

InetBoot (GRUB + BuildRoot) for **Fedora/Ubuntu/KNOPPIX/VMKnoppix** is released.

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

InetBoot is a **bootloader** which gets kernel and disk image via Internet and boots from it. This version boots Linux from a ISO file of LiveCD(Fedora/Ubuntu/KNOPPIX/VMKnoppix) which is uploaded on a HTTP server. The sample bootable CD (6MB) can boot:

2 types of **Fedora (9,8)**

3 types of **Ubuntu (804, 710, 704)**

4 types of **KNOPPIX(531, 511, 501, 402)** and

5 types of **VMKnoppix (Xen: 3.2.0, 3.1.1, 3.1.0, 3.0.4.1, 3.0.4)**

InetBoot will boot the other customized LiveCD. **(CAUTION: The sample URL may far from your PC and make slow boot. Please replace the URL with the nearest one. The URL of Live CD is listed in the distributor's HP).**

■ 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 are used for normal network boot (PXE), InetBoot is not limited on LAN environment. It 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 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 miniroot**, reboots with “kexec”. The new OS boots with loopback-mounting an ISO file at HTTP server with **httpfs**.

■ Usage

The Requirement is P 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 lang=us vga=normal type=fedora  
initrd /boot/grub/minirt.gz
```

Ex: Ubuntu

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

Ex: KNOPPIX

```
kernel /boot/grub/linux netdir=http://***/knoppix.iso ramdisk_size=100000 lang=ja vga=normal  
initrd /boot/grub/minirt.gz
```

Ex: VMKnoppix

```
kernel /boot/grub/linux netdir=http://***/VMKoppix.iso bootxen=1 ramdisk_size=100000 lang=ja  
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 2.5.25-14.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)
- ◆ Knoppix531 (Linux 2.6.24)
- ◆ knoppix511 (linux 2.6.19)
- ◆ knoppix501 (linux 2.6.17)
- ◆ knoppix402 (linux 2.6.12)
- ◆ VMKnoppix (Xen3.2.0+Linux 2.6.18)
- ◆ VMKnoppix (Xen3.1.1+Linux 2.6.18)
- ◆ VMKnoppix (Xen3.1.0+Linux 2.6.18)
- ◆ VMKnoppix (Xen3.0.4.1+Linux 2.6.18) Oprofile
- ◆ VMKnoppix (Xen3.0.4) +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 KNOPPIX 5.3.1 (Remastered CD)  
netfsboot KNOPPIX 5.1.1  
netfsboot KNOPPIX 5.0.1  
netfsboot KNOPPIX 4.0.2  
netfsboot VMKnoppix(Xen3.2.1)  
netfsboot VMKnoppix(Xen3.2.0)  
netfsboot VMKnoppix(Xen3.1.1)
```

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	yum	synaptic/apt-get	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.

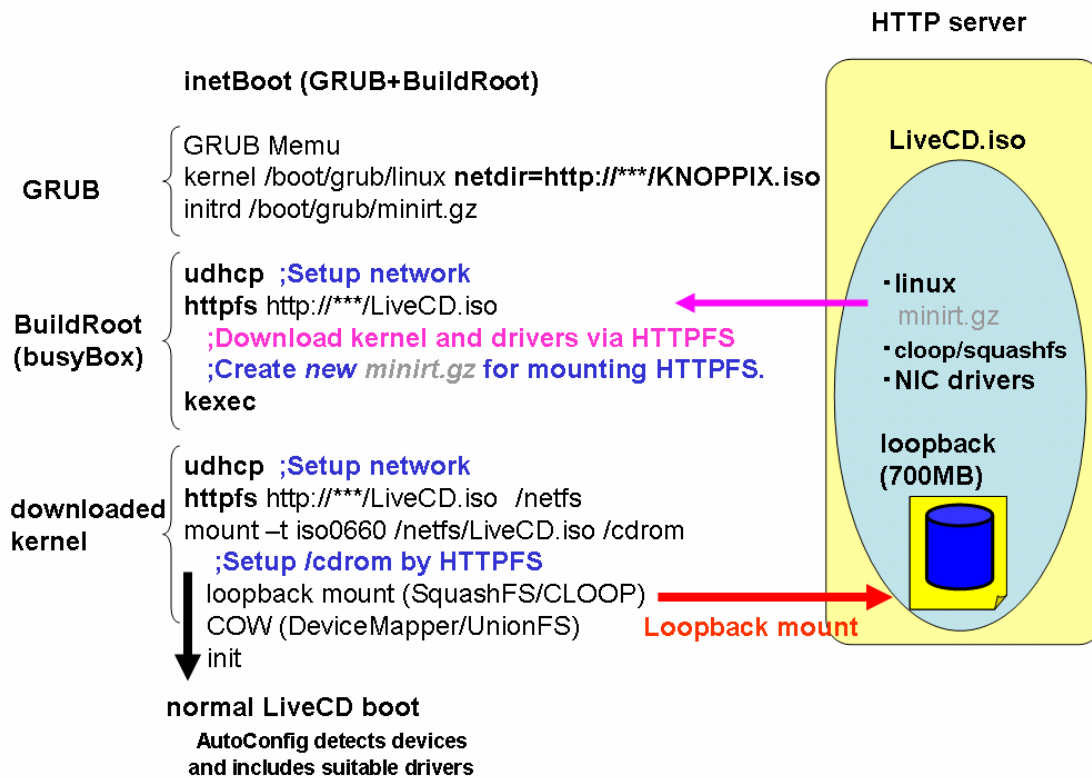
- 1) Set up the network by “udhcp”
- 2) Mount the ISO file by “httpfs”
- 3) Extract the kernel
- 4) Re-master the miniroot. (The new kernel will mount ISO file with “httpfs”.)
- 5) Reboot by “kexec” (Warm Boot)

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.



■ 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
- [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
 - (C) Slide PDF <http://openlab.jp/oscircular/LISA07-Slide-suzaki.pdf>

■ Download

- ◆ Sample Bootable CD (ISO file 6.3MB)
 - ◇ <http://ring.aist.go.jp/archives/linux/oscircular/iso/inetboot-20080620-us.iso>
 - ◇ MD5: e37dee2e403f0626aef170d3d298a5be
 - ◇ **CAUTION:** The included UPLs are temporal service. Please set a URL of ISO file.
- ◆ Kernel for GRUB(2.7MB)
 - ◇ <http://ring.aist.go.jp/archives/linux/oscircular/iso/inetboot-20080620/linux>
 - ◇ MD5: 1aa5c84793a6b0f18f3fb53aa3f03486
- ◆ BuildRoot for GRUB(3.2MB):
 - ◇ <http://ring.aist.go.jp/archives/linux/oscircular/iso/inetboot-20080620/minirt.gz>
 - ◇ MD5: e10e457c539a64fdd872c3f809340043

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