FAI – The Universal Deployment Tool

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finger lange@localhost

- whoami
  - Diploma in computer science, University of Bonn, Germany
  - Sysadmin since over two decades
  - SunOS 4.1.1 on SPARC hardware
  - Solaris Jumpstart
  - Started FAI in 1999
  - 1999 first cluster (16× Dual PII 400 MHz)
  - Debian developer since 2000
  - Several talks and tutorials:

    Linux Kongress, Linuxtag, DebConf, SANE, LCA, FOSDEM, CeBit, OSDC, UKUUG, FrOSCon, Chemnitzer Linuxtag

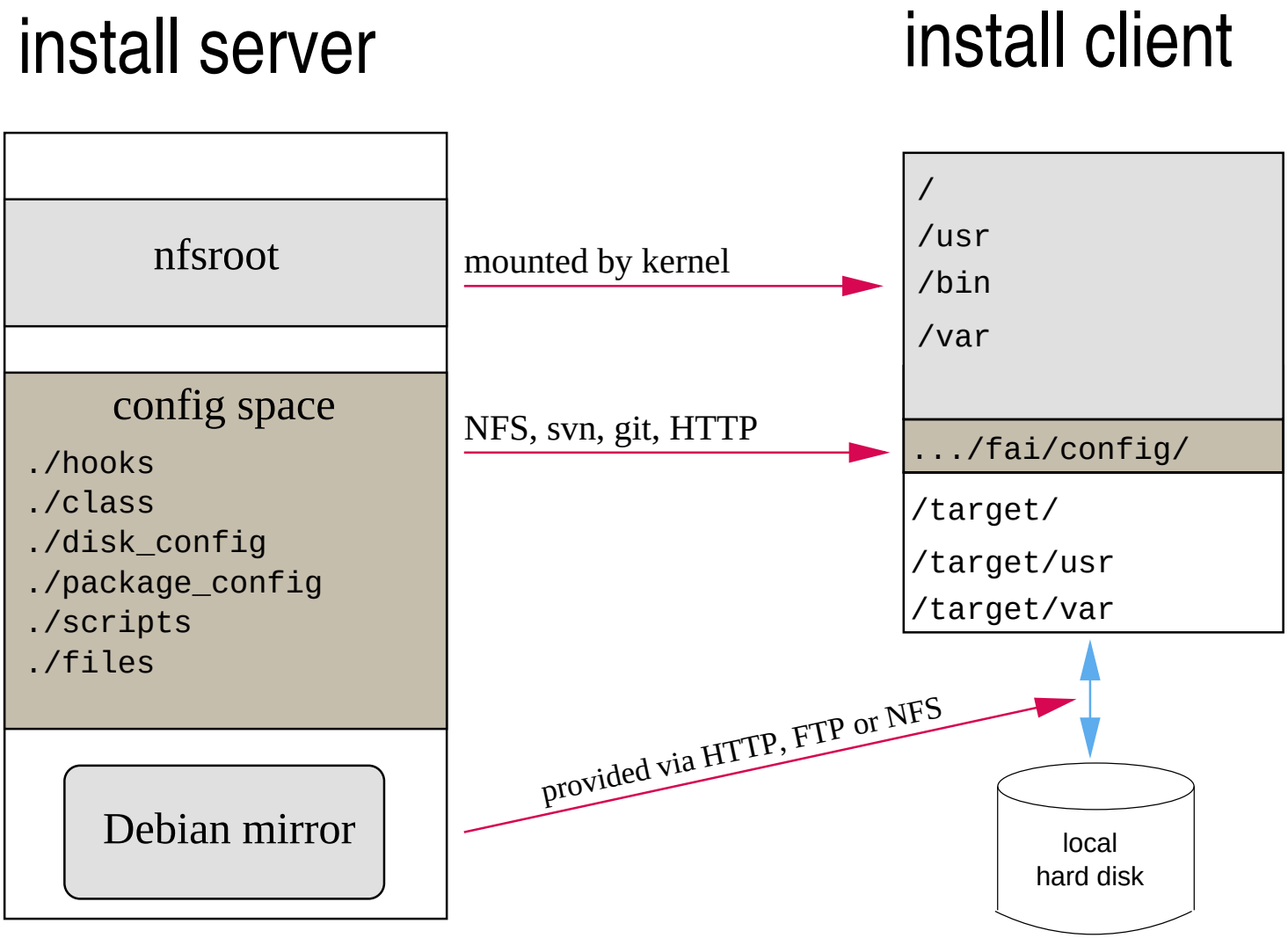
What is a deployment?

- FAI = Fully Automatic Installation
- Making a computer ready to work
- From power-off to applications running
- It's all about software packages
- Installation and configuration
- Central administration and control

What is FAI?

- FAI does everything a sysadmin (you!) has to do, before users can log in to a brand new computer for the first time
- Server based tool for a script based automatic installation
- Installs and configures the OS and all applications
- No master or golden image needed
- Class system provides modularity
- Flexible and easy to expand with hooks
- It can't plan your installation :-(but
- **Plan your installation and FAI installs your plan! :-)**

FAI overview



- The configuration is stored on the install server
- The installation runs on the client

Parts of an installation I

- Plan your installation!
- PXE boot (DHCP, TFTP)
- Install client runs as diskless client (aufs for rw access)
- Define Classes and variables

Parts of an installation II

- Create partitions on local hard disk
- Create file systems
- Install software packages (OS and applications)
- Configure and customize packages (using scripts)
- Boot new system

The class concept of FAI

- You can group a list of hosts by using a class
- A host may belong to multiple classes
- Examples: `FAIBASE GRUB DESKTOP GNOME demohost LAST`
- Order of the classes defines the priority from low to high
- All parts of the installation are using the classes

The config space

```
|-- class/
|   |-- 10-base-classes
|   |-- 50-host-classes
|   |-- FAIBASE.var
|   `-- GERMAN.var

|-- disk_config/
|   |-- FAIBASE
|   |-- DESKTOP
|   `-- foobar04

|-- basefiles/

|-- package_config/
|   |-- FAIBASE
|   |-- DESKTOP
|   |-- GERMAN
|   |-- GNOME
|   `-- server07
```

Defining classes

Example: `.../class/10-base-classes`:

```
#! /bin/sh

dpkg --print-architecture | tr a-z A-Z       # AMD64, I386

case $HOSTNAME in
    demohost)
        echo "FAIBASE DHCPC DEMO" ;;
    gnomehost)
        echo "FAIBASE DHCPC DEMO XORG GNOME";;
esac
case $IPADDR in
    123.45.6.*) echo "CS_KOELN DESKTOP NET_6" ;;
esac

ifclass -o AMD64 I386 && echo "GRUB"

lspci | grep -q MATROX || echo "MATROX"
```

Variables

Example: `.../class/FAIBASE.var`:

```
FAI_ALLOW_UNSIGNED=1

KEYMAP=de-latin1-nodeadkeys
UTC=yes
TIMEZONE=Europe/Berlin

ROOTPW='$1$kBn.MWcO.B$djxB38B7dMkplhJHPf2d1'
LOGUSER=fai

YPDOMAIN=dept-a
```

- Define your own variables
- Use the variables in `.../scripts/*`

Disk partitioning

Example: `.../disk_config/FAIBASE`:

```
disk_config disk1     preserve_always:8 fstabkey:uuid

primary  /       4G-10G      ext4  rw,noatime,errors=remount-ro
logical  swap    1G          swap  rw
logical  /var    1G-2G       ext4  rw   createopts="-L var -m 5"
logical  /tmp    1G-2%       ext4  rw   tuneopts="-c 0 -i 0"
logical  /home   5G-         ext4  defaults
```

- File systems: ext[2,3,4], vfat, xfs, ReiserFS, NTFS, **brtfs**

RAID, LVM

```
disk_config disk1
primary   -     50-100      - -
primary   swap  1G          swap       sw
primary   -     2G-10G      - -
logical   -     0-          - -
logical   -     0-          - -

disk_config disk2    sameas:disk1

disk_config raid
raid1    /boot disk1.1,disk2.1    ext4       rw
raid1    /     disk1.3,disk2.3    ext4       rw,acl,user_xattr
raid1    -     disk1.5,disk2.5    - -
raid1    -     disk1.6,disk2.6    - -

disk_config lvm
vg  volg1  md2,md3
volg1-usr  /usr          8G   ext4  rw createopts="-O dir_index,resize_inode"
volg1-var  /var          2G   ext4  rw createopts="-O dir_index,resize_inode"
volg1-hl   /home/local   10G  ext4  rw,acl,user_xattr,noexec,nosuid,nodev
volg1-es   /export/sites 3G   ext4  rw createopts="-O none"
volg1-v    /vservers     8G   ext4  rw createopts="-O ^dir_index,^resize_inode"
```

Software package installation

Example: `.../package_config/BEOWULF`:

```
# packages for Beowulf clients

PACKAGES aptitude
fping ganglia-monitor

lam-runtime lam4 lam4-dev libpvm3 pvm-dev mpich
scalapack-mpich-dev


PACKAGES install BEOWULF_MASTER
gmetad apache
```

- Supported package tools: `aptitude`, `apt-get`, `smart`, `rpm`, `urpmi`, `y2pmsh`, `yast`, `yum`, `zypper`

Scripts and files

```
|-- scripts/
|   |-- FAIBASE/
|   |   |-- 10-misc                     Bourne shell script
|   |   |-- 30-interface                Bourne shell script
|   |   `-- 40-misc                     Cfengine script
|   `-- DEMO/
|       |-- 10-misc                     Perl script
|       `-- 30-demo                     Cfengine script
|
`- files/
    `-- etc/
       `-- X11/
           `-- xorg.xonf/               fcopy /etc/X11/xorg.conf
               |-- FAIBASE
               |-- MATROX
               |-- CAD
               `-- demohost
```

Config scripts

```
#! /bin/bash
# create NIS/NONIS config

fcopy -M /etc/nsswitch.conf /etc/host.conf
ifclass NONIS && rm -f $target/etc/defaultdomain
if ifclass NIS; then
    echo $YPDOMAIN > $target/etc/defaultdomain
    rm -f $target/etc/yp.conf
    for s in $YPSRVR; do
        ainsl -av /etc/yp.conf "ypserver $s"
        # don't do this! # echo "ypserver $s" >> $target/etc/yp.conf
    done
fi

ainsl -v /etc/fstab "${hserver}:/home /home nfs ro 0 0"
ainsl -av /etc/default/ssh 'SSHD_OPTS=-4'

fcopy -Mv /etc/hosts.allow /etc/hosts.deny
fcopy -M /etc/X11/xorg.conf
```

Installation times

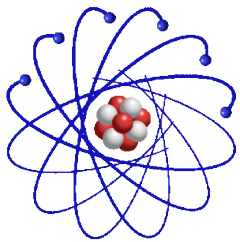
Host, RAM	Software	Zeit
E5-2690v2, 3.0 GHz, 128GB	5.4 GB	7 min
Core i7, 3.2 GHz, 6GB	4.3 GB	7 min
Core i7, 3.2 GHz, 6GB	471 MB	77 s
Core2duo, 2 GHz, 2GB	4.3 GB	17 min
Core2duo, 2 GHz, 2GB	471 MB	165 s
Pentium 4, 3 GHz, 1GB	2200 MB	10 min
Pentium 4, 3 GHz, 1GB	1100 MB	6 min
Pentium 4, 3 GHz, 1GB	300 MB	105 s

- New Cluster: 36 node, each Gbit, server with 10Gbit
- No change of the installation time (426 sec)
- Max. CPU usage on the server: system $< 13\%$, user $< 1.5\%$
- 10 Gbit network was saturated for 1 minute (98%)
- NFS is **NOT** a bottleneck

The universal tool

debian ubuntu

CentOS



Scientific Linux

Installing different distributions

- Booting FAI and disk partitioning does not need modification
- You can use a Debian nfsroot when installing CentOS
- Use a different base file for each distribution (`rinse`)
- Different access to package repository (`sources.list`, `yum.repos.d`)
- Adjust package names
- Adjust customization scripts

```
|-- basefiles/
    |-- CENTOS6_32.tar.xz
    |-- CENTOS6_64.tar.xz
    |-- CENTOS7_64.tar.xz
    |-- SLC6_64.tar.xz
    `-- UBUNTU_1410.tar.xz
```

The universal tool

- FAI does not distinguish between
  - bare metal
  - virtual host
  - chroot
  - LiveCD
  - Golden image

- It's always about installing and configuring software packages
- chroot: `fai dirinstall`
- chroot does not have a hard disk
- chroot does not need a kernel
- TODO: `fai-cloudimage`
- Maybe: `fai-stack ;-)`
- FAI runs on i386, amd64, IA64, SPARC, PowerPC, ALPHA, z10 mainframe

FAI users

- Anonymous, financial industry, 32.000 hosts
- LVM insurance, 10.000 hosts
- City of Munich, 16.000 hosts
- Albert Einstein Institute, 1725 hosts
- Zivit, 260 hosts on two IBM z10 EC mainframes
- Archive.org, 200+ hosts
- XING AG, 300-400 hosts
- Opera Software, ∼300 hosts
- Stanford University, 450 hosts
- MIT Computer science research lab, 200 hosts
- The Welcome Trust Sanger Institute, 540 hosts
- Deutsches Elektronen-Synchrotron, 273 hosts
- Mobile.de, ∼600 hosts
- Electricité de France (EDF), 1500 hosts
- BUF, digital visual effects company, 1000 hosts
- ETH Zurich, systems group, ∼300 hosts
- StayFriends, 700+ hosts
- Grml, creating eight different ISOs, daily builds

fai-monitor-gui

http://fai-project.org

Questions?