# OS Circulation environment “Trusted HTTP-FUSE Xenoppix”

http://unit.aist.go.jp/itri/knoppix/http-fuse/index-en.html

http://unit.aist.go.jp/itri/knoppix/xen/index-en.html

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  - Virtual Bootloader “Xenoppix”
  - Globalized Virtual Disk “HTTP-FUSE CLOOP”
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# Purpose of OS Circular

- OS Migration System for anonymous Users
  - Boot OSes on anonymous PC without installation.
- FLOZ (Free Live OS Zoo) has same concept.
  - http://www.oszoo.org/wiki/index.php/Free_Live_OS_Zoo
  - “QEMU” runs OSes(Linux, Minix, Plan9, OpenSolaris, etc) on the server. The GUI is transferred by VNC on Client PC.
  - **Server Centric System**
    - Bad response because the server exits in Italy
    - Guest OS has no network service for security & resource

# OS Circular

- OS Circular is Client Centric System and utilize virtualization technology.
  - Virtual Bootloader + Globalized Virtual Disks
  - Client PC boots with the Virtual Bootloader and get OS images via Globalized Virtual Disks
    - Current PC has powerful CPU, much Memory, and wide Network.
      - It prevents server bottleneck. The network is managed by the user.
    - OS images are maintained on the server and they are execute on a Client PC.
  - Same idea is implemented on Collective[NSDI'05] and Internet Suspend/Resume[WMCSA'02]
    - What is different?
    - ***OS Circular utilizes existing, in-expensive and popular Infrastructure.***

# Virtual BootLoader

- Virtual Bootloader is consisted of “Virtual Machine software” and host OS which runs Virtual Machine
- Virtual Machine offers an Abstraction Layer which offers a common PC environment on any PCes.
  - Full Virtualization enables us to use normal installer and security management for Guest OS.
  - The abstraction is used for OS migration.
    - SoulPAD [Mobisys’05], VAT of Collective[NSDI’05], Internet Suspend/Resume[WMCSA’02 ] use VMware.
- Host OS supports real device drivers
    - KNOPPIX is used on SoulPAD and VAT of Collective, because KNOPPIX automatically detects available devices and loads the appropriate Linux drivers.

# Xenoppix as Virtual Bootloader

- Xenoppix (2005.09 ～ ) = Xen + KNOPPIX
  - Old Xenoppix uses Para-Virtualizaiton and runs Plan9 & NetBSD. Current Xenoppix runs Para & Ful Virtualizaion
  - Full Virtualzation of Xen “HVM” prepares a common PC environment on anonymous PC.
    - HVM requires virtualization instructions; Intel VT or AMD-V.
  - KNOPPIX works on Domain0 of Xen (as the host OS).
    - Xen has no device drivers and utilize the drivers of the OS on Domain0.“Autoconfig” of KNOPPIX detects devices and setup drives.
    - So, Xen and KNOPPIX is the best marriage.

# Globalized Virtual Disk

- Virtual Disk is Block Level Abstraction.
- The requirement for globalization.
  - Versioning
    - Partial update
  - Globalization
    - World Wilde Deployment
    - Network/Storage Transparent for mobile computing
      - Handle network (dis/re)-connection
  - Security
    - OS itself should maintained by Security Software
    - Virtual disks have to keep validness of contents

# Versioning

- 2 type of versioning
  - Non-persistent versioning
    - “undo” of operations during OS lives.
  - persistent versioning
    - “rollback” of OS image

- Trusted HTTP-FUSE CLOOP has same versioning of Venti[USENIX’02] of Plan9.
  - A SHA-1 hash of the data acts as the address of the data.
  - Data blocks are write once and aren’t removed. They make ideal for permanent or backup storage.
  - Unfortunately Venti requires special protocol for file system and limits the scalability.
- Trusted HTTP-FUSE CLOOP saves data blocks to files.
  - The feature makes to utilize HTTP to distribute them.

# Globalization (1/2)

- Virtual disk are desired to be shared on Internet.

- We must consider network latency and extensibility of server.
  - NBD, iSCSI and iFCP look fine, but they require special software on server. This feature prevents scalability.
- Policy of Trusted HTTP-FUSE CLOOP
  - Don’t require special daemons and special ports on servers. The requirement is file distribution only.
  - For World Wilde Deployment , utilize existing infrastructure.
    - Web hosting services, Mirror servers, Proxies

# Globalization (2/2)

- We have to consider dis-connection of network for mobile computing.
  - StatelessLinux of RHEL5 takes snapshot on a local storage as cache.
- The blocks of Trusted HTTP-FUSE CLOOP are cached on a local storage.
  - While applications don’t access extra blocks, it works fine.

# Security

- Basically security management is independent of virtual disk, because security of OS should be managed by security software or package manager.
- The commitment of virtual disk is to keep uncontaminated contents.

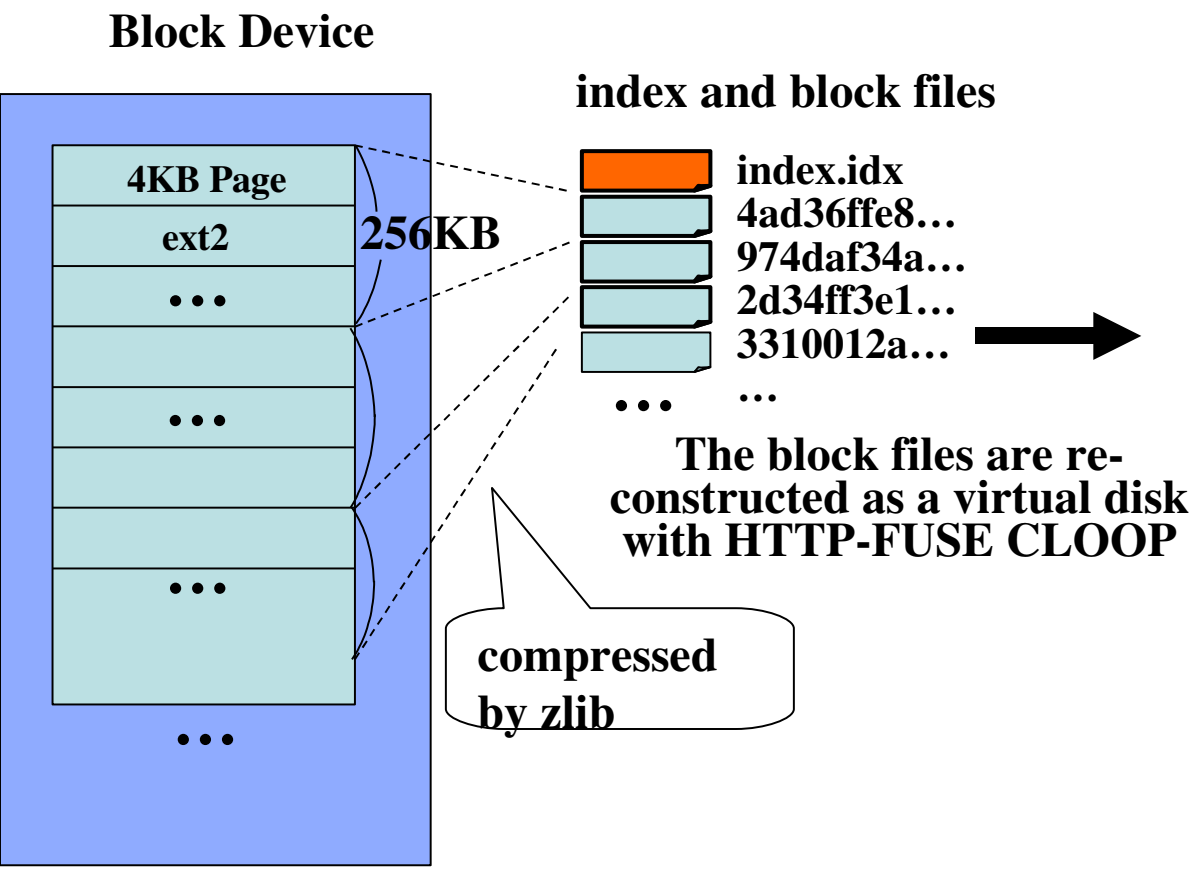
- Trusted HTTP-FUSE CLOOP check the validness of contents when it mapped to a virtual disk.

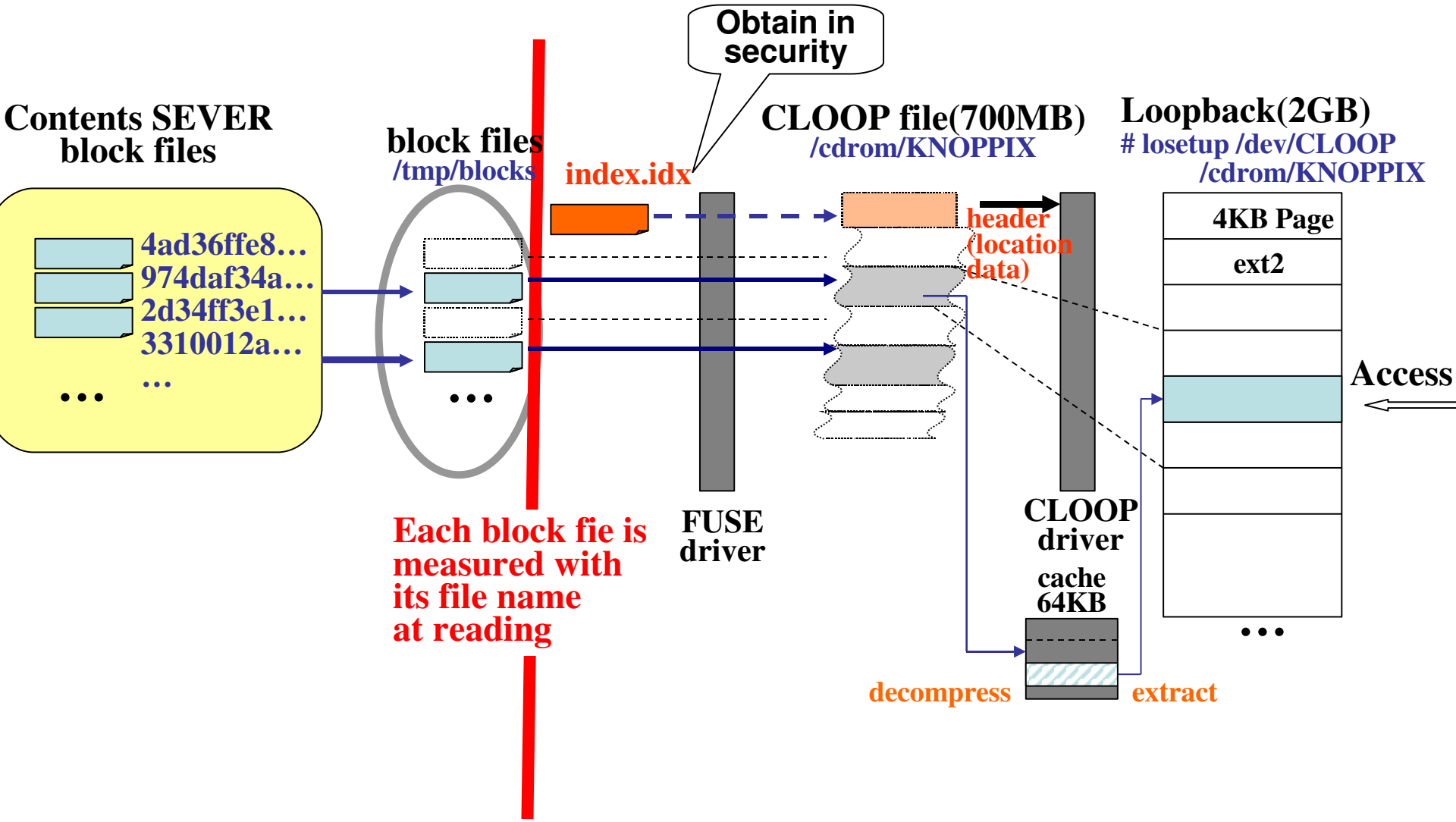
# HTTP-FUSE CLOOP (1/2)

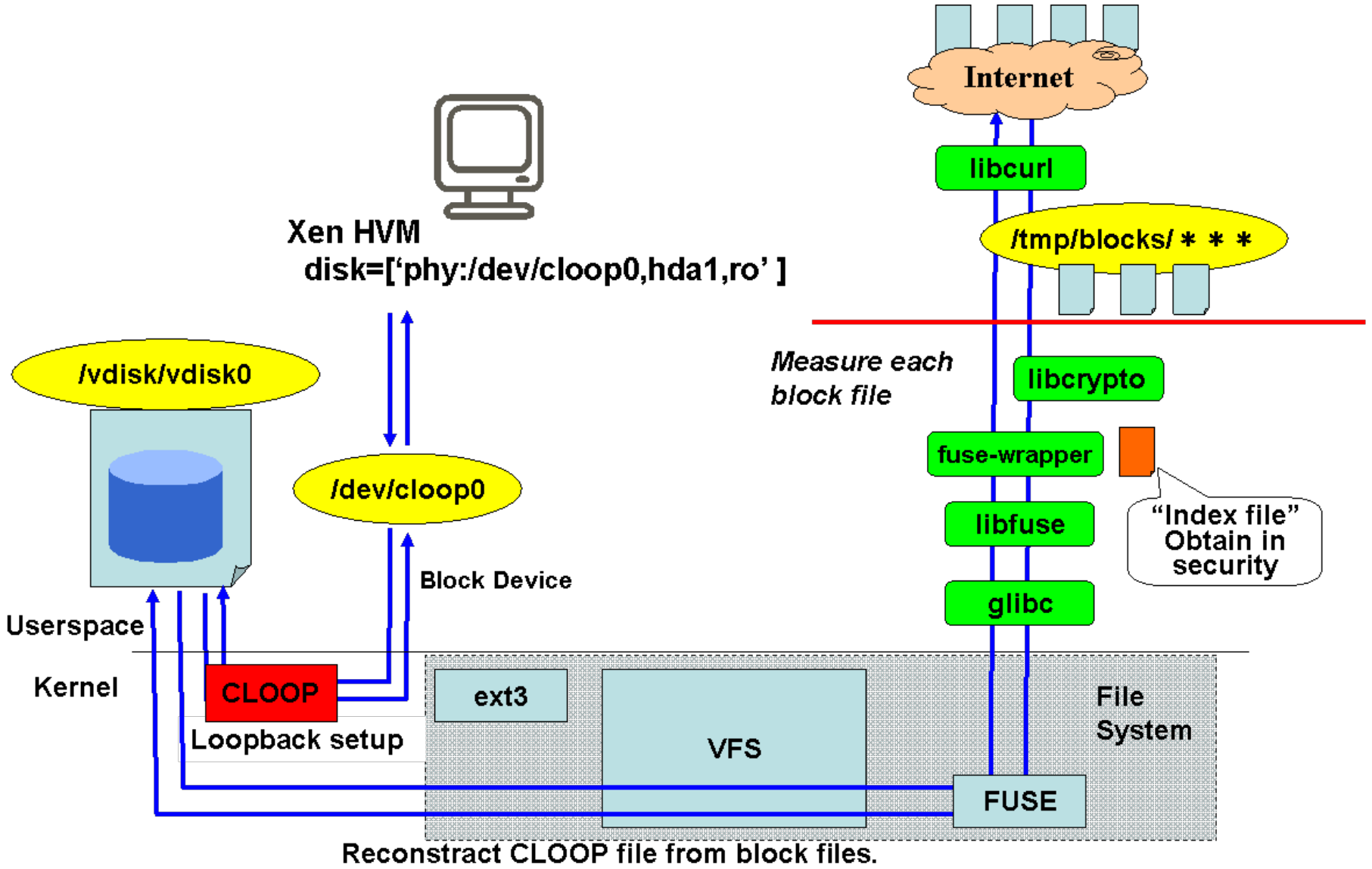
- Original block device is split by 256KB and compressed by zlib. Each data is saved to a block file.
- Block files are managed by “index” file which works as a header of CLOOP.
- Block file name is a SHA1 value of its contents.
  - If there is a same contests blocks, they are held together a same name file and **reduce total file space**.
  - The basic idea is resemble to “Venti of Plan9”
- Block files are reconstructed to a CLOOP file by FUSE wrapper.
  - FUSE is a User-land File System.
    - http://fuse.sf.net
- Each block file is measured with the SHA1 file name when it mapped to CLOOP.

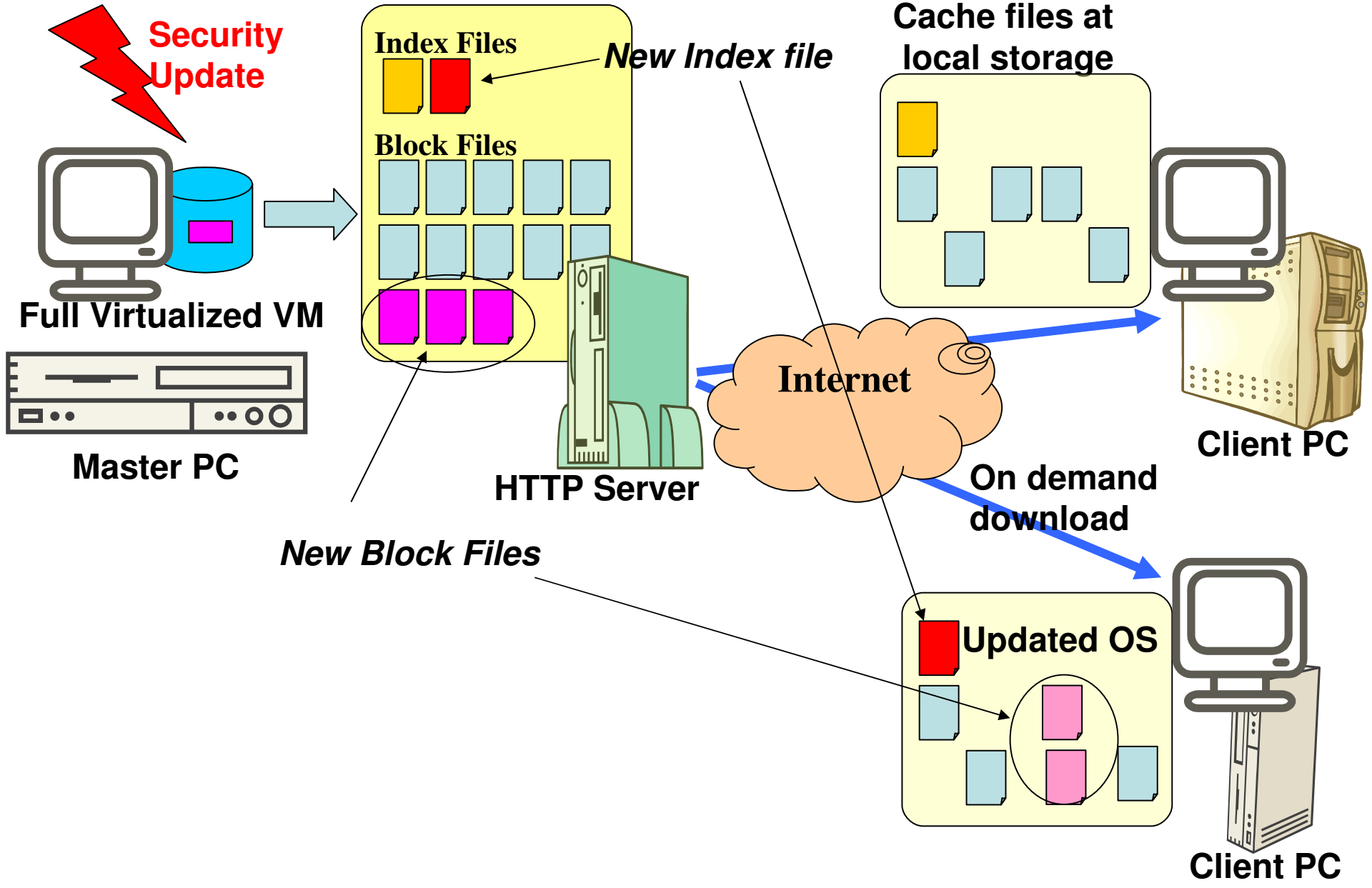
# HTTP-FUSE CLOOP (2/2)

- When a file is updated or created on an original block device, the relevant block files are newly created with new SHA1 name. The “index” file are also renewed.
  - Old block files are reusable.
- HTTP for file deliver
  - Most popular and well designed.
    - Web hosting is inexpensive.
    - 80 port is usually opened.
      - Other network block devices use special port which is usually closed.
- Block files are network/storage transparent.
  - Block files are cached and reused on local storage.
  - If necessary block files are stored in a local storage, network connection is not necessary.


Block Device
index and block files
4KB Page
ext2
256KB
index.idx
4ad36ffe8…
974daf34a…
2d34ff3e1…
3310012a…
…
The block files are re-constructed as a virtual disk with HTTP-FUSE CLOOP
compressed by zlib


Contents SEVER
block files
4ad36ffe8…
974daf34a…
2d34ff3e1…
3310012a…
…
block files
/tmp/blocks
index.idx
Obtain in security
CLOOP file(700MB)
/cdrom/KNOPPIX
Loopback(2GB)
# losetup /dev/CLOOP
/cdrom/KNOPPIX
header (location data)
4KB Page
ext2
Access
Each block fie is measured with its file name at reading
FUSE driver
CLOOP driver
cache 64KB
decompress
extract


Internet
libcurl
/tmp/blocks/＊＊＊
Xen HVM
disk=['phy:/dev/cloop0,hda1,ro' ]
Measure each
block file
libcrypto
/vdisk/vdisk0
/dev/cloop0
fuse-wrapper
"Index file"
Obtain in
security
libfuse
Block Device
glibc
Userspace
Kernel
CLOOP
Loopback setup
ext3
VFS
File
System
FUSE
Reconstract CLOOP file from block files.


Security Update
Index Files
New Index file
Block Files
Cache files at local storage
Full Virtualized VM
Master PC
Internet
Client PC
HTTP Server
On demand download
New Block Files
Updated OS
Client PC

# Weak point of HTTP-FUSE CLOOP

- HTTP-FUSE CLOOP is Vulnerable for Network Latency
  - On demand & small data request makes narrow bandwidth on long latency.

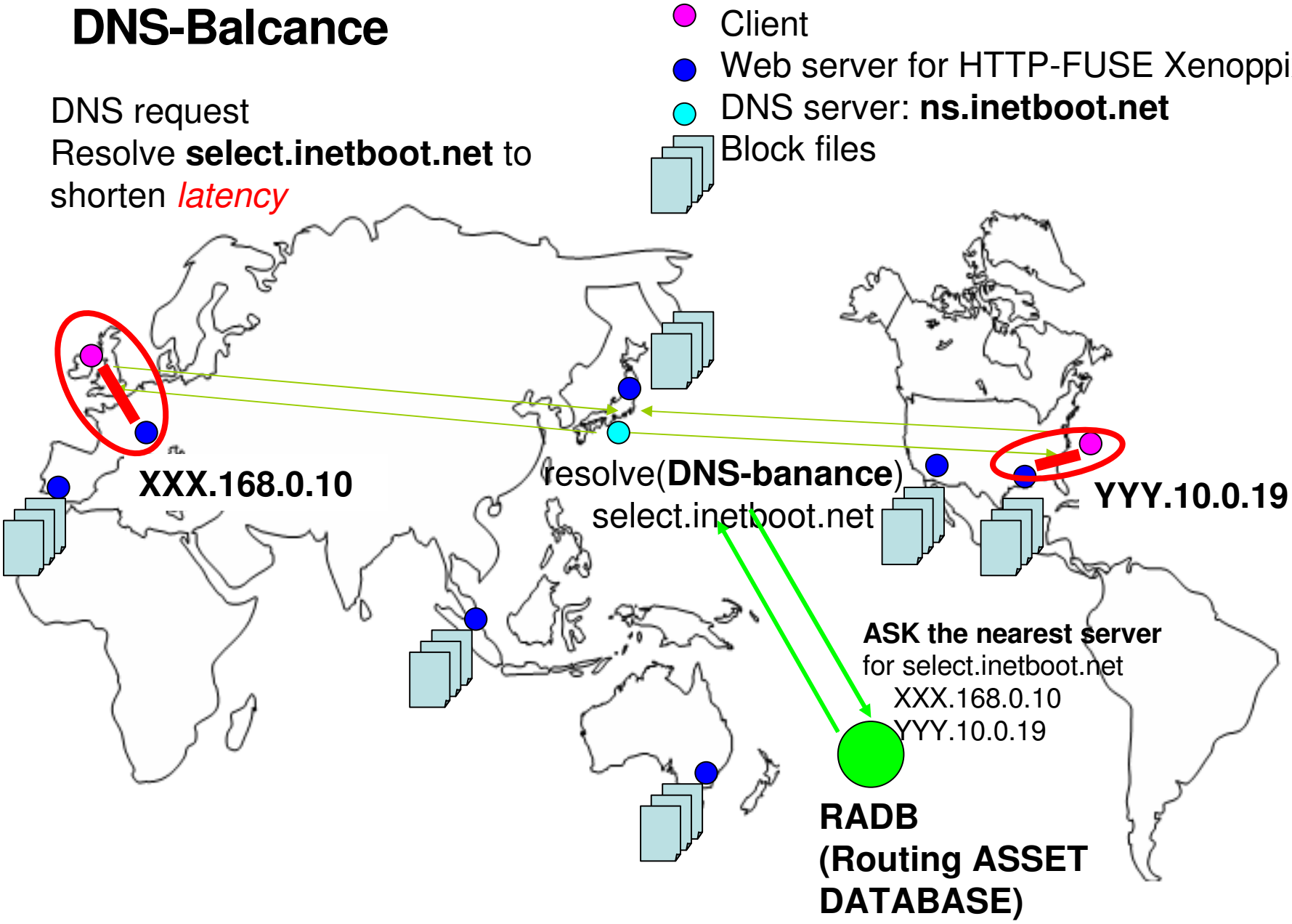
- Solutions
  - Shorten Latency
    - Find the nearest one among candidates dowonload sites
  - Widen Bandwidth
    - Pre download necessary block files
    - Software RAID

# Care for network latency (Find near download site)

- Client Side Solution: netselect
  - netselect measures the latency of candidate servers and finds nearest one.
    - http://www.worldvisions.ca/~apenwarr/netselect/
- Server Side Solution: DNS-Balance
  - DNS-Balance is a name resolver which suggests near candidate servers with routing information offered by RADB.net
    - http://openlab.jp/dns_balance/dns_balance.html

# DNS-Balcance

DNS request
Resolve **select.inetboot.net** to shorten *latency*



# Care for network latency
# (Multiple download connections)

- DLAHEAD (DownLoad AHEAD)
  - Preparation
    - Take a profile of downloaded block files at boot time.
  - At boot time
    - The block files are downloaded in advance with extra download connections. (Default is 4)
  - Effective and easy to implement
- Software RAID using MD
  - Mirroring(RAID1) virtual block device makes fault tolerant and broadband with multiple access.

# Current Status of OS Circular

- Virtual Boot Loader
  - Xenoppix (Xen 3.0.3 + KNOPPIX 5.0.1)
  - Debian package
    - HTTP-FUSE CLOOP
    - Setup script for OS Circular

- OS Images is obtained by Trusted HTTP-FUSE CLOOP
  - Debian GNU/Linux
    - Secure updated with “apt-get” command
  - FreeBSD

# Current HTTP sites

- Web Hosting Service is reasonable.
  - 5GB/ mount from $10

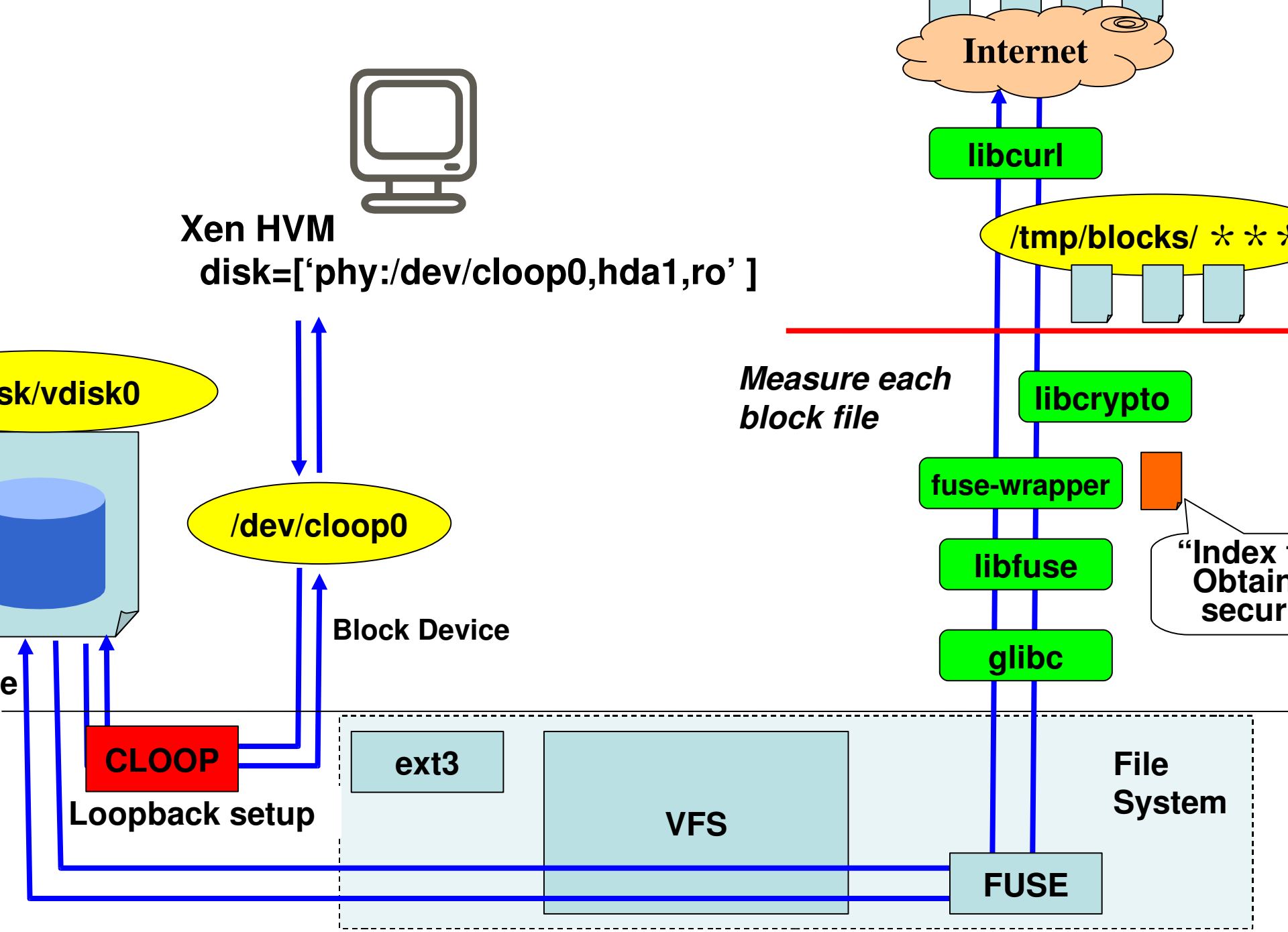
# Discussions

- Live OS update
  - Intel vPro, LUCOS[VEE'06]
  - We have plan to  integrate IDS and IPS on OS Circular.

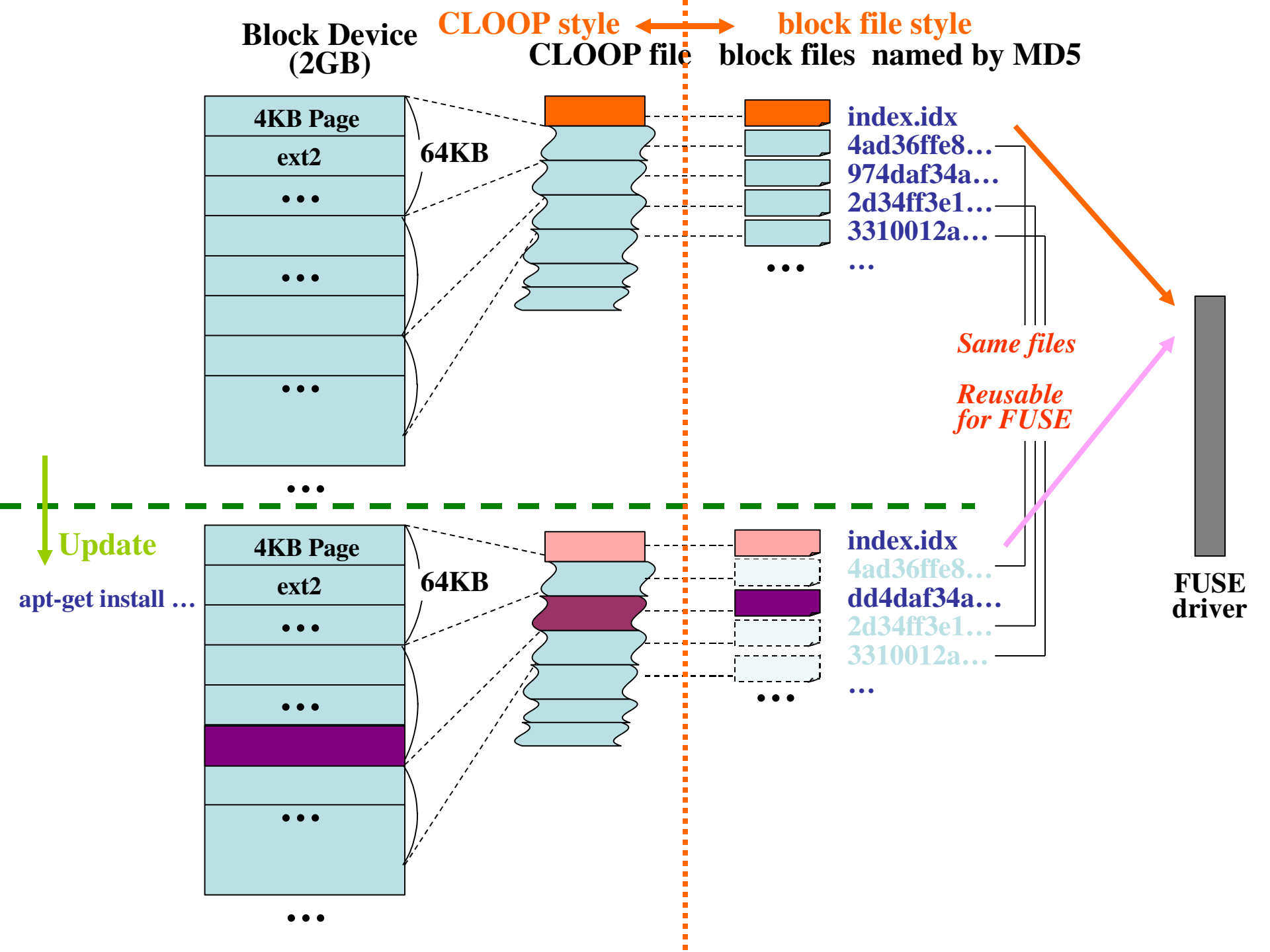
- BlkTap of Xen [USENIX'05]
  - Xen offers an interface of software device "BlkTap".
  - We want to make an offload engine of Trusted HTTP-FUSE CLOOP.

# Conclusions

- OS Circular is Client Centric OS Migration System which is consisted of Virtual Bootloader “Xenoppix” and Global Virtual Disk “Trusted HTTP-FUSE CLOOP”.
- The current target OSes are Debian GNU/Linux and FreeBSD.
  - Debian is updated by “apt-get” automatically.
- We hope OS Circular easy-to-try OS environment.




Reconstract CLOOP file from block files.


Block Device
(2GB)
CLOOP style
block file style
CLOOP file
block files named by MD5
4KB Page
ext2
64KB
index.idx
4ad36ffe8…
974daf34a…
2d34ff3e1…
3310012a…
Same files
Reusable
for FUSE
FUSE
driver
Update
apt-get install …
dd4daf34a…