Variation on AFS as root filesystem

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Outline

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Problem statement

setup

- laboratories ca. 100 clients = 50 + 40 + 10
- Linux (Debian, Ubuntu) installation on local HDs
- activation of auto updates
- some clients out of sync
- exposure to local tampering

wish for centralized image plus clean-up on boot

context

- PXE boot already in use
- NFS root file system not desirable
- AFS available for HOMEs
- yet no redundancy for RW volumes
- PCs with more than 1GB RAM and 40 GB HD

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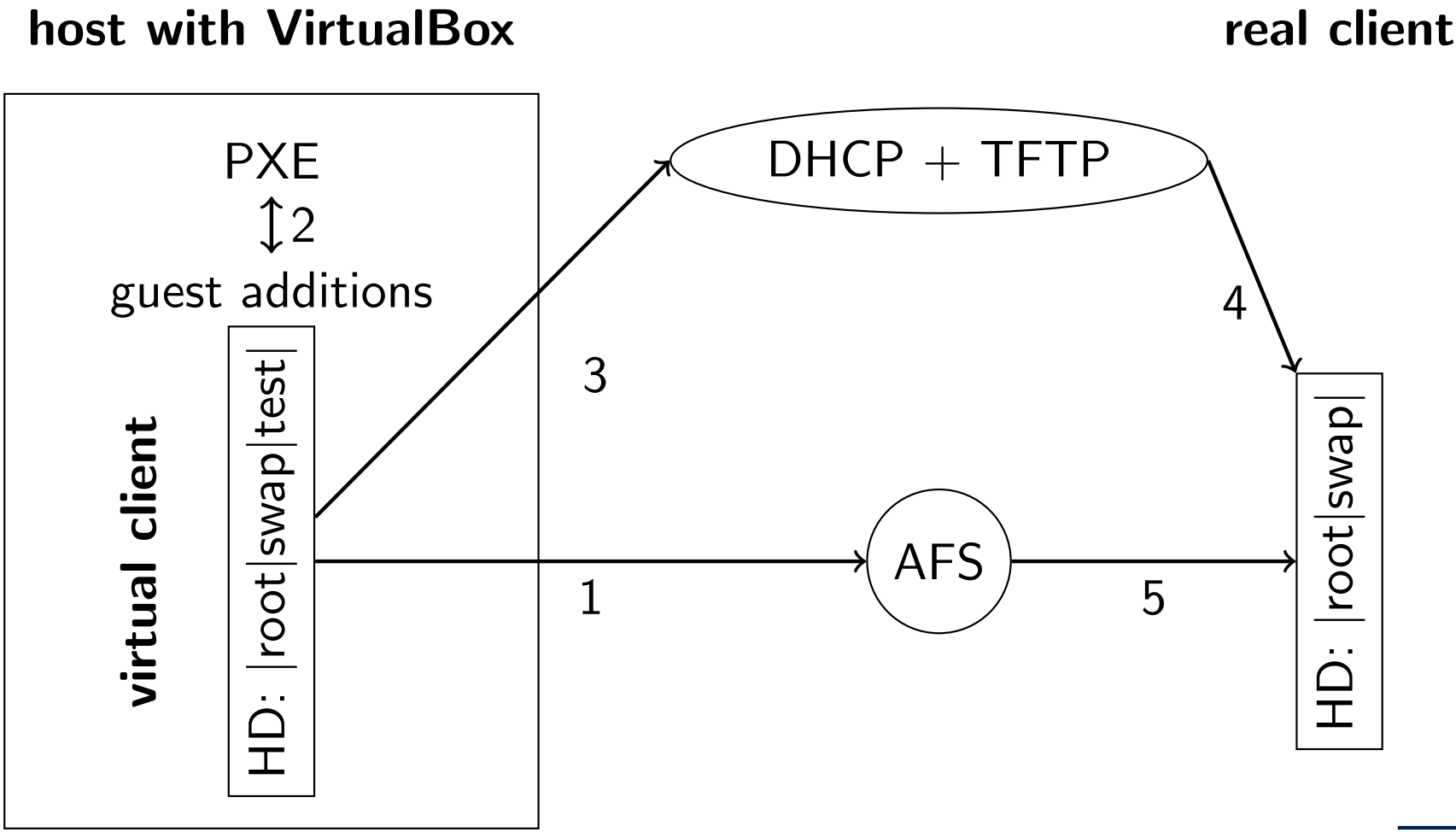
Sketch


host with VirtualBox
real client
virtual client
PXE
2
guest additions
HD: |root|swap|test|
DHCP + TFTP
3
4
AFS
1
5
HD: |root|swap|

Virtualization

why

- creation of one virtual master image
- test host OS independent (Linux, Mac OS X, Windows)
- image just a simple file
- snapshots possible
- several persons can update the image

software Virtualbox with guest additions

benefits

- allows for PXE boot to try resulting kernel and ramdisk
- partition client's HD accordingly
- e.g. 1 root + 1 swap + 1 test partition
- DHCP client as in real installation
- different virtual network configurations possible

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PXE boot

1. boot computer with (PXE supporting) network card
2. contact *proxy* DHCP server for boot server and network settings
3. contact TFTP server for network bootstrap program
4. load NBP into RAM
5. optionally verify check-sum then execute the program
6. Debian Linux uses pxelinux
7. pxelinux: `pxelinux.0` and `pxelinux.cfg/default`
8. Linux kernel over TFTP ca. 1.5MB for Debian
9. initial ramdisk over TFTP ca. 6.0MB for Debian (max. 32MB ?)
10. potentially *multicast* TFTP

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AFS part

1. no RW replication hence same problem as NFS
2. but RO replication for redundancy
3. allowing just RO from clients adds further security
4. move as much as possible of the system into RO space
5. *.tar or *.tgz for variable parts of the file system
6. AFS in that case is needed early in the boot process
7. client caching reduces network traffic
8. `vos release` for live upgrades
9. kernel + ramdisk upgrades on TFTP server
   potentially serving from RW space in AFS

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Modifications in initial ramdisk

- prepare `/afs` mount point and kernel module for AFS
- add all `/bin` and `/sbin` contents
- append all necessary libraries for dependencies
- copy `/usr/bin/fs`
- etc.tar for settings like keytabs or ssh keys

- take care of parsing extra boot parameters
- activate network and start AFS client with memcache
- prepare a swap and root partition with symlinks into AFS
- untar variable space, also `/etc` from ramdisk
- move `/afs` mount to destination before `pivot_root`

- requires at least 1GB RAM and ca. 15MB ramdisk

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Boot parameters

initrd=initrd.new name of initial ramdisk

ramdisk_size=128000 enlarge the size reservation

ip=dhcp for the network settings

root=/afs similar to NFS for setup script

afssrc=/afs/dia.uniroma3.it/projects/debian source for file system
(bin/ boot/ home.tar lib/ opt/ sbin/ srv/ usr/ var.tar)

afsdst=/dev/sda2 root partition

swap=/dev/sda3 swap partition

cell=dia.uniroma3.it home cell and activation of *setuid*

cache=100000 AFS cache size for memcache

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Upgrade procedure

scripting with `Makefile` under `root` account in virtual client

image in AFS space

1. upgrade master client
2. activate AFS on master client
3. work as root with system:administrators credentials
4. `rsync` of RO parts and tar of RW parts (no hard links)
5. small corrections are necessary (`/lib/udev/devices/` `/lib/init/rw/`)
6. release the master image volume

kernel and initial ramdisk

1. dist-upgrade master client
2. copy new kernel to TFTP server
3. create new ramdisk with modifications
4. copy new ramdisk to TFTP server

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Benefits of this setting

- master client as image file within virtualization
- resulting setup can be tested in the virtual environment
- `rc.local` can provide customization based on hostname
- all essential parts are provided from redundant RO space in AFS
- security relevant parts are coded into initial ramdisk
- Linux kernel remains unchanged
- upgrades can be pushed with running clients
- logging is centralized with `rsyslogd` over TCP
- central logserver with MySQL backend
- users can activate further services with `sudo` as necessary using local space below `/var` (deploy `/etc/sudoers`)

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How does it work so far?

- tests done with Debian Linux 5.0 i386
- Ubuntu 10.04 different because of new start procedure for services
- 10 clients work reliably booting in ca. 3 minutes (10/100 network)
- laboratory with 50 clients needs reconfiguration of network hardware
- image file for master client on a *Mac mini* running Mac *OS X server*
- image can be mounted over Kerberized NFS from two Mac OS X clients
- *VirtualBox* used with Mac *OS X* as host operating system
- for Debian different *runlevels* can be prepared
- specialized `rc.local` can activate a kiosk mode

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What next?

- extend this approach to Linux servers
- requires special treatment of persistent RW part of the file system
- possible solution could be *GlusterFS* over dedicated network

- look into alternatives for client
- push changing parts of file system into RO, too
- *unionfs* like in KNOPPIX could be applied

- reflect to support other client OS
- Linux can make use of just a single image but not Windows (SID ?)
- could also a virtualization layer fit into the initial ramdisk?
  this goes in the direction of *desktop virtualization*

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