Building disk images with FAI

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MiniDebConf Cambridge 2017
finger lange@localhost

- whoami

  - Sysadmin for more than two decades
  - Debian developer since 2000
  - Diploma in computer science, University of Bonn, Germany
  - SunOS 4.1.1 on SPARC hardware, then Solaris Jumpstart
  - Started FAI in 1999 for my first cluster (16× Dual PII 400 MHz)
  - Several talks and tutorials:
    - Linux Kongress, Linuxtag, DebConf, SANE, LCA, FOSDEM, CeBit, OSDC, UKUUG, FrOSCon, Chemnitzer Linuxtag
What is FAI?

- FAI = Fully Automatic Installation
- Non-interactive system for customized installations
- Bare metal, virtual machines, chroot environment
- Installation via network (PXE), CD, USB
- Live CD, diskless client
- Debian, Ubuntu, CentOS, RHEL, SUSE
Customized disk images

- Always had the idea to support cloud images
- DebConf15 Heidelberg: Creating bootable Debian images by Riku Voipio
- July 2016 first version of fai-diskimage
- Sep 2016, FAI 5.2, first release
- Debian Cloud sprint 2016: Try out fai-diskimage
- Sep 2017, FAI 5.4, adding cross architecture support
- Debian Cloud sprint 2017, FAI will be used for cloud images for Google, Amazon, Microsoft
- Config spaces for vagrant and OpenStack are available
Creating disk images with FAI

- fai-diskimage only 200 lines of code
- Create empty disk image
- Create loop device
- Call fai install $tmpdir
- Convert raw image into other format on demand

```bash
# export FAI_BASEFILEURL=https://fai-project.org/download/basefiles/
# CL="DEBIAN,STRETCH64,AMD64,FAIBASE,GRUB_PC,DHCPC,CLOUD"
# fai-diskimage -vu cloud3 -S2G -c$CL cloud.raw
```
The config space

|-- class/
| |-- FAIBASE.var
| `-- DEBIAN.var

|-- disk_config/
| |-- FAIBASE
| `-- CLOUD
| `-- demohost

|-- basefiles/

|-- package_config/
| |-- DEBIAN
| |-- FAISERVER
| `-- XFCE
| `-- GNOME
| `-- server07
Variables

Example: .../class/DEBIAN.var:

FAI_ALLOW_UNSIGNED=1

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

ROOTPW='\$1\$kBn.MWc0.B$djxB38B7dMkplhJHPf2d1'

release=stretch
apt_cdn=http://deb.debian.org
security_cdn=http://security.debian.org

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

Example: .../disk_config/FAIBASE:

disk_config disk1 preserve_always:8 fstabkey:uuid

primary / 2G-50G ext4 rw,noatime,errors=remount-ro
logical swap 200-10G swap sw
logical /home 1G- ext4 defaults

Example: .../disk_config/CLOUD:

disk_config disk1 disklabel:msdos fstabkey:uuid align-at:1M

primary / 300- ext4 rw,barrier=0,discard tuneopts="-c 0 -i 0"

▶ File systems: ext[2,3,4], vfat, xfs, ReiserFS, NTFS, btrfs
<table>
<thead>
<tr>
<th>Disk Configuration</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>disk_config disk1</strong></td>
<td></td>
</tr>
<tr>
<td><strong>primary</strong></td>
<td>50-100</td>
</tr>
<tr>
<td><strong>primary swap</strong></td>
<td>1G, swap, sw</td>
</tr>
<tr>
<td><strong>primary</strong></td>
<td>2G-10G</td>
</tr>
<tr>
<td><strong>logical</strong></td>
<td>0-</td>
</tr>
<tr>
<td><strong>logical</strong></td>
<td>0-</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
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<tbody>
<tr>
<td><strong>disk_config disk2</strong></td>
<td>sameas:disk1</td>
</tr>
</tbody>
</table>

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<tr>
<th>Disk Configuration</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>disk_config raid</strong></td>
<td></td>
</tr>
<tr>
<td><strong>raid1 /boot</strong></td>
<td>disk1.1,disk2.1, ext4, rw</td>
</tr>
<tr>
<td><strong>raid1 /</strong></td>
<td>disk1.3,disk2.3, ext4, rw, acl, user_xattr</td>
</tr>
<tr>
<td><strong>raid1 -</strong></td>
<td>disk1.5,disk2.5, - -</td>
</tr>
<tr>
<td><strong>raid1 -</strong></td>
<td>disk1.6,disk2.6, - -</td>
</tr>
</tbody>
</table>

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<tr>
<td><strong>disk_config lvm</strong></td>
<td></td>
</tr>
<tr>
<td><strong>vg volg1 md2,md3</strong></td>
<td></td>
</tr>
<tr>
<td><strong>volg1-usr /usr</strong></td>
<td>8G, ext4, rw, createopts=&quot;-O dir_index&quot;</td>
</tr>
<tr>
<td><strong>volg1-var /var</strong></td>
<td>2G, ext4, rw, createopts=&quot;-O dir_index&quot;</td>
</tr>
<tr>
<td><strong>volg1-hl /home/local</strong></td>
<td>10G, ext4, rw, acl, user_xattr, noexec, nosuid</td>
</tr>
<tr>
<td><strong>volg1-es /export/sites</strong></td>
<td>3G, ext4, rw, createopts=&quot;-O none&quot;</td>
</tr>
<tr>
<td><strong>volg1-v /vservers</strong></td>
<td>8G, ext4, rw, createopts=&quot;-O ^dir_index&quot;</td>
</tr>
</tbody>
</table>
Software package installation

Example: .../package_config/DEBIAN:

```
PACKAGES install-norec
file less rsync pciutils usbutils
openssh-client openssh-server
procinfo nullmailer locales
console-setup kbd
unattended-upgrades

PACKAGES install NONFREE
firmware-bnx2 firmware-bnx2x firmware-realtek
firmware-linux-nonfree

PACKAGES install AMD64
linux-image-amd64 initramfs-tools
memtest86+

PACKAGES install ARM64
grub-efi-arm64
linux-image-arm64
```

- Supported package tools: aptitude, apt, apt-get, smart, rpm, urpmi, y2pmsh, yast, yum, zypper, dnf
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/
        |-- FAIBASE
        |-- MATROX
        |-- CAD
        '|-- demohost

fcopy /etc/X11/xorg.conf
#! /bin/bash

if ifclass DISABLE_IPV6; then
    ainsl -av /etc/sysctl.d/70-disable-ipv6.conf \
        'net.ipv6.conf.all.disable_ipv6 = 1'
    ainsl -av /etc/sysctl.d/70-disable-ipv6.conf \
        'net.ipv6.conf.lo.disable_ipv6 = 0'
fi

$ROOTCMD shadowconfig on
sed -i -e 's/^#PasswordAuthentication yes/PasswordAuthentication no/' \
    $target/etc/ssh/sshd_config
sed -i -e 's/^PermitRootLogin .*/PermitRootLogin no/' \
    $target/etc/ssh/sshd_config
ainsl /etc/ssh/sshd_config 'ClientAliveInterval 420'

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
FAI users

- Anonymous, financial industry, 32,000 hosts
- LVM insurance, 10,000 hosts
- City of Munich, 16,000 hosts
- Albert Einstein Institute, 1,725 hosts
- Zivit, 260 hosts on two IBM z10 EC mainframes
- Archive.org, 1,200 bare metal + 800 KVM 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), 1,500 hosts
- BUF, digital visual effects company, 1,000 hosts
- ETH Zurich, systems group, ~300 hosts
- StayFriends, 700+ hosts
- Grml, creating eight different ISOs, daily builds
Live demo time

- Build simple image
- Build XFCE image
- Build ARM64 image
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**

- I will attend the [Mini-Debconf in Cambridge](https://www.debconf.org) end of november. There I will announce a new FAI feature.
- [8 Nov 2017] FAI 5.5 released and new ISO images are available
- [18 Oct 2017] We had a great Debian cloud sprint in Seattle/Bellevue. We've created a FAI [config space](https://www.debconf.org/config.html) for GCE, Azure, EC2 and Openstack cloud images and a huge test suite.
- [6 Oct 2017] Video of creating a cross architecture disk image for ARM64
- [5 Oct 2017] FAI 5.4 released, new ISO images available
- [6 Sep 2017] Have a look at the video of my FAI demo at DebConf 17
- [14 Oct 2016] FAI 5.2 is going to the cloud

**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

**Questions?**
The configuration is stored on the install server

The installation runs on the client