Practical Installation for
Fully Automation Installation (FAI)

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Abstract

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 [1]. The RAON Accelerator Control Team will uses FAI in order to handle massive Control computers in the Accelerator Control System. This document is the first step of this destination and shows the practical installation procedure for beginners and myself.

1   Requirements

1.1   FAI Server

The most works will be done in so-called a faiserver, as a typical PC. We uses Debian 7 Wheezy up-to-date version as OS and its system information (`uname -a` is as follows:

```
Linux faiserver 3.2.0-4-amd64 #1 SMP Debian 3.2.57-3+deb7u1 x86_64 GNU/Linux
```

---

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1.2 Media Access Control (MAC) addresses of Target Computers

We need to get MAC address of target PCs. Here we use two PCs : one is the real PC, and another is the virtual one by vmplayer. The real one is named as *demohost* and the virtual one does *gnomehost*. Two names are simply used by using the fai-example configuration. So the total computers are **faiserver**, **demohost**, and **gnomehost**. Figure 1 shows the vmplayer screen-shot of the MAC address for a virtual PC.

For the installation examples, two MAC addresses and the hostnames are used as follows :

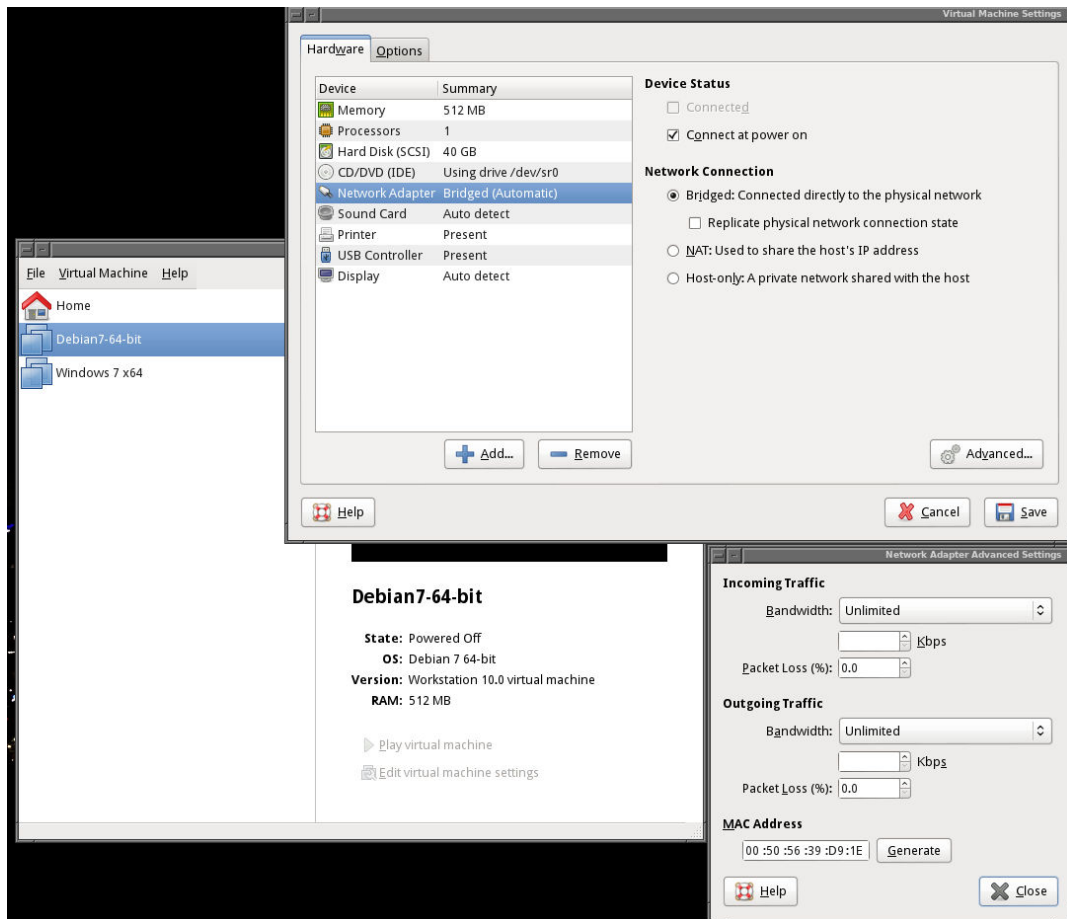- demohost : `E8:03:9A:63:83:81`

- gnomehost : `00:50:56:39:D9:1E`

Figure 1 MAC address setup for a virtual PC by using vmplayer.

1.3   Packages

We will use the up-to-date fai packages from fai-project site[1] instead of the Debian Wheezy repository. The first thing is to modify the apt sources list to let the system know where the fai project is

```
root@faiserver:~# emacs /etc/apt/sources.list

  deb http://ftp.lecl.net/debian/ wheezy main contrib non-free
  deb http://fai-project.org/download wheezy koeln

root@faiserver:~# aptitude update
```

The next step is to install the fai packages such as `fai-client`, `fai-server`, and `faiquickstart`. Debian will care the other package dependencies, so simply use the following command :

```
root@faiserver:/etc# aptitude install fai-client fai-server fai-quickstart

The following NEW packages will be installed:
  debootstrap{a} fai-client fai-doc{a} fai-quickstart fai-server libapt-pkg-perl{a} libgraph-perl{
    a} libheap-perl{a}
  libproc-daemon-perl{a} libproc-processtable-perl{a} nfs-kernel-server{a} openbsd-inetd{a}
    reprepro{a}
0 packages upgraded, 13 newly installed, 0 to remove and 0 not upgraded.
Need to get 0 B/2,137 kB of archives. After unpacking 4,829 kB will be used.
Do you want to continue? [Y/n/?]

.....................................
.....................................


Setting up nfs-kernel-server (1:1.2.6-4) ...
[ ok ] Stopping NFS kernel daemon: mountd nfsd.
[ ok ] Unexporting directories for NFS kernel daemon....
[warn] Not starting NFS kernel daemon: no exports. ... (warning).
Setting up openbsd-inetd (0.20091229-2) ...
[ ok ] Stopping internet superserver: inetd.
[info] Not starting internet superserver: no services enabled.
Setting up debootstrap (1.0.48+deb7u1) ...
Setting up fai-client (4.2) ...
Setting up fai-doc (4.2) ...
Setting up fai-server (4.2) ...
You might want to edit fai.conf and nfsroot.conf in /etc/fai or
go with the defaults. You should edit /etc/fai/apt/sources.list
for faster access to a package repository.
Setting up reprepro (4.12.5-1) ...
Setting up fai-quickstart (4.2) ...
```

1.4   Dynamic Host Configuration Protocol (DHCP) Configuration

The DHCP setting has all FAI host computers' MAC address and its ip address. And if there is no isc-dhcp packages, please install them by using the following command:

---

[1]http://fai-project.org

```
root@faiserver:~# aptitude install isc-dhcp-server
```

Since the DHCP configuration is essential for the FAI setup, please edit dhcp daemon configuration file (dhcpd.conf) as follows:

```
root@faiserver:/etc# emacs /etc/dhcp/dhcpd.conf
```

The following example is used in the `10.1.4.0` subnet inside the RISP 2nd floor office network. So, the ip range is limited for only two addresses (210 and 211). The `domain-name` is provided by the local nameserver (`10.1.5.11`). The gateway of the `10.1.4.0` subnet is used as `routers`. The DHCP server has `10.1.4.100`.

```
ddns-update-style none;
log-facility local7;

deny unknown-clients;
option dhcp-max-message-size 2048;
use-host-decl-names on;

subnet 10.1.4.0 netmask 255.255.255.0 {

        option domain-name         "risp.invalid";
        option domain-name-servers 10.1.5.11;
        option routers             10.1.4.254;

        range  10.1.4.210 10.1.4.211;
        default-lease-time 60;
        max-lease-time 720;

        next-server 10.1.4.100;
        filename "fai/pxelinux.0";
}

host demohost {
         hardware ethernet e8:03:9a:63:83:81;
         fixed-address 10.1.4.210;
}

host gnomehost{
        hardware ethernet 00:50:56:39:D9:1E;
        fixed-address 10.1.4.211;
}
```

In addition, we have one more example which is a local *home* domain, because of the better understanding for the DHCP configuration. In this example, the router is the DHCP server which provides an automatic IP address to wire and wireless clients. The faiserver (`10.0.185.12`) is one of the wire client and the target, i.e., a host with `10.0.185.200`, is the virtual image on the faiserver.

```
dns-update-style none;

default-lease-time 600;
max-lease-time 7200;

log-facility local7;


deny unknown-clients;
option dhcp-max-message-size 2048;
```

```
use-host-decl-names on;

subnet 10.0.185.0 netmask 255.255.255.0 {
        # network settings
        option domain-name          "home.invalid";
        option domain-name-servers 10.0.185.1;
        option routers              10.0.185.1;

        # client IP allocation
        range  10.0.185.200 10.0.185.210;
        default-lease-time 60;
        max-lease-time 720;

        # PXE boot server
        next-server 10.0.185.12;
        filename "fai/pxelinux.0";

}

host demohost {
        hardware ethernet 00:50:56:36:52:2A;
        fixed-address 10.0.185.200;
}
```

After saving the configuration, one should restart or start the DHCP server on the faiserver as follows:

```
root@faiserver:/etc# /etc/init.d/isc-dhcp-server restart
[FAIL] Stopping ISC DHCP server: dhcpd failed!
[ ok ] Starting ISC DHCP server: dhcpd.
```

It the DHCP server never be executed before, Stoping process will be failed as the above what we see.

1.5   The /etc/hosts file

One should add the FAI server and FAI hosts IP addresses and their hostname in the /etc/hosts file. The information must be the same as what is inside /etc/dhcp/dhcpd.conf file.

```
127.0.0.1       localhost
10.1.4.100      faiserver
10.1.4.210      demohost
10.1.4.211      gnomehost
```

2 FAI Settings

In this chapter, we configure many FAI settings one by one. There are two important directories : 1) the FAI server configuration directory (/ect/fai) is created by the fai packages, and 2) another one (/srv/fai) is created by the fai-setup command as follows :

- /etc/fai

```
root@faiserver:/etc/fai# tree
.
├── apt
│   └── sources.list
├── fai.conf
├── grub.cfg
├── live.conf
├── NFSROOT
└── nfsroot.conf
```

- /srv/fai

```
root@faiserver:/srv# tree -d -L 3
.
├── fai
│   ├── config
│   │   ├── basefiles
│   │   ├── class
│   │   ├── debconf
│   │   ├── disk_config
│   │   ├── files
│   │   ├── hooks
│   │   ├── package_config
│   │   ├── scripts
│   │   └── tests
│   └── nfsroot
│       ├── bin
│       ├── boot
│       ├── dev
│       ├── etc
│       ├── home
│       ├── lib
│       ├── lib64
│       ├── media
│       ├── mnt
│       ├── opt
│       ├── proc
│       ├── root
│       ├── run
│       ├── sbin
│       ├── selinux
│       ├── srv
│       ├── sys
│       ├── tmp
│       ├── usr
│       └── var
└── tftp
    └── fai
        └── pxelinux.cfg
```

2.1 The `/etc/fai/apt/sources.list` File

In the same way, we should change the Debian repository with the local (S.Korea) one, i.e., `http://ftp.lecl.net/debian/`, in order to speed up our installation method. Please edit `/etc/fai/apt/sources.list` as follows:

```
root@faiserver:/etc/fai/apt# emacs sources.list

   #deb http://http.debian.net/debian wheezy main contrib non-free
   deb http://ftp.lecl.net/debian/ wheezy main contrib non-free
   deb http://security.debian.org/debian-security wheezy/updates main contrib non-free

   # repository that may contain newer fai packages for wheezy
   deb http://fai-project.org/download wheezy koeln
```

2.2 NFSROOT Configuration

GPG Key for NFSROOT

The GPG key of the fai project repository must be installed in nfsroot. Note that the `chroot /srv/fai/nfsroot/` command must be before `apt-key add -`.

```
root@faiserver:/etc/fai/apt# wget -O - http://fai-project.org/download/074BCDE4.asc | chroot /srv/
    fai/nfsroot/ apt-key add -

--2014-06-05 14:01:15--  http://fai-project.org/download/074BCDE4.asc
Resolving fai-project.org (fai-project.org)... 134.95.9.240
Connecting to fai-project.org (fai-project.org)|134.95.9.240|:80... connected.
HTTP request sent, awaiting response... 200 OK
Length: 5607 (5.5K) [text/plain]
Saving to: 'STDOUT'

100\%[=============================================>] 5,607       --.-K/s   in 0s
2014-06-05 14:01:16 (762 MB/s) - written to stdout [5607/5607]
OK
```

Debian Repository for NFSROOT

We change the Debian repository as the local one to save the installation or downloading time, e.g., `http://ftp.lecl.net/debian`.

```
root@faiserver:/etc/fai/apt# emacs /etc/fai/nfsroot.conf

  # For a detailed description see nfsroot.conf(5)

  # "<suite> <mirror>" for debootstrap
  FAI_DEBOOTSTRAP="wheezy http://ftp.lecl.net/debian/"
  FAI_ROOTPW='\$1\$kBnWcO.E\$djxB128U7dMkrltJHPf6d1'

  NFSROOT=/srv/fai/nfsroot
  TFTPROOT=/srv/tftp/fai
  NFSROOT_HOOKS=/etc/fai/nfsroot-hooks/
  FAI_DEBOOTSTRAP_OPTS="--exclude=info"

  # Configuration space
  FAI_CONFIGDIR=/srv/fai/config
```

Package List for NFSROOT

One must change the default package list from the FAI packages, because there are some
dependent issues, which are described in Troubleshooting later. Here the summary what
I've modified as follows:

- **mandatory :** remove the troublesome `console-tools` and `console-common` packages in the line number 14 in Listing 2.1.

- **mandatory :** add `console-setup-linux` and `console-data` in the line number 15 in Listing 2.1 in order to compensate two troublesome `console-tools` and `console-common` packages.

- **convenience :** replace `ntpdate` with `ntp` in the line numbers 10 and 11 in Listing 2.1

- **mandatory for some FAI hosts :** add `firmware-linux-nonfree` for selected demohost. If not, after successfully installation, there is no network connection on the demohost in the line number 23 in Listing 2.1.

```
1   root@faiserver:/etc/fai# emacs -nw NFSROOT
2
3      # package list for creating the NFSROOT
4
5      PACKAGES aptitude
6      nfs-common fai-nfsroot module-init-tools ssh rdate lshw rpcbind
7      rsync lftp less dump reiserfsprogs e2fsprogs usbutils
8      hwinfo psmisc pciutils hdparm smartmontools parted mdadm lvm2
9      dnsutils
10     #ntpdate
11     ntp
12     dosfstools xfsprogs xfsdump
13     procinfo numactl dialog
14     #console-tools console-common
15     console-setup-linux console-data
16     kbd
17     iproute moreutils udev subversion
18     xz-utils
19     cupt
20
21     # some network cards needs firmware
22     firmware-bnx2 firmware-bnx2x firmware-realtek
23     firmware-linux-nonfree
24
25     # dracut can replace live-boot
26     dracut-network live-boot- live-boot-initramfs-tools-
27
28     # choose if you like live-boot or dracut inside the nfsroot
29     #live-boot live-boot-doc
30
31     # you should not edit the lines below
32     # architecture dependend list of packages that are installed
33
34     #git # git consumes a lot of disk space on the FAI CD (ISO 9660)
35
36     PACKAGES aptitude I386
```

```
37    grub-pc
38    linux-image-686
39
40    # packages for Ubuntu natty/oneiric/precise:
41    # linux-image-generic live-boot
42
43    PACKAGES aptitude AMD64
44    grub-pc
45    linux-image-amd64
46
47    # packages for Ubuntu natty/oneiric/precise:
48    # linux-image-generic live-boot
```

Listing 2.1 Editing `/etc/fai/NFSROOT`

2.3 FAI Setup

Now, ready to execute `fai-setup` command. With `-v` option, we can see the verbose output.

First `fai-setup` command

```
1  root@faiserver:/etc/fai# fai-setup -v
2  Using configuration files from /etc/fai
3  Creating FAI nfsroot in /srv/fai/nfsroot
4  Creating base system using debootstrap version 1.0.48+deb7u1
5  Calling debootstrap --exclude=info wheezy /srv/fai/nfsroot http://ftp.lecl.net/debian/
6  I: Retrieving Release
7  I: Retrieving Release.gpg
8  I: Checking Release signature
9  ....................
10
11 WARNING: untrusted versions of the following packages will be installed!
12
13 Untrusted packages could compromise your system's security.
14 You should only proceed with the installation if you are certain that
15 this is what you want to do.
16
17   liblinux-lvm-perl fai-nfsroot fai-client fai-setup-storage
18
19 *** WARNING ***   Ignoring these trust violations because
20                   aptitude::CmdLine::Ignore-Trust-Violations is 'true'!
21 Writing extended state information...
22 ..................
23 '/srv/fai/nfsroot/boot/vmlinuz-3.2.0-4-amd64' -> '/srv/tftp/fai/vmlinuz-3.2.0-4-amd64'
24 '/srv/fai/nfsroot/boot/initrd.img-3.2.0-4-amd64' -> '/srv/tftp/fai/initrd.img-3.2.0-4-amd64'
25 TFTP environment prepared. Enable DHCP and start the TFTP daemon on root /srv/tftp/fai.
26 FAI packages inside the nfsroot:
27 fai-client       4.2
28 fai-nfsroot      4.2
29 fai-setup-storage 4.2
30 FAI related packages inside the nfsroot:
31 dracut           037-1
32 dracut-network   037-1
33 Waiting for background jobs to finish
34 [1]+ Done                  nice xz -q \$NFSROOT/var/tmp/base.tar  (wd: /srv/fai/nfsroot)
35 fai-make-nfsroot finished properly.
```

```
36  Log file written to /var/log/fai/fai-make-nfsroot.log
37  Adding line to /etc/exports: /srv/fai/nfsroot 10.1.4.100/24(async,ro,no_subtree_check,
       no_root_squash)
38  Re-exporting directories for NFS kernel daemon....
39
40    You have no FAI configuration space yet. Copy the simple examples with:
41    cp -a /usr/share/doc/fai-doc/examples/simple/* /srv/fai/config
42    Then change the configuration files to meet your local needs.
43  Please don't forget to fill out the FAI questionnaire after you've finished your project with FAI.
44
45  FAI setup finished.
46  Log file written to /var/log/fai/fai-setup.log
```

Listing 2.2 fai-setup output

NFS setup

The `fai-setup` command adds one important nfs path in `/etc/exports` in the line number 37 in Listing 2.2. However, it is necessary to add another nfs path in `/etc/exports`. Consult the line number 4 in Listing 2.3.

```
1  root@faiserver:/etc/fai# emacs /etc/exports
2
3    /srv/fai/nfsroot 10.1.4.100/24(async,ro,no_subtree_check,no_root_squash)
4    /srv/fai/config  10.1.4.100/24(async,ro,no_subtree_check)
```

Listing 2.3 Add `/srv/fai/config` directory to `/etc/exports`

After that, restart NFS services

```
root@faiserver:/etc/fai#  /etc/init.d/nfs-kernel-server restart

[ ok ] Stopping NFS kernel daemon: mountd nfsd.
[ ok ] Unexporting directories for NFS kernel daemon....
[ ok ] Exporting directories for NFS kernel daemon....
[ ok ] Starting NFS kernel daemon: nfsd mountd.
```

Example Configurations : demohost and gnomehost

- According to the line number 41 in Listing 2.3, we simply copy the example configuration into `/srv/fai/config`.

```
root@faiserver:/etc/fai# cp -a /usr/share/doc/fai-doc/examples/simple/* /srv/fai/config
```

- Generate boot parameters for two example hosts which are named as `demohost` and `gnomehost`.

```
1   root@faiserver:/etc/fai#  fai-chboot -IFv -u nfs://10.1.4.100/srv/fai/config demohost
2
3   Booting kernel vmlinuz-3.2.0-4-amd64
4    append initrd=initrd.img-3.2.0-4-amd64 ip=dhcp
5      FAI_FLAGS=verbose,sshd,createvt FAI_CONFIG_SRC=nfs://10.1.4.100/srv/fai/config
6
7   demohost has 10.1.4.210 in hex 0A0104D2
8   Writing file /srv/tftp/fai/pxelinux.cfg/0A0104D2 for demohost
9
10  root@faiserver:/etc/fai#  fai-chboot -IFv -u nfs://10.1.4.100/srv/fai/config gnomehost
11
```

```
12  Booting kernel vmlinuz-3.2.0-4-amd64
13   append initrd=initrd.img-3.2.0-4-amd64 ip=dhcp
14     FAI_FLAGS=verbose,sshd,createvt FAI_CONFIG_SRC=nfs://10.1.4.100/srv/fai/config
15
16  gnomehost has 10.1.4.211 in hex 0A0104D3
17  Writing file /srv/tftp/fai/pxelinux.cfg/0A0104D3 for gnomehost
```

Listing 2.4 Generate Boot Parameters for `demohost` and `gnomehost`

- Edit the boot parameters in the line numbers 8 and 17 in Listing 2.4. If not, we will meet the message like as `can't open /etc/fstab`. This is the bug of NFS.V4, so this change makes to let systems to use NFS.V3.

```
1  root@faiserver:/etc/fai# emacs /srv/tftp/fai/pxelinux.cfg/0A0104D2
2
3    # generated by fai-chboot for host demohost with IP 10.1.4.210
4    default fai-generated
5
6    label fai-generated
7    kernel vmlinuz-3.2.0-4-amd64
8    append initrd=initrd.img-3.2.0-4-amd64 ip=dhcp  root=/srv/fai/nfsroot aufs  FAI_FLAGS=
         verbose,sshd,createvt FAI_CONFIG_SRC=nfs://10.1.4.100/srv/fai/config FAI_ACTION=install
```

Listing 2.5 Default Boot Parameters

Add the `:vers=3` at the end of `root=/srv/fai/nfsroot` in the line number 8 in Listing 2.5. So it should be

```
   root=/srv/fai/nfsroot:vers=3
```

Modify `/srv/tftp/fai/pxelinux.cfg/0A0104D3` also.

- Restart tftpd-hpa (Trivial File Transfer Protocol Server) service.

```
root@faiserver:/etc/fai# /etc/init.d/tftpd-hpa restart

[ ok ] Restarting HPA's tftpd: in.tftpd.
```

- Add FAI repository GPG key to `/srv/fai/nfsroot`

```
root@faiserver:/etc/fai# wget -O - http://fai-project.org/download/074BCDE4.asc | chroot /
     srv/fai/nfsroot/ apt-key add -
--2014-06-05 14:21:43--  http://fai-project.org/download/074BCDE4.asc
Resolving fai-project.org (fai-project.org)... 134.95.9.240
Connecting to fai-project.org (fai-project.org)|134.95.9.240|:80... connected.
HTTP request sent, awaiting response... 200 OK
Length: 5607 (5.5K) [text/plain]
Saving to: 'STDOUT'
100\%[===========================================>] 5,607       --.-K/s   in 0s
2014-06-05 14:21:44 (749 MB/s) - written to stdout [5607/5607]
OK
```
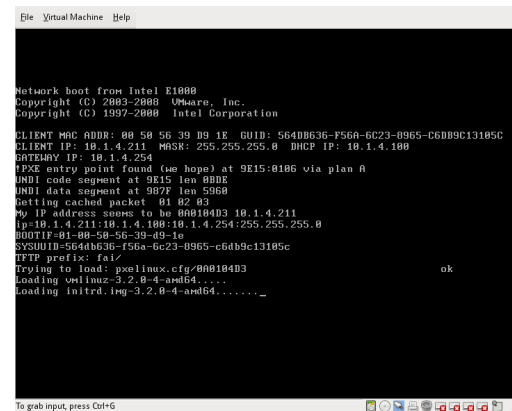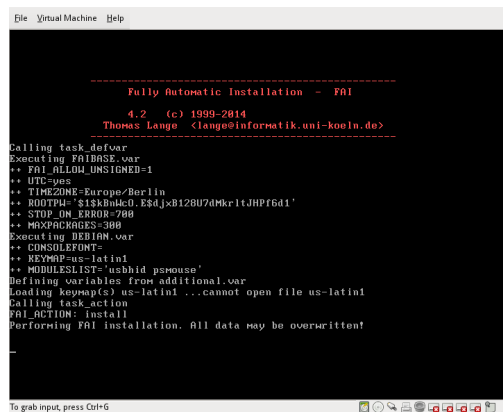
2.4 Start gnomehost

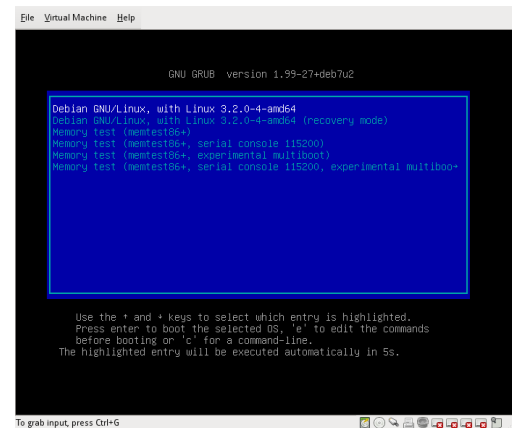Figure 2 shows the whole screen shots for the gnomehost, which is the virtual PC by vmplayer.
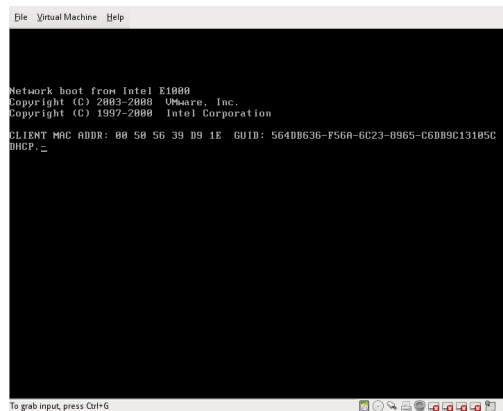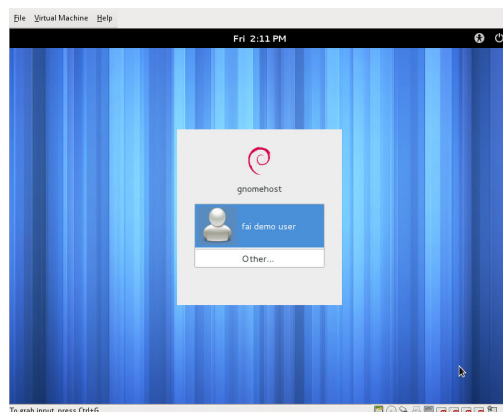
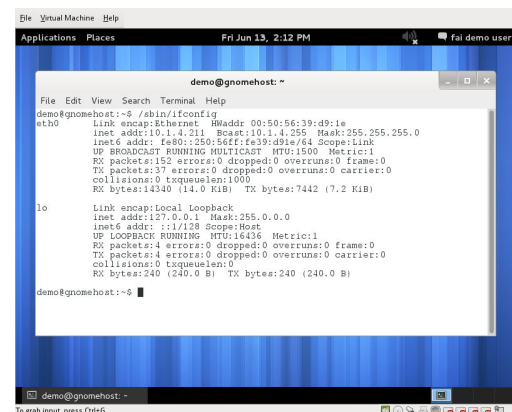(a) F12 lets us to boot this host

(b) Booting ....

(c) Clearly see the FAI Screen

(d) After reboot, the grub screen is shown

(e) GNOME login screen

(f) IP address in Gnome terminal

Figure 2 FAI Installation screenshots and the installed Debian Linux

2.5   Update FAI Setup

Technically, it is unnecessary to update the FAI setup. Once one follows the instructions one by one, it should work. I think, from this ugly installation experience, it may be necessary to run later on after changing any default packages and so on. However, I am not sure when we need this later on. It should be tested a bit more later.

```
root@faiserver:/etc/fai# fai-setup -vk
Using configuration files from /etc/fai
Upgrading nfsroot and installing new packages into the nfsroot.
Hit http://ftp.lecl.net wheezy Release.gpg

........................
........................

install_packages: executing chroot /srv/fai/nfsroot apt-get clean
install_packages: executing chroot /srv/fai/nfsroot dpkg --configure --pending
install_packages: executing chroot /srv/fai/nfsroot dpkg -C
install_packages: executing chroot /srv/fai/nfsroot apt-get clean
install_packages exit code: 0
'/srv/fai/nfsroot/boot/vmlinuz-3.2.0-4-amd64' -> '/srv/tftp/fai/vmlinuz-3.2.0-4-amd64'
'/srv/fai/nfsroot/boot/initrd.img-3.2.0-4-amd64' -> '/srv/tftp/fai/initrd.img-3.2.0-4-amd64'
TFTP environment prepared. Enable DHCP and start the TFTP daemon on root /srv/tftp/fai.
fai-make-nfsroot finished properly.W: GPG error: http://fai-project.org wheezy Release:
The following signatures couldn't be verified because the public key is not available: NO_PUBKEY 2
    BF8D9FE074BCDE4

Re-exporting directories for NFS kernel daemon....
FAI setup finished.
Log file written to /var/log/fai/fai-setup.log
```

3   Build i386 Compatible FAI Server on x86_64

There are two references [2, 3] to this issue. Both methods do not give me the full instruction for setup to build i386 compatible FAI server. So, this chapter was developed by a traditional trial and error. However, they [2, 3] gave me a way where I should go. The general procedure is almost the same as the normal procedure, which is described before. Therefore, I use the same way to do so here.

3.1   Requirements

I slightly modify what I've done before to rename gnomehost to ctrldemo01, and add a virtual i386 PC in a vmplayer. So ctrldemo01 is the 64bit virtual PC. Note that one must select a proper virtual image setting for an i386 PC in a vmplayer.

MAC addresses of target computers

- demohost : `e8:03:9a:63:83:81`, a PC

- ctrldemo01 : `00:50:56:39:D9:1E`, a virtual 64bit PC

- ctrldemo02 : `00:50:56:3E:0B:CE`, a virtual i386 PC

DHCP configuration

The existing DHCP configuration is modified as follows :

```
ddns-update-style none;

log-facility local7;

deny unknown-clients;
option dhcp-max-message-size 2048;
use-host-decl-names on;

subnet 10.1.4.0 netmask 255.255.255.0 {
        # network settings
        option domain-name          "risp.invalid";
        option domain-name-servers 10.1.5.11;
        option routers              10.1.4.254;

        # client IP allocation
        range  10.1.4.210 10.1.4.219;
        default-lease-time 60;
        max-lease-time 720;

        # PXE boot server
        next-server 10.1.4.100;
        filename "fai/pxelinux.0";

}


host demohost {
        hardware ethernet e8:03:9a:63:83:81;
        fixed-address 10.1.4.210;
}


host ctrldemo01{
        hardware ethernet 00:50:56:39:D9:1E;
        fixed-address 10.1.4.211;
}

host ctrldemo02 {
        hardware ethernet 00:50:56:3E:0B:CE;
        fixed-address 10.1.4.212;
}
```

After saving the configuration, one should restart or start the DHCP server on the faiserver as follows:

```
root@faiserver:/etc/dhcp# /etc/init.d/isc-dhcp-server restart
[ ok ] Stopping ISC DHCP server: dhcpd.
[ ok ] Starting ISC DHCP server: dhcpd.
root@faiserver:/etc/dhcp#
```

The /etc/hosts file

One should add the FAI hosts' IP addresses and their hostnames in the /etc/hosts file as follows:

```
127.0.0.1       localhost
```

```
10.1.4.100      faiserver
10.1.4.210      demohost
10.1.4.211      ctrldemo01
10.1.4.212      ctrldemo02
10.1.4.213      ctrldemo03
10.1.4.214      ctrldemo04
10.1.4.215      ctrldemo05
10.1.4.216      ctrldemo06
10.1.4.217      ctrldemo07
10.1.4.218      ctrldemo08
10.1.4.219      ctrldemo09
```

And the list is generated by a perl command in the reference [3] Chapter 9 as follows :

```
perl -e 'for (1..9) {printf "10.1.4.21%s ctrldemo%02s\n",$_,$_;}'

10.1.4.211 ctrldemo01
10.1.4.212 ctrldemo02
10.1.4.213 ctrldemo03
10.1.4.214 ctrldemo04
10.1.4.215 ctrldemo05
10.1.4.216 ctrldemo06
10.1.4.217 ctrldemo07
10.1.4.218 ctrldemo08
10.1.4.219 ctrldemo09
```

I add seven more ctrldemo for further tests.

3.2 i386 FAI Settings

In this section, we re-use the existent fai setting of a 64bit. Thus, first of all, simple copy
them to a new directory which name is `fai-i386` as

```
root@faiserver:/etc# cp -a /etc/fai /etc/fai-i386
```

Create New Host Classes for ctrldemo hosts

The ctrldemo host names are not in the class in `/srv/fai/config`, so I add it to be the
same as `gnomehost` as

```
root@faiserver:/srv/fai/config/class# emacs 50-host-classes
# use a list of classes for our demo machine
case \$HOSTNAME in
    ctrldemo*)
        echo "FAIBASE DEBIAN DHCPC DEMO XORG GNOME";;
```

NFSROOT configuration for i386

- GPG Key

  ```
  root@faiserver:/etc/fai-i386# wget -O - http://fai-project.org/download/074BCDE4.asc |
      chroot /srv/fai/nfsroot-i386/ apt-key add -
  --2014-07-07 19:44:54--  http://fai-project.org/download/074BCDE4.asc
  Resolving fai-project.org (fai-project.org)... 134.95.9.240
  Connecting to fai-project.org (fai-project.org)|134.95.9.240|:80... connected.
  HTTP request sent, awaiting response... 200 OK
  ```

```
Length: 5607 (5.5K) [text/plain]
Saving to: 'STDOUT'

100\%[=======================================================>] 5,607       --.-K/s   in 0s

2014-07-07 19:44:55 (487 MB/s) - written to stdout [5607/5607]

OK
```

- Edit `nfsroot.conf` file for i386 hosts. I add the `i386` suffix in the line numbers 7 and include the architecture in `FAI_DEBOOTSTRAP_OPTS` in the line number 10 in Listing 3.1.

```
1   # For a detailed description see nfsroot.conf(5)
2
3   # "<suite> <mirror>" for debootstrap
4   FAI_DEBOOTSTRAP="wheezy http://ftp.lecl.net/debian/"
5   FAI_ROOTPW='\$1\$kBnWcO.E\$djxB128U7dMkrltJHPf6d1'
6
7   NFSROOT=/srv/fai/nfsroot-i386
8   TFTPROOT=/srv/tftp/fai
9   NFSROOT_HOOKS=/etc/fai/nfsroot-hooks/
10  FAI_DEBOOTSTRAP_OPTS="--arch i386 --exclude=info"
11
12  # Configuration space
13  FAI_CONFIGDIR=/srv/fai/config
```

Listing 3.1 Editing `nfsroot.conf` for i386

3.3   i386 FAI Setup

First `fai-setup` command

```
root@faiserver:/srv/fai/config/class# fai-setup -C /etc/fai-i386 -vk
```

, where the options are

- `-C` : Use `CFDIR` as the configuration directory. Default is `/etc/fai`. You can also set the environment variable `FAI_ETC_DIR`.

- `-k` : Update/install packages defined in NFSROOT config.

- `-v` : I guess this option is Verbose mode, because I cannot find it in manpage and so on.

Check NFS environment

Check the NFS environment for i386 in `/etc/exports` which should have the following line :

```
/srv/fai/nfsroot-i386 10.1.4.100/24(async,ro,no_subtree_check,no_root_squash)
```

After that, restart NFS services (is it necessary?)

```
root@faiserver:/etc/fai#  /etc/init.d/nfs-kernel-server restart

[ ok ] Stopping NFS kernel daemon: mountd nfsd.
[ ok ] Unexporting directories for NFS kernel daemon....
[ ok ] Exporting directories for NFS kernel daemon....
[ ok ] Starting NFS kernel daemon: nfsd mountd.
```

Create Boot Parameters for `ctrldemo02` host

First of all, we must select proper Linux Kernel Executable (vmlinuz) and Initial RAM disk (initrd) for i386 in `/srv/tftp/fai/` directory.

```
root@faiserver:/srv/fai# ls /srv/tftp/fai/initrd.img-*
/srv/tftp/fai/initrd.img-3.2.0-4-686-pae  /srv/tftp/fai/initrd.img-3.2.0-4-amd64
root@faiserver:/srv/fai# ls /srv/tftp/fai/vmlinuz-3.2.0-4-*
/srv/tftp/fai/vmlinuz-3.2.0-4-686-pae  /srv/tftp/fai/vmlinuz-3.2.0-4-amd64
```

By using `fai-chboot` command,

```
root@faiserver:/etc/fai-i386# fai-chboot -IFv -s3.2.0-4-686-pae -u nfs://10.1.4.100/srv/fai/config
      -C /etc/fai-i386/ ctrldemo02
Booting kernel vmlinuz-3.2.0-4-686-pae
 append initrd=initrd.img-3.2.0-4-686-pae ip=dhcp
   FAI_FLAGS=verbose,sshd,createvt FAI_CONFIG_SRC=nfs://10.1.4.100/srv/fai/config

ctrldemo02 has 10.1.4.212 in hex 0A0104D4
Writing file /srv/tftp/fai/pxelinux.cfg/0A0104D4 for ctrldemo02
root@faiserver:/etc/fai-i386# fai-chboot -L
ctrldemo02 0A0104D4 vmlinuz-3.2.0-4-686-pae initrd=initrd.img-3.2.0-4-686-pae ip=dhcp  root=/srv/
    fai/nfsroot-i386 aufs  FAI_FLAGS=verbose,sshd,createvt FAI_CONFIG_SRC=nfs://10.1.4.100/srv/
    fai/config FAI_ACTION=install
```

, where the options are

- `-s` : Use SUFFIX to determine which kernel and initrd to use.

- `-u` : Set `FAI_CONFIG_SRC` to URL. Setting this variable is mandatory for the operation of FAI.

- `-C` : Use `CFDIR` as the configuration directory. Default is `/etc/fai`. You can also set the environment variable `FAI_ETC_DIR`.

- `-I` : Same as -i but also sets `FAI_ACTION=install`. So a fully automatic installation will be performed. ATTENTION! This will erase most of the data on the local disks of the install clients.

- `-F` : Set default values for `FAI_FLAGS`. This is the same as -f verbose,sshd,createvt

And after adding `:vers=3`,

```
root@faiserver:/etc/fai-i386# fai-chboot -L
ctrldemo02 0A0104D4 vmlinuz-3.2.0-4-686-pae initrd=initrd.img-3.2.0-4-686-pae ip=dhcp  root=/srv/
    fai/nfsroot-i386:vers=3 aufs  FAI_FLAGS=verbose,sshd,createvt FAI_CONFIG_SRC=nfs
    ://10.1.4.100/srv/fai/config FAI_ACTION=install
```

And restart tftpd-hpa (Trivial File Transfer Protocol Server) service.

```
root@faiserver:/etc/fai-i386# /etc/init.d/tftpd-hpa restart
[ ok ] Restarting HPA's tftpd: in.tftpd.
```

And turn on `ctrldemo01` and `ctrldemo02` in a vmplayer, all FAI installation are done well. See the Figure 3 for its results.
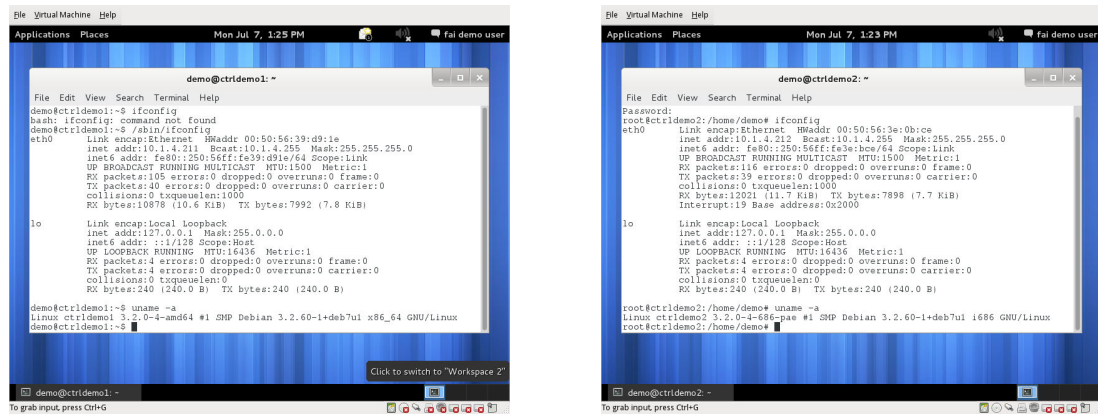
(a) `ctrldemo01` : x86_64 host

(b) `ctrldemo02` : x86 host

Figure 3 i386 and x86_64 compatible FAI server on x86_64

4 Troubleshooting

This chapter has trial and error while installing and configuring the FAI server.

4.1 Kernel Panic

One can see the following message during a host network booting :

```
can't open /etc/fstab.... >>> kernel panic
```

As far as I understand, NFS.V4 doesn't fully support some features of FAI, so force to use V3. One can add `:vers=3` in the generated network boot configuration. For example, the generated network boot configuration of the demohost is located in

```
/srv/tftp/fai/pxelinux.cfg/0A0104D2
```

4.2 GPG Error

Debian has been using strong crypto to validate downloaded packages [4]. Each release files has a GPG signature. If the system, i.e., faiserver, does not know the GPG signature of fai-project, the following error is shown as

```
W: GPG error: http://fai-project.org wheezy Release:
The following signatures couldn't be verified because the public key is not available: NO_PUBKEY 2
    BF8D9FE074BCDE4
```

The easy way to resolve to let the system (faiserver) knows the gpg key of the fai-project.

```
root@faiserver:/etc/fai# wget -O - http://fai-project.org/download/074BCDE4.asc | chroot /srv/fai/
    nfsroot/ apt-key add -
--2014-06-05 14:21:43--  http://fai-project.org/download/074BCDE4.asc
Resolving fai-project.org (fai-project.org)... 134.95.9.240
Connecting to fai-project.org (fai-project.org)|134.95.9.240|:80... connected.
HTTP request sent, awaiting response... 200 OK
Length: 5607 (5.5K) [text/plain]
Saving to: 'STDOUT'

100\%[=============================================>] 5,607       --.-K/s   in 0s

2014-06-05 14:21:44 (749 MB/s) - written to stdout [5607/5607]

OK
```

4.3   Deprecated Option

If one uses only the Debian Wheezy repositories, one should see the following lines in the network boot configuration, e.g., `/srv/tftp/fai/pxelinux.cfg/0A0104D2`, generated by fai-chroot as

```
append initrd=initrd.img-3.2.0-4-amd64 ip=dhcp  root=/dev/nfs nfsroot=/srv/fai/nfsroot aufs
FAI_FLAGS=verbose,sshd,createvt FAI_CONFIG_SRC=nfs://10.1.4.100/srv/fai/config FAI_ACTION=install
```

instead of

```
append initrd=initrd.img-3.2.0-4-amd64 ip=dhcp  root=/srv/fai/nfsroot aufs
FAI_FLAGS=verbose,sshd,createvt FAI_CONFIG_SRC=nfs://10.1.4.100/srv/fai/config FAI_ACTION=install
```

The option `root=/dev/nfs nfsroot=/srv/fai/nfsroot` is depreciated [5]. The man-page of the dracut.cmdline [6] shows

```
root=/dev/nfs nfsroot=[<server-ip>:]<root-dir>[:<nfs-options>]
        Deprecated!  kernel Documentation_/filesystems/nfsroot.txt_
        defines this method. This is supported by dracut, but not
        recommended.
```

The recent dracut is provided by the fai-project repository. Therefore, it is the better way to use **one** repository selected from Debian Wheezy or fai project. Both cases works well with the additional :vers=3 option.

4.4   Debian Package Dependency Error

If one follow the instruction before, the following error will not be shown. However, just in case that one might see the following error :

```
Errors were encountered while processing:
 linux-image-3.2.0-4-amd64
E: Sub-process /usr/bin/dpkg returned an error code (1)
```

```
A package failed to install.  Trying to recover:
..........................
1 errors during executing of commands
```

If one sees the error message, `chroot /srv/fai/nfsroot/ apt-get install -f` may solve this problem temporarily. However, it will fail again later on. This error, as far as I know, is related the following section problem.

4.5   Infinite Error Messages with fai-setup -vk command

One might see the following infinite error messages when fai-setup -vk is issued in both cases : 1) only Debian Wheezy repository and 2) Debian Wheezy/fai-project repositories.

```
root@faiserver:/srv/fai/nfsroot/etc/apt# fai-setup -vk

.........................................

Building dependency tree...
Reading state information...
The following NEW packages will be installed:
  ca-certificates curl libcurl3 librtmp0 libssh2-1 openssl
The following packages will be upgraded:
  dracut dracut-network fai-client fai-nfsroot fai-setup-storage
  liblinux-lvm-perl
6 upgraded, 6 newly installed, 0 to remove and 0 not upgraded.
Need to get 2323 kB of archives.
After this operation, 3316 kB of additional disk space will be used.
WARNING: The following packages cannot be authenticated!
  librtmp0 libssh2-1 libcurl3 openssl ca-certificates curl dracut
  dracut-network liblinux-lvm-perl fai-client fai-setup-storage fai-nfsroot
Authentication warning overridden.


.........................................

The following NEW packages will be installed:
  console-tools{b} libconsole{a}
0 packages upgraded, 2 newly installed, 0 to remove and 0 not upgraded.
Need to get 467 kB of archives. After unpacking 1561 kB will be used.
The following packages have unmet dependencies:
 kbd : Conflicts: console-utilities which is a virtual package.
 console-tools : Conflicts: console-utilities which is a virtual package.
The following actions will resolve these dependencies:

    Remove the following packages:
1)      dracut
2)      dracut-network
3)      kbd
4)      linux-image-3.2.0-4-amd64
5)      linux-image-amd64

The following NEW packages will be installed:
  console-tools libconsole{a}
The following packages will be REMOVED:
  dracut{a} dracut-network{a} kbd{a} linux-image-3.2.0-4-amd64{a}
  linux-image-amd64{a}
0 packages upgraded, 2 newly installed, 5 to remove and 0 not upgraded.
Need to get 467 kB of archives. After unpacking 109 MB will be freed.
Writing extended state information...
```

```
Get: 1 http://ftp.lecl.net/debian/ wheezy/main libconsole amd64 1:0.2.3dbs-70 [155 kB]
Get: 2 http://ftp.lecl.net/debian/ wheezy/main console-tools amd64 1:0.2.3dbs-70 [312 kB]
Fetched 467 kB in 0s (5577 kB/s)
Can not write log, openpty() failed (/dev/pts not mounted?)
(Reading database ... 18224 files and directories currently installed.)
Removing dracut-network ...
Removing linux-image-amd64 ...
Removing linux-image-3.2.0-4-amd64 ...
Aborting removal of running kernel image.
dpkg: error processing linux-image-3.2.0-4-amd64 (--remove):
 subprocess installed pre-removal script returned error exit status 1
dpkg: dracut: dependency problems, but removing anyway as you requested:
 linux-image-3.2.0-4-amd64 depends on initramfs-tools (>= 0.99~) | linux-initramfs-tool; however:
  Package initramfs-tools is not installed.
  Package linux-initramfs-tool is not installed.
  Package dracut which provides linux-initramfs-tool is to be removed.

Removing dracut ...
Processing triggers for man-db ...
Errors were encountered while processing:
 linux-image-3.2.0-4-amd64
E: Sub-process /usr/bin/dpkg returned an error code (1)
A package failed to install.  Trying to recover:
Reading package lists...
Building dependency tree...
Reading state information...
Reading extended state information...
Initializing package states...
Writing extended state information...
Reading task descriptions...
ERROR: 65280 65280
ERROR: chroot /srv/fai/nfsroot aptitude -R -y -o Dpkg::Options::=--force-confdef -o Dpkg::Options
    ::=--force-confnew install nfs-common fai-nfsroot module-init-tools ssh rdate lshw rpcbind
    rsync lftp less dump reiserfsprogs e2fsprogs usbutils hwinfo psmisc pciutils hdparm
    smartmontools parted mdadm lvm2 dnsutils ntpdate dosfstools xfsprogs xfsdump procinfo numactl
     dialog console-tools console-common kbd iproute moreutils udev subversion xz-utils cupt
    firmware-bnx2 firmware-bnx2x firmware-realtek dracut-network live-boot- live-boot-initramfs-
    tools- grub-pc linux-image-amd64 return code 255
install_packages: executing chroot /srv/fai/nfsroot apt-get clean
install_packages: executing chroot /srv/fai/nfsroot dpkg --configure --pending
install_packages: executing chroot /srv/fai/nfsroot dpkg -C
install_packages: executing chroot /srv/fai/nfsroot apt-get clean
1 errors during executing of commands
Log file written to /var/log/fai/fai-setup.log


root@faiserver:/srv/fai/nfsroot/etc/apt# chroot /srv/fai/nfsroot/ apt-get install -f
Reading package lists... Done
Building dependency tree
Reading state information... Done
Correcting dependencies... Done
The following extra packages will be installed:
  busybox initramfs-tools klibc-utils libklibc
Suggested packages:
  bash-completion
The following NEW packages will be installed:
  busybox initramfs-tools klibc-utils libklibc
0 upgraded, 4 newly installed, 0 to remove and 0 not upgraded.
Need to get 792 kB of archives.
After this operation, 1661 kB of additional disk space will be used.
WARNING: The following packages cannot be authenticated!
  busybox libklibc klibc-utils initramfs-tools
```

```
Authentication warning overridden.

..................

Fetched 792 kB in 1s (539 kB/s)
perl: warning: Setting locale failed.
perl: warning: Please check that your locale settings:
        LANGUAGE = "en_US:en",
        LC_ALL = (unset),
        LANG = "en_US.UTF-8"
    are supported and installed on your system.
perl: warning: Falling back to the standard locale ("C").
locale: Cannot set LC_CTYPE to default locale: No such file or directory
locale: Cannot set LC_MESSAGES to default locale: No such file or directory
locale: Cannot set LC_ALL to default locale: No such file or directory
Can not write log, openpty() failed (/dev/pts not mounted?)
Selecting previously unselected package busybox.
(Reading database ... 17844 files and directories currently installed.)
Unpacking busybox (from .../busybox_1\%3a1.20.0-7_amd64.deb) ...
Selecting previously unselected package libklibc.
Unpacking libklibc (from .../libklibc_2.0.1-3.1_amd64.deb) ...
Selecting previously unselected package klibc-utils.
Unpacking klibc-utils (from .../klibc-utils_2.0.1-3.1_amd64.deb) ...
Selecting previously unselected package initramfs-tools.
Unpacking initramfs-tools (from .../initramfs-tools_0.109.1_all.deb) ...
Processing triggers for man-db ...
locale: Cannot set LC_CTYPE to default locale: No such file or directory
locale: Cannot set LC_MESSAGES to default locale: No such file or directory
locale: Cannot set LC_ALL to default locale: No such file or directory
Can not write log, openpty() failed (/dev/pts not mounted?)
Setting up busybox (1:1.20.0-7) ...
Setting up libklibc (2.0.1-3.1) ...
Setting up klibc-utils (2.0.1-3.1) ...
Setting up initramfs-tools (0.109.1) ...
update-initramfs: deferring update (trigger activated)
Processing triggers for initramfs-tools ...
update-initramfs: /boot/initrd.img-3.2.0-4-amd64 has been altered.
update-initramfs: Cannot update. Override with -t option.

root@faiserver:/srv/fai/nfsroot/etc/apt# chroot /srv/fai/nfsroot/ apt-get install bash-completion
Reading package lists... Done
Building dependency tree
Reading state information... Done
The following NEW packages will be installed:
  bash-completion
0 upgraded, 1 newly installed, 0 to remove and 0 not upgraded.
Need to get 193 kB of archives.
After this operation, 784 kB of additional disk space will be used.
WARNING: The following packages cannot be authenticated!
  bash-completion
Authentication warning overridden.
Get:1 http://ftp.lecl.net/debian/ wheezy/main bash-completion all 1:2.0-1 [193 kB]
Fetched 193 kB in 0s (2922 kB/s)
perl: warning: Setting locale failed.
perl: warning: Please check that your locale settings:
        LANGUAGE = "en_US:en",
        LC_ALL = (unset),
        LANG = "en_US.UTF-8"
    are supported and installed on your system.
perl: warning: Falling back to the standard locale ("C").
locale: Cannot set LC_CTYPE to default locale: No such file or directory
locale: Cannot set LC_MESSAGES to default locale: No such file or directory
```
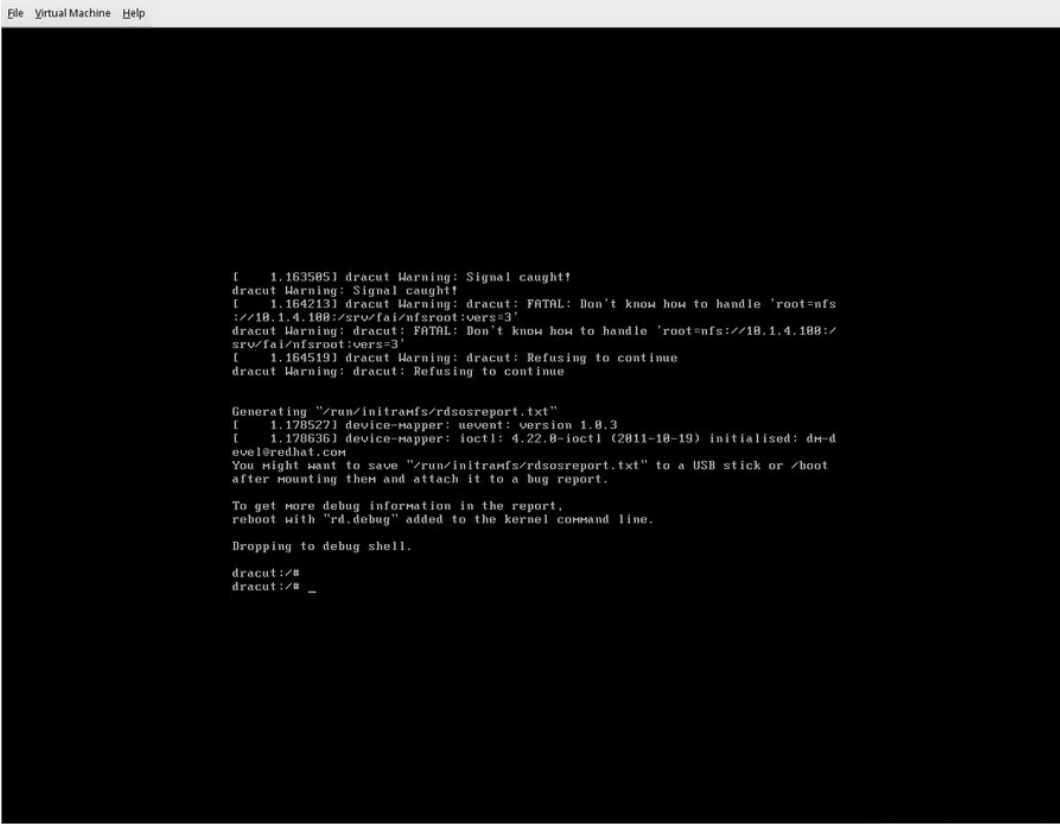
```
locale: Cannot set LC_ALL to default locale: No such file or directory
Can not write log, openpty() failed (/dev/pts not mounted?)
Selecting previously unselected package bash-completion.
(Reading database ... 17976 files and directories currently installed.)
Unpacking bash-completion (from .../bash-completion_1\%3a2.0-1_all.deb) ...
Processing triggers for man-db ...
locale: Cannot set LC_CTYPE to default locale: No such file or directory
locale: Cannot set LC_MESSAGES to default locale: No such file or directory
locale: Cannot set LC_ALL to default locale: No such file or directory
Can not write log, openpty() failed (/dev/pts not mounted?)
Setting up bash-completion (1:2.0-1) ...
```

It looks like that works again. However, it doesn't work. See Figure 4 for the possible error which one may see.

Figure 4 A Booting Failure for a demohost within a virtual environment.

In order to solve this issue, it is necessary to remove two packages in `/etc/fai/NFSROOT` as follows: `console-tools` and `console-common`. The exact reason why it is so, I don't know. However, if I remove two packages in `NFSROOT` and add `console-setup-linux` and `console-data` instead, the infinite install/uninstall procedures are disappeared.

4.6   Useful information

- One subject of the FAI project wiki [7], gave me many helps to resolve some issues.

- The useful package is fai-doc, will be installed at

  ```
  /usr/share/doc/fai-doc/examples/etc/
  ```

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