

InetBoot for x86&x86_64 LiveCD

(Debian-Lenny-Beta1/**Feora**/**Ubuntu**/**KNOPPIX**/**VMKnoppix**) is released.

<http://openlab.jp/oscircular/inetboot/>

The InetBoot is a kind of Internet bootloader, which boots an OS from a LiveCD ISO file on the Web. We do not need to burn a CD-ROM for each liveCD.

The sample bootable CD (6.6MB) can boot:

x86 LiveCD

2 types of Debian Lenny Beta1 (KDE, GNOME)

2 types of Fedora (9, 8)

3 types of Ubuntu (804, 710, 704)

1 types of KNOPPIX (531 Re-mastered CD)

1 types of VMKnoppix (Xen: 3.2.1)

x86_64 LiveCD

2 types of Fedora x86_64 (9,8)

1 types of Ubuntu x86_64 (804)

InetBoot will boot the other customized LiveCD. Please try to designate the URL. (CAUTION: InetBoot does not support special customization. Refer to known problems.)

We offered **gPXE scripts** to boot InetBoot itself from the Inetnet. gPXE, which is included syslinux (<http://syslinux.zytor.com>), is an open source Network Bootloader. It can download a kernel and initrd from HTTP server and boot the OS.

■ Special Feature

InetBoot downloads a kernel from a HTTP server and reboots it with “**kexec**”. Since it does not use BOOTP and TFTP, which require *multi-cast at LAN* environment, InetBoot is not limited on LAN environment. It also does not use *statefull* NFS server for root file system. InetBoot uses *stateless* HTTP for root file system and enables dynamic load balancing.

All you have to do is to set the URL of LiveCD at the boot menu and you can boot the LiveCD from the Internet. It means you do not need to burn a CD/DVD for new LiveCD.

InetBoot consists of **GRUB and BuildRoot (BusyBox)**. It is not a simple boot loader. It boots a mini Linux, sets up the network, obtains a new kernel from a HTTP server, **re-masters the initrd to replace the root file system from CD-ROM to httpfs**, and reboots it with “**kexec**”. The new OS boots with loopback-mounting an ISO file at HTTP server with **httpfs**.

httpfs: <http://httpfs.sourceforge.net/>

■ Usage of InetBoot

The Requirement is IP reachable network with DHCP service and more than 256MB memory. With the sample bootable-CD, all you have to do is to select a URL of LiveCD at GRUB menu.

```

GNU GRUB  version 0.97  (638K lower / 522176K upper)

netfsboot Debian Lenny LiveCD KDE Beta1 (casper)
netfsboot Debian Lenny LiveCD GNOME Beta1 (casper)
netfsboot Fedora9
netfsboot Fedora8
netfsboot Ubuntu 8.04 (casper)
netfsboot Ubuntu 7.10 (casper)
netfsboot Ubuntu 7.04 (casper)
netfsboot x86_64 Fedora9
netfsboot x86_64 Fedora8
netfsboot x86_64 Ubuntu 8.04 (casper)
netfsboot KNOPPIX 5.3.1 (Remastered CD)
netfsboot VMKnoppix(Xen3.2.1)

```

The GRUB Menu of sample bootable CD

CAUTION: The included URLs are temporal service. The service will be stop after a certain period.

If you want to setup InetBoot on your GRUB, download “linux” and “minirt.gz” and set up GRUB Menu.

Ex: Fedora

```
kernel /boot/grub/linux netdir=http://***/FedoraLiveCD.iso type=fedora
```

```
initrd /boot/grub/minirt.gz
```

Ex: Fedora x86_64

```
kernel /boot/grub/linux netdir=http://***/Fedora-x86_64-Live.iso type=fedora acpi=off
```

```
initrd /boot/grub/minirt.gz
```

Ex: Ubuntu & Debian Lenny Live

```
kernel /boot/grub/linux netdir=http://***/ubuntuLiveCD.iso type=casper
```

```
initrd /boot/grub/minirt.gz
```

Ex: Ubuntu x86_64

```
kernel /boot/grub/linux netdir=http://***/ubuntu- -amd64.iso type=casper
```

```
initrd /boot/grub/minirt.gz
```

Ex: KNOPPIX

```
kernel /boot/grub/linux netdir=http://***/knoppix.iso type=knoppix ramdisk_size=100000 lang=us
```

```
initrd /boot/grub/minirt.gz
```

Ex: VMKnoppix with Xen

```
kernel /boot/grub/linux netdir=http://***/VMKoppix.iso bootxen=1 type=knoppix ramdisk_size=100000
```

```
lang=us vga=normal # One line
```

```
initrd /boot/grub/minirt.gz
```

The sample bootable-CD includes some URLs of ISO file. They are load balanced by SLB(Global Server Load Balance) and InetBoot finds a suitable site automatically from 3 sites in US, 3 sites in EU, and 3-7 sites in Japan.

- ◆ Debian Lenny Beta1 KDE (Linux 2.6.25-2-486)
- ◆ Debian Lenny Beta1 GNOME (Linux 2.6.25-2-486)
- ◆ Fedora9 LiveCD (Linux 2.6.25-14.fc9.i686)
- ◆ Fedora8 LiveCD (Linux 2.6.23.1-42.fc8)
- ◆ Ubuntu804 (Linux 2.6.24-16-generic)
- ◆ Ubuntu 710 (Linux 2.6.22-14-generic)
- ◆ Ubuntu 704 (Linux 2.6.20-15-generic)
- ◆ x86_64 Fedora9 (Linux 2.6.25-14.fc9 x86-64)
- ◆ x86_64 Fedora8 (Linux 2.6.23.1-42.fc8 x86-64)
- ◆ x86_64 Ubuntu 8.04 (Linux 2.6.24-19-generic x86-64)
- ◆ Knoppix531 (Linux 2.6.24)
- ◆ VMKnoppix (Xen3.2. 1+Linux 2.6.18)

■ Usage of gPXE (<http://www.etherboot.org>)

gPXE, which is included in syslinux (<http://syslinux.zytor.com>), is an open source Network Bootloader. It can download a kernel and initrd from HTTP server and boot the OS. We offered gPXE scripts to boot InetBoot from the Internet.

gPXE tries PXE boot as default. Press **CTL+B** to change to the shell mode. After that, execute the following commands on the shell to boot InetBoot

```
gPXE> dhcp net0
gPXE> kernel http://www.inetboot.net/gpxe/fedora9
gPXE> boot
```

```
ISOLINUX 3.11 2005-09-02 Copyright (C) 1994-2005 H. Peter Anvin
Etherboot ISO boot image generated by geniso
Loading gpxe.krn.....Ready.
pcnet32.c: Found pcnet32, Vendor=0x1022 Device=0x2000
10Mbps Full-Duplex
WARNING: Using legacy NIC wrapper on 00:0c:29:69:66:7d

gPXE 0.9.3 -- Open Source Boot Firmware -- http://etherboot.org
Features: HTTP DNS TFTP iSCSI AoE bzImage Multiboot NBI PXE PXEXT
Press Ctrl-B for the gPXE command line..._
```

```
gPXE> dhcp net0
DHCP (net0 | ██████████ )... ok
gPXE> kernel http://www.inetboot.net/gpxe/fedora9
http://www.inetboot.net/gpxe/fedora9... ok
gPXE> boot
http://www.inetboot.net/gpxe/080731/linux... ok
http://www.inetboot.net/gpxe/080731/minirt.gz... _
```

The first command sets up IP address with DHCP. It depends on network interface. If network interface is not recognized, network boot is not available.

The second command downloads a script to boot InetBoot. The last command boots an OS of LiveCD.

Current available gPXE scripts are following. Please try on your gPXE or SysLinux.

- ◆ <http://www.inetboot.net/gpxe/debian-lenny-kde-beta1>
- ◆ <http://www.inetboot.net/gpxe/debian-lenny-gnome-beta1>
- ◆ <http://www.inetboot.net/gpxe/fedora9>
- ◆ <http://www.inetboot.net/gpxe/fedora8>
- ◆ http://www.inetboot.net/gpxe/fedora9-x86_64
- ◆ http://www.inetboot.net/gpxe/fedora8-x86_64
- ◆ <http://www.inetboot.net/gpxe/ubuntu804>
- ◆ <http://www.inetboot.net/gpxe/ubuntu710>
- ◆ <http://www.inetboot.net/gpxe/ubuntu704>
- ◆ http://www.inetboot.net/gpxe/ubuntu804-x86_64
- ◆ <http://www.inetboot.net/gpxe/knoppix531-remasterCD>
- ◆ <http://www.inetboot.net/gpxe/vmknoppix-xen321>

■ Detail of Implementation

The designated URL at GRUB Menu is passed to BuildRoot as a kernel option.

On the BuildRoot (BusyBox) do the following steps.

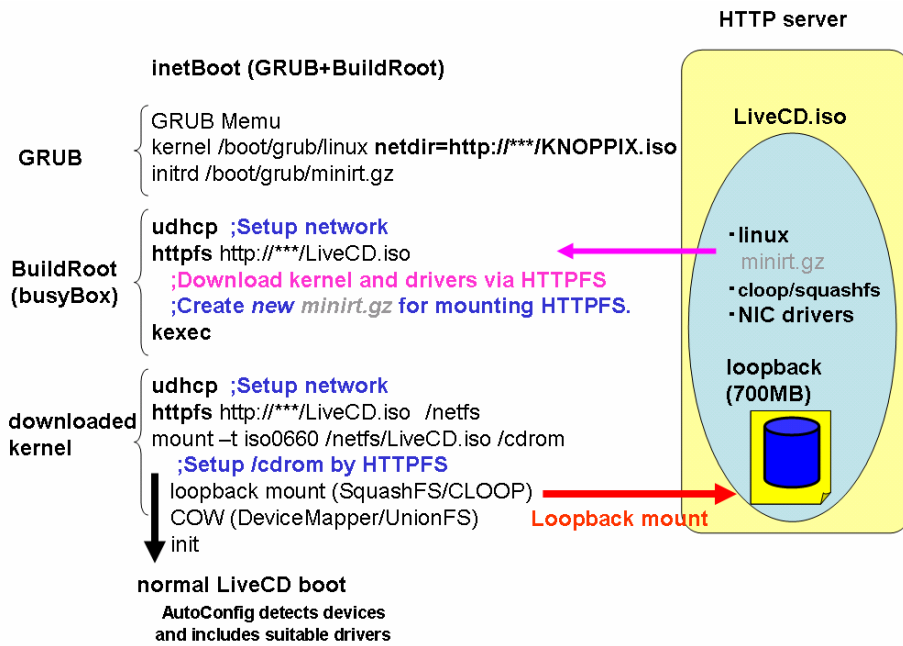
- 1) Set up the network by “udhcp”
- 2) Mount the ISO file by “httpfs”
- 3) Extract the kernel
- 4) Re-master the miniroot. (The new kernel will mount ISO file with “httpfs”.)
- 5) Reboot by “kexec” (Warm Boot)

The download kernel boots with the re-mastered miniroot.

- 1) Mount the ISO file at /cdrom with “httpfs”
- 2) Pass the control to “init” and boots as the normal LiveCD.

After that it works as the normal LiveCD.

The boot procedure is described in the following figure.



File System and COW

Each LiveCD has original feature of file system, COW (CopyOnWrite). InetBoot deals with them and enables to update packages with package manager.

	Debian-Lenny-Beta1	Fedora	Ubuntu	KNOPPIX/VMknoppix
Compress/FileSystem	SquashFS	SquashFS+Ext3	SquashFS	CLOOP+ ISO9660
CopyOnWrite	UnionFS	DeviceMapper	UnionFS	UnionFS
Package Manager	apt-get	yum	synaptic/apt-get	apt-get

■ Known Problems

- ◆ Depend on Network Interface.
 - InetBoot sets up Network Interface TWICE (in BuildRoot and downloaded new kernel). Both of them have to set up a suitable driver.
- ◆ Depend on the situation of server and network.
 - It is sensitive of network latency and load of the server because the root file system is mounted by “httpfs”.
 - The situation may change by rebooting because the load balancer (GSLB) may select another site.
- ◆ InetBoot is not applied to a deeply re-mastered LiveCD.
 - InetBoot has to know the boot procedure to re-master miniroot.
- ◆ Some HTTP servers have 2GB limitation. “httpfs” can not mount DVD ISO file from the servers.

■ Related URL and Paper

URL

- [1] BuildRoot: <http://buildroot.uclibc.org/>
- [2] httpfs: <http://httpfs.sourceforge.net/>
- [3] kboot: <http://kboot.sourceforge.net/>

Paper & Presentation

- [1] Kuniyasu Suzuki, Linux Symposium 08 BOF: OS Circular,
 - (A) http://www.linuxsymposium.org/2008/view_abstract.php?content_key=231
 - (B) Slide: <http://openlab.ring.gr.jp/oscircular/OLS08-BOF-OSCircular.pdf>
- [2] Kuniyasu Suzuki, Kengo Iijima, Toshiki Yagi, Nguyen Anh Quynh, InetBoot and **VMSeed: Trusted Internet Bootloader for Hypervisor and Guest OS**, USENIX Annual Tech Poster 2008.
 - (A) HP: <http://www.usenix.org/events/usenix08/poster.html>
 - (B) Poster: <http://openlab.ring.gr.jp/oscircular/USENIX08Poster-suzaki.pdf>
- [3] Kuniyasu Suzuki, Kengo Iijima, Toshiki Yagi, Nguyen Anh Quynh, Megumi Nakamura and Seiji Muhetoh, **TPM + Internet Virtual Disk + Platform Trust Services = Internet Client**, ASPLOS08 poster (Thirteenth International Conference on Architectural Support for Programming Languages and Operating Systems)
 - (A) HP: <http://research.microsoft.com/asplos08/posters.htm>
 - (B) Poster: <http://openlab.jp/oscircular/ASPLOS08-poster-slide.pdf>
 - (C) Leaflet: <http://openlab.jp/oscircular/ASPLOS08-poster-leaflet.pdf>
- [4] Kuniyasu Suzuki, Toshiki Yagi, Kengo Iijima, and Nguyen Anh Quynh, **OS Circular: Internet Client for Reference**, USENIX LISA07 (21st Large Installation System Administration Conference)
 - (A) HP: <http://www.usenix.org/events/lisa07/tech/suzaki.html>
 - (B) Paper PDF http://www.usenix.org/events/lisa07/tech/full_papers/suzaki/suzaki.pdf
 - (C) Slide PDF <http://openlab.jp/oscircular/LISA07-Slide-suzaki.pdf>

■ Download

- ◆ Sample Bootable CD (ISO file)
 - ◇ <http://ring.aist.go.jp/archives/linux/oscircular/iso/inetboot-20080925-us.iso>
 - ◇ MD5: 5a88fa779151c1cca69b899275719db7
 - ◇ **CAUTION: The included UPLs are temporal service. Please designate your favorite URL.**
- ◆ Kernel for GRUB(2.7MB)
 - ◇ <http://ring.aist.go.jp/archives/linux/oscircular/iso/inetboot-20080925/linux>
 - ◇ MD5: f17ba540614ac02eb419dc2fecfb85da
- ◆ BuildRoot for GRUB(3.2MB):
 - ◇ <http://ring.aist.go.jp/archives/linux/oscircular/iso/inetboot-20080925/minirt.gz>
 - ◇ MD5: f0ea38301122712361e61a961b00f539

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