

**InetBoot (GRUB + BuildRoot + HTTP-FUSE) is released.**

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

InetBoot (GRUB + BuildRoot + HTTP-FUSE) is a **bootloader** which gets hypervisor, kernel and miniroot via Internet and reboots them with “**kexec**”(Warm Reboot). The root file system is obtained by **HTTP-FUSE CLOOP** via Internet. The sample bootable CD (5.4MB) boots 3 types of KNOPPIX and 3 types of Xenoppix.

3 types of KNOPPIX; 511,501, and 402

3 types of Xenoppix(Xen2.0.6); KNOPPIX on Dom0, **Plan9** on DomU, and **NetBSD** on DomU.

# Xen environment uses old Linux kernel and limits the network interface (for examples NE2000 and RL8139). Fortunately they boots on QEMU, KQEMU, and VMWare (Xen2.0.6 on a virtual machine!).

### ■ Special Feature

InetBoot downloads a kernel from a HTTP server and reboots it with “kexec”. Since InetBoot doesn’t use BOOTP and TFTP which are used for normal network boot (PXE), InetBoot is not limited on LAN environment. It also doesn’t use *safefull*/NFS server for root file system. InetBoot uses *stateless* HTTP for root file system and enables dynamic load lancing.

All you have to designate the URL of KNOPPIX at the GRUB menu and you can boot the KNOPPIX/VMKnoppix from Internet. It means you don’t need to burn a CD/DVD for new KNOPPIX/VMKnoppix.

InetBoot is consisted of **GRUB and BuildRoot (BusyBox)**. It is not simple boot loader. It boots a mini Linux, sets up the network, obtains hypervisor, kernel, and miniroot from a HTTP server, and reboots them with “kexec”. The new OS boots with loopback-mounting **HTTP-FUSE CLOOP**. So InetBoot is **PreBoot-Linux** which adds some operations before targeted OS.

InetBoot can download a script and execute it. This function makes flexible to control the PreBoot-Linux. Xenoppix uses this function.

**HTTP-FUSE CLOOP saves parts of block device (block files) on a local storage.** The saved block files prevent downloads of same block files and reduces total traffic. They are used for re-boot and makes quick boot.

### ■ Usage

Download “linux” and “minirt.gz” of BuildRoot and set up GRUB.

Only you have to designate the URL of HTTP-FUSE KNOPPIX/Xenoppix at GRUB menu.

Ex: Normal KNOPPIX

kernel /boot/grub/linux

**httpfuse=http://knoppix.inetboot.net/archives/linux/oscircular/tcgeeks/v1.0/ ramdisk\_size=100000**

lang=en vga=normal nodhcp lang=us # one line form here

initrd /boot/grub/minirt.gz

Ex: Xenoppix.

```
kernel /boot/grub/linux
```

```
iscript=http://knoppix.inetboot.net/archives/linux/knoppix/xenoppix_http/kexec.sh
```

```
ramdisk_size=100000 lang=en vga=normal nodhcp lang=us # one line form here
```

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

# "iscript=" designate a script which is executed on the BuildRoot.

The sample bootable-CD includes some URLs of HTTP-FUSE KNOPPIX/Xenoppix. They are load-balanced by SLB(Global Server Load Balance) and InetBoot finds a suitable site automatically form 3 sites in US, 3 sites in EU, and 7 sites in Japan. The available OS are

- ◆ knoppix511 (linux 2.6.19)
- ◆ knoppix501 (linux 2.6.17)
- ◆ knoppix402 (linux 2.6.12)
- ◆ Xenoppix (Xen2.0.6+Linux 2.6.12)
- ◆ Plan9 on Xenoppix (Xen2.0.6+Linux 2.6.12)
- ◆ NetBSD on Xenoppix (Xen2.0.6+Linux 2.6.12)

#### The GRUB Menu of sample bootable CD

```
GNU GRUB  version 0.97  (638K lower
HTTP-FUSE KNOPPIX511
HTTP-FUSE KNOPPIX501
HTTP-FUSE KNOPPIX402
HTTP-FUSE Xenoppix+Xen 2.0.6
HTTP-FUSE Plan9 (Xenoppix+Xen 2.0.6)
HTTP-FUSE NetBSD (Xenoppix+Xen 2.0.6)
BuildRoot Shell
```

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

#### Disk Image Caching

The disk image is distributed by block files. Some block files are saved on local storage and reduce the network traffic.

The “¥knxblock” folder on a local storage (Ex. USB memory) is detected by the driver of HTTP-FUSE CLOOP and block files are saved at the folder. The local storage must be FAT or Ext2/Ext3 because the driver can recognize it. The free space should be more than 100MB. If the free space is 1GB, it will save whole image of an OS.

#### ■ Detail of Implementation

The following indicates the boot procedure of InetBoot.

##### ● GRUB

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

- **BuildRoot (BusyBox)**

The BuildRoot (BusyBox) operates the following steps.

- 1) Set up the network by “udhcp”
- 2) Download hypervisor, kernel miniroot from a HTTP server.
- 3) Reboot them with “kexec” (Warm Boot)

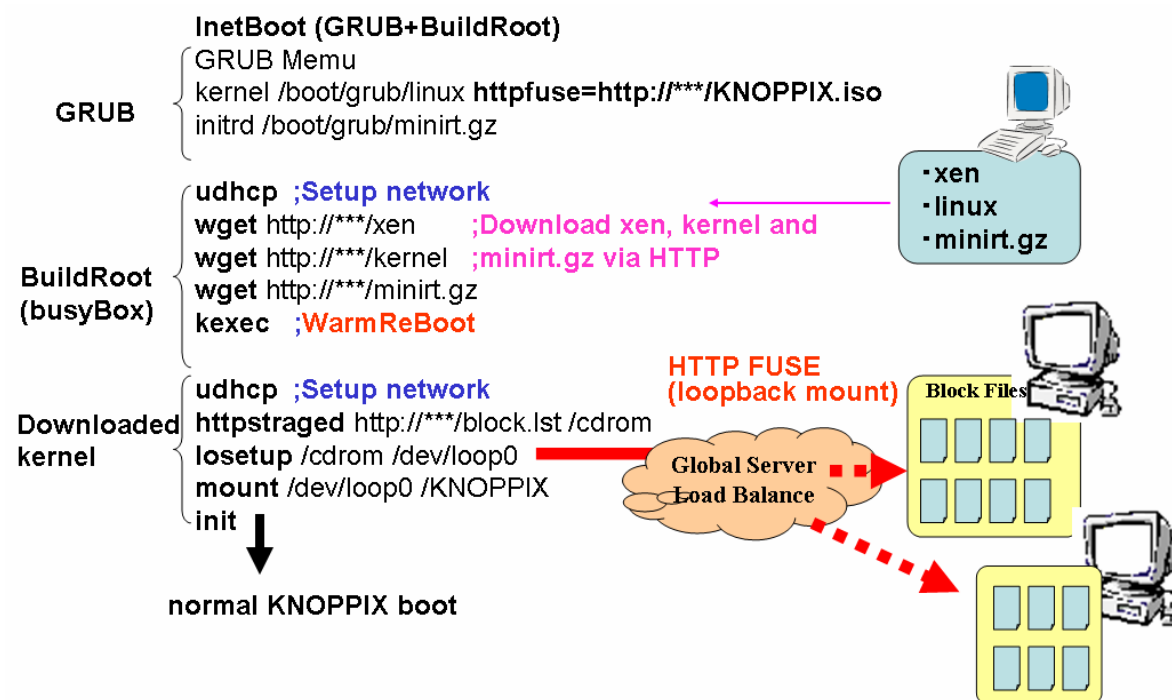
- **Targeted kernel**

The download kernel boots with the downloaded miniroot which includes the driver of HTTP-FUSE CLOOP.

- 1) Set up the network by “udhcp”
- 2) Mount “/cdrom” with the driver of HTTP-FUSE CLOOP.
- 3) Loopback mount “/KNOPPIX” with “/cdrom/Disk1/knoppix”.
- 4) Pass the control to “init”.

After that it works as the normal KNOPPIX.

The boot procedure is indicated at 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.
  - Xenoppix uses old kernel and boots with a few Network Interface. We confirmed only RealTeck RL8139 and NE2000. Xenoppix can boots on QEMU, KQEMU, and VMWare.
- ◆ 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 “HTTP-FUSE CLOOP”.

- The situation may change by rebooting because the load balancer (GSLB) may select another site.

## ■ Related URL and Paper

### URL

- [1] BuildRoot: <http://buildroot.uclibc.org/>
- [2] httpfs: <http://httpfs.sourceforge.net/>
- [3] kboot: <http://kboot.sourceforge.net/>
- [4] Linux Symposium 08 BOF: OS Circular, [http://www.linuxsymposium.org/2008/view\\_abstract.php?content\\_key=231](http://www.linuxsymposium.org/2008/view_abstract.php?content_key=231)

### Paper & Presentation

- [1] Kuniyasu Suzaki, 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>
- [2] Kuniyasu Suzaki, 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://www.ring.gr.jp/archives/linux/oscircular/iso/inetboot-http-fuse-20080418.iso>
  - ◇ MD5: cb93a918ebec70d1763a116a133a50ce
- ◆ kernel and miniroot of BuildRoot. They are used on sample bootable CD.
  - ◇ <http://www.ring.gr.jp/archives/linux/oscircular/iso/inetboot-http-fuse-20080418/linux>
  - ◇ <http://www.ring.gr.jp/archives/linux/oscircular/iso/inetboot-http-fuse-20080418/minirt.gz>

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