

# 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?

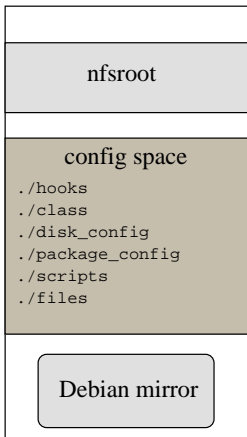
- ▶ FAI = Fully Automatic Installation
- ▶ Making a computer ready to work
- ▶ From power-off to applications running
- ▶ It's all about software packages
- ▶ Installation and configuration
- ▶ Central administration and control

# What is FAI?

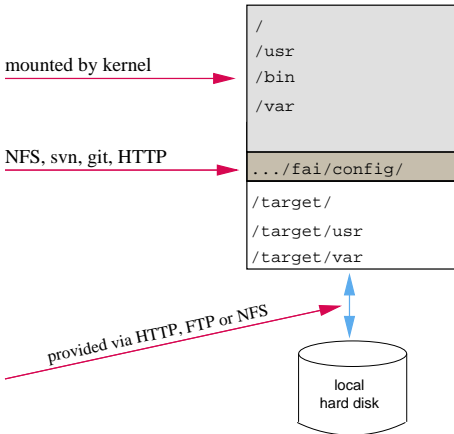
- ▶ FAI does everything a sysadmin (you!) has to do, before users can log in to a brand new computer for the first time
- ▶ Server based tool for a script based automatic installation
- ▶ Installs and configures the OS and all applications
- ▶ No master or golden image needed
- ▶ Class system provides 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

### install server



### install client



- ▶ 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 DHCPD DEMO" ;;
    gnomehost)
        echo "FAIBASE DHCPD 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-noddeadkeys
```

```
UTC=yes
```

```
TIMEZONE=Europe/Berlin
```

```
ROOTPW='$1$kBn.MWc0.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, y2pms, 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



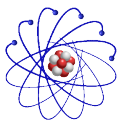
**debian**



**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 Wellcome 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



The screenshot shows the 'FaiMonitor-gui' window with a table of host configurations. The table has columns for 'hostname' and various configuration steps: 'confdir', 'defclass', 'partition', 'extrbase', 'debconf', 'instsoft', 'configure', 'tests', 'savelog', 'failend', and 'reboot'. Each cell contains a status icon: a green checkmark for success, a yellow exclamation mark for warning, a red 'X' for failure, an orange circle with an 'O' for pending, or a blue arrow for a pending action.

hostname	confdir	defclass	partition	extrbase	debconf	instsoft	configure	tests	savelog	failend	reboot
demohost	✓	✓	✓	✓	✓	O	X	!	✓	→	
atom03	✓	!	✓	✓	✓	!	✓	X	✓	→	
atom02	✓	✓	✓	✓	✓	→					
atom01	✓	✓	✓	✓	✓	✓	✓	O	→		
gnomehost	✓	✓	✓	✓	✓	✓	✓	✓	✓	→	

## FAI - Fully Automatic Installation

- Home
  - Features
  - Poster / Flyer
  - User reports
  - Mailing Lists / IRC / Wiki
  - Clusters built with FAI
- Screenshots
- Download
  - FAI-CD
  - Packages
  - FAI questionnaire
- Documentation
  - FAI Guide
  - Manual pages
  - Other documentation
- Developers
  - Seources / Bugs
  - Roadmap
  - Team
- Contact / Support
- Site search

  
Go

FAI is a non-interactive system to install, customize and manage Linux systems and software configurations on computers as well as virtual machines and chroot environments, from small networks to large-scale infrastructures like clusters and cloud environments.

It's a tool for unattended mass deployment of Linux. You can take one or more virgin PC's, turn on the power, and after a few minutes, the systems are installed, and completely configured to your exact needs, without any interaction necessary.

Motto: Plan your installation, and FAI installs your plan.

### NEWS

- [26 Nov 2014] **New FAI CD image available, FAI 4.3.1-vheezy1**
- [19 Nov 2014] **FAI 4.3.1 released, bug fixes**
- [24 Oct 2014] **FAI 4.3 released, btrfs support added**
- [3 Jun 2014] **FAI 4.2 released, new ISO images created**
- [15 September 2011] **CentOS and Scientific Linux Cern support [more...](#)**
- [21 Dec 2009] The FAI project celebrates its [10th anniversary](#).

### Features

- Installs and updates Debian, Ubuntu, CentOS, RHEL, SUSE, ...
- Centralized deployment and configuration management
- Installs virtual machines using KVM, XEN or VirtualBox and Vserver
- Easy set up of software RAID and LVM
- Full remote control via ssh during installation
- Integrated disaster recovery system
- Every stage can be customized via hooks

Download FAI CD



# Questions?