Single User Secure Shell Tutorial

EuroBSD Conference
Basel, Switzerland
Friday, November 25th, 2005
9:00-13:00, 14:00-17:00

Introduction

Who am I?

- Ph.D. in Mathematical Physics (long time ago)
- Webgroup Consulting AG (now)
- IT Consulting Open Source, Security, Perl
- FreeBSD since version 1.0
- Traveling, Sculpting, Go

Schedule for the day

- Part 1
  Overview SW and HW for small systems
- Part 2
  The single user secure shell explained
- Part 3
  The maintenance RAMdisk in action
- Part 4 (afternoon)
  You install and use the maintenance RAMdisk on your own systems

FreeBSD for Small HW

Many choices! – Too many?

- PicoBSD
- miniBSD
- m0n0wall
- Freesbie Live CD
- NanoBSD
- STYX.

PicoBSD

- Initial import into src/release/picobsd/ in 1998 by Andrzej Bialecki <abial@freebsd.org>
- Geared towards floppy-based systems
- man picobsd(8):

  "Building picobsd is still a black art. The biggest problem is determining what will fit on the floppies, and the only practical method is trial and error"

- "Small FreeBSD Home Page"

  `http://people.freebsd.org/~picobsd/`

  – (still) a good starting point for small systems!

miniBSD

- Manuel Kasper's <mk@neon1.net> precursor to m0n0wall in 2002 for FreeBSD 4.x: **`https://neon1.net/misc/minibsd.html`**
- David Courtney <minibsd@ultradesic.com> in 2005 for 5.x: **`www.ultradesic.com/index.php?section=86`**
- Cookbooks on how to whittle down the FreeBSD base system using a chroot environment
- A few utility scripts (for example, to find shared object dependancies)

- Full-fledged firewall based on m0n0BSD, a stripped down 4.x-based FreeBSD for CF
- Configuration via a PHP web GUI, and stored as one big XML file (!)
- Very much "end-user" oriented
- Distributed mainly as CF images for PC-Engines and Soekris platforms
- **`http://m0n0.ch/wall/`**
  2003-2005 Manuel Kasper <mk@neon1.net>

- By Italian FreeBSD User Group in 2004-2005
  (Gruppo Utenti FreeBSD Italia, **`www.gufi.org`**):
  Davide D'Amico <dave@FreeSBIE.org>
  Dario Freni <saturnero@FreeSBIE.org>
  Massimiliano Stucchi <stucchi@FreeSBIE.org>
- Currently 5.3-based
- Appears to be “Knoppix” inspired
- Not really small, but a good RAMdisk model to study
- **`www.freesbie.org`**

NanoBSD

- In tree since 2004 src/tools/tools/nanobsd by Poul-Henning Kamp <phk@freebsd.org>

  "Nanobsd should make it very simple for people to create (CF-)disk images for embedded use of FreeBSD"

- Rewrite from Makefile to Shell Script in 2005 (see talk by PHK at this conference)
- Geared to 256MB CF, with up to three partitions "live", "fallback", and "config"
- CF geometry needs to be specified case-by-case because fdisk is done on vnode device

- A remote managed firewall service since 1998 by Adrian Steinmann <ast@styx.ch>
- Customers have a mainly-read-only web GUI for status of their “firewall appliance”
- Remote administration via SSH cmd-line Revision control: **`www.webgroup.ch/pi`**
- Remote OS upgrades via Secure Shell maintenance RAMdisk
- Tracks FreeBSD since 3.x, runs on 6.x

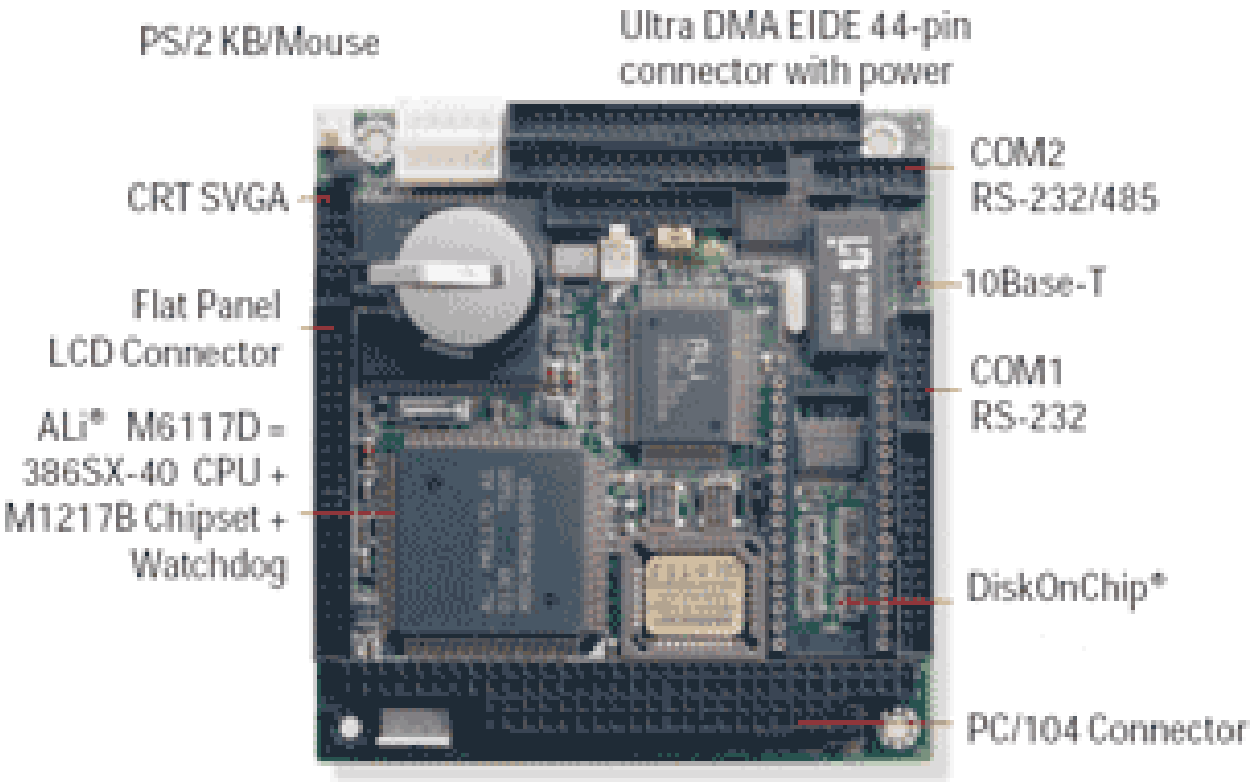
Small SW calls for small HW

- Look for "Embedded Systems" — albeit a misnomer
- What is PC/104 based HW?
- Advantages and disadvantages of PC/104 based systems

What is PC/104 ?

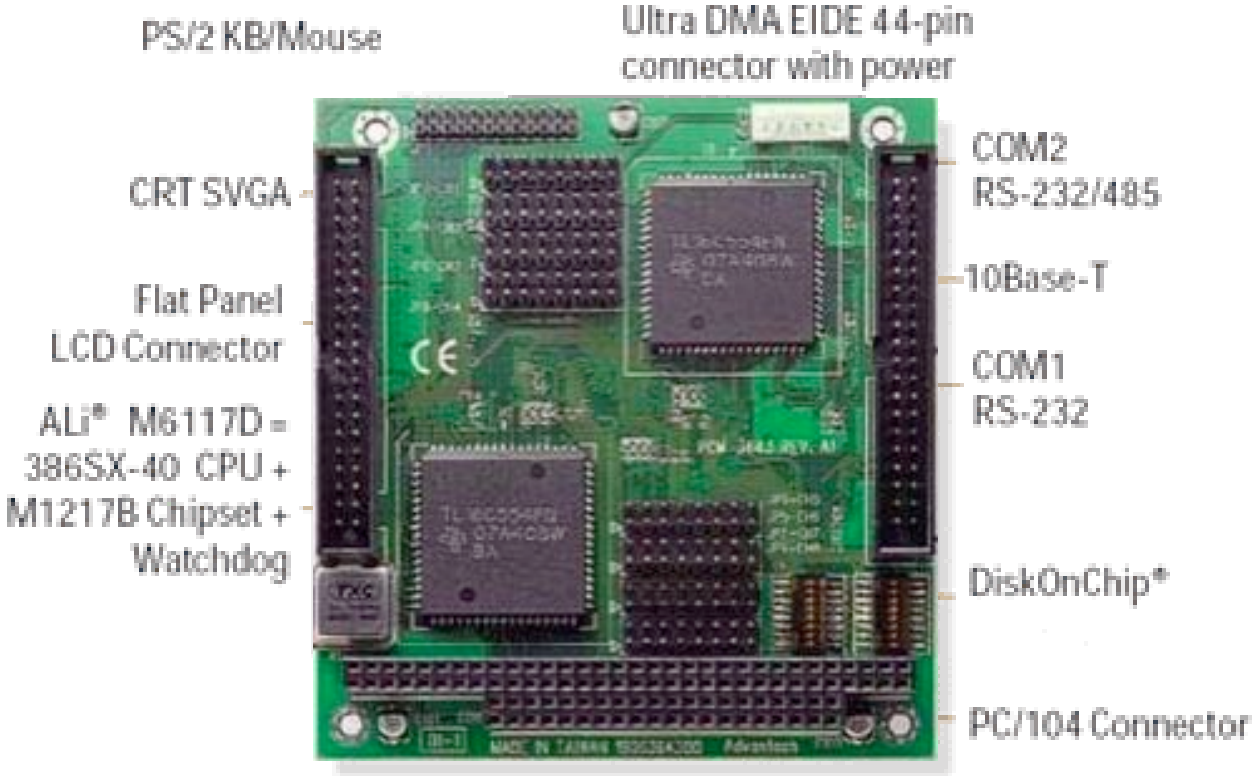
- PC/104 is simply an ISA bus in another, more compact and versatile form factor
- The bus doubles as the structural backbone for the system
- Some good starting points:
  www.controlled.com/pc104faq/
  www.pc104.com/whatis.html

Example PC/104 CPU module



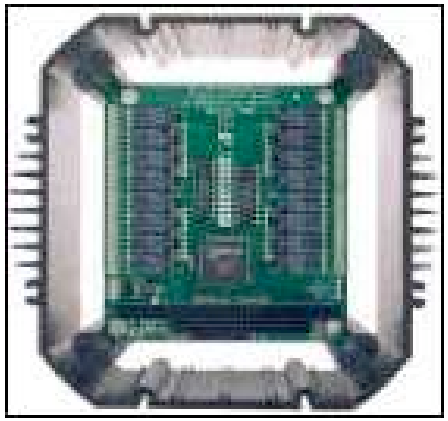
3.78" x 3.54" (96mm x 90mm) PC/104 CPU Module with
Embedded FANLESS 386 class ALI M6117D 40 MHz CPU,
ALI 5113 chipset, 4 MB EDO RAM, LCD/CRT/TFT/DSTN/VGA, ATA 33,
Realtek 8019AS 10 Mbps LAN, 16-bit GPIO and DOC interfaces

Example PC/104 CPU module and peripheral module



3.78" x 3.54" (96mm x 90mm) PC/104 CPU Module with Embedded FANLESS 386 class ALI M6117D 40 MHz CPU, ALI 5113 chipset, 4 MB EDO RAM, LCD/CRT/TFT/DSTN/VGA, ATA 33, Realtek 8019AS 10 Mbps LAN, 16-bit GPIO and DOC interfaces with "PCM-3643"PC/104 8-Port RS-232 Module

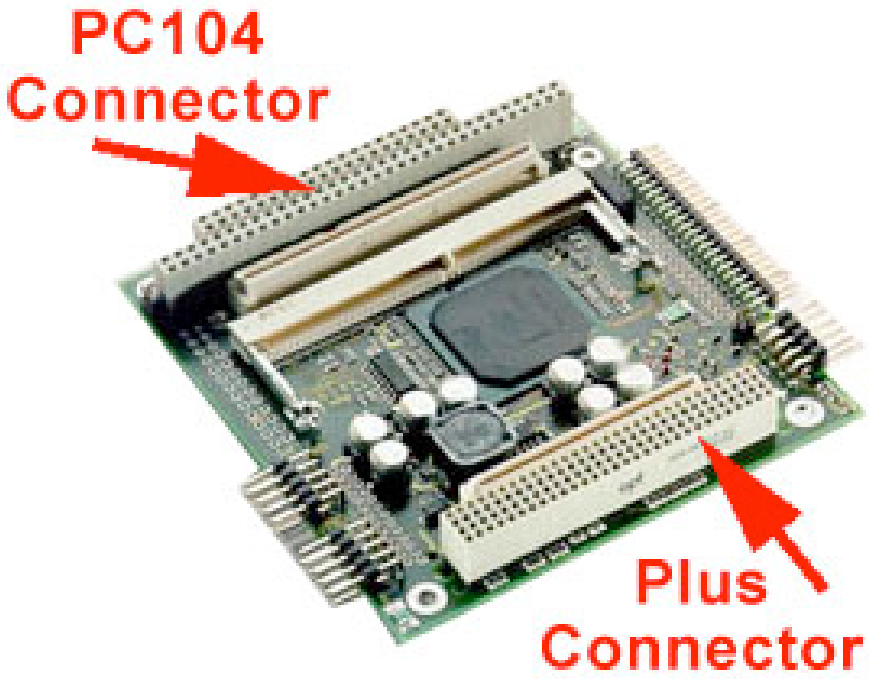
PC/104 “Stacks”



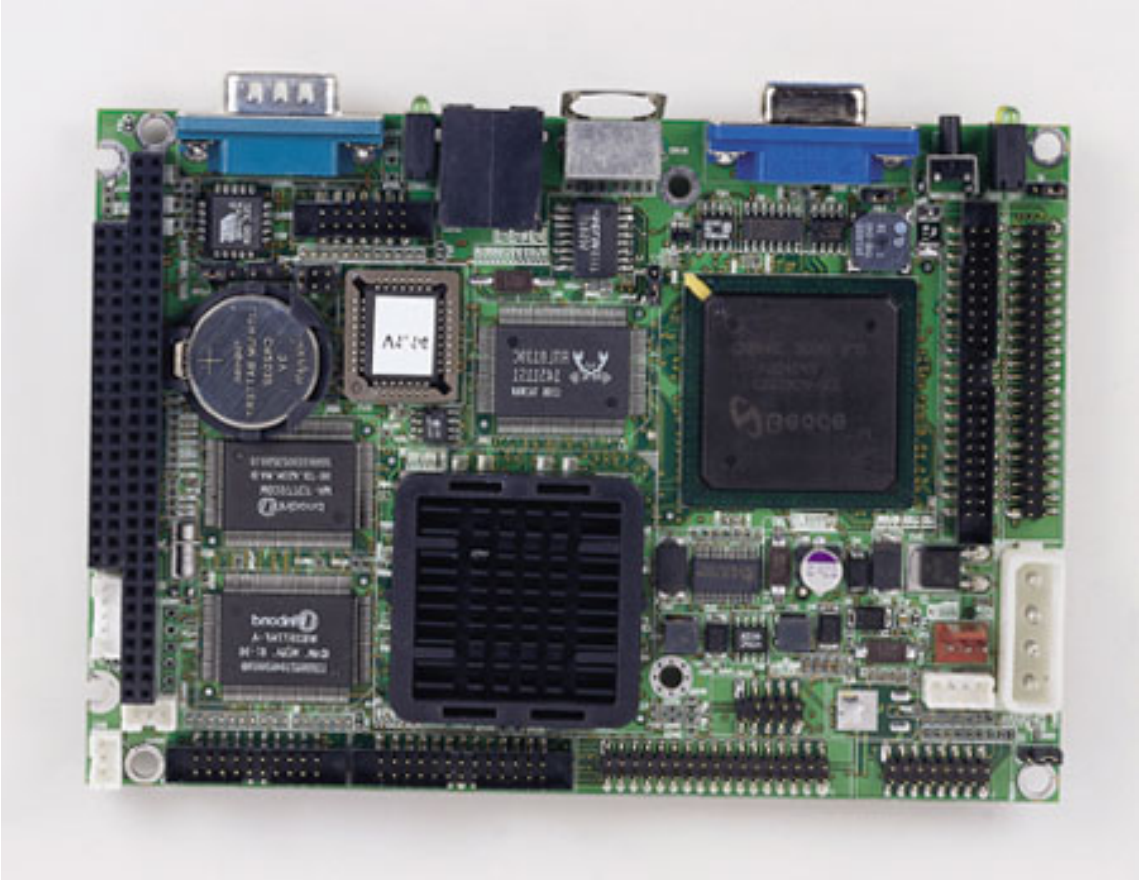
Tri-M Systems PC/104 CAN-TAINER™
PC/104 Container Designed For Hostile Environments
“Priced for Everyday Use”
(if you’re millionaire, that is)
http://www.dpie.com/pc104/cantainer.html

PC-104 vs PC-104+

- PC-104+ is the PCI bus version of PC/104
- Additional connector (PC/104 - compatible)
- But the modules are often quite expensive!



Single Board Computers (SBC)
3.5 inch “Bisquit PCs”



Advantech's PCM-5825: 3.5" SBC with an on-board 586-class NS GX-300 processor
VGA/LCD, Audio, CF socket, PC/104 sockets and Intel 10/100 Mbps Ethernet (fxp0)

Advantech, iEi, ... PCM-58xx

- NS Geode 200MHz-300MHz
- “Passive” cooling
- AT kbd, VGA/LCD, 2-4 COMs, [Audio]
- ATA HD support
- 1-2 Ethernet [Realtek or Intel]
- PC/104 socket, [USB]
- Example sources:
  `www.advantech.com`
  `www.ieiworld.com`

Advantages of PC-104 based HW

- Supports the standard PC components:
  i.e. Keyboard, Video, Floppies, and ATA HDs
- Usually without fans (Low Power CPUs, passive cooling)
- Lots of PC/104 boards available
  FreeBSD ISA device drivers usually work
- Well established in industrial environment

A small, silent PC!

Some disadvantages of most PC/104 based HW

- Has PC Keyboard and Video (cost, security)
- "Passive" cooling may really not be enough
- ISA devices are becoming legacy
- Are still expensive although only i486-like
- ... and Geode ATA DMA falls back to PIO

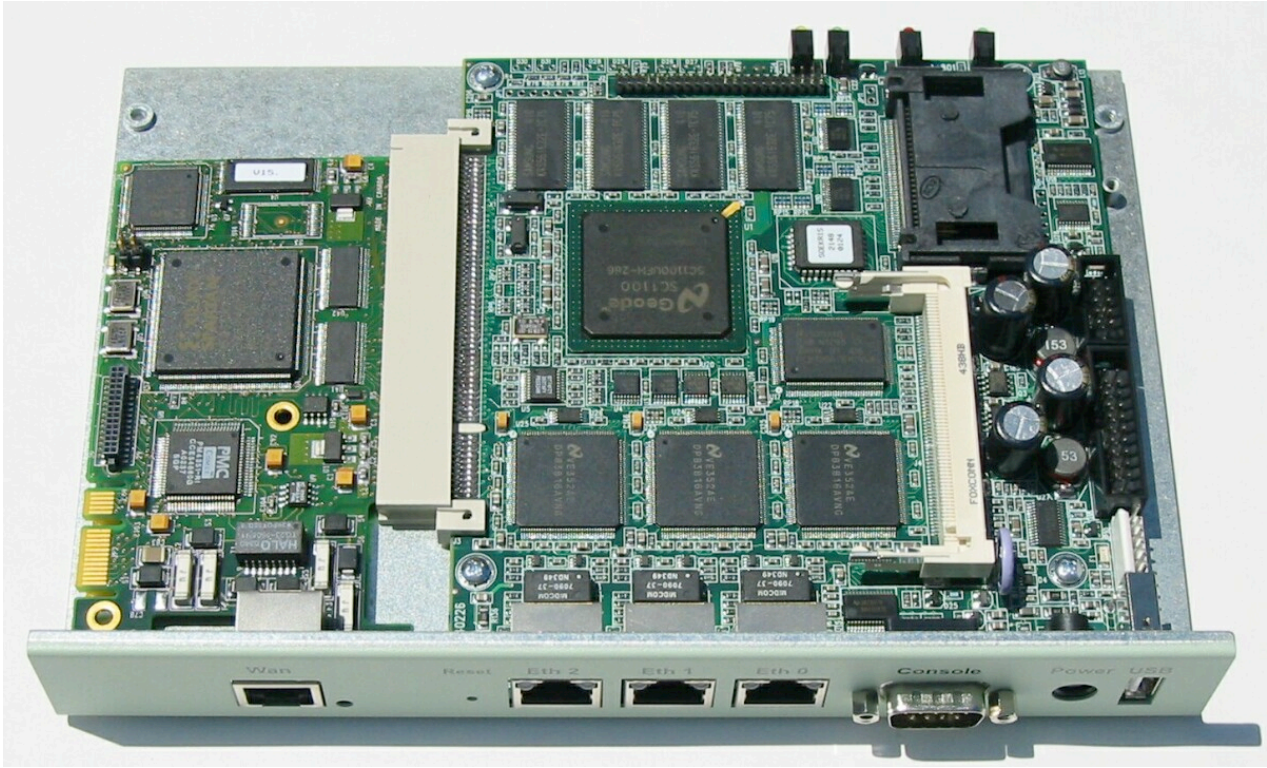
Yesterday's PeeCee

Today's Alternatives

- No PC keyboard, video, floppy
- Not "passive" cooling – NO cooling needed!
- Systems have CF socket
- Support PCI or mini-PCI yet cost significantly less than PC/104+
- "Cool"

Affordable and reliable HW for Open Source OSs

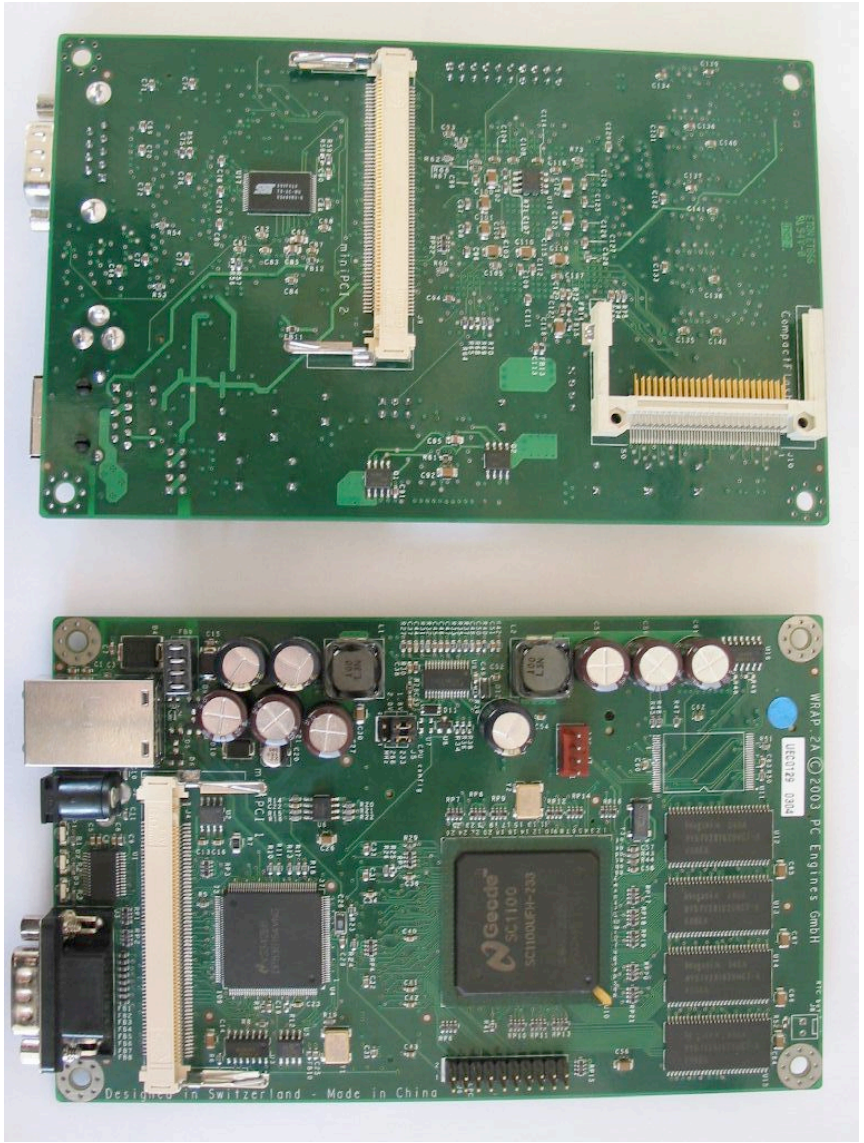
Soekris: www.soekris.com



NET4801
NSC SC1100 266 Mhz CPU, 128 Mbyte SDRAM, 3 Ethernet, 2 serial
USB connector, CF socket, 44 pins IDE connector,
Mini-PCI socket, 3.3V PCI connector
here with Sangoma A101u E1/T1 PCI interface board

PC Engines: www.pcengines.ch

WRAP.2C
AMD Geode
SC1100 266 MHz
128MB SDRAM
1 serial, 1 Ethernet,
CF socket
2 Mini-PCI sockets



Serial BIOS parameters for PC Engines and Soekris

- PC Engines factory default parameters

  `38400 8N1`

  Type "S" at power-on for BIOS

- Soekris factory default parameters

  `19200 8N1`

  Type "Control-P" at power-on for BIOS

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  Type "Control-P" at power-on for BIOS

What's different in userland

- Serial console:

```
$ cat /boot.config
 -h
```

- No AT Keyboard, no video

```
$ cat /boot/loader.conf
hint.atkbdc.0.disabled="1"
hint.sc.0.disabled="1"
hint.vga.0.disabled="1"
```

What's different in userland

- Serial console:

```
$ cat /boot.config
 -h
```

- No AT Keyboard, no video, ...

```
$ cat /boot/loader.conf
hint.atkbdc.0.disabled="1"
hint.sc.0.disabled="1"
hint.vga.0.disabled="1"
hint.sio.1.disabled="1"
hint.fdc.0.disabled="1"
hint.pcic.0.disabled="1"
hint.ppc.0.disabled="1"
hint.ata.1.disabled="1"
hint.ata.ata_dma="0"
```

Installing without CD drive, video, keyboard

- Installation via PXE netboot?
  BIOS and NIC needs to support Intel® PXE support
  "FreeBSD Jumpstart Guide":

  `http://people.freebsd.org/~alfred/pxe/en_US.ISO8859-1/articles/pxe/article.html`

- Install and setup FreeBSD on (laptop) harddisk
  on another system, then install on target system
- Essential for systems which only have CF:
  PCCard or USB adapter to initiallize CF via laptop

Compact Flash (CF)

- Most are good for a million write/erase cycles
  www.robgalbraith.com/bins/multi_page.asp?cid=6007
- Superblocks of filesystems get written (saved) often, so a million writes is still not enough!
- Mount CF read-only, easy:
  - touch /etc/diskless
  - /conf/base/... for /etc/rc.initdiskless

RAMdisks

mdmfs(8)

```
mkdir /foo
mdmfs -X -s 32m md /foo
```

```
umount /foo
mdconfig -d -u #
rm -rf /foo
```

mdconfig(8)

```
dd if=/dev/zero of=bar bs=1k count=5k
mdconfig -a -t vnode -f bar
bsdlabel -w md# auto
newfs md#a
mkdir /bar
mount /dev/md#a /bar
```

```
umount /bar
mdconfig -d -u #
rm -rf /bar bar
```

Kernel tuning GEODE and "SOEKRIS"

For Geode CPUs

```
options CPU_GEODE
options CPU_SOEKRIS
```

- Creates watchdog device (**`/dev/fido`**) on Advantech, PC Engines, and Soekris
- Creates LED devices (**`/dev/led/*`**) on PC Engines and Soekris

  – see **`/usr/src/sys/i386/i386/geode.c`**

Kernel tuning for AMD ELAN 520 CPU

- For ELAN CPUs
  `options CPU_ELAN`
  enables watchdog and LED (on Soekris net4501)
  – see man CPU_ELAN(4), led(4) and
  `src/sys/i386/i386/elan-mmcr.c`
- For timestamping external signals and attaching an LCD display on GPIO Soekris
  `http://phk.freebsd.dk/soekris/`

Summary Part 1

- ☑ FreeBSD for small platforms:
  Decide between tools or an all-in-one distribution
- ☑ Small Hardware:
  Look for embedded systems, fanless systems, and don't be afraid of PC/104 - it's just an ISA bus
- ☑ Serial consoles, RAMdisks, and read-only filesystems are your friends
- ☑ Build custom kernels on a fast "build" system to take full advantage of HW features

Outlook Part 11

i. A closer look at how FreeBSD boots/installs
   the install CD
   the boot sequence
   building crunched binaries

ii. The missing bits needed for building a networked
    maintenance RAMdisk (Single User Secure Shell)

iii. Some details of building and installing the
     maintenance RAMdisk (time permitting)

iv. Using the "Single User Secure Shell"
    to install/upgrade OS (demonstration)

Tutorial sets

- Set includes: PC Engine WRAP.1E-2
  (3 LAN / 1 miniPCI / 128 MB DRAM), 128MB CF,
  Nullmodem serial cable, RJ45 crossover patch cable,
  14VA power brick, and enclosure (red, alu, or black)
- Preorders can all be fulfilled (there are a few left)
- Most sets are preassembled, people who pre-ordered
  2 sets get one unassembled
- People who really want to assemble their own set, must
  populate the CF first (and will need tools)
  `/cdrom/6.0-STYX/EuroBSD05Tutorial/stagecf.sh`
- Tutorial price is 140 Euro or 230 CHF in cash
- ITGarage is selling WiFi Upgrade options at conference

Booting FreeBSD

www.FreeBSD.org/doc/en_US.ISO8859-1/books/handbook/boot.html
www.freebsd.org/doc/en_US.ISO8859-1/books/arch-handbook/boot.html

i. BIOS POST "executes" mbr, boot0, or boot0sio, or ...

```
F1, 'no operating system on disk', F1-loop, ...
```

fdisk -B|-b
boot0cfg

ii. boot2 loads /boot/loader from active BIOS partition

```
>>FreeBSD/i386 BOOT
Default: 1:ad(1,a)/boot/loader
boot:
```

bsdlabel -B

iii. loader sets kernel environment, loads kernel and modules and boots FreeBSD

```
BTX loader 1.0 BTX version is 1.01
...
Hit [Enter] to boot immediately, or any other key ...
OK
```

/boot/loader

- help
- show
- set
- ls
- more
- 1000 ms
- words

FreeBSD Install CD

```
$ cat /cdrom/boot/loader.conf
mfsroot_load="YES"
mfsroot_type="mfs_root"
mfsroot_name="/boot/mfsroot"
loader_logo="beastie"


$ zcat /cdrom/boot/mfsroot > /tmp/m
# mdconfig -a -t vnode -f /tmp/m
md0
# mount /dev/md0 /mnt
$ ls -isl /mnt/stand
$ ldd /mnt/stand/*
```

crunchgen

Makes one statically linked binary for a set of programs (/rescue)

Toy example

i. **`crunchgen pls.conf`**

ii. **`make -f pls.mk`**

iii. **`./pls`**

```
srcdirs /usr/src/bin
progs ls
libs -lncurses -lutil
progs ps
libs -lm -lkvm
```

Compare sizes of **`/bin/ps`**, **`/bin/ls`**, **`./pls`**

A straightforward plan

i. Use crunchgen to combine all commands into one “static” binary

ii. Craft a RAMdisk filesystem image which configures network and starts SSH daemon

iii. Use the boot loader to preload the RAMdisk

iv. Either mount it as the root filesystem for maintenance ...

v. ... or mount it very early form a startup script to check filesystem integrity

Yet not so easy, because

- We specifically want some programs on RAMdisk which turn out to be *crunchgen-unfriendly:*
  - SSH doesn't crunch "out of the box"
  - By default, SSH links in far too many libraries
  - Programs based on GEOM classes require the runtime loader
- Network parameters should be text-file editable, and the RAMdisk md_image should stay generic

Crunching SSHD fails

- This **`crunchgen.conf`** fragment fails:

```
buildopts -DNO_KERBEROS
buildopts -DNO_PAM
srcdirs /usr/src/secure/usr.bin
srcdirs /usr/src/secure/usr.sbin
progs scp ssh sshd
libs -lssh -lutil -lz -lcrypt
libs -lcrypto -lmd
```

  link phase wants **`libwrap.a`** and **`libpam.a`** routines

Crunching SSHD fixed

- Change hard-coded **`#defines`** directly in

  `/usr/src/crypto/openssh/config.h`

```
#undef LIBWRAP
#undef USE_PAM
#undef HAVE_LIBPAM
#undef HAVE_PAM_GETENVLIST
#undef HAVE_SECURITY_PAM_APPL_H
#undef XAUTH_PATH
```

GEOM uses dlopen()

The GEOM commands use dlopen() to load classes from **`/lib/geom`** dynamically

`geom(8), gconcat(8), glabel(8), gmirror(8), gnop(8), graid3(8), gshsec(8), gstripe(8)`

... yet it is exactly these commands – among others – that we need most in a maintenance environment!

“Mostly static” linking

Include **`rtld(1)`** in RAMdisk:

```
/libexec/ld-elf.so.1
```

then, for GEOM classes link dynamically:

```
ldd /lib/geom/*.so
/lib/geom/geom_concat.so
/lib/geom/geom_eli.so
        libmd.so.3 => /lib/libmd.so.3 (0x2815a000)
        libcrypto.so.4 => /lib/libcrypto.so.4 (0x28168000)
/lib/geom/geom_label.so
/lib/geom/geom_mirror.so
        libmd.so.3 => /lib/libmd.so.3 (0x28155000)
/lib/geom/geom_nop.so
/lib/geom/geom_raid3.so
        libmd.so.3 => /lib/libmd.so.3 (0x28154000)
/lib/geom/geom_shsec.so
/lib/geom/geom_stripe.so
```

crunchgen with a twist

- Linking "mostly static" is for now mentioned in **`crunchgen.conf`** as a comment:

```
# LIBS_SO
    -lmd -lcrypto -lgeom -lsbuf -lbsdxml
```

- Before running make, the **`crunchgen.mk`** is fixed by replacing all `$(CC) -static ...`

  with `$(CC) -Xlinker -Bstatic ...`
  `-Xlinker -Bdynamic $LIBS_SO`

What's on the RAMdisk ?

```
-sh
[               du                              mkdir

                                                                sh
                                                                sleep
                expr

                                hostname
                                                                stty
cat
chflags                                         mv
chgrp
chmod
chown                           kill
chroot
                                                ps
cp                                              pwd             test
date                                                            touch
                                                realpath        tset
df                              link
                                ln
                                ls                              unlink
                                                rm
                                                rmdir
```

Basics on RAMdisk

```
-sh
[               du                              mkdir

                                                                sh
                                                                sleep
                expr

                                hostname
                                                                stty
cat                             init
chflags                                         mv
chgrp
chmod                           kenv
chown                           kill
chroot

                                                ps
cp                                              pwd             test
date                                                            touch
                                ldconfig        realpath        tset
df                              link
                                ln
                                ls                              unlink
                                                rm
                                                rmdir
```

SysAdmin on RAMdisk

```
atacontrol
badsect         dumpfs
boot0cfg
bsdlabel

                fastboot        halt
                fasthalt
camcontrol      fdisk
                ffsinfo
                fsck
                fsck_4.2bsd
                fsck_ffs
                fsck_ufs
                                kldconfig
clri                            kldload
                                kldstat
                                kldunload
dd

                                                reboot          tunefs
                                                                umount

diskinfo                        mdconfig
disklabel                       mdmfs

mknod
mount
mount_cd9660
mount_devfs
mount_fdescfs
mount_linprocfs

mount_procfs
mount_std
                                                swapctl
newfs                                           swapoff
                                                swapon
                                                sync
                                                sysctl
```

Networking on RAMdisk

route

ifconfig

ping

dhclient
dhclient-script

More networking RAMdisk

route

scp

slogin
ssh
mount_nfs sshd
ifconfig

ipf
ipfw

pfctl
ping

ggatec
ggated
dhclient ggatel
dhclient-script

Archiving tools on RAMdisk

rrestore

dump

gunzip
gzcat
gzip

bunzip2
bzcat
bzip2

pax

tar

rdump

restore

zcat

Editors on the RAMdisk

sed

ed
ex

red

and last but not least ...

Requires a (small) **`/usr/share/misc/termcap`**

Only 5306 bytes (not 204798 bytes!) supporting
`vt100, vt220, xterm, screen, ansi, AT386`

Being on RAMdisk, the required **`/var/tmp`** exists

`vi`

Maintenance RAMdisk

```
-sh              dmesg            graid3           mini_crunch      route
[                du               growfs           mkdir            rrestore
atacontrol       dump             gshsec           mknod            scp
badsect          dumpfs           gstripe          mount            sed
boot0cfg         ed               gunzip           mount_cd9660     sh
bsdlabel         ex               gzcat            mount_devfs      sleep
bunzip2          expr             gzip             mount_fdescfs    slogin
bzcat            fastboot         halt             mount_linprocfs  ssh
bzip2            fasthalt         hostname         mount_nfs        sshd
camcontrol       fdisk            ifconfig         mount_procfs     stty
cat              ffsinfo          init             mount_std        styxinstall
chflags          fsck             ipf              mv               swapctl
chgrp            fsck_4.2bsd      ipfw             newfs            swapoff
chmod            fsck_ffs         kenv             pax              swapon
chown            fsck_ufs         kill             pfctl            sync
chroot           gbde             kldconfig        ping             sysctl
clri             gconcat          kldload          ps               tar
cp               geli             kldstat          pwd              test
date             geom             kldunload        rdump            touch
dd               ggatec           ldconfig         realpath         tset
df               ggated           link             reboot           tunefs
dhclient         ggatel           ln               red              umount
dhclient-script  glabel           ls               restore          unlink
diskinfo         gmirror          mdconfig         rm               vi
disklabel        gnop             mdmfs            rmdir            zcat
```

RAMdisk disk usage 5MB

```
$ du -sk .
5186    .
```

```
$ du -sk * | sort -rn
2682    bin
2218    lib
136     libexec
78      etc
26      boot
22      usr
12      var
6       root
2       mnt
2       dev
0       tmp
0       sbin
```

On-disk 2.5 MB

- The boot loader is able to preload *gzip-compressed* RAMdisk images
- Additional on-disk (CF) usage is minimal

```
$ du -ks fs.6.0-RAMdisk.gz
2352    fs.6.0-RAMdisk.gz
```

On-disk 2.5 MB / RAM 7MB

- The boot loader is able to preload *gzip-compressed* RAMdisk images
- Additional on-disk (CF) usage is minimal

```
$ du -ks fs.6.0-RAMdisk.gz
2352    fs.6.0-RAMdisk.gz
```

- In RAM currently defined as 7MB md0

```
# mdconfig -l -u 0
md0     preload   7.0M
```

RAMdisk versus /rescue

Additional on RAMdisk (today)

boot0cfg	geli	gnop	scp	swapctl
chgrp	geom	graid3	sed	swapoff
chown	ggatec	growfs	sleep	touch
diskinfo	ggated	gshsec	slogin	tset
du	ggatel	gstripe	ssh	
ffsinfo	glabel	ipfw	sshd	
gconcat	gmirror	pfctl	styxinstall	

Additional in /rescue (6.x)

atm	fsdb	md5	nos-tun	setfacl
atmconfig	fsirand	mount_ext2fs	ping6	slattach
ccdconfig	getfacl	mount_msdosfs	raidctl	spppcontrol
chio	groups	mount_ntfs	rcorder	startslip
csh	id	mount_nullfs	rcp	tcsh
devfs	ilmid	mount_udf	routed	vinum
dumpon	ipfs	mount_umapfs	rtquery	whoami
echo	ipfstat	mount_unionfs	rtsol	
fore_dnld	ipmon	newfs_msdos	savecore	
fsck_msdosfs	ipnat	nextboot.sh	sconfig	

The RAMdisk personality

- The compressed RAMdisk image stays generic
- The key idea is to pass all machine-specific parameters via the kernel environment **`kenv(1)`**
- These can be set in a **`/boot/maint/params`** file which is an editable textfile and is included by the loader
- Those values are read back into RAMdisk user space via **`kenv(1)`** calls

Example personality

```
OK more /boot/maint/params
*** FILE /boot/maint/params BEGIN ***
set maint.ifconfig_sis0="192.168.1.200/24"
set maint.defaultrouter="192.168.1.1"
set maint.domain="mydomain.ch"
set maint.nameservers="192.168.1.1 192.168.1.100"
set maint.sshkey_01a="ssh-dss AAAAB3N..........cZ9"
set maint.sshkey_01b="ucifE5QoUN..(120 chars)..PYik"
...
*** FILE /boot/maint/params END ***


RAMdisk# sed -ne /kenv/p /etc/rc
kenv | sed -ne 's/^maint\.//p' >> /etc/params
```

One way into RAMdisk

By replacing **`/boot/loader.rc`** (remotely) with:

```
include /boot/loader.4th
start
unload
load /boot/maint/k.CUSTOM
load -t md_image /boot/maint/fs.6.0-STYX
include /boot/maint/params
set vfs.root.mountfrom=ufs:/dev/md0
autoboot 10
```

Another way into RAMdisk

By starting with a very early script:

```
$ cd /etc/rc.d; rcorder * | head -4
rcconf.sh
dumpon
initrandom
maint_sshd

$ head maint_sshd
#!/bin/sh
PATH=/rescue:/usr/bin:/bin:/usr/sbin:/sbin
# REQUIRE: initrandom
# PROVIDE: maint_sshd
# KEYWORD: nojail
# BEFORE:  disks
```

/etc/rc.d/maint_sshd steps

i. Check for preloaded RAMdisk
   If it hasn't been preloaded, look for it at **`$maint_sshd_fs_img`** and **`mdconfig`** it

ii. Mount it on **`/boot/maint`** and mount devfs on **`/boot/maint/dev`**

iii. Execute **`chroot /boot/maint /etc/rc`**

RAMdisk /etc/rc

i. Configure network and start a **`/usr/sbin/sshd`** (in RAMdisk)

ii. Check the "real" root filesystem

iii. Check the **`/usr`** filesystem as specified by **`/etc/fstab`** on the "real" root

iv. If called from **`/etc/rc.d/maint_sshd`** and the filesystems checked well, exit

v. Otherwise, wait for administrator login

Cleaning up after RAMdisk

A. Returning from RAMdisk **`/etc/rc`**, we know that the real root filesystem (and **`/usr`**) are clean

B. Continue with the startup scripts ...

C. Right before launching the real SSHD:

   i. Kill the SSHD running in RAMdisk

   ii. Unmount **`/boot/maint/dev`** and **`/boot/maint`**

   iii. Relinquish RAM used by RAMdisk (if possible)

Single User Secure Shell

- A more sophisticated "rescue" environment in a RAMdisk which configures the network and also supports SSH, SSHD, and GEOM commands
- Is launched either stand-alone from boot loader or from `/etc/rc.d` before filesystems are checked
- Secure Shell remote login for root is possible – even when system is stuck in "Single User"

Overview of "full build"

- Build world
- Build release
- Build sandbox(es) and customize
  ⇒ _DEV, _128MB, _64MB tarballs
- Build custom kernel per architecture
- Build mfs image
  customize its /etc directory
  copy appropriate kernel into /boot/maint
  ⇒ boot+maint.tbz tarballs

Details building a release

Get FreeBSD CVS repository with CVSUP (/usr/cvs)

www.freebsd.org/doc/en_US.ISO8859-1/books/handbook/cvsup.html

```
cd /usr && cvs -d /usr/cvs co src -r RELENG_6
   && cd src && make buildworld

cd release && make release \
   BUILDNAME=NAME CVSROOT=/usr/cvs \
   CHROOTDIR=/r/BUILD RELEASETAG=RELENG_6
```

After a while, results in **/r/BUILD/R**

Common gotchas

- Not enough disk space in **/usr/obj** or **/r/BUILD**
- Environment or **/etc/make.conf** incompatibilities

Details _DEV dist tarball

```
SB=/r/BUILD
STYXTREE=${SB}/STYX/stage/trees
STYXTREEDEV=${STYXTREE}/DEV
mkdir -m 0755 -p ${STYXTREEDEV}

for d in `cd ${SB}/R/stage/trees; echo *`
do
    cd ${SB}/R/stage/trees/$d && \
      find . -depth | cpio -dump ${STYXTREEDEV}
done
cd ${SB}/R/stage/mfsfd && \
      find stand -depth | cpio -dump ${STYXTREEDEV}

mount_devfs ${STYXTREEDEV}/dev
cp /etc/resolv.conf ${STYXTREEDEV}/etc
# copy customization scripts into ${STYXTREEDEV}
# run customization scripts in chroot ${STYXTREEDEV}

cd `dirname ${STYXTREEDEV}` && tar cvBjf DEV.tbz DEV
```

Details _generic tarball

```
SB=/r/BUILD
STYXTREE=${SB}/STYX/stage/trees
STYXTREEGENERIC=${STYXTREE}/GENERIC_generic
mkdir -m 0755 -p ${STYXTREEGENERIC}

# default /boot hierarchy
cd ${SB}/R/stage/trees/base && \
      find boot -depth | cpio -dump ${STYXTREEGENERIC}

# GENERIC kernel
cd ${SB}/usr/src
make buildkernel KERNCONF=GENERIC
make installkernel DESTDIR=${STYXTREEGENERIC}

# maintenance RAMdisk
mkmfs.sh

cd `dirname ${STYXTREEGENERIC}` && \
      tar cvBjf GENERIC_generic.tbz boot
```

mkmfs.sh pseudocode

```
mkdir ${mfs}
cd ${mfs}
mkdir -m 0755 -p boot dev etc mnt libexec lib/geom \
    usr/share/misc var/db var/run root/.ssh mini
mkdir -m 1777 var/tmp
ln -s var/tmp tmp && ln -s mini bin && ln -s mini sbin
cd usr && ln -s ../bin && ln -s ../sbin
cd ${SB}/R/stage/trees/base/boot
cp boot boot0 boot0sio boot1 boot2 mbr ${mfs}
cp -p ${SB}/R/stage/trees/base/libexec/ld-elf.so.[0-9] ${mfs}/libexec
cp -p ${SB}/R/stage/trees/base/lib/geom/geom_*.so ${mfs}/lib/geom
do_crunchgen_with_a_twist && install_mini_crunch_into_mfs_mini
# i.e., /lib/geom/geom_eli.so, requires libmd.so and libcrypto.so
# see also man rtld(1)
ldd -f "cp -p ${SB}/R/stage/trees/base%p ${mfs}%p\n" \
    lib/geom/* mini/mini_crunch | grep -v : | sort -u | /bin/sh -x
cp_some_etc_files_to_mfs_etc
# make RAMdisk image file fssize=7k (7MB) fsinode=32k (big binaries)
/usr/src/release/scripts/doFS.sh bsdlabel "" \
    fs_img ${SB}/R/stage /mnt ${fssize} ${mfs} ${fsinode} auto
gzip -cv9 fs_img > ${STYXTREEGENERIC}/maint/fs.gz
```