FQA 3 – Hardware

3.1 – Selecting Hardware

Selecting appropriate hardware to run your 9front system on is important, as it can mean the difference between success and failure of a project. Fortunately, most common PC hardware is at least minimally functional in Plan 9 (excluding certain exotic audio, VGA, and WiFi devices). Nowadays, thanks to `9boot`(8), `realemu`(8), and the VESA driver, it is at least very likely that your PC will boot. In addition, most popular virtualization platforms are reasonably well supported.

Check *FQA 3.2 – Known Working Hardware* as well as the various supported hardware pages on the Bell Labs Plan 9 wiki to help determine if your hardware or VM is supported.

3.2 – Known Working Hardware

This list adds to the various supported hardware pages on the Plan 9 from Bell Labs wiki. **Note:** NONE of these lists are all-inclusive. Some drivers listed on the Bell Labs wiki have not been tested by 9front developers. The following list consists of hardware, 1.) that we have actually used, or 2.) about which we have received reliable reports from users.

Some drivers and their options are also documented in `plan9.ini(8)`.

Read: *FQA 1.3.1.2 – New Hardware Support* for information about hardware drivers that are new in 9front.

3.2.0 – Input Devices

3.2.0.1 – Mice

Almost any PS/2 or USB mouse is going to work. The following are preferred for use with Plan 9.

3.2.0.1.1 – IBM/Lenovo

N700 Wireless/Bluetooth, 3 button Mouse and Laser Pointer

Part Number: 888015450
DPI: 1200
"Just works" with USB receiver. No additional driver required.

ScrollPoint Optical Mouse, 3 button, USB/PS2

Part Number: 31P7405
DPI: 800

3.2.0.2 – Keyboards

Almost any AT, PS/2, or USB keyboard is going to work. The following are preferred for use with Plan 9.

3.2.0.2.1 – IBM/Lenovo

IBM Model M 1391401

Part Number: 1391401

IBM UltraNav SK-8835

Part Number: SK-8835

3.2.0.2.2 – TEX Electronics

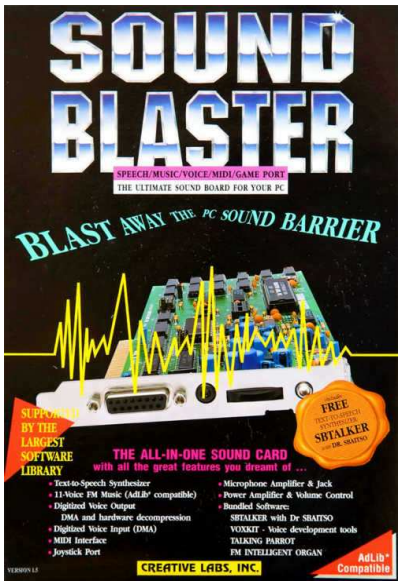
TEX Shinobi

3.2.0.2.3 – MNT Research GmbH

MNT Reform USB Keyboard

Configuration:
`http://plan9.stanleylieber.com/hardware/mnt/reform/`

3.2.1 – Audio Audio support is much improved in 9front, with added support for AC97, Intel HDA, and (ha!) Soundblaster 16.



AMD FCH Azalia Controller

vid/did: 1022/780d

Intel 888 Microsoft UAA bus for HD audio

vid/did: 8086/284b

Intel 82801CA/CAM AC97

vid/did: 8086/2485

Intel 82801 DB DBM/DA AC 97

vid/did: 8086/24c5

Intel 486486 82801IB/IR/IH HD Audio

vid/did: 8086/293e

Intel Gemeni Lake

vid/did 8086/3198

Intel HD NM10/ICH7

vid/did: 8086/27d8

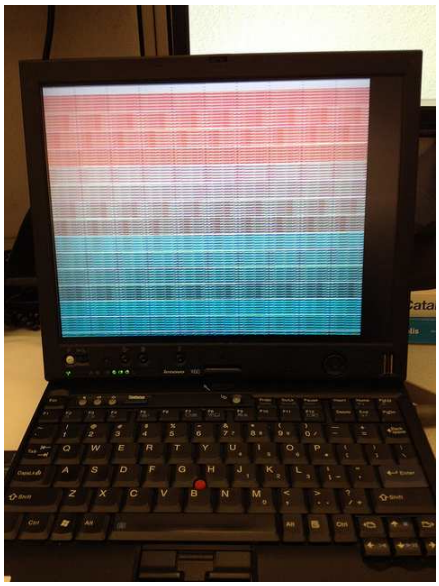
Intel HD 6 Series/C200 Series

vid/did: 8086/1c20

Intel HD 7 Series/C210 Series

vid/did: 8086/1e20

3.2.2 – Graphics Many video cards for which there exists no native VGA driver can be made to work with the generic VESA driver. Examples are provided below.



3.2.2.1 – AGP

NVidia GeForce FX 5200 128MB VGA output

vid/did: 10de/0322

```
monitor=vesa vgasize=1600x1200x32
monitor=dellst2210 vgasize=1920x1080x32
```

NVidia GeForce FX 5700

vid/did: 10de/0341

```
monitor=vesa vgasize=1600x1200x32
monitor=dellst2210 vgasize=1920x1080x32
```

3.2.2.2 – Integrated

ATI Mobility Radeon 7500 128MB DVI/VGA output

vid/did: 1002/4c57

```
monitor=vesa vgasize=1024x768x32
```

ATI Mobility Radeon FireGL V3200/X600

vid/did: 1002/3154

```
monitor=vesa vgasize=1600x1200x32
```

ATI RS880

```
monitor=vesa vgasize=1280x1024x32
```

ATI X1300

Intel Mobile 945GM/GMS/GME, 943/940GML Express

vid/did: 8086/27a6

```
monitor=vesa vgasize=1400x1050x32
monitor=x60t vgasize=1400x1050x32
```

Intel X3100/GM965/PM965/GL960

vid/did: 8086/2a03

```
monitor=vesa vgasize=1680x1050x32
```

Intel Mobile Intel 4 Series 4500MHD

vid/did: 8086/2a42, 8086/2a43

```
monitor=vesa vgasize=1440x900x32
monitor=x301 vgasize=1440x900x32
```

Intel HD 3rd Gen Core processor Graphics Controller

vid/did: 8086/0166

```
monitor=vesa vgasize=1366x768x32
monitor=x230 vgasize=1366x768x32
```

NVidia GeForce FX Go5200 64M

vid/did: 10de/0324

```
monitor=cinema vgasize=1152x768x32
```

S3 SuperSavage IX/C 16MB

vid/did: 5333/8c2e
```
monitor=t23 vgasize=1024x768x32
monitor=vesa vgasize=1024x768x32
```

3.2.2.3 - PCI Express

NVidia GeForce 6200 AGB

vid/did: 10de/0220

NVidia GeForce 6200 LE

vid/did: 10de/0163
```
monitor=e228wfp vgasize=1680x1050x32
```

NVidia GeForce 8400 GS

vid/did: 10de/0422
```
monitor=vesa vgasize=1680x1050x32
```

NVidia GeForce 8600 GT

vid/did: 10de/0402
```
monitor=vesa vgasize=1600x1200x32
```

NVidia GeForce GTX 550

vid/did: 10de/0bee
```
monitor=vesa vgasize=1600x1200x32
```

3.2.3 - Networking

3.2.3.1 - Ethernet

Ethernet is well supported across many vendors and chipsets. 9front introduces a "medium-to-low quality" driver for Broadcom BCM57xx cards, previously unsupported by Plan 9.

3.2.3.1.1 - Integrated

Broadcom BCM5751M NetXtreme Gigabit

vid/did: 14e4/167d
tested 100/1000 mbps

Broadcom BCM5755/5780 NetXtreme Gigabit

vid/did: 14e4/167b
tested 100/1000 mbps

Broadcom BCM5782 NetXtreme Gigabit

vid/did: 14e4/1696

Intel X553/X550-AT 10GBASE-T

vid/did: 8086/15c8

Intel 82540EP Gigabit

vid/did: 8086/101e
tested 100/1000 mbps

Intel 82562ET

tested 10/100 mbps

Intel 82566MM Gigabit

vid/did: 8086/1049
tested 100/1000 mbps

Intel 82567LM 82567LM-2 Gigabit

vid/did: 8086/10f5
tested 100/1000 mbps

Intel 82573L Gigabit

vid/did: 8086/109a
tested: 100/1000 mbps

Intel 82579LM Gigabit

vid/did: 8086/1502
tested: 100/1000 mbps

Intel 82801CAM PRO/100 VE

vid/did: 8086/1031
tested 10/100 mbps

Realtek RTL8139

vid/did: 10ec/8139
tested 10/100/1000 mbps

Realtek RTL8156

Realtek RTL8169/RTL8101E/RTL8102E

vid/did: 10ec/8136
tested 10/100/1000 mbps

3.2.3.1.2 – USB

Beceem Communications CLEAR Stick

vid/did 198f:8160
This is a WiMAX device that appears as a USB CDC Ethernet device
Works with nusb/ether

RNDIS

Android phones should work
Works with nusb/ether

3.2.3.1.3 – PCMCIA

3Com 3c589c

Set the following in `plan9.ini`: `irq=3 port=0x300`

3.2.3.2 – WiFi

9front adds support for several WiFi adapters from Ralink and Intel, as well as support for WPA and WPA2.

Note: Some WiFi hardware requires a corresponding firmware blob to exist under `/lib/firmware/`. Contents of this directory get included into the kernel paqfs when the kernel is rebuilt, so make sure you don't have so much firmware in there that your kernel gets too large for your machine to boot. This, of course, varies from machine to machine.

Read: `wpa`(8), and `plan9.ini`(8)

3.2.3.2.1 – Bridge (external)

IOgear GWU627

802.11n
connect ethernet port to GWU627
HTTP management interface requires Javascript. Managed to program it using Inferno's `charon` browser, which supports ecmascript 1.0.

IOgear GWU637

802.11n
connect ethernet port to GWU6

Vonets VAP11G

802.11g
connect ethernet port to VAP11G
Requires a proprietary Windows program (ships with the device) to program its settings before using it for the first time.

3.2.3.2.2 – Mini-PCI

Actiontec 800MIP

802.11b
often branded Lucent WaveLAN

```
ether0=type=wavelanpci ssid=YOUR_AP station=T42 irq=11
```

Ralink RT2860 802.11b

3.2.3.2.3 – Mini-PCI Express

3.2.3.2.3.1 – iwl

Intel Wireless WiFi Link mini PCI-Express adapters require firmware from http://firmware.openbsd.org/firmware/*/iwn-firmware*.tgz to be present on attach in `/lib/firmware` or `/boot`. To limit the selected APs the options `essid=` and `bssid=` may be set at boot or in the ether interface clone file using a space as the separator between option and value, e.g. `echo essid left-armpit >/net/ether1/clone` Scan results appear in the ifstats file and can be read out like: `cat /net/ether1/ifstats` Ad-hoc mode or WEP encryption is currently not suppported.

Example configuration for `plan9.ini`:

```
ether0=type=iwl essid=YOUR_AP
wpapsk=PASSWORD
```

List of relevant Intel WiFi cards in their various hardware configurations: https://ark.intel.com/content/www/us/en/ark/products/series/59485/wireless.html

Note: Many of these cards come in different configurations (sometimes coupled with Bluetooth, sometimes with different physical dimensions, connectors, or antennas). The specific versions listed below are known to work based on user reports or the author's own testing. Every effort has been made to keep this list accurate and up to date. No refunds.

Intel Centrino Advanced-N 6205

vid/did: 8086/0085
firmware: iwl-6005

Intel Centrino Advanced-N 6235

firmware: iwn-6030
vid/did: 8086/088f

Intel Centrino Ultimate-N

firmware: iwl-6000

Intel Centrino Wireless-N 100

Intel Centrino Wireless-N 2200/2230

vid/did: 8086/0891

Intel WiFi Link 1000/5350 AGN

Intel Wireless AC 3160

Intel Wireless 4965 AG or AGN

vid/did: 1180/0476

Intel Wireless 5100 AGN

firmware: iwn-5000
vid/did: 104c/ac56

Intel Ultimate N WiFi Link 5300

firmware: iwn-5000
vid/did: 1180/0476

Intel 5300 AGN

firmware: iwn-5000
vid/did: 8086/444e

Intel Wireless AC 7260

firmware: iwm-7260
vid/did: 8086/08b2

Intel Wireless AC 8260

firmware: iwm-8000C-34

Intel Wireless 8265/8275

firmware: iwm-8265-34
vid/did: 8086/15c0

Intel Wireless AC 9260

firmware: iwm-9260-34

3.2.3.2.3.2 - wpi

Intel PRO Wireless 3945abg PCI/PCI-Express wireless adapters require firmware from http://firmware.openbsd.org/firmware/*/wpi-firmware*.tgz to be present on attach in `/lib/firmware` or `/boot`. See the `iwl` section above for configuration details.

Example configuration for `plan9.ini`:

```
ether0=type=wpi essid=YOUR_AP
wpapsk=PASSWORD
```

Intel PRO Wireless 3945ABG

firmware: wpi-3945abg
vid/did: 1180/0476

3.2.3.2.3.3 - rt2860

Ralink Technology PCI/PCI-Express wireless adapters require firmware from http://firmware.openbsd.org/firmware/*/ral-firmware*.tgz to be present on attach in `/lib/firmware` or `/boot`. See the above`iwl`section

Ralink RT3090

802.11g

3.2.3.2.4 - PCI

Ralink RT3090

802.11b

3.2.3.2.5 - PCMCIA

Linksys WPC11

802.11b
Prism 2.5
ISL37300P
RevA

Lucent WaveLAN PC24E-H-FC

802.11b

```
ether0=type=wavelan essid=YOUR_AP crypt=off station=x61 irq=11
```

3.2.4 - Tablet Digitizers

Support for Wacom serial tablets was added in 2012. The touchscreen digitizers in some Lenovo ThinkPads (notably, the X230) also seem to function without need of any drivers (presumably, controlled by the BIOS).

3.2.4.1 - Serial

3.2.4.1.1 - Integrated

Wacom WACF004

ThinkPad X4* series tablets

To enable the tablet's serial port in `plan9.ini`:

```
uart2=type=isa port=0x200 irq=5
```

To turn on the tablet:

```
aux/wacom; aux/tablet &
```

Wacom WACF008

ThinkPad X6* series tablets

To enable the tablet's serial port in `plan9.ini`:

```
uart2=type=isa port=0x200 irq=5
```

To turn on the tablet:

```
aux/wacom; aux/tablet &
```

3.2.4.2 – USB

3.2.4.2.1 – Integrated

Wacom (from ThinkPad X230 Tablet, model unknown)

Treated as a mouse.

Wacom (from ThinkPad X1 Yoga 3rd Gen, model unknown)

Treated as a mouse.

3.2.4.2.2 – External

Wacom CTE-640

Treated as a mouse.

3.2.5 – Desktop and Laptop Systems

The ever-expanding list of supported desktop and laptop systems has been redacted from this book and moved exclusivly online. Access it here: `http://plan9.stanleylieber.com/hardware/`

3.3 – Virtual Machines

9front has been tested on several virtual machines. Details below.

Note: As a general rule it is a good idea to manually specify a unique MAC address for each virtual machine instance running on the network, to avoid collisions.

3.3.1 – Qemu

The following generic setup is tested with qemu 1.5.0 and 2.0.50 running on Linux, using *FQA 3.3.3 – virtio* for disk and network. This same generic setup should work for most host operating systems.

3.3.1.1 – Installation

Create a sparse disk image:

```
qemu-img create -f qcow2 9front.qcow2.img 30G
```

Boot the 9front.iso:

```
qemu-system-x86_64 -cpu host -m 1024 \
-net nic,model=virtio,macaddr=00:20:91:37:33:77 -net user \
-device virtio-scsi-pci,id=scsi \
-drive if=none,id=vd0,file=9front.qcow2.img \
-device scsi-hd,drive=vd0 \
-drive if=none,id=vd1,file=9front.iso \
-device scsi-cd,drive=vd1,bootindex=0
```

Finally, see: *FQA 4.3 – Performing a simple install*

3.3.1.2 - Post-Installation Booting

```
qemu-system-x86_64 -cpu host -m 1024 \
-net nic,model=virtio,macaddr=00:20:91:37:33:77 -net user \
-device virtio-scsi-pci,id=scsi \
-drive if=none,id=vd0,file=9front.qcow2.img \
-device scsi-hd,drive=vd0
```

3.3.1.2.1 - Multiboot

Multiboot can be used to start the 9front kernel directly, skipping the bootloader step:

```
qemu -kernel 9pc -initrd plan9.ini
```

3.3.1.4 - Networking

User networking is the default and works the same on every platform. More advanced options are particular to specific host operating systems; several are described below.

Note: On many operating systems ICMP is limited to the superuser. One consequence is that a VM running with guest networking cannot ping remote hosts.

3.3.1.4.1 - Linux VDE

Install vde2.

Setup a tap interface:

```
sudo tunctl -u $USER -t tap0
```

Start a virtual switch connected to the tap interface:

```
vde_switch --tap tap0 -daemon
```

Connect the switch to the network of the host. Use DHCP:

```
slirpvde --dhcp --daemon
```

When booting 9front, add the following to the `qemu` command line arguments:

```
-net vde
```

3.3.1.4.2 - OpenBSD TAP

Tested: OpenBSD/amd64 6.0-STABLE, qemu-2.6.0

Note: Read over this first. Be careful not to clobber any system settings you may already have configured. If you don't understand something, read the relevant man pages until you do. Feel free to substitute arbitrary network values below.

```
# as root
pkg_add bzip2 plan9port qemu ssvnc wget
cp -f /usr/local/plan9/bin/rc /bin/     # for scripts
sysctl net.inet.ip.forwarding=1
echo  'net.inet.ip.forwarding=1' >>/etc/sysctl.conf
echo inet 192.168.54.1 255.255.255.0 NONE >/etc/hostname.vether0
ed /etc/pf.conf
/ext_if
a
int_if="vether0"

match out from $int_if:network to any nat-to ($ext_if:0)
.
w
q
pfctl -f /etc/pf.conf
echo link0 up >/etc/hostname.tap0
echo add vether0 add tap0 up >/etc/hostname.bridge0
sh /etc/netstart
>/etc/dhcpd.conf
ed /etc/dhcpd.conf
i
option domain-name "example.com";
option domain-name-servers 192.168.54.1;

subnet 192.168.54.0 netmask 255.255.255.0 {
        option routers 192.168.54.1;

        range 192.168.54.100 192.168.54.199;
}
.
w
q
rcctl enable dhcpd
rcctl start dhcpd
ed /var/unbound/etc/unbound.conf
/interface
a
        interface: 192.168.54.1
.
/access-control
a
        access-control: 192.168.54.0/24 allow
w
q

rcctl enable unbound
rcctl start unbound
echo ´permit setenv { -ENV PS1=$DOAS_PS1 SSH_AUTH_SOCK } :wheel´ \
        >/etc/doas.conf

# as user who is in wheel group
mkdir -p $HOME/9 $HOME/bin
cd $HOME/9
qemu-img -f qcow2 9front.qcow2.img 30G
```

```
# adjust url for current iso
wget http://9front.org/iso/9front-5561.df1dc1ff2475.iso.bz2
bunzip2 9front-5561.df1dc1ff2475.iso.bz2
mv 9front-5561.df1dc1ff2475.iso 9front.iso
cd $HOME/bin
wget http://openbsd.stanleylieber.com/rc/q9
chmod 775 q9
cd
# boot from iso (install)
doas -u root q9 -i
# boot from qcow image (after completing the install)
doas -u root q9
# connect to qemu via vnc
q9 -v
```

3.3.1.4.3 – Windows TAP

This is tested with the qemu for windows distribution. Download and run the installer from openvpn to install the windows TAP driver. Create a new TAP interface with the "Add a new TAP virtual ethernet adapter" from the openvpn start menu. Go to the network manager and rename that new TAP interface to something more sane like: "qemu-tap". Configure ip addresses or bridge that interface with the network manager.

Now you should be able to run qemu on that interface:

```
qemu.exe -net nic -net tap,ifname="tap-qemu" ...
```

3.3.1.4.4 – Linux TAP

Contributed by joe9:

on the host:

```
sudo ip tuntap add dev tap0 mode tap user joe
sudo ip address add 10.0.0.1/24 dev tap0
```

start qemu using (do not need sudo for qemu):

```
SDL_VIDEO_X11_DGAMOUSE=0 qemu-system-x86_64 \
        -cpu host -enable-kvm -m 1024 \
        -netdev tap,id=eth,ifname=tap0,script=no,downscript=no \
        -device e1000,netdev=eth,mac=00:20:91:37:33:77 \
        -device virtio-scsi-pci,id=scsi -drive \
        if=none,id=vd0,file=9front.qcow2.img \
        -device scsi-hd,drive=vd0 \
        -usb -usbdevice tablet -sdl \
        -ctrl-grab
```

on 9front: add the below line to `/lib/ndb/local`

```
sys=cirno ether=52540000ee03 ip=10.0.0.2 ipmask=255.255.255.0
        ipgw=10.0.0.1
        dns=10.0.0.1
        dom=cirno.9front
```

run: `ip/ipconfig -N`

Now, "ping 10.0.0.2" from linux host and "ip/ping 10.0.0.1" from qemu 9front should work.

check the communication between the vm and the linux host using (on the linux host):

```
sudo tcpdump -nS -vv -i tap0
```

Contributed by hiro:

If you want to enable internet access enable NAT forwarding on the linux host (as root).

To do this, first globally enable forwarding:

```
echo 1 > /proc/sys/net/ipv4/ip_forward
```

Enable Masquerading for everything comping from the VM's tap device (eth0 being your host's way to the internet):

```
iptables -t nat -A POSTROUTING -s 10.0.0.0/24 -o eth0 -j MASQUERADE
```

block everything else from being forwarded:

```
iptables -A FORWARD -m state --state RELATED,ESTABLISHED -j ACCEPT
iptables -A FORWARD -s 10.0.0.0/24 -i tap0 -j ACCEPT
iptables -P FORWARD DROP
```

3.3.1.5 - Audio

Run qemu with the flag `-soundhw sb16` and put the following line in `plan9.ini`:

```
audio0=type=sb16 port=0x220 irq=5 dma=5
```

Note: `irq` and `dma` values may vary.

3.3.1.6 - Graphics

Use `monitor=vesa`

Note: Some versions of QEMU running on OSX have exhibited graphical glitches when using a 16-bit color mode (for example: 1024x768x16. Try a 32-bit mode instead (for example: 1024x768x32).

3.3.2 – Virtualbox

Don't use Virtualbox. It tends to break between versions.

Read: `http://www.landley.net/notes-2015.html#25-06-2015`

If you can't be dissuaded, the following sections detail empircal observations re: Virtualbox.

3.3.2.1 – Ethernet The emulated "Intel PRO/1000 MT Server" ethernet controller is known to work.

3.3.2.2 – Audio

Put the following in `plan9.ini`:

```
audio0=type=sb16
```

3.3.2.3 – Graphics Use `monitor=vesa`

3.3.2.4 – Known Working Versions

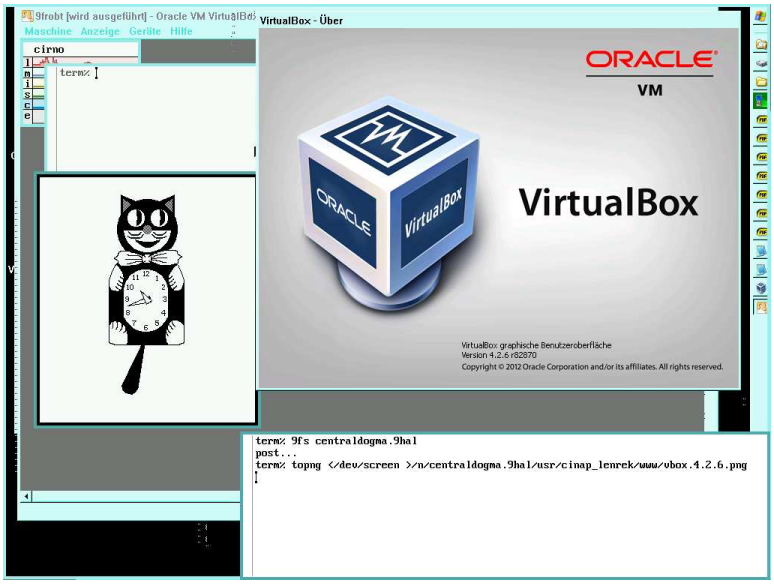
- 4.3.14 r95030 on Windows 7
- 4.3.16 on Mac OS X
- 4.3.18 r96516 on Linux x86_64 kernel 3.14.22
- 4.3.18 on Windows 7:

> just tried with vbox 4.3.18 on windows7. 9front boots fine in BIOS mode, but the PCnet nic dosnt work. reason is that vbox pIIx pci irq routing is fucked so the ethernet doesnt get interrupts. if i boot with *nopcirouting=1, it works fine. theres a option to select the chipset so i tried ICH9 with IO-APIC enabled. normal mp mode fails because of broken mp tables, but works with *acpi=. also, it works with UEFI mode (which always uses ACPI). the usual intel mt server nic also works (thats what is usually recommended for working arround the broken ethernet).
>
> pci routing issue has been fixed in latest kernel, should be available in iso release after 3960.

- 4.3.20 r96996 on Mac OS X 10.6.8/10.9 and Ubuntu 14.04/14.10:

```
General -> Basic
Type: Other
Version: Other/Uknown

System -> Motherboard
Chipset: PIIX3
Pointing Device: PS/2 Mouse
Extended Features: [x] Enable I/O APIC

System -> Processor
Extended Features: [x] PAE/NX (not sure this matters)

System -> Acceleration
[x] Enable VT-x/AMD-V
[x] Enable Nested Paging

Display -> Video
Extended Features: [x] Enable 3D Acceleration (not sure this matters)

Storage -> Attributes
Name: IDE
Type: PIIX4
[x] Use Host I/O Cache

Audio ->
[x] Enable Audio
Host Audio Driver: CoreAudio (Can be PulseAudio or otherwise for Linux,
etc. Shouldn't be hard to set this)
Audio Controller: Soundblaster 16

Network -> Adapter 1
Attached to: NAT
-> Advanced
Adapter Type: Intel PRO/1000 MT Server
Promiscuous Mode: Deny (Not sure this matters)
```

Note: Enabling USB 2.0 Controll in 'Ports -> USB' works just fine in 9front, mounting under `/shr` flawlessly as long as the host has the Virtualbox Extension Pack running.



3.3.3 - Virtio

Current versions of qemu/kvm and virtualbox as of 3.1 support faster paravirtualized devices. Presently, 9front provides drivers for virtio hard disk and network.

The virtio-blk disk device should show up as: `/dev/sdF0`

The virtio-scsi disk device should show up as: `/dev/sd00`

3.3.4 - bhyve

Two different guides (and a bonus video) have appeared elsewhere on the Internet:

FreeBSD Wiki: https://wiki.freebsd.org/bhyve/9front

9front Wiki: http://wiki.9front.org/freebsd-bhyve

Watch: https://youtu.be/m7igZ1fR7ZA