

# 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?

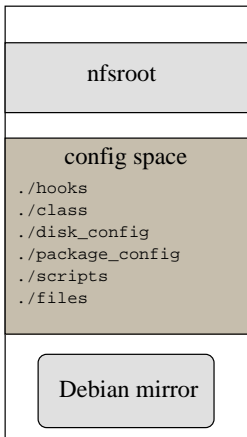
- ▶ FAI = Fully Automatic Installation
- ▶ Making a computer ready to work
- ▶ From power-off to applications running
- ▶ It's all about software packages
- ▶ Initial installation and maintenance upgrade
- ▶ Configuration and customization
- ▶ Central administration and control

## What is FAI?

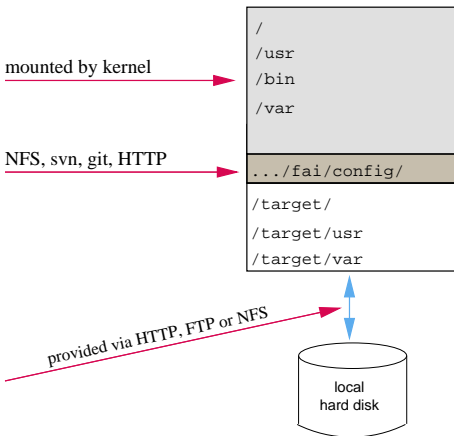
- ▶ FAI does everything a sysadmin (you!) has to do, before users can log in to a brand new computer for the first time
- ▶ Server based tool for a script based automatic installation
- ▶ Installs and configures the OS and all applications
- ▶ No master or golden image needed
- ▶ Class system provides modularity
- ▶ Flexible and easy to expand with hooks
- ▶ FAI documents the installation and configuration for you
- ▶ 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
- ▶ These hosts share the same configuration data defined in this class (e.g. a partitioning scheme, a list of packages, a customization script)
- ▶ A host usually belongs to multiple classes
- ▶ Example: GRUB DESKTOP XORG 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  
|   '-- demohost
```

```
|-- 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 DHCP DEMO" ;;
    gnomehost)
        echo "FAIBASE DHCP 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$djxB38B7dMkp1hJHPf2d1'
LOGUSER=fai

YPPDOMAIN=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"
volg1-var /var          2G      ext4      rw createopts="-O dir_index"
volg1-hl  /home/local 10G     ext4      rw,acl,user_xattr,noexec,nosuid
volg1-es  /export/sites 3G      ext4      rw createopts="-O none"
volg1-v   /vservers    8G      ext4      rw createopts="-O ^dir_index"
```

# 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



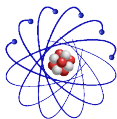
**debian**



**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
  - ▶ Live CD
  - ▶ Golden image
  - ▶ disk image, cloud 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`
- ▶ FAI runs on i386, amd64, IA64, SPARC, PowerPC, ALPHA, z10 mainframe
- ▶ GOsa, FusionDirectory, openQRM, Qlustar, DebianLAN

# 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

## NEWS in FAI 4.4

- ▶ major rewrite and update of FAI guide \o/
- ▶ image installations (e.g. from a tarball)
- ▶ fai-cd now uses dracut instead of live-boot/initramfs-tools
- ▶ allows single device/partition btrfs configurations

# fai-monitor-gui



The screenshot shows the FaiMonitor GUI window with a table of host configurations. The table has columns for various configuration steps and a 'reboot' column. The status of each step is indicated by a colored icon: a green checkmark for success, a yellow exclamation mark for warning, a red 'X' for failure, a blue arrow for pending, and an orange circle for a specific state.

hostname	confdir	defclass	partition	extrbase	debconf	instsoft	configure	tests	save log	faiend	reboot
demohost	✓	✓	✓	✓	✓	○	✗	!	✓	→	
atom03	✓	!	✓	✓	✓	!	✓	✗	✓	→	
atom02	✓	✓	✓	✓	✓	→					
atom01	✓	✓	✓	✓	✓	✓	✓	○	→		
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
  - Seances / 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?