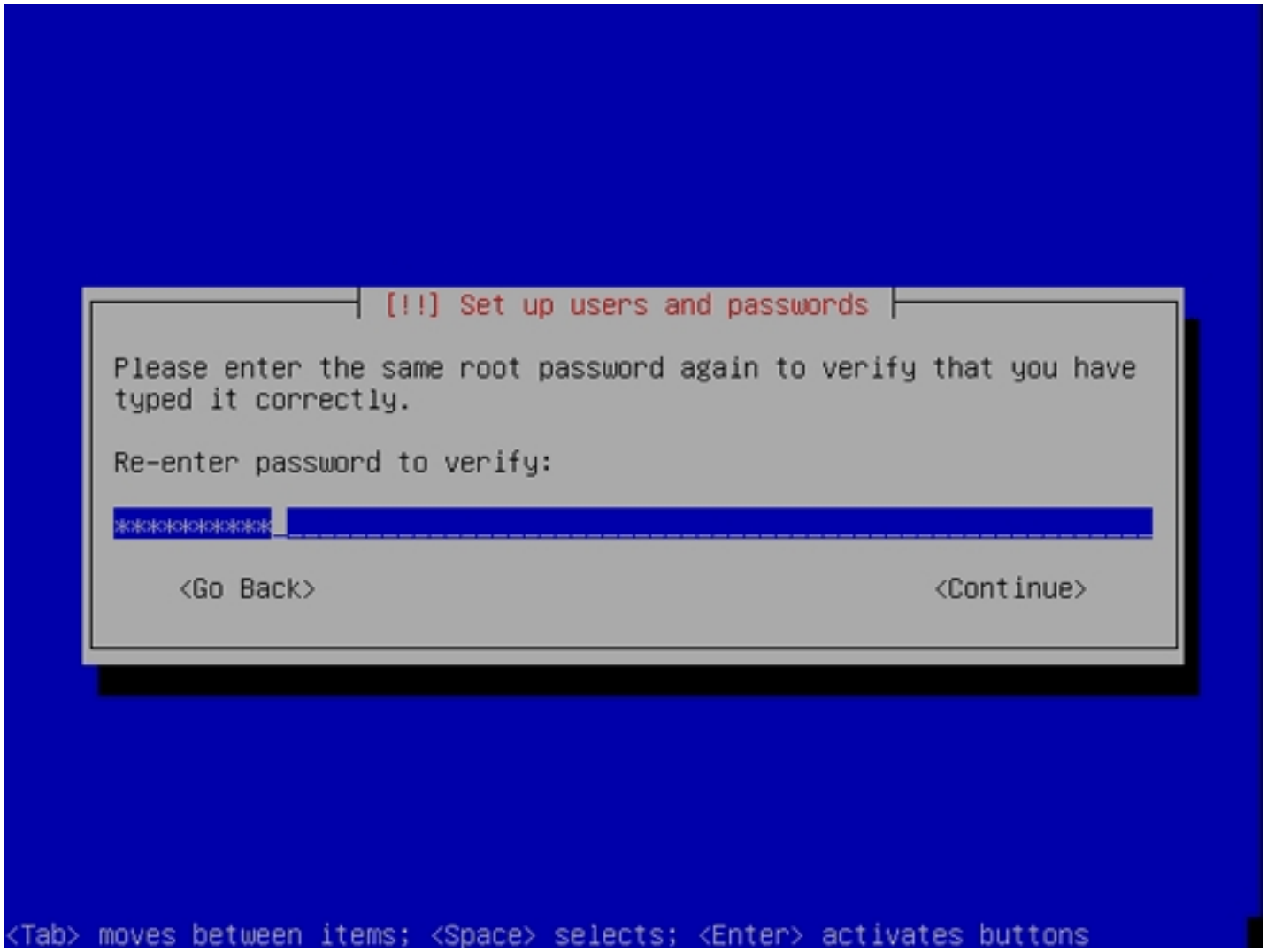
Afterwards, your new partitions are being created and formatted:



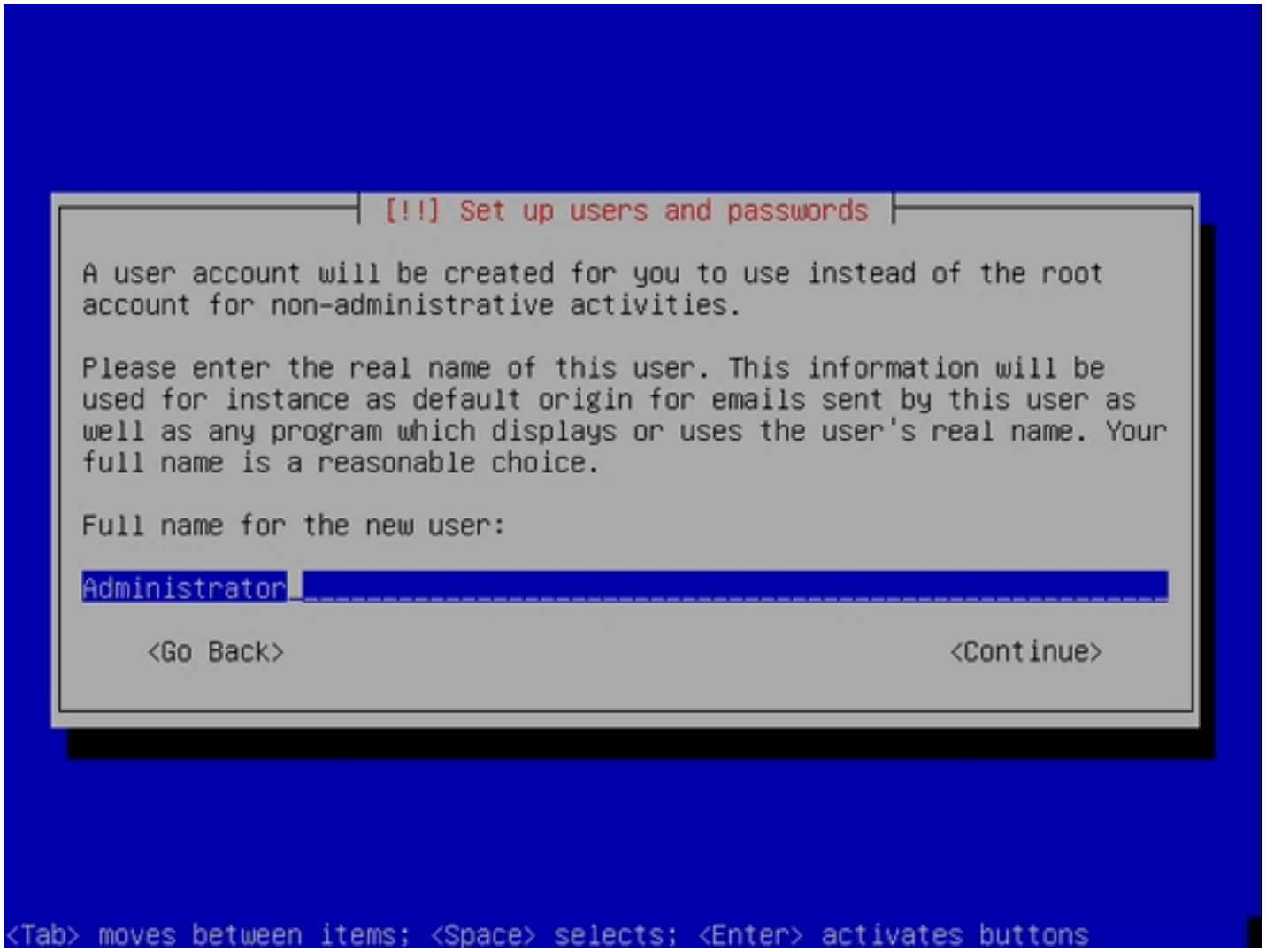
Afterwards, give the root user a password:

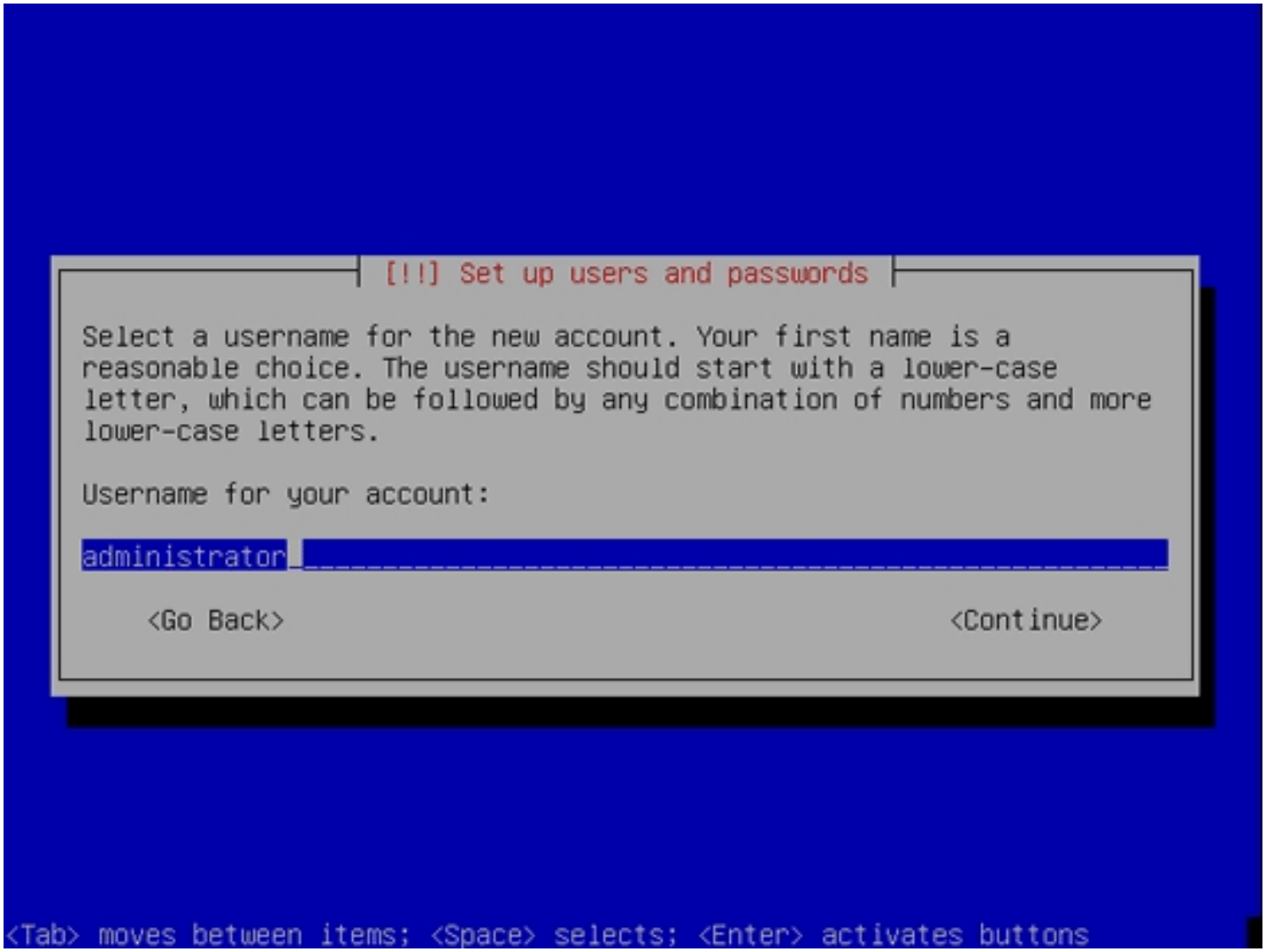


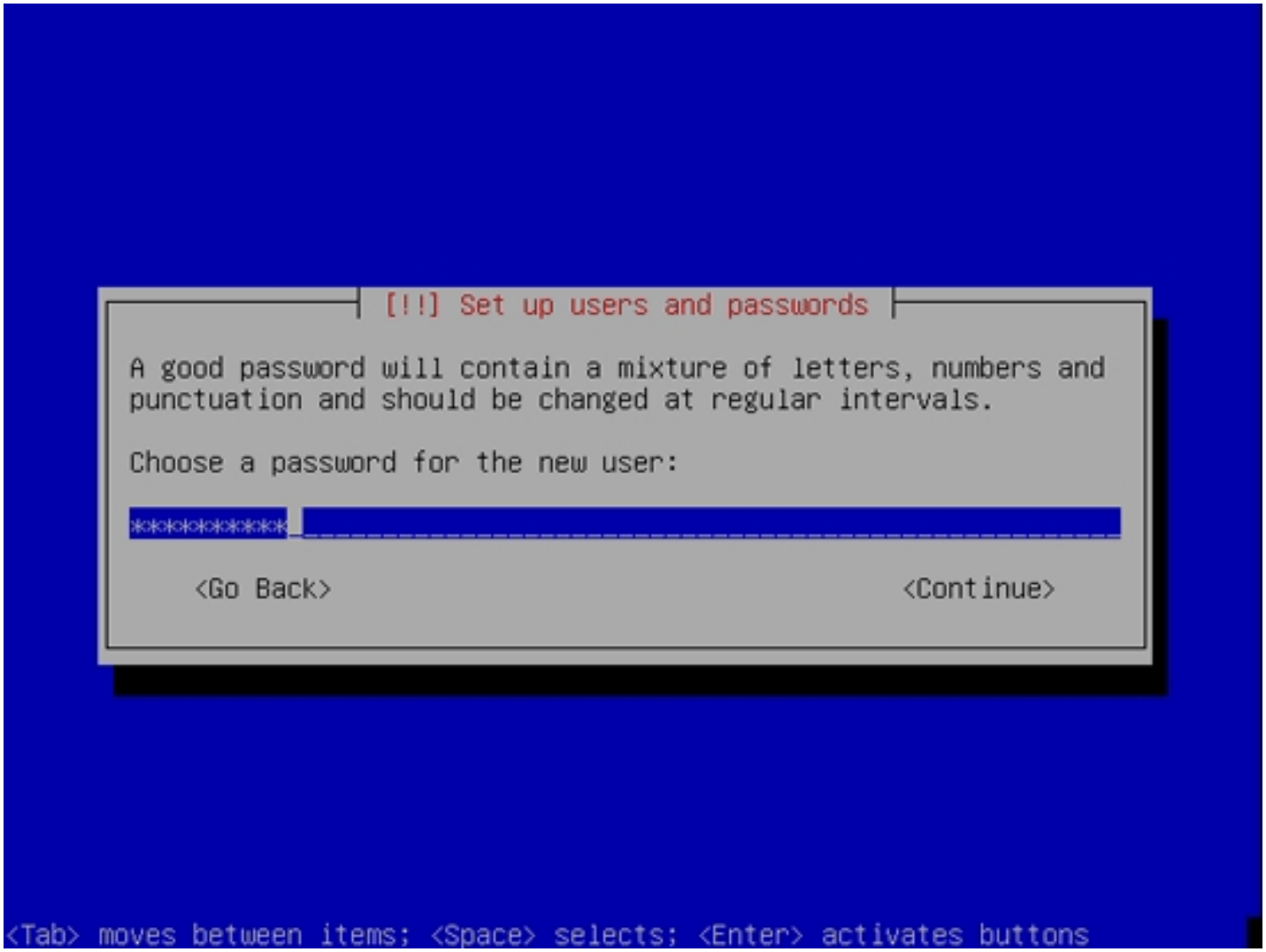
Confirm that password to avoid typos:

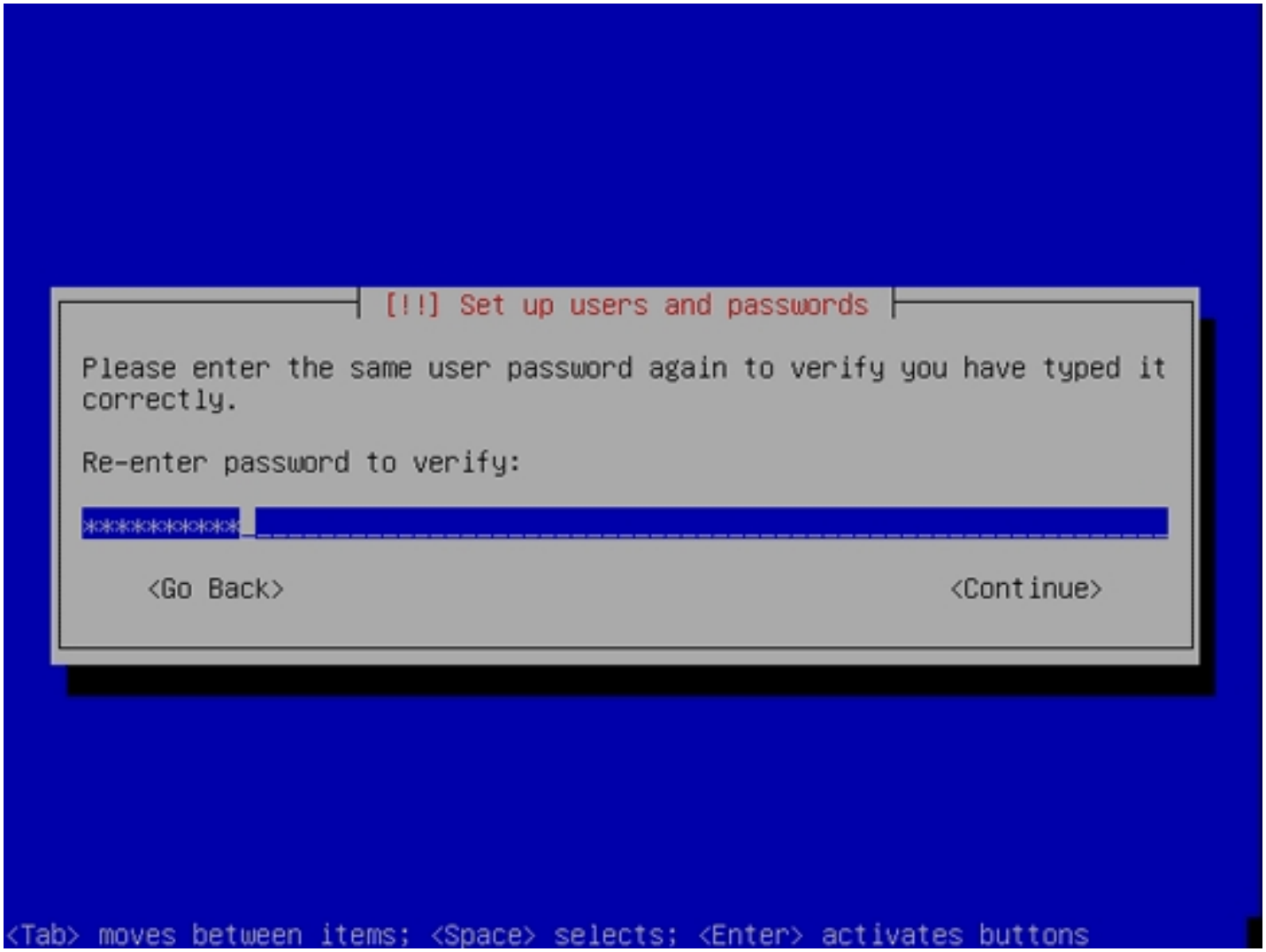


Create a normal user account, for example the user *Administrator* with the user name *administrator* (don't use the user name *admin* as it is a reserved name on Debian Etch):

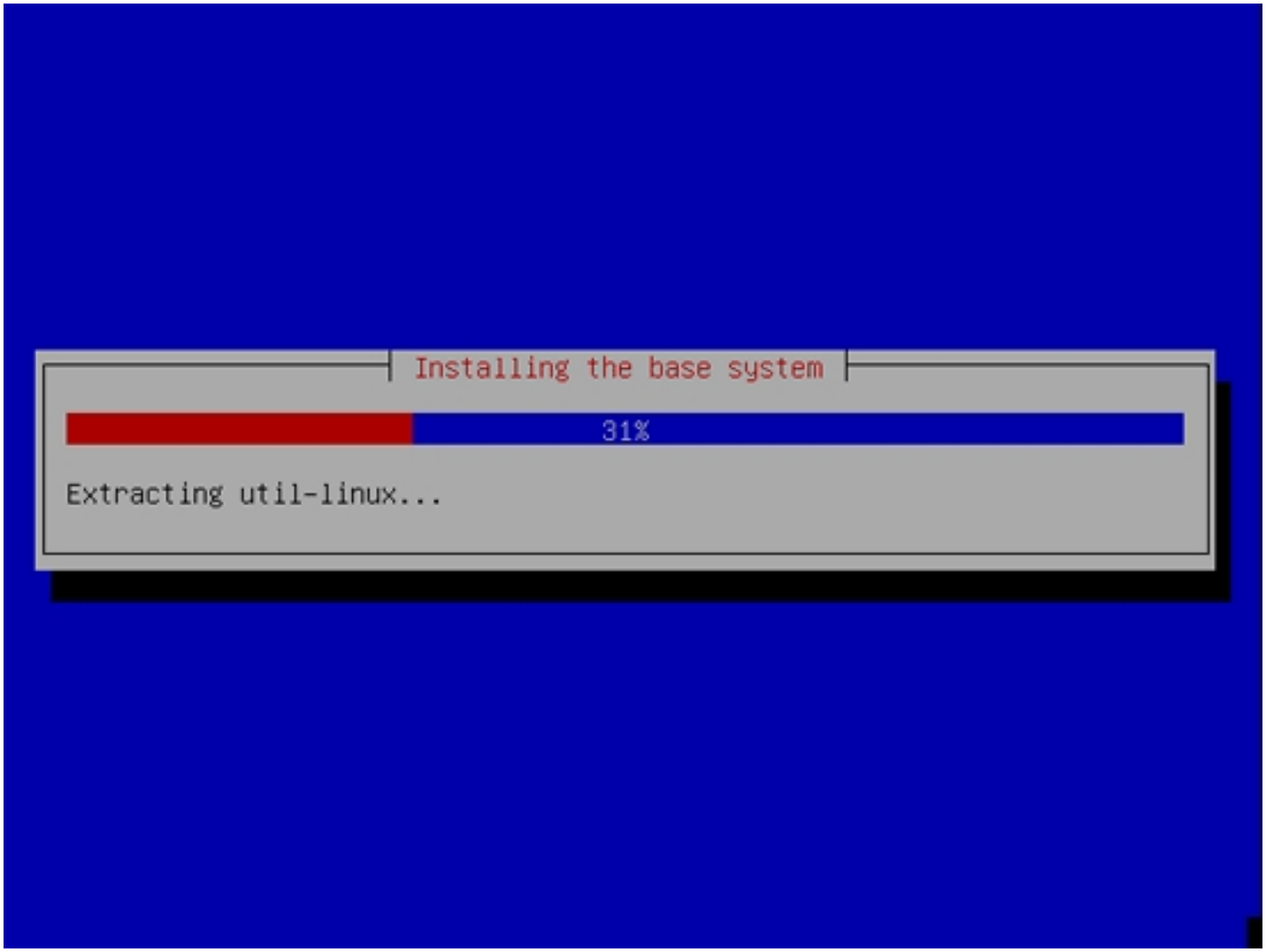




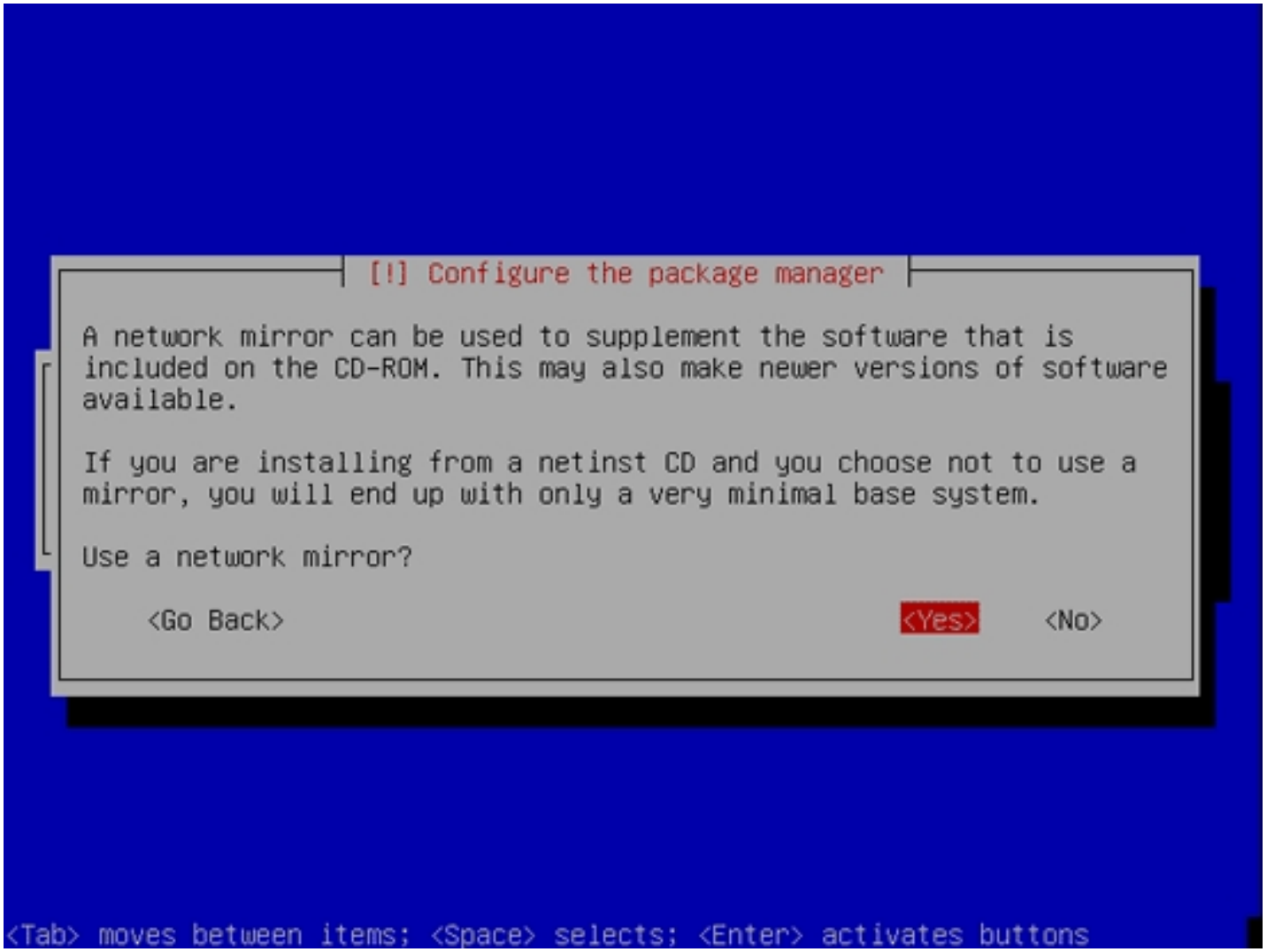




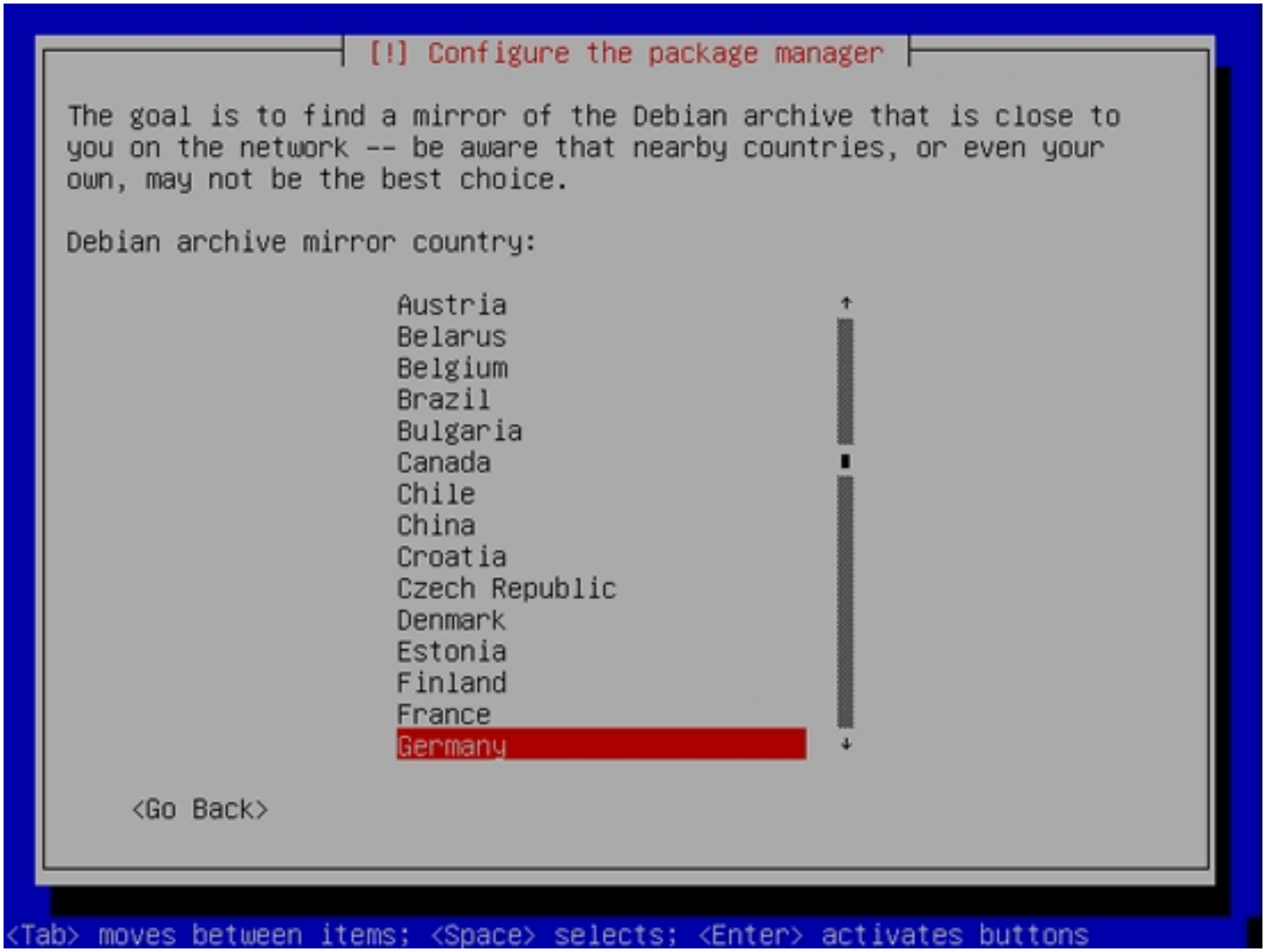
Now the base system is being installed:



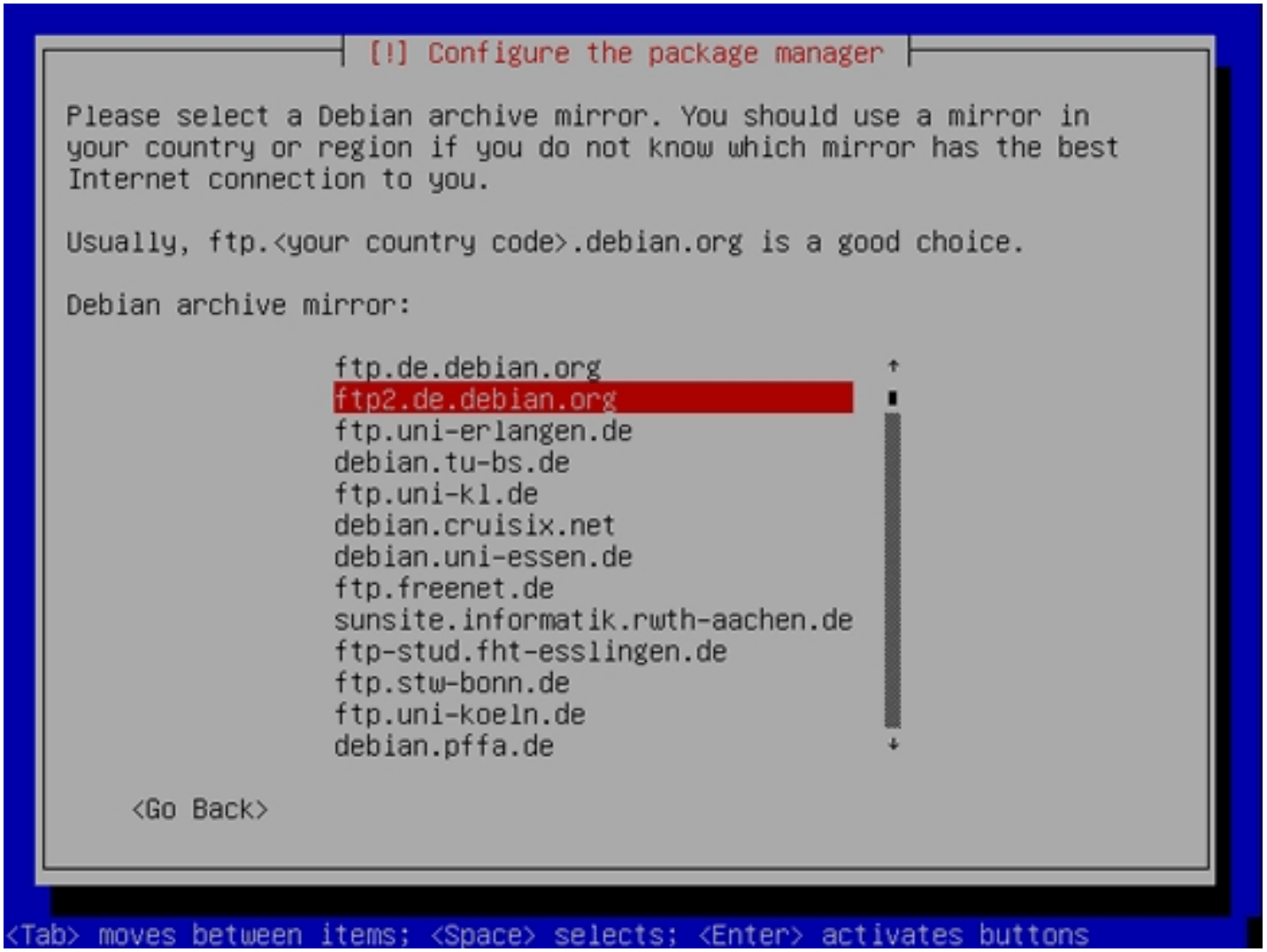
Next you must configure apt. Because you are using the Debian Etch Netinstall CD which contains only a minimal set of packages, you must use a network mirror:



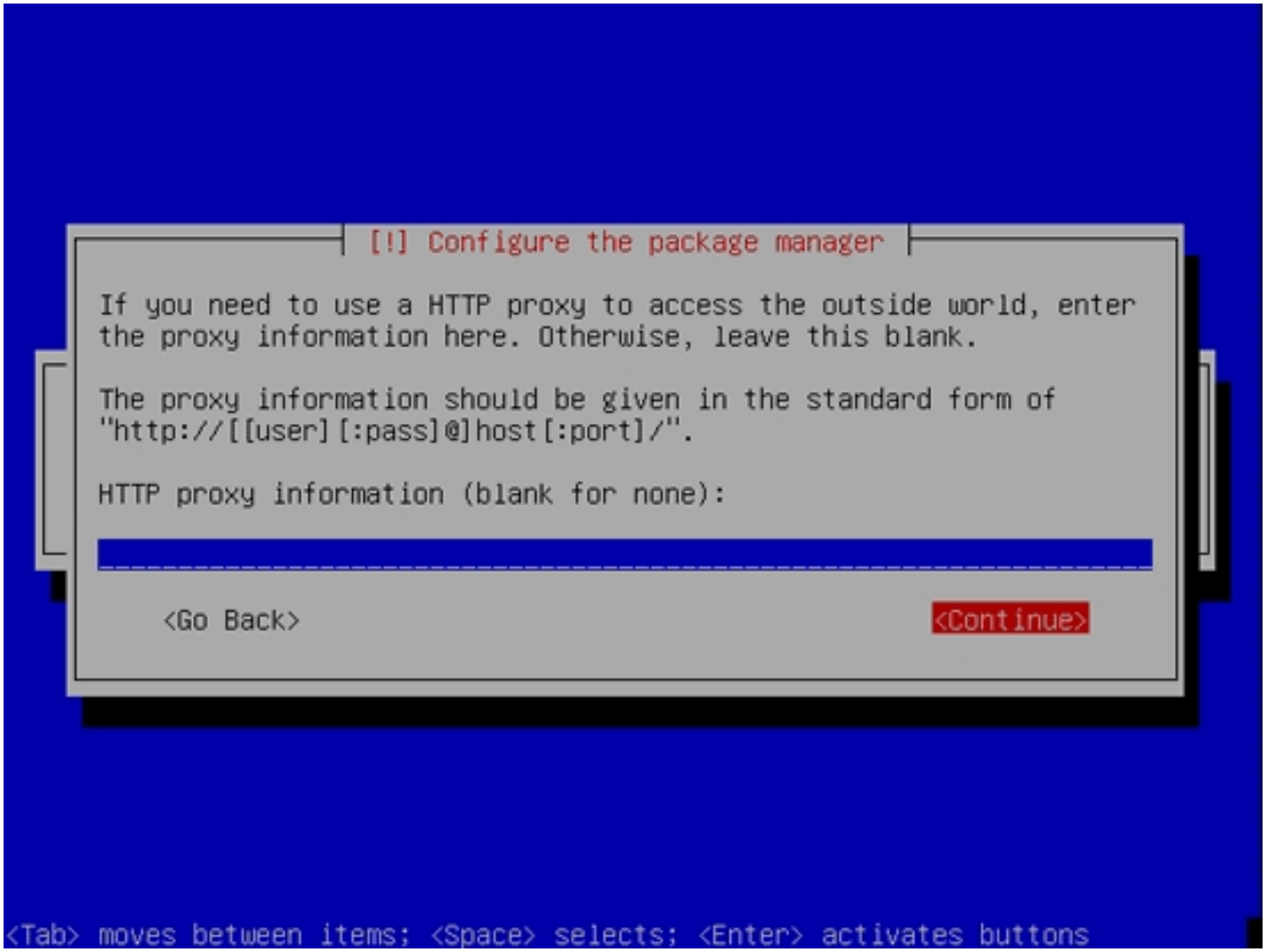
Select the country where the network mirror that you want to use is located (usually this is the country where your Debian Etch system is located):



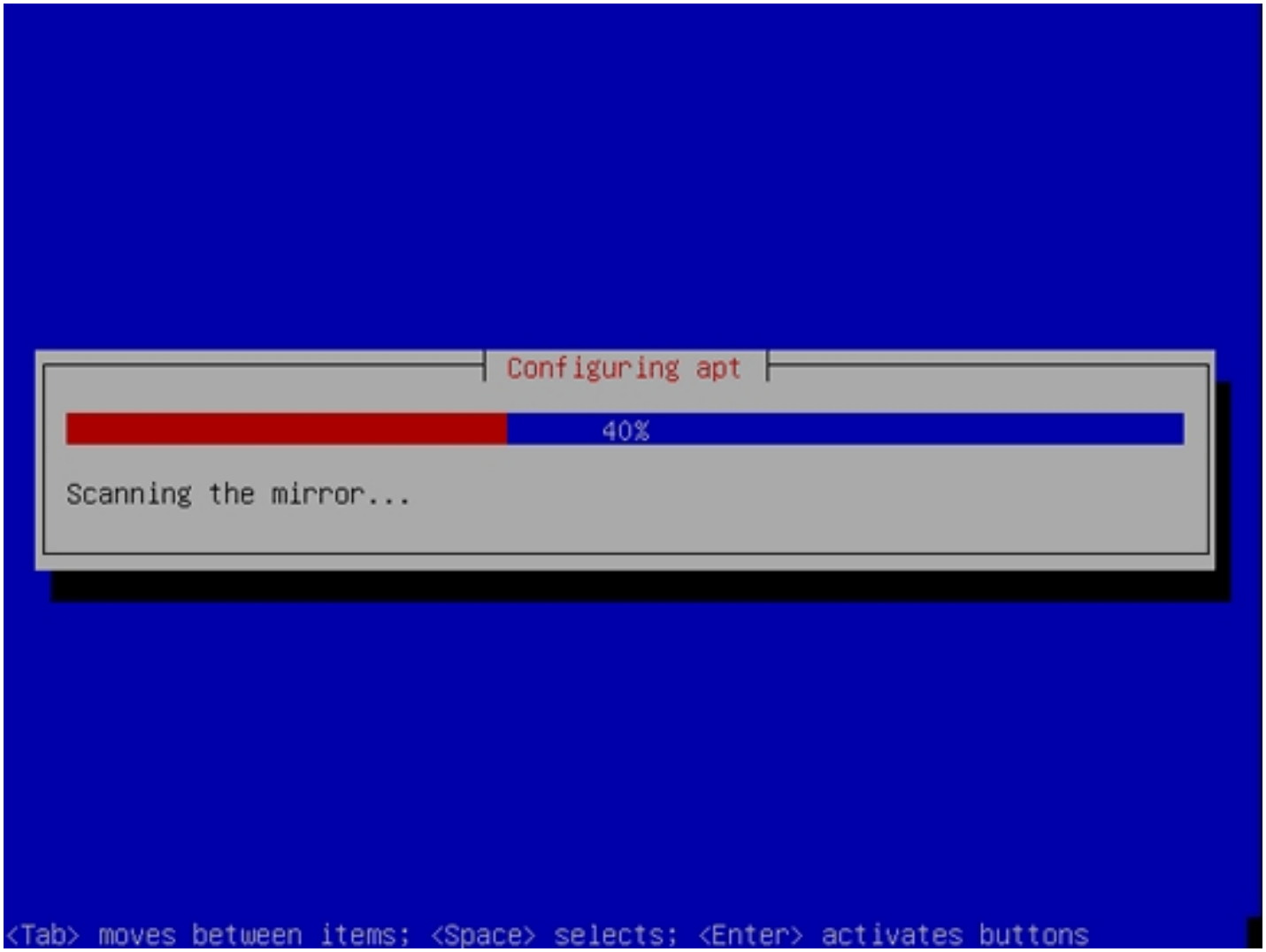
Then select the mirror you want to use (e.g. *ftp2.de.debian.org*):



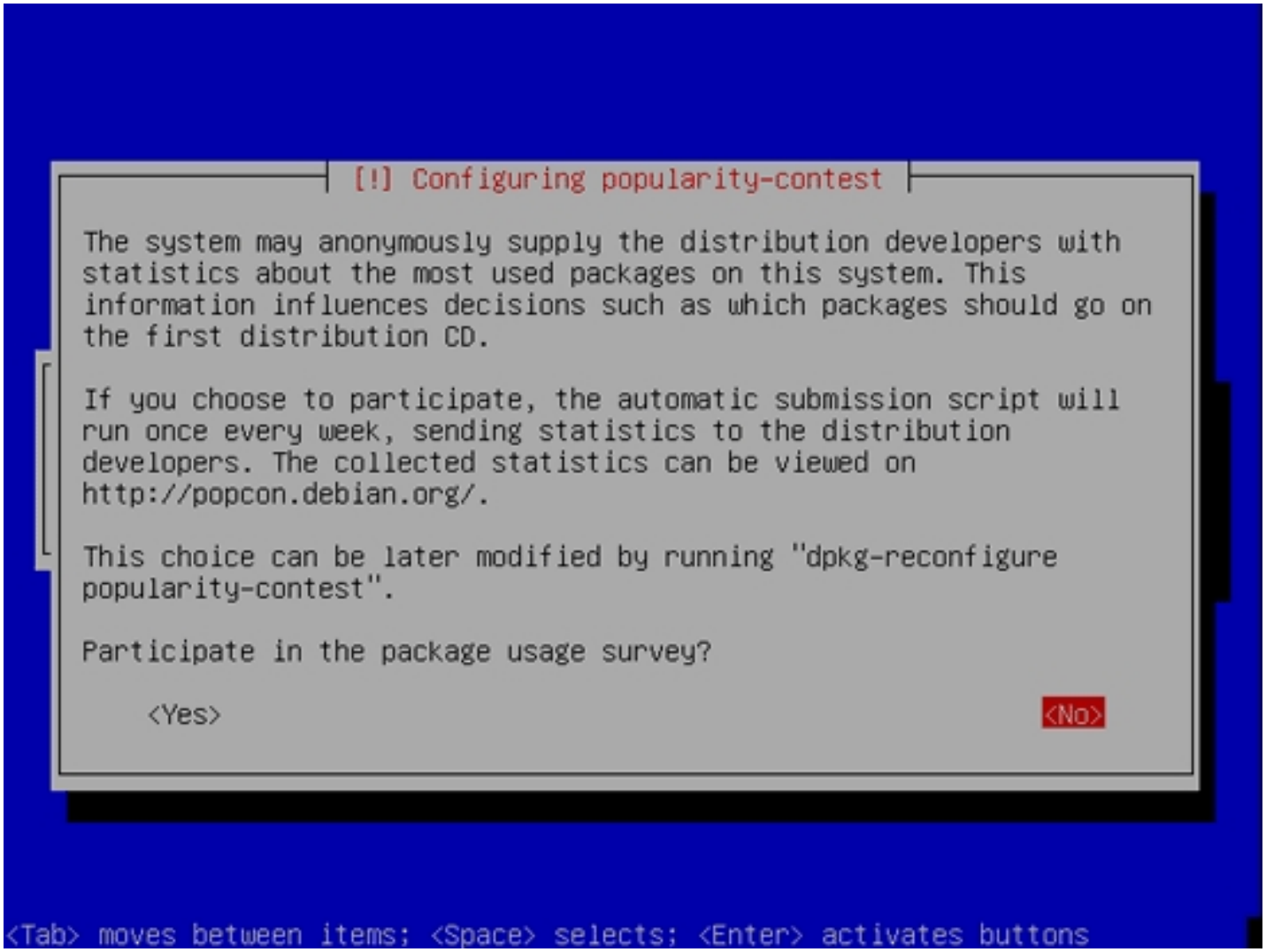
Unless you use an HTTP proxy, leave the following field empty and hit *Continue*:



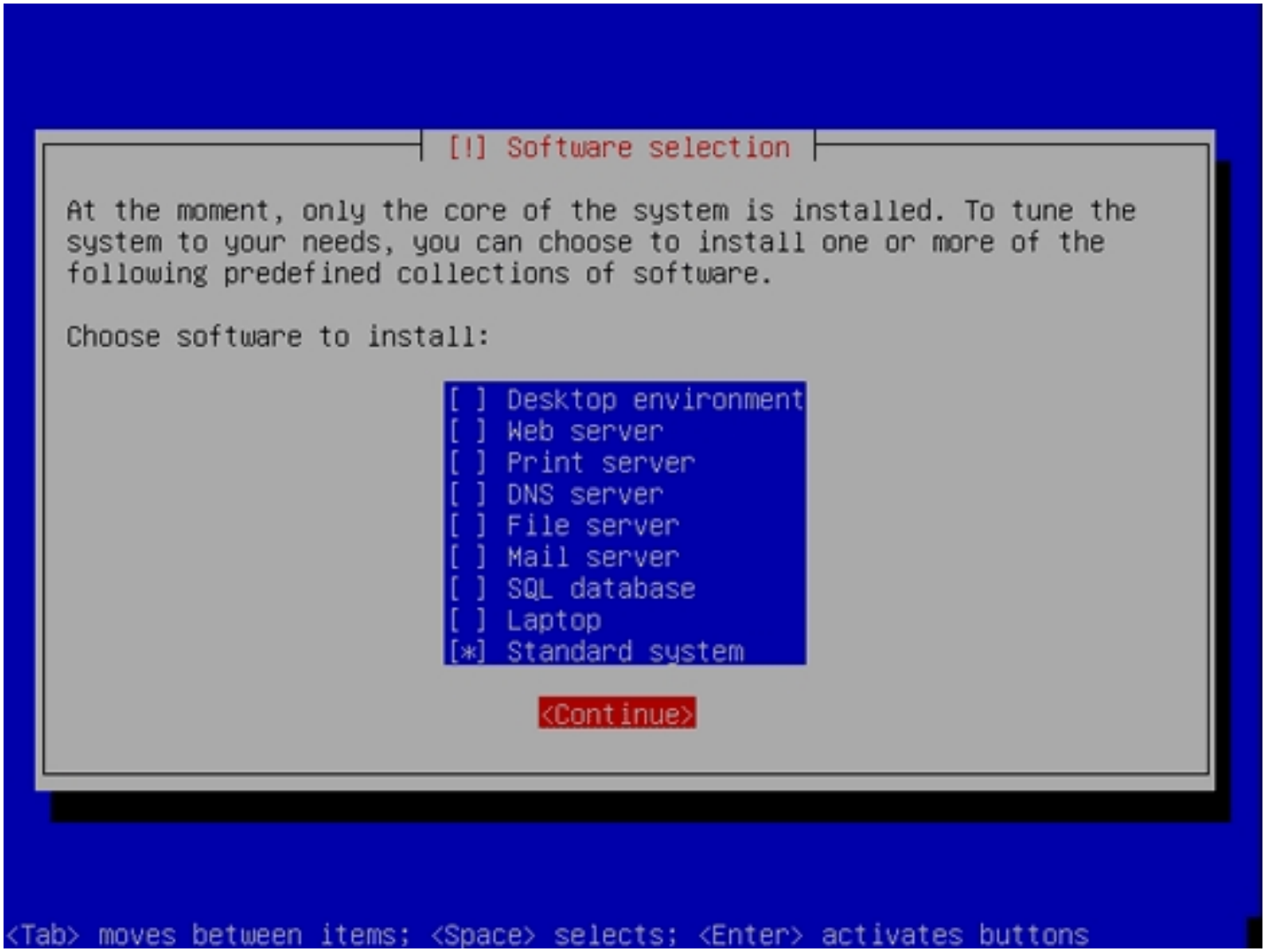
Apt is now updating its packages database:



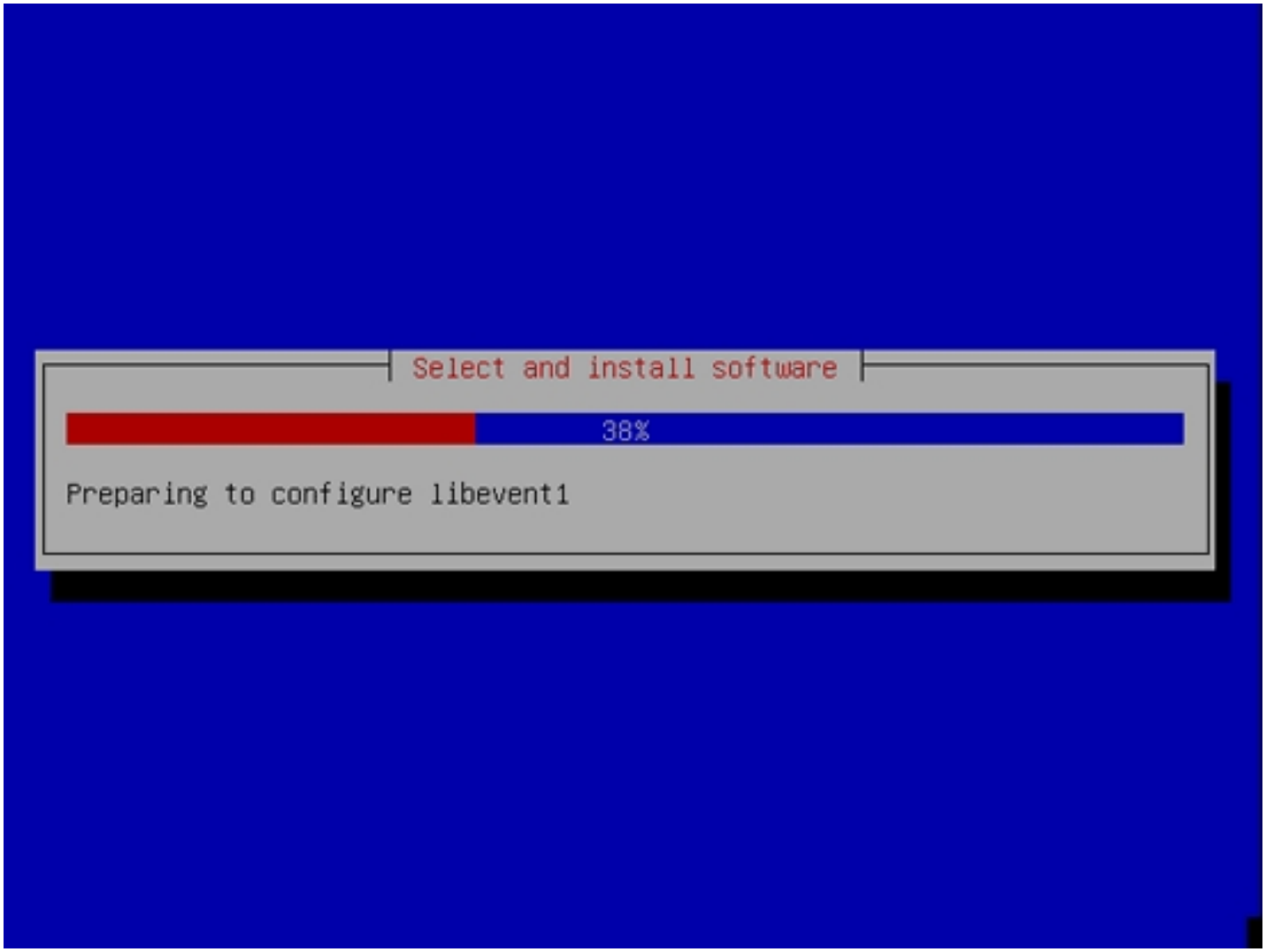
You can skip the package usage survey by selecting *No*:



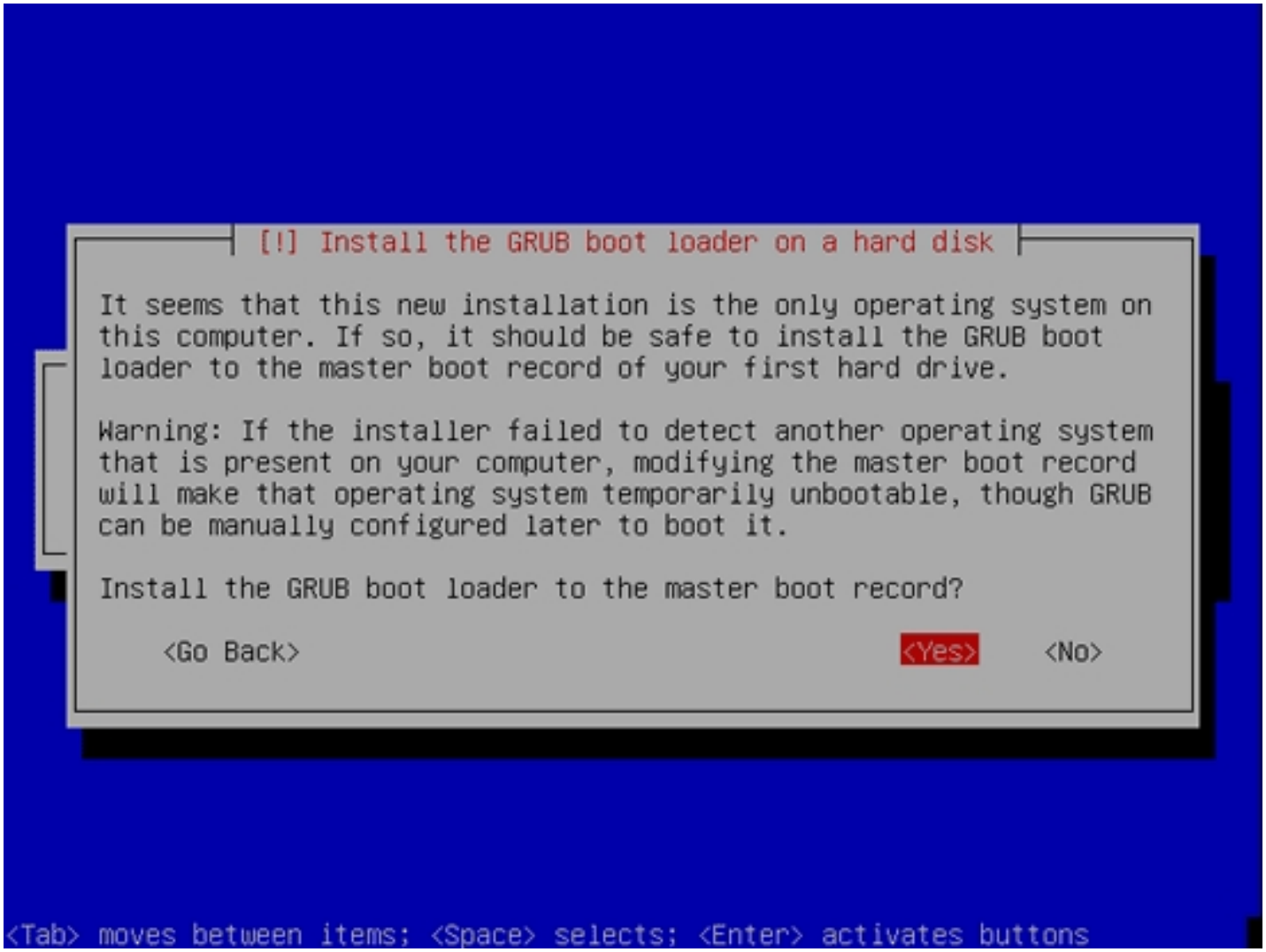
We want a minimal system, therefore we just select *Standard system* and hit *Continue*:



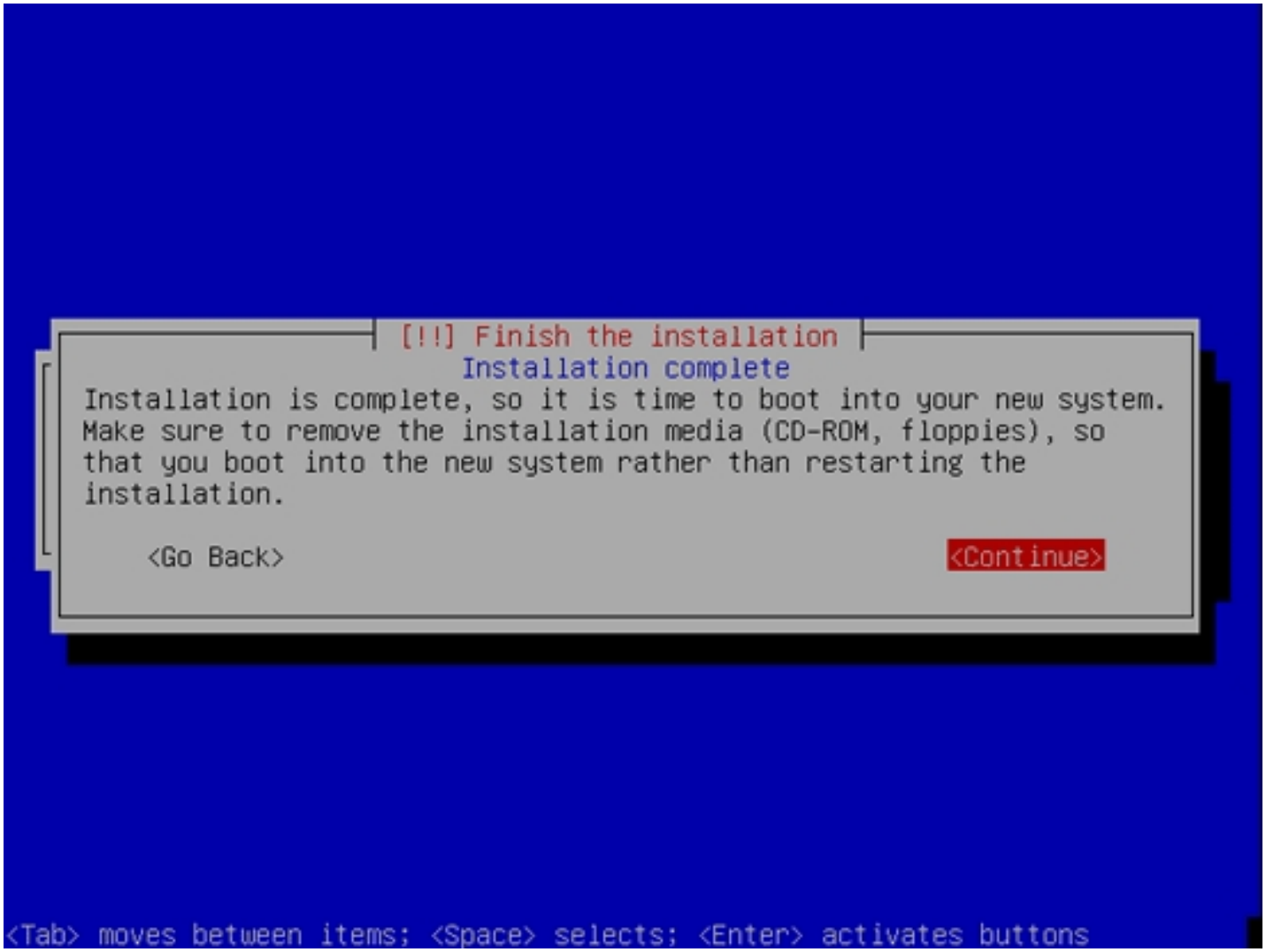
The required packages are being installed on the system:



When you're asked *Install the GRUB boot loader to the master boot record*, select *Yes*:



The base system installation is now finished. Remove the Debian Etch Netinstall CD from the CD drive and hit *Continue* to reboot the system:



On to the next step...

3 Preparing The Physical Nodes

node1/node2:

First we update the packages database:

```
apt-get update
```

Then we install OpenSSH and a full-featured *vim* text editor (unless you prefer another text editor such as nano):

```
apt-get install ssh openssh-server vim-full
```

node1:

Because the Debian Etch installer has configured our system to get its network settings via DHCP, we have to change that now because a server should have a static IP address. Edit */etc/network/interfaces* and adjust it to your needs (please note that I replace *allow-hotplug eth0* with *auto eth0*; otherwise restarting the network doesn't work, and we'd have to reboot the whole system):

```
vi /etc/network/interfaces
```

```
# The loopback network interface
auto lo
iface lo inet loopback

# The primary network interface
#allow-hotplug eth0
#iface eth0 inet dhcp
auto eth0
iface eth0 inet static
        address 192.168.0.100
        netmask 255.255.255.0
```

```
    network 192.168.0.0
    broadcast 192.168.0.255
    gateway 192.168.0.1
```

Then restart your network:

```
/etc/init.d/networking restart
```

Then edit */etc/hosts*. Make it look like this:

```
vi /etc/hosts
```

```
127.0.0.1       localhost.localdomain   localhost
192.168.0.100   node1.example.com       node1         cluster1.example.com    cluster1
192.168.0.101   node2.example.com       node2
192.168.0.105   inst1.example.com       inst1

# The following lines are desirable for IPv6 capable hosts
::1     ip6-localhost ip6-loopback
fe00::0 ip6-localnet
ff00::0 ip6-mcastprefix
ff02::1 ip6-allnodes
ff02::2 ip6-allrouters
ff02::3 ip6-allhosts
```

Next we must make sure that the commands

```
hostname
```

and

```
hostname -f
```

print out the full hostname (*node1.example.com*). If you get something different (e.g. just *node1*), do this:

```
echo node1.example.com > /etc/hostname

/etc/init.d/hostname.sh start
```

Afterwards, the *hostname* commands should show the full hostname.

node2:

Now we do the same again on *node2.example.com*:

```
vi /etc/network/interfaces
```

```
# The loopback network interface
auto lo
iface lo inet loopback

# The primary network interface
#allow-hotplug eth0
#iface eth0 inet dhcp
auto eth0
iface eth0 inet static
        address 192.168.0.101
        netmask 255.255.255.0
```

```
    network 192.168.0.0
    broadcast 192.168.0.255
    gateway 192.168.0.1
```

```
/etc/init.d/networking restart
```

```
vi /etc/hosts
```

```
127.0.0.1       localhost.localdomain   localhost
192.168.0.100   node1.example.com       node1         cluster1.example.com    cluster1
192.168.0.101   node2.example.com       node2
192.168.0.105   inst1.example.com       inst1

# The following lines are desirable for IPv6 capable hosts
::1     ip6-localhost ip6-loopback
fe00::0 ip6-localnet
ff00::0 ip6-mcastprefix
ff02::1 ip6-allnodes
ff02::2 ip6-allrouters
ff02::3 ip6-allhosts
```

```
echo node2.example.com > /etc/hostname

/etc/init.d/hostname.sh start
```

node1/node2:

Edit */etc/apt/sources.list*. Comment out the CD. It should look like this:

```
vi /etc/apt/sources.list
```

```
#
# deb cdrom:[Debian GNU/Linux 4.0 r0 _Etch_ - Official i386 NETINST Binary-1 20070407-11:29]/ etch contrib main

#deb cdrom:[Debian GNU/Linux 4.0 r0 _Etch_ - Official i386 NETINST Binary-1 20070407-11:29]/ etch contrib main

deb http://ftp2.de.debian.org/debian/ etch main
deb-src http://ftp2.de.debian.org/debian/ etch main

deb http://security.debian.org/ etch/updates main contrib
deb-src http://security.debian.org/ etch/updates main contrib
```

Then run

```
apt-get update
```

to update the apt packages database and

```
apt-get upgrade
```

to install the latest updates (if there are any). Afterwards, install the *build-essential* package:

```
apt-get install build-essential
```

4 Installing Xen

node1/node2:

Next we install Xen on both physical nodes:

```
apt-get install xen-linux-system-2.6.18-5-xen-686 libc6-xen
```

Then we edit */etc/xen/xend-config.sxp* and modify the *dom0-min-mem* line so that it looks like this:

```
vi /etc/xen/xend-config.sxp
```

```
[...]
# Dom0 will balloon out when needed to free memory for domU.
# dom0-min-mem is the lowest memory level (in MB) dom0 will get down to.
# If dom0-min-mem=0, dom0 will never balloon out.
(dom0-min-mem 0)
[...]
```

Next open */boot/grub/menu.lst* and find the *# xenhopt=* and *# xenkopt=* lines and modify them as follows (don't remove the # at the beginning!):

```
vi /boot/grub/menu.lst
```

```
[...]

## Xen hypervisor options to use with the default Xen boot option
# xenhopt=dom0_mem=64M
```

```
## Xen Linux kernel options to use with the default Xen boot option
# xenkopt=console=tty0 nosmp
[...]
```

(Remember what I said about memory in chapter 1. If you have enough RAM, you should probably use *256M* or *512M* here, at least on production systems.)

Afterwards, update the GRUB boot loader:

```
update-grub
```

and reboot both physical nodes:

```
shutdown -r now
```

At the boot prompt, select the new Xen kernel and boot from it.

After the nodes have come up, do this:

```
cd /boot

ln -s vmlinuz-`uname -r` vmlinuz-2.6-xenU

ln -s initrd.img-`uname -r` initrd-2.6-xenU
```

5 Installing DRBD

node1/node2:

Next we install DRBD:

```
apt-get install drbd0.7-module-source drbd0.7-utils
```

Now we must compile and enable the DRBD kernel module:

```
m-a update
```

```
m-a a-i drbd0.7
```

```
echo drbd minor_count=64 >> /etc/modules

modprobe drbd minor_count=64
```

6 Installing LVM And A Few Other Needed Packages

node1/node2:

Now we install LVM and some other needed packages:

```
apt-get install lvm2 ssh bridge-utils iproute iputils-arping fping python2.4 python-twisted-core python-pyopenssl openssl mdadm
```

You will see this question:

`MD arrays needed for the root filesystem:` <-- all

7 Reconfiguring The Network For Ganeti

Ganeti relies on Xen running in bridge mode, using a bridge called *xen-br0* on dom0. Therefore we have to reconfigure the network on our physical nodes (dom0):

node1:

Edit */etc/network/interfaces* and replace the *eth0* stanza with a stanza for *xen-br0* so that it looks like this:

```
vi /etc/network/interfaces
```

```
# This file describes the network interfaces available on your system
# and how to activate them. For more information, see interfaces(5).

# The loopback network interface
auto lo
iface lo inet loopback

# The primary network interface
#allow-hotplug eth0
#iface eth0 inet dhcp
auto xen-br0
iface xen-br0 inet static
        address 192.168.0.100
        netmask 255.255.255.0
        network 192.168.0.0
        broadcast 192.168.0.255
        gateway 192.168.0.1
        bridge_ports eth0
        bridge_stp off
        bridge_fd 0
```

Then take down *eth0* and bring up *xen-br0*:

```
ifdown eth0

ifup xen-br0
```

Afterwards, check that your new bridge is working:

```
ip a show xen-br0
```

```
node1:~# ip a show xen-br0
4: xen-br0: <BROADCAST,MULTICAST,UP,10000> mtu 1500 qdisc noqueue
    link/ether 00:0c:29:d6:b1:55 brd ff:ff:ff:ff:ff:ff
    inet 192.168.0.100/24 brd 192.168.0.255 scope global xen-br0
    inet6 fe80::20c:29ff:fed6:b155/64 scope link
       valid_lft forever preferred_lft forever
node1:~#
```

```
brctl show xen-br0
```

```
node1:~# brctl show xen-br0
bridge name     bridge id               STP enabled     interfaces
xen-br0         8000.000c29d6b155       no              eth0
node1:~#
```

```
ifconfig
```

```
node1:~# ifconfig
eth0      Link encap:Ethernet  HWaddr 00:0C:29:D6:B1:55
```

```
          inet6 addr: fe80::20c:29ff:fed6:b155/64 Scope:Link
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:26917 errors:7 dropped:1408 overruns:0 frame:0
          TX packets:1571 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:22665198 (21.6 MiB)  TX bytes:178098 (173.9 KiB)
          Interrupt:17 Base address:0x1400

lo        Link encap:Local Loopback
          inet addr:127.0.0.1  Mask:255.0.0.0
          inet6 addr: ::1/128 Scope:Host
          UP LOOPBACK RUNNING  MTU:16436  Metric:1
          RX packets:8 errors:0 dropped:0 overruns:0 frame:0
          TX packets:8 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:0
          RX bytes:560 (560.0 b)  TX bytes:560 (560.0 b)

xen-br0   Link encap:Ethernet  HWaddr 00:0C:29:D6:B1:55
          inet addr:192.168.0.100  Bcast:192.168.0.255  Mask:255.255.255.0
          inet6 addr: fe80::20c:29ff:fed6:b155/64 Scope:Link
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:101 errors:0 dropped:0 overruns:0 frame:0
          TX packets:96 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:0
          RX bytes:6727 (6.5 KiB)  TX bytes:10936 (10.6 KiB)

node1:~#
```

node2:

Now do the same on *node2.example.com*:

```
vi /etc/network/interfaces
```



```
# This file describes the network interfaces available on your system
# and how to activate them. For more information, see interfaces(5).

# The loopback network interface
auto lo
iface lo inet loopback

# The primary network interface
#allow-hotplug eth0
#iface eth0 inet dhcp
auto xen-br0
iface xen-br0 inet static
        address 192.168.0.101
        netmask 255.255.255.0
        network 192.168.0.0
        broadcast 192.168.0.255
        gateway 192.168.0.1
        bridge_ports eth0
        bridge_stp off
        bridge_fd 0
```

```
ifdown eth0

ifup xen-br0
```

```
ip a show xen-br0
```

```
node2:~# ip a show xen-br0
4: xen-br0: <BROADCAST,MULTICAST,UP,10000> mtu 1500 qdisc noqueue
    link/ether 00:0c:29:d0:19:53 brd ff:ff:ff:ff:ff:ff
    inet 192.168.0.101/24 brd 192.168.0.255 scope global xen-br0
    inet6 fe80::20c:29ff:fed0:1953/64 scope link
       valid_lft forever preferred_lft forever
node2:~#
```

```
brctl show xen-br0
```

```
node2:~# brctl show xen-br0
bridge name     bridge id               STP enabled     interfaces
xen-br0         8000.000c29d01953       no              eth0
node2:~#
```

```
ifconfig
```

```
node2:~# ifconfig
eth0      Link encap:Ethernet  HWaddr 00:0C:29:D0:19:53
          inet6 addr: fe80::20c:29ff:fed0:1953/64 Scope:Link
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:9469 errors:8 dropped:3521 overruns:0 frame:0
          TX packets:1655 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:8597242 (8.1 MiB)  TX bytes:183126 (178.8 KiB)
          Interrupt:16 Base address:0x1400

lo        Link encap:Local Loopback
          inet addr:127.0.0.1  Mask:255.0.0.0
          inet6 addr: ::1/128 Scope:Host
          UP LOOPBACK RUNNING  MTU:16436  Metric:1
```

```
          RX packets:8 errors:0 dropped:0 overruns:0 frame:0
          TX packets:8 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:0
          RX bytes:560 (560.0 b)  TX bytes:560 (560.0 b)

xen-br0   Link encap:Ethernet  HWaddr 00:0C:29:D0:19:53
          inet addr:192.168.0.101  Bcast:192.168.0.255  Mask:255.255.255.0
          inet6 addr: fe80::20c:29ff:fed0:1953/64 Scope:Link
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:18 errors:0 dropped:0 overruns:0 frame:0
          TX packets:24 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:0
          RX bytes:1070 (1.0 KiB)  TX bytes:2832 (2.7 KiB)

node2:~#
```

8 Setting Up LVM On The Free HDD Space

node1/node2:

Let's find out about our hard drive:

```
fdisk -l
```

```
node1:~# fdisk -l

Disk /dev/sda: 53.6 GB, 53687091200 bytes
255 heads, 63 sectors/track, 6527 cylinders
Units = cylinders of 16065 * 512 = 8225280 bytes

   Device Boot      Start         End      Blocks   Id  System
/dev/sda1   *           1        1216     9767488+  83  Linux
```

```
/dev/sda2            1217        1338      979965   82  Linux swap / Solaris
node1:~#
```

We will now create the partition */dev/sda3* (on both physical nodes) using the rest of the hard drive and prepare it for LVM:

```
fdisk /dev/sda
```

```
node1:~# fdisk /dev/sda

  The number of cylinders for this disk is set to 6527.
  There is nothing wrong with that, but this is larger than 1024,
  and could in certain setups cause problems with:
  1) software that runs at boot time (e.g., old versions of LILO)
  2) booting and partitioning software from other OSs
   (e.g., DOS FDISK, OS/2 FDISK)

Command (m for help): <-- m
Command action
   a   toggle a bootable flag
   b   edit bsd disklabel
   c   toggle the dos compatibility flag
   d   delete a partition
   l   list known partition types
   m   print this menu
   n   add a new partition
   o   create a new empty DOS partition table
   p   print the partition table
   q   quit without saving changes
   s   create a new empty Sun disklabel
   t   change a partition's system id
   u   change display/entry units
   v   verify the partition table
```

```
   w   write table to disk and exit
   x   extra functionality (experts only)

Command (m for help): <-- n
Command action
   e   extended
   p   primary partition (1-4)
<-- p
Partition number (1-4): <-- 3
First cylinder (1339-6527, default 1339): <-- ENTER
Using default value 1339
Last cylinder or +size or +sizeM or +sizeK (1339-6527, default 6527): <-- ENTER
Using default value 6527

Command (m for help): <-- t
Partition number (1-4): <-- 3
Hex code (type L to list codes): <-- L

 0  Empty           1e  Hidden W95 FAT1 80  Old Minix       be  Solaris boot
 1  FAT12           24  NEC DOS         81  Minix / old Lin bf  Solaris
 2  XENIX root      39  Plan 9          82  Linux swap / So c1  DRDOS/sec (FAT-
 3  XENIX usr       3c  PartitionMagic  83  Linux           c4  DRDOS/sec (FAT-
 4  FAT16 <32M      40  Venix 80286     84  OS/2 hidden C:  c6  DRDOS/sec (FAT-
 5  Extended        41  PPC PReP Boot   85  Linux extended  c7  Syrinx
 6  FAT16           42  SFS             86  NTFS volume set da  Non-FS data
 7  HPFS/NTFS       4d  QNX4.x          87  NTFS volume set db  CP/M / CTOS / .
 8  AIX             4e  QNX4.x 2nd part 88  Linux plaintext de  Dell Utility
 9  AIX bootable    4f  QNX4.x 3rd part 8e  Linux LVM       df  BootIt
 a  OS/2 Boot Manag 50  OnTrack DM      93  Amoeba          e1  DOS access
 b  W95 FAT32       51  OnTrack DM6 Aux 94  Amoeba BBT      e3  DOS R/O
 c  W95 FAT32 (LBA) 52  CP/M            9f  BSD/OS          e4  SpeedStor
 e  W95 FAT16 (LBA) 53  OnTrack DM6 Aux a0  IBM Thinkpad hi eb  BeOS fs
 f  W95 Ext'd (LBA) 54  OnTrackDM6      a5  FreeBSD         ee  EFI GPT
```

```
10  OPUS            55  EZ-Drive        a6  OpenBSD         ef  EFI (FAT-12/16/
11  Hidden FAT12    56  Golden Bow      a7  NeXTSTEP        f0  Linux/PA-RISC b
12  Compaq diagnost 5c  Priam Edisk     a8  Darwin UFS      f1  SpeedStor
14  Hidden FAT16 <3 61  SpeedStor       a9  NetBSD          f4  SpeedStor
16  Hidden FAT16    63  GNU HURD or Sys ab  Darwin boot     f2  DOS secondary
17  Hidden HPFS/NTF 64  Novell Netware  b7  BSDI fs         fd  Linux raid auto
18  AST SmartSleep  65  Novell Netware  b8  BSDI swap       fe  LANstep
1b  Hidden W95 FAT3 70  DiskSecure Mult bb  Boot Wizard hid ff  BBT
1c  Hidden W95 FAT3 75  PC/IX
Hex code (type L to list codes): <-- 8e
Changed system type of partition 3 to 8e (Linux LVM)

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

Calling ioctl() to re-read partition table.

WARNING: Re-reading the partition table failed with error 16: Device or resource busy.
The kernel still uses the old table.
The new table will be used at the next reboot.
Syncing disks.
node1:~#
```

Now let's take a look at our hard drive again:

```
fdisk -l
```

```
node1:~# fdisk -l

Disk /dev/sda: 53.6 GB, 53687091200 bytes
255 heads, 63 sectors/track, 6527 cylinders
Units = cylinders of 16065 * 512 = 8225280 bytes
```

```
   Device Boot      Start         End      Blocks   Id  System
/dev/sda1   *           1        1216     9767488+  83  Linux
/dev/sda2            1217        1338      979965   82  Linux swap / Solaris
/dev/sda3            1339        6527    41680642+  8e  Linux LVM
node1:~#
```

Looks good. Now we must reboot both physical nodes so that the kernel can read in the new partition table:

```
shutdown -r now
```

After the reboot, we prepare */dev/sda3* for LVM on both nodes and add it to the volume group *xenvg*:

```
pvcreate /dev/sda3

vgcreate xenvg /dev/sda3
```

It is recommended to configure LVM not to scan the DRBD devices. Therefore we open */etc/lvm/lvm.conf* and replace the *filter* line as follows:

```
vi /etc/lvm/lvm.conf
```

```
[...]
filter = [ "r|/dev/cdrom|", "r|/dev/drbd[0-9]+|" ]
[...]
```

9 Installing Ganeti

node1/node2:

First, install *docbook-utils*:

```
apt-get install docbook-utils
```

Then download and install Ganeti as follows:

```
cd /tmp

wget http://ganeti.googlecode.com/files/ganeti-1.2b1.tar.gz

tar xvzf ganeti-1.2b1.tar.gz

cd ganeti-1.2b1

./configure --localstatedir=/var

make

make install

mkdir /srv/ganeti/ /srv/ganeti/os /srv/ganeti/export
```

Copy the Ganeti init script to */etc/init.d*...

```
cp docs/examples/ganeti.initd /etc/init.d/ganeti
```

... and tell both nodes to start Ganeti at boot time:

```
update-rc.d ganeti defaults 20 80
```

10 Installing The Ganeti Scripts For Debian Etch Instances

node1/node2:

Next we install the scripts that Ganeti needs to install Debian Etch in a virtual machine (or *instance*):

```
cd /srv/ganeti/os

wget http://ganeti.googlecode.com/files/instance-debian-etch-0.1.tar

tar xvf instance-debian-etch-0.1.tar

mv instance-debian-etch-0.1 debian-etch
```

We also need the *debootstrap* package:

```
apt-get install debootstrap
```

11 Initializing The Cluster

node1:

Now we can initialize our cluster (this has to be done only once per cluster). Our clustername is *cluster1.example.com*, and I want *node1.example.com* to be the master, therefore we run the following command on *node1.example.com*:

```
gnt-cluster init cluster1.example.com
```

12 Adding node2.example.com To The Cluster

node1:

Now that *node1* is the master, we run all commands for managing the cluster on *node1*. In order to add *node2.example.com* to the cluster, we run:

```
gnt-node add node2.example.com
```

This will look like this:

```
node1:/srv/ganeti/os# gnt-node add node2.example.com
  The authenticity of host 'node2.example.com (192.168.0.101)' can't be established.
  RSA key fingerprint is 1c:83:24:cc:05:ab:9a:d6:51:ba:4d:31:42:1f:0a:6f.
  Are you sure you want to continue connecting (yes/no)? <-- yes
 root@node2.example.com's password:
node1:/srv/ganeti/os#
```

Now let's check if our cluster really consists out of *node1* and *node2*:

```
gnt-node list
```

You should get something like this:

```
node1:/srv/ganeti/os# gnt-node list
Node              DTotal DFree MTotal MNode MFree Pinst Sinst
node1.example.com  40700 40700    203    64   124     0     0
node2.example.com  40700 40700    203    64   124     0     0
node1:/srv/ganeti/os#
```

13 Setting Up An Instance

node1:

Now let's create our first virtual machine (called an *instance* in Ganeti speak), *inst1.example.com*. I want to use DRBD for it (remote RAID1), I want *node2* to be the primary node, and I want the instance to have a 5 GB hard drive, 256 MB swap and 64 MB RAM. Again, we run the command on the

cluster master, *node1.example.com*:

```
gnt-instance add -t remote_raid1 -n node2.example.com --secondary-node node1.example.com -o debian-etch -s 5g --swap-size 256 -m 64 inst1.example.com
```

This can take some time. This is how the output looks:

```
node1:~# gnt-instance add -t remote_raid1 -n node2.example.com --secondary-node node1.example.com -o debian-etch -s 5g
--swap-size 256 -m 64 inst1.example.com
  * creating instance disks...
  adding instance inst1.example.com to cluster config
  Waiting for instance inst1.example.com to sync disks.
  - device sda: 18.90% done, 2661 estimated seconds remaining
  - device sda: 22.10% done, 1278 estimated seconds remaining
  - device sda: 26.40% done, 1611 estimated seconds remaining
  - device sda: 30.70% done, 1301 estimated seconds remaining
  - device sda: 34.70% done, 1524 estimated seconds remaining
  - device sda: 38.80% done, 894 estimated seconds remaining
  - device sda: 43.30% done, 1753 estimated seconds remaining
  - device sda: 48.40% done, 1195 estimated seconds remaining
  - device sda: 52.70% done, 1213 estimated seconds remaining
  - device sda: 57.70% done, 1011 estimated seconds remaining
  - device sda: 61.10% done, 730 estimated seconds remaining
  - device sda: 64.60% done, 698 estimated seconds remaining
  - device sda: 69.40% done, 595 estimated seconds remaining
  - device sda: 73.80% done, 430 estimated seconds remaining
  - device sda: 78.30% done, 438 estimated seconds remaining
  - device sda: 82.00% done, 169 estimated seconds remaining
  - device sda: 85.80% done, 298 estimated seconds remaining
  - device sda: 91.20% done, 146 estimated seconds remaining
  - device sda: 95.50% done, 85 estimated seconds remaining
  - device sda: 99.20% done, 18 estimated seconds remaining
```

```
  Instance inst1.example.com's disks are in sync.
  creating os for instance inst1.example.com on node node2.example.com
  * running the instance OS create scripts...
  * starting instance...
node1:~#
```

Ganeti has created a complete virtual machine (using Debian Etch) which you can now use.

14 Configuring The Instance

node1:

To get to *inst1.example.com*'s command line, run

```
gnt-instance console inst1.example.com
```

on *node1*.

inst1.example.com:

Now you can log in to *inst1.example.com*. The username is *root* along with no password. Therefore the first thing we do after the login is create a password for *root*:

```
passwd
```

Next we must add a stanza for *eth0* to */etc/network/interfaces*. Right now, *inst1.example.com* has no network connectivity because only *lo* (the loopback interface) is up.

As I said in chapter 1, I want *inst1.example.com* to have the IP address *192.168.0.105*:

```
vi /etc/network/interfaces
```

```
auto lo
iface lo inet loopback

auto eth0
iface eth0 inet static
        address 192.168.0.105
        netmask 255.255.255.0
        network 192.168.0.0
        broadcast 192.168.0.255
        gateway 192.168.0.1
```

Restart the network afterwards:

```
/etc/init.d/networking restart
```

Run

```
apt-get update
```

to update the packages database on *inst1*, and then install OpenSSH and a full-featured *vim*:

```
apt-get install ssh openssh-server vim-full
```

Now you can connect to *inst1.example.com* using an SSH client such as **PuTTY** on the IP address *192.168.0.105*.

To leave *inst1*'s console and get back to *node1*, type *CTRL+]* if you are at the console, or *CTRL+5* if you're using PuTTY (this is the same as if you were

using Xen's *xm* commands instead of Ganeti).

15 Further Ganeti Commands

To learn more about what you can do with Ganeti, take a look at the following man pages:

```
man gnt-instance
```

```
man gnt-cluster
```

```
man gnt-node
```

```
man gnt-os
```

```
man gnt-backup
```

```
man 7 ganeti
```

```
man 7 ganeti-os-interface
```

and also at the Ganeti administrator's guide that comes with the Ganeti package (in */docs/admin.html*). The **Ganeti installation tutorial** also has some hints.

The most interesting commands should be these:

Start an instance:

```
gnt-instance startup inst1.example.com
```

Stop an instance:

```
gnt-instance shutdown inst1.example.com
```

Go to an instance's console:

```
gnt-instance console inst1.example.com
```

Failover an instance to its secondary node:

```
gnt-instance failover inst1.example.com
```

Delete an instance:

```
gnt-instance remove inst1.example.com
```

Get a list of instances:

```
gnt-instance list
```

```
node1:~# gnt-instance list
Instance          OS          Primary_node      Autostart Status  Memory
inst1.example.com debian-etch node2.example.com yes       running     64
node1:~#
```

Get more details about instances:

```
gnt-instance info
```

```
node1:~# gnt-instance info
Instance name: inst1.example.com
State: configured to be up, actual state is up
  Nodes:
    - primary: node2.example.com
    - secondaries: node1.example.com
  Operating system: debian-etch
  Hardware:
    - memory: 64MiB
    - NICs: {MAC: aa:00:00:ac:67:3a, IP: None, bridge: xen-br0}
  Block devices:
    - sda, type: md_raid1, physical_id: a8984725:92a66329:e9453b29:5f438b80
      primary:   /dev/md0 (9:0) in sync, status ok
      - type: drbd, logical_id: ('node2.example.com', 'node1.example.com', 11000)
        primary:   /dev/drbd0 (147:0) in sync, status ok
        secondary: /dev/drbd0 (147:0) in sync, status ok
        - type: lvm, logical_id: ('xenvg', '577164fd-b0cb-4043-9d57-aa59f41fddf1.sda_data')
          primary:   /dev/xenvg/577164fd-b0cb-4043-9d57-aa59f41fddf1.sda_data (253:0)
          secondary: /dev/xenvg/577164fd-b0cb-4043-9d57-aa59f41fddf1.sda_data (253:0)
        - type: lvm, logical_id: ('xenvg', '22071c7b-37e7-4aa1-be4a-74021599c1a7.sda_meta')
          primary:   /dev/xenvg/22071c7b-37e7-4aa1-be4a-74021599c1a7.sda_meta (253:1)
          secondary: /dev/xenvg/22071c7b-37e7-4aa1-be4a-74021599c1a7.sda_meta (253:1)
    - sdb, type: md_raid1, physical_id: 1e974569:29fa6cab:e9453b29:5f438b80
      primary:   /dev/md1 (9:1) in sync, status ok
      - type: drbd, logical_id: ('node2.example.com', 'node1.example.com', 11001)
        primary:   /dev/drbd1 (147:1) in sync, status ok
        secondary: /dev/drbd1 (147:1) in sync, status ok
        - type: lvm, logical_id: ('xenvg', 'd89067b9-cae6-4b15-ba3b-76f17f70553e.sdb_data')
```

```
          primary:   /dev/xenvg/d89067b9-cae6-4b15-ba3b-76f17f70553e.sdb_data (253:2)
          secondary: /dev/xenvg/d89067b9-cae6-4b15-ba3b-76f17f70553e.sdb_data (253:2)
        - type: lvm, logical_id: ('xenvg', 'c17a8468-b3f5-4aa3-8644-0a2c890d68be.sdb_meta')
          primary:   /dev/xenvg/c17a8468-b3f5-4aa3-8644-0a2c890d68be.sdb_meta (253:3)
          secondary: /dev/xenvg/c17a8468-b3f5-4aa3-8644-0a2c890d68be.sdb_meta (253:3)
node1:~#
```

Get info about a cluster:

```
gnt-cluster info
```

```
node1:~# gnt-cluster info
  Cluster name: node1.example.com
  Master node: node1.example.com
  Architecture (this node): 32bit (i686)
node1:~#
```

Check if everything is alright with the cluster:

```
gnt-cluster verify
```

```
node1:~# gnt-cluster verify
  * Verifying global settings
  * Gathering data (2 nodes)
  * Verifying node node1.example.com
  * Verifying node node2.example.com
  * Verifying instance inst1.example.com
  * Verifying orphan volumes
  * Verifying remaining instances
node1:~#
```

Find out who's the cluster master:

```
gnt-cluster getmaster
```

Failover the master if the master has gone down (fails over the master to the node on which this command is run):

```
gnt-cluster masterfailover
```

Find out about instance volumes on the cluster nodes:

```
gnt-node volumes
```

```
node1:~# gnt-node volumes
Node              PhysDev   VG    Name                                             Size Instance
node1.example.com /dev/sda3 xenvg 22071c7b-37e7-4aa1-be4a-74021599c1a7.sda_meta   128 inst1.example.com
node1.example.com /dev/sda3 xenvg 577164fd-b0cb-4043-9d57-aa59f41fddf1.sda_data 10240 inst1.example.com
node1.example.com /dev/sda3 xenvg c17a8468-b3f5-4aa3-8644-0a2c890d68be.sdb_meta   128 inst1.example.com
node1.example.com /dev/sda3 xenvg d89067b9-cae6-4b15-ba3b-76f17f70553e.sdb_data  4096 inst1.example.com
node2.example.com /dev/sda3 xenvg 22071c7b-37e7-4aa1-be4a-74021599c1a7.sda_meta   128 inst1.example.com
node2.example.com /dev/sda3 xenvg 577164fd-b0cb-4043-9d57-aa59f41fddf1.sda_data 10240 inst1.example.com
node2.example.com /dev/sda3 xenvg c17a8468-b3f5-4aa3-8644-0a2c890d68be.sdb_meta   128 inst1.example.com
node2.example.com /dev/sda3 xenvg d89067b9-cae6-4b15-ba3b-76f17f70553e.sdb_data  4096 inst1.example.com
node1:~#
```

Removing a node from a cluster:

```
gnt-node remove node2.example.com
```

Find out about the operating systems supported by the cluster (currently only Debian Etch):

```
gnt-os list
```

16 A Failover Example

Now let's assume you want to take down *node2.example.com* due to maintenance, but you want *inst1.example.com* to **not** go down.

First, let's find out about our instances:

node1:

```
gnt-instance list
```

As you see, *node2* is the primary node:

```
node1:~# gnt-instance list
Instance          OS          Primary_node      Autostart Status  Memory
inst1.example.com debian-etch node2.example.com yes       running     64
node1:~#
```

To failover *inst1.example.com* to *node1*, we run the following command (again on *node1*):

```
gnt-instance failover inst1.example.com
```

Afterwards, we run

```
gnt-instance list
```

again. *node1* should now be the primary node:

```
node1:~# gnt-instance list
Instance          OS          Primary_node      Autostart Status  Memory
inst1.example.com debian-etch node1.example.com yes       running     64
node1:~#
```

Now you can take down *node2*:

node2:

```
shutdown -h now
```

After *node2* has gone down, you can try to connect to *inst1.example.com* - it should still be running.

Now after the maintenance on *node2* is finished and we have booted it again, we'd like to make it the primary node again.

Therefore we try a failover on *node1* again:

node1:

```
gnt-instance failover inst1.example.com
```

This time we get this:

```
node1:~# gnt-instance failover inst1.example.com
  Failover will happen to image inst1.example.com. This requires a
  shutdown of the instance. Continue?
  y/[n]: <-- y
 * checking disk consistency between source and target
  Can't get any data from node node2.example.com
  Failure: command execution error:
  Disk sda is degraded on target node, aborting failover.
```

```
node1:~#
```

The failover doesn't work because *inst1.example.com*'s hard drive on *node2* is degraded (i.e., not in sync).

To fix this, we can replace *inst1.example.com*'s disks on *node2* by mirroring the disks from the current primary node, *node1*, to *node2*:

node1:

```
gnt-instance replace-disks -n node2.example.com inst1.example.com
```

During this process (which can take some time) *inst1.example.com* can stay up.

```
node1:~# gnt-instance replace-disks -n node2.example.com inst1.example.com
  Waiting for instance inst1.example.com to sync disks.
  - device sda: 0.47% done, 474386 estimated seconds remaining
  - device sdb: 22.51% done, 593 estimated seconds remaining
  - device sda: 0.68% done, 157798 estimated seconds remaining
  - device sdb: 70.50% done, 242 estimated seconds remaining
  - device sda: 0.87% done, 288736 estimated seconds remaining
  - device sda: 0.98% done, 225709 estimated seconds remaining
  - device sda: 1.10% done, 576135 estimated seconds remaining
  - device sda: 1.22% done, 161835 estimated seconds remaining
  - device sda: 1.32% done, 739075 estimated seconds remaining
  - device sda: 1.53% done, 120064 estimated seconds remaining
  - device sda: 1.71% done, 257668 estimated seconds remaining
  - device sda: 1.84% done, 257310 estimated seconds remaining
  - device sda: 3.43% done, 4831 estimated seconds remaining
  - device sda: 6.56% done, 4774 estimated seconds remaining
  - device sda: 8.74% done, 4700 estimated seconds remaining
  - device sda: 11.20% done, 4595 estimated seconds remaining
  - device sda: 13.49% done, 4554 estimated seconds remaining
  - device sda: 15.57% done, 4087 estimated seconds remaining
```

```
- device sda: 17.49% done, 3758 estimated seconds remaining
- device sda: 19.82% done, 4166 estimated seconds remaining
- device sda: 22.11% done, 4075 estimated seconds remaining
- device sda: 23.94% done, 3651 estimated seconds remaining
- device sda: 26.69% done, 3945 estimated seconds remaining
- device sda: 29.06% done, 3745 estimated seconds remaining
- device sda: 31.07% done, 3567 estimated seconds remaining
- device sda: 33.41% done, 3498 estimated seconds remaining
- device sda: 35.77% done, 3364 estimated seconds remaining
- device sda: 38.05% done, 3274 estimated seconds remaining
- device sda: 41.17% done, 3109 estimated seconds remaining
- device sda: 44.11% done, 2974 estimated seconds remaining
- device sda: 46.21% done, 2655 estimated seconds remaining
- device sda: 48.40% done, 2696 estimated seconds remaining
- device sda: 50.84% done, 2635 estimated seconds remaining
- device sda: 53.33% done, 2449 estimated seconds remaining
- device sda: 55.75% done, 2362 estimated seconds remaining
- device sda: 58.73% done, 2172 estimated seconds remaining
- device sda: 60.91% done, 2015 estimated seconds remaining
- device sda: 63.16% done, 1914 estimated seconds remaining
- device sda: 65.41% done, 1760 estimated seconds remaining
- device sda: 68.15% done, 1681 estimated seconds remaining
- device sda: 70.61% done, 1562 estimated seconds remaining
- device sda: 73.55% done, 1370 estimated seconds remaining
- device sda: 76.01% done, 1269 estimated seconds remaining
- device sda: 78.14% done, 1108 estimated seconds remaining
- device sda: 80.59% done, 1011 estimated seconds remaining
- device sda: 82.86% done, 858 estimated seconds remaining
- device sda: 85.25% done, 674 estimated seconds remaining
- device sda: 87.74% done, 638 estimated seconds remaining
- device sda: 90.01% done, 518 estimated seconds remaining
- device sda: 92.40% done, 392 estimated seconds remaining
- device sda: 94.87% done, 265 estimated seconds remaining
```

```
  - device sda: 97.10% done, 147 estimated seconds remaining
  - device sda: 99.38% done, 30 estimated seconds remaining
  Instance inst1.example.com's disks are in sync.
node1:~#
```

Afterwards, we can failover *inst1.example.com* to *node2*:

```
gnt-instance failover inst1.example.com
```

node2 should now be the primary again:

```
gnt-instance list
```

```
node1:~# gnt-instance list
  Instance          OS          Primary_node      Autostart Status  Memory
  inst1.example.com debian-etch node2.example.com yes       running     64
  node1:~#
```

17 Links

- Ganeti: **http://code.google.com/p/ganeti**
- Xen: **http://xen.xensource.com**
- DRBD: **http://www.drbd.org**
- LVM: **http://sourceware.org/lvm2**
- Debian: **http://www.debian.org**