

InetBoot for x86&x86\_64 LiveCD ([Feora](#)/[Ubuntu](#)/[KNOPPIX](#)/[VMKnoppix](#)) is released.  
<http://openlab.jp/oscircular/inetboot/>

The InetBoot is a small boot image (6.6MB) which boots an OS from a LiveCD ISO file on the Web. This version includes “**x86\_64 handling**”, “**SSH client on BuildRoot**” and “**gPXE**(<http://www.etherboot.org>)”. gPXE downloads the kernel and initrd of InetBoot and re-boots another OS from a ISO file on the Web.

**The sample bootable CD (6.6MB) can boot:**

#### **x86 LiveCD**

- 2 types of Fedora (9,8)
- 3 types of Ubuntu (804, 710, 704)
- 1 types of KNOPPIX(531 Remastered 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 doesn't not support special customization. Refer known problems.)

**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. **We offered gPXE scripts to boot InetBoot from the Inetnet.**

#### ■ **Special Feature**

InetBoot down-loads 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 doesn't use *satefull* 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**

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. 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

```
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.

- ◆ 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)

### The GRUB Menu of sample bootable CD

```
GNU GRUB  version 0.97  (638K lower /
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)
gPXE
BuildRoot Shell
```

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

### 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.

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

### ■ 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.

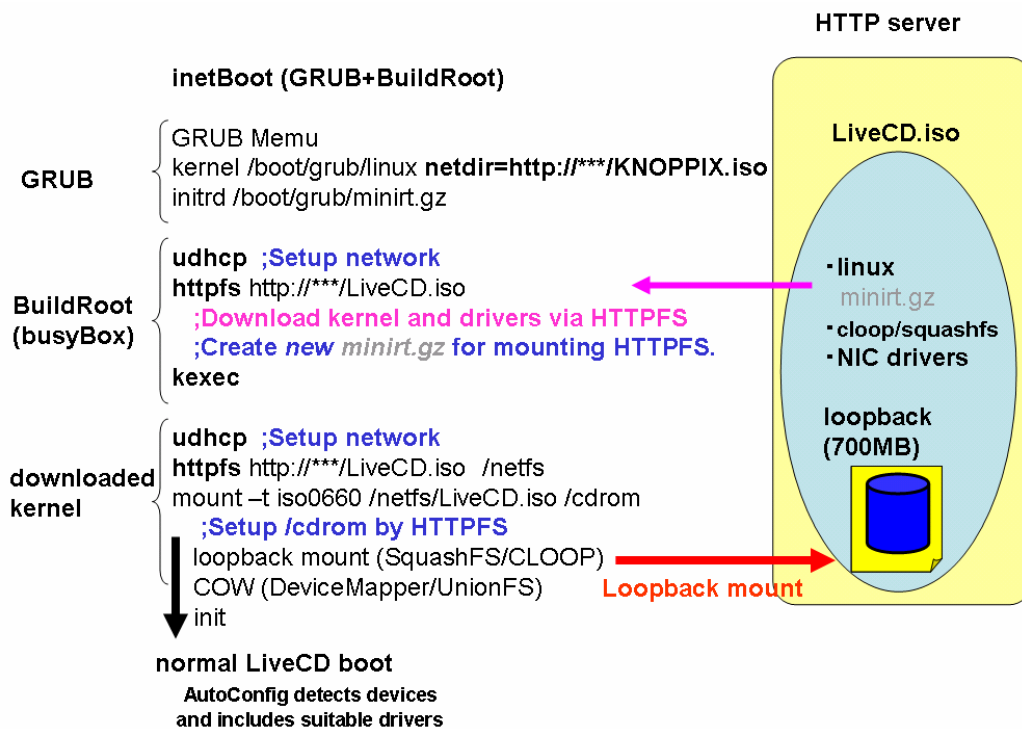
- 1) Set up the network by “udhcp”
- 2) Mount the ISO file by “httpfs”
- 3) Extract the kernel
- 4) Re-master the miniroot. (The new kernel will mount ISO file with “httpfs”.)
- 5) Reboot by “kexec” (Warm Boot)

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.



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

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. We offered gPXE scripts to boot InetBoot from the Inetnet.

gPXE tries PXE boot as default. Press **CTL+B** to change 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/fedora9>
- ◆ <http://www.inetboot.net/gpxe/fedora8>
- ◆ [http://www.inetboot.net/gpxe/fedora9-x86\\_64](http://www.inetboot.net/gpxe/fedora9-x86_64)
- ◆ [http://www.inetboot.net/gpxe/fedora8-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/ubuntu804-x86_64)
- ◆ <http://www.inetboot.net/gpxe/knoppix531-remasterCD>
- ◆ <http://www.inetboot.net/gpxe/vmknoppix-xen321>

#### ■ 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](http://www.linuxsymposium.org/2008/view_abstract.php?content_key=231)
- [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>
- [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](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-20080620-us.iso>
  - ◇ MD5: e37dee2e403f0626aef170d3d298a5be
  - ◇ **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-20080731/linux>
  - ◇ MD5: 1aa5c84793a6b0f18f3fb53aa3f03486
- ◆ BuildRoot for GRUB(3.2MB):
  - ◇ <http://ring.aist.go.jp/archives/linux/oscircular/iso/inetboot-20080731/minirt.gz>
  - ◇ MD5: e10e457c539a64fdd872c3f809340043

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