Honeybees and Hardware:
Open-Source Solutions for the Small Family Farm

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Beekeeper
Sugar Maple Apiaries

Agenda

Monitoring the Beeyard

Protecting the Hives

Expanding the Colonies

Network-Attached Cameras

Trendnet TVIP100: ~$70

640x480; ethernet via RJ45
Focus down to ~8”
Nice embedded video player
Needs the occasional reboot

Axis 2100: $100+ on Ebay

640x480; ethernet via RJ45
Nice timestamp feature
Not great for closeups
Linux-based; rock-solid reliability.

Network-Attached Cameras

Trendnet TVIP100W: ~$110

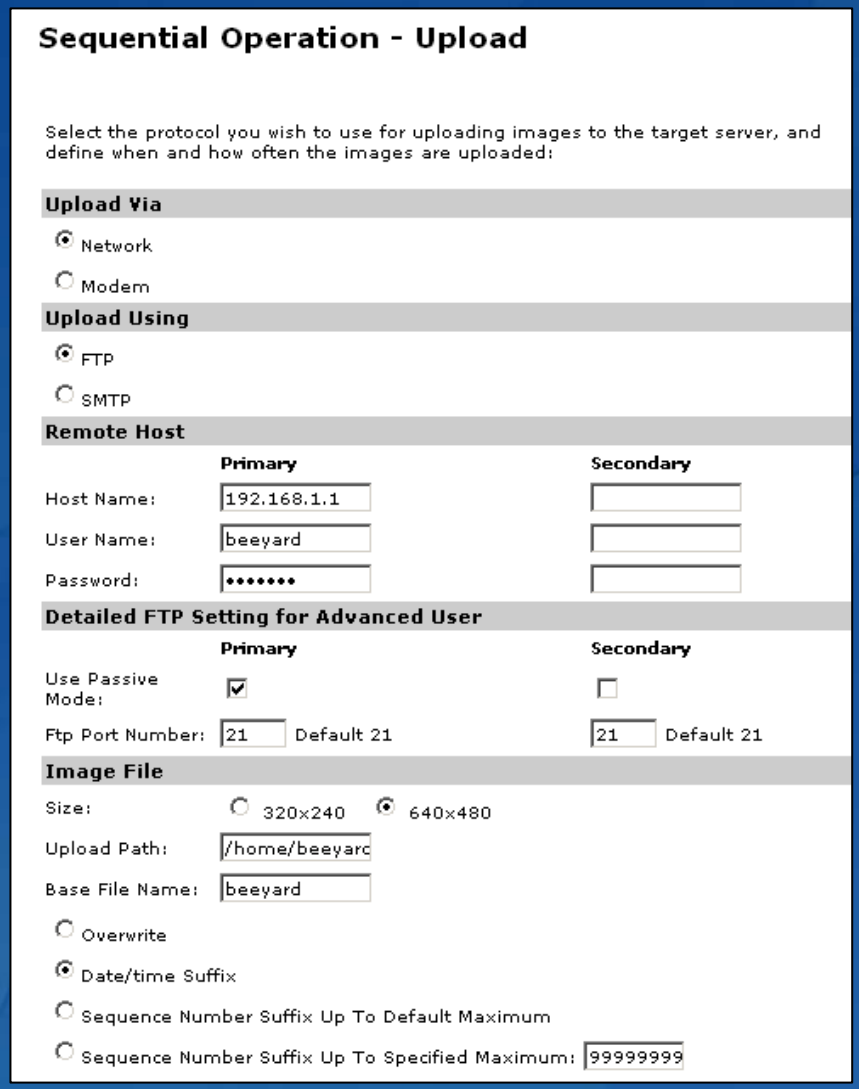
640x480; ethernet via 802.11g
Focus down to ~8”
Nice embedded video player
Needs the occasional reboot

Network Guy’s Rant:

Connectivity via wireless is an order of magnitude less reliable than via copper.


Kawasaki

Network-Attached Cameras



Sequential Operation - Upload

Select the protocol you wish to use for uploading images to the target server, and define when and how often the images are uploaded:

Upload Via

- (•) Network
- ( ) Modem

Upload Using

- (•) FTP
- ( ) SMTP

Remote Host

	Primary	Secondary
Host Name:	192.168.1.1	
User Name:	beeyard	
Password:	•••••••	

Detailed FTP Setting for Advanced User

	Primary	Secondary
Use Passive Mode:	[x]	[ ]
Ftp Port Number:	21 Default 21	21 Default 21

Image File

Size: ( ) 320x240 (•) 640x480

Upload Path: /home/beeyarc

Base File Name: beeyard

- ( ) Overwrite
- (•) Date/time Suffix
- ( ) Sequence Number Suffix Up To Default Maximum
- ( ) Sequence Number Suffix Up To Specified Maximum: 99999999

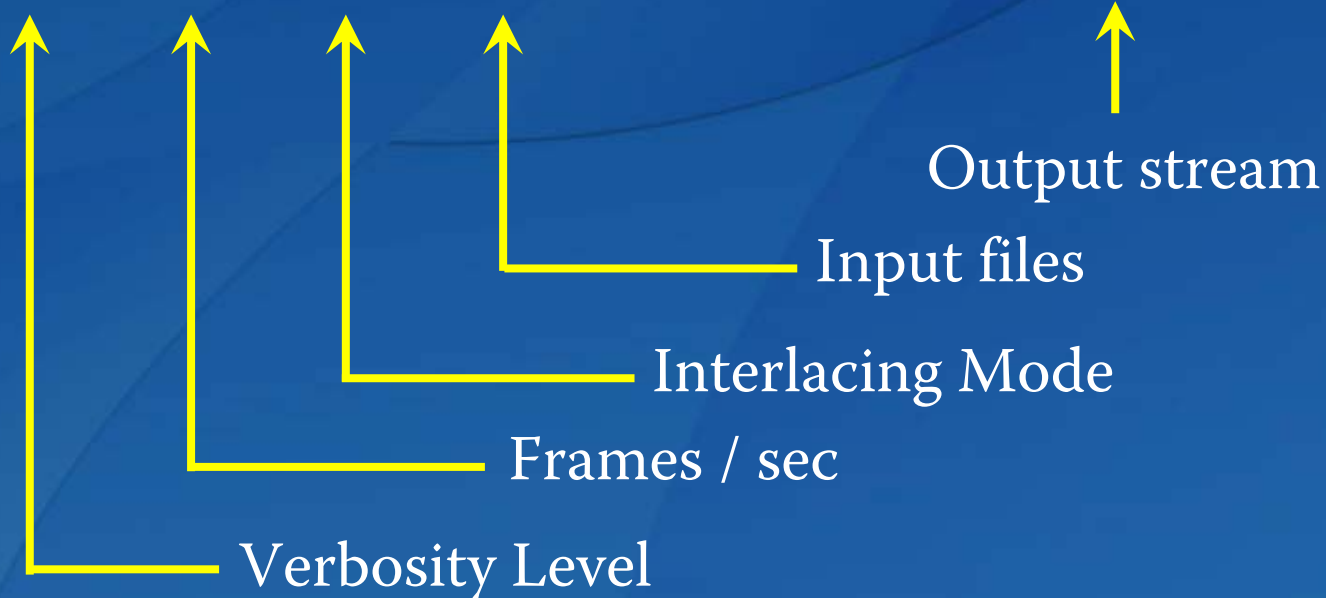
Great – a folder full of JPEGs. Now what?

```
root@beeyard:/home/beeyard/camera1# ls -l | more
total 1246708
-rw-r--r-- 1 beeyard beeyard 40103 2008-10-11 16:21 beeyard_081011_162103.jpg
-rw-r--r-- 1 beeyard beeyard 40368 2008-10-11 16:21 beeyard_081011_162118.jpg
-rw-r--r-- 1 beeyard beeyard 40805 2008-10-11 16:21 beeyard_081011_162133.jpg
-rw-r--r-- 1 beeyard beeyard 40638 2008-10-11 16:21 beeyard_081011_162148.jpg
-rw-r--r-- 1 beeyard beeyard 40714 2008-10-11 16:22 beeyard_081011_162203.jpg
-rw-r--r-- 1 beeyard beeyard 40950 2008-10-11 16:22 beeyard_081011_162218.jpg
-rw-r--r-- 1 beeyard beeyard 40824 2008-10-11 16:22 beeyard_081011_162233.jpg
-rw-r--r-- 1 beeyard beeyard 40910 2008-10-11 16:22 beeyard_081011_162248.jpg
-rw-r--r-- 1 beeyard beeyard 40819 2008-10-11 16:23 beeyard_081011_162303.jpg
-rw-r--r-- 1 beeyard beeyard 40792 2008-10-11 16:23 beeyard_081011_162318.jpg
-rw-r--r-- 1 beeyard beeyard 40861 2008-10-11 16:23 beeyard_081011_162333.jpg

-- snip --

root@mediaserver:/home/beeyard/camera1# ls -l | wc -l
133222
```

JPEG2YUV: Convert JPEGs to YUV MPEG Video stream

Ubuntu Install: `# apt-get install mjpegtools`

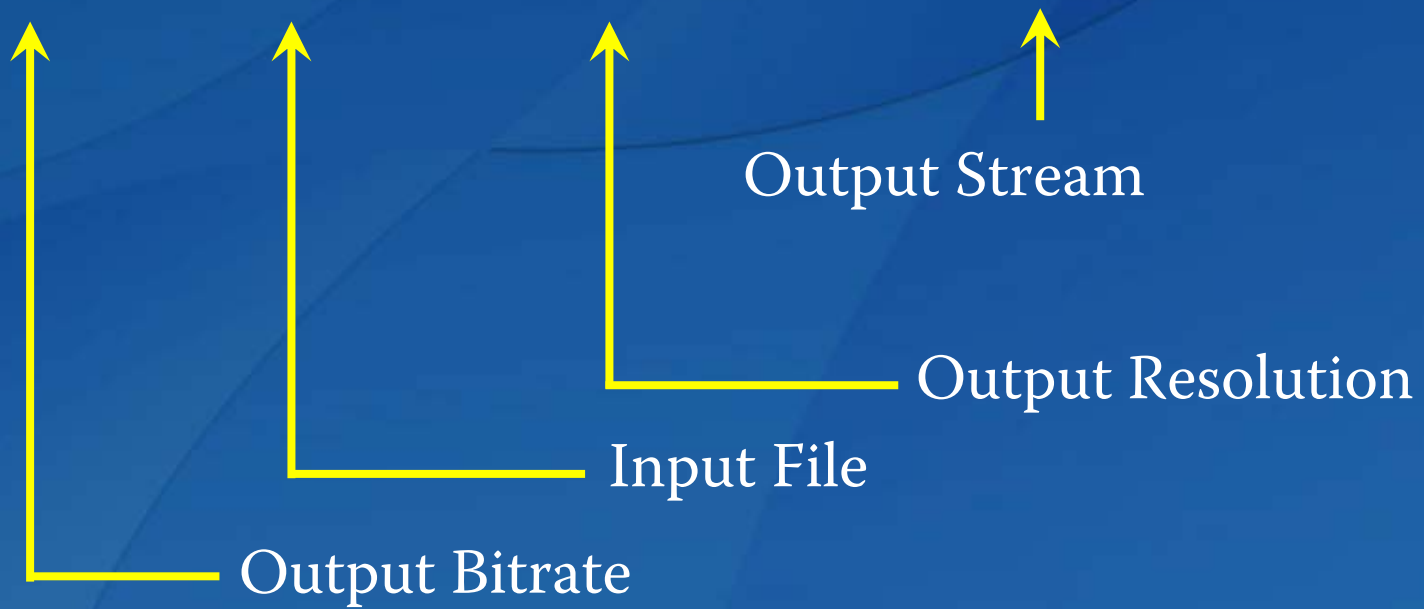
```
$ jpeg2yuv -v 0 -f 5 -I p -j /jpegs/%d.jpg > bc.yuv
```



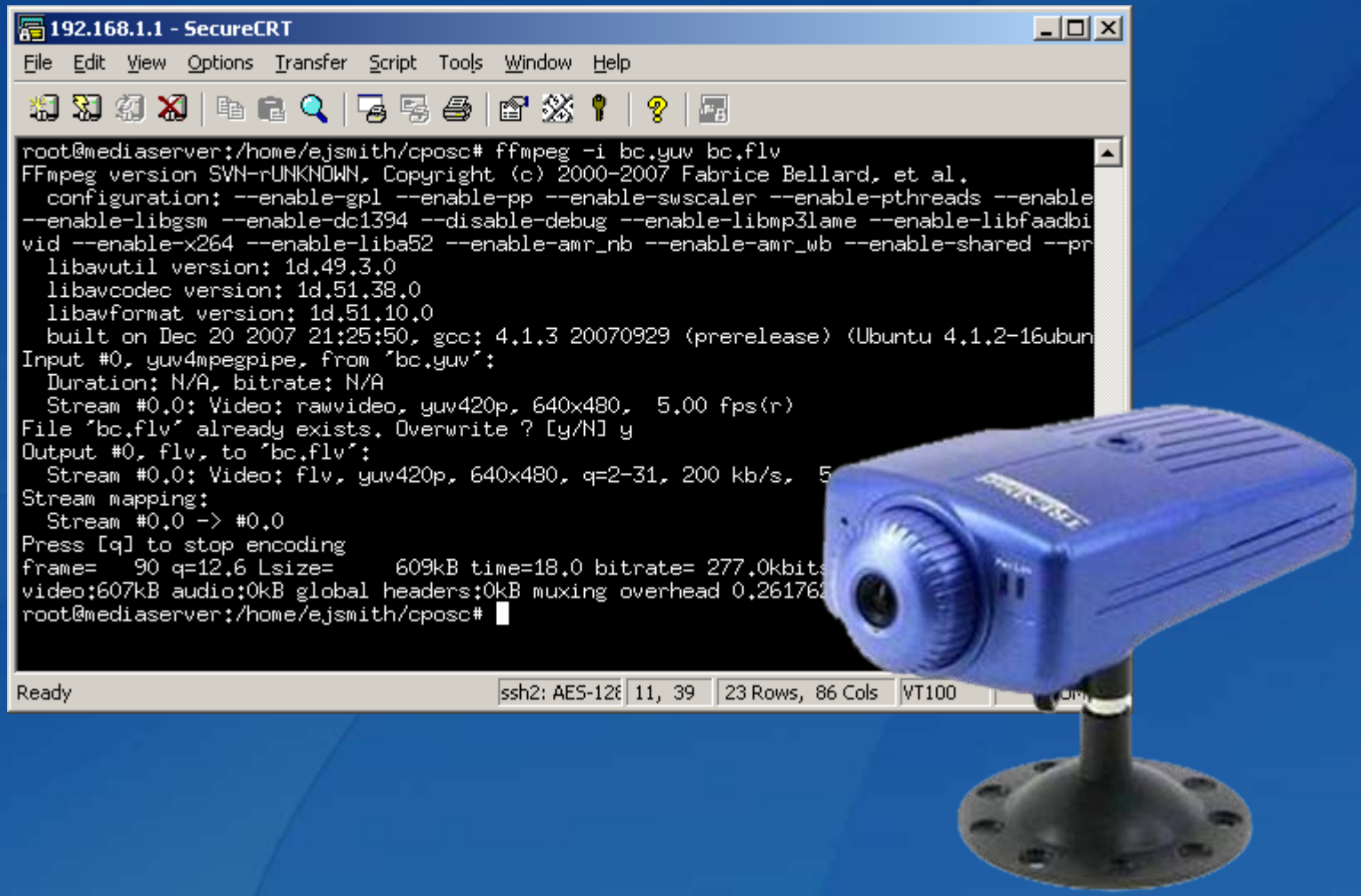
FFMPEG: Video Encoder/Decoder/Transcoder

Ubuntu Install: `# apt-get install ffmpeg`

```
$ffmpeg -b 700k -i bc.yuv -s 320x240 bc.flv
```



JPEG to FLV Demo



Agenda

Monitoring the Beeyard

Protecting the Hives

Expanding the Colonies

The Bear:Honeybee relationship that most people understand.

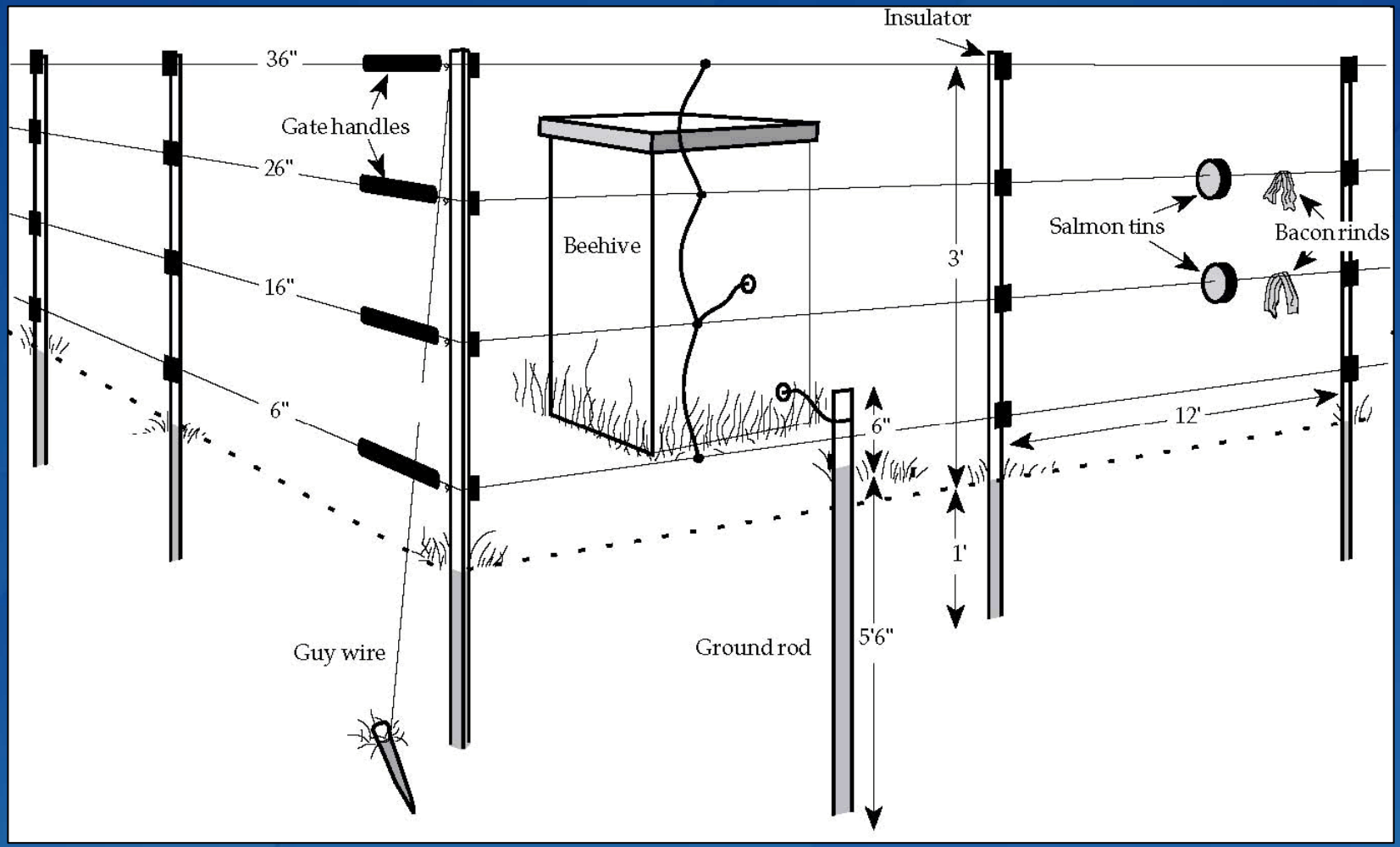
The Beekeeper's perspective

Beekeepers and Bears: Sugar Maple Apiaries, November 2007

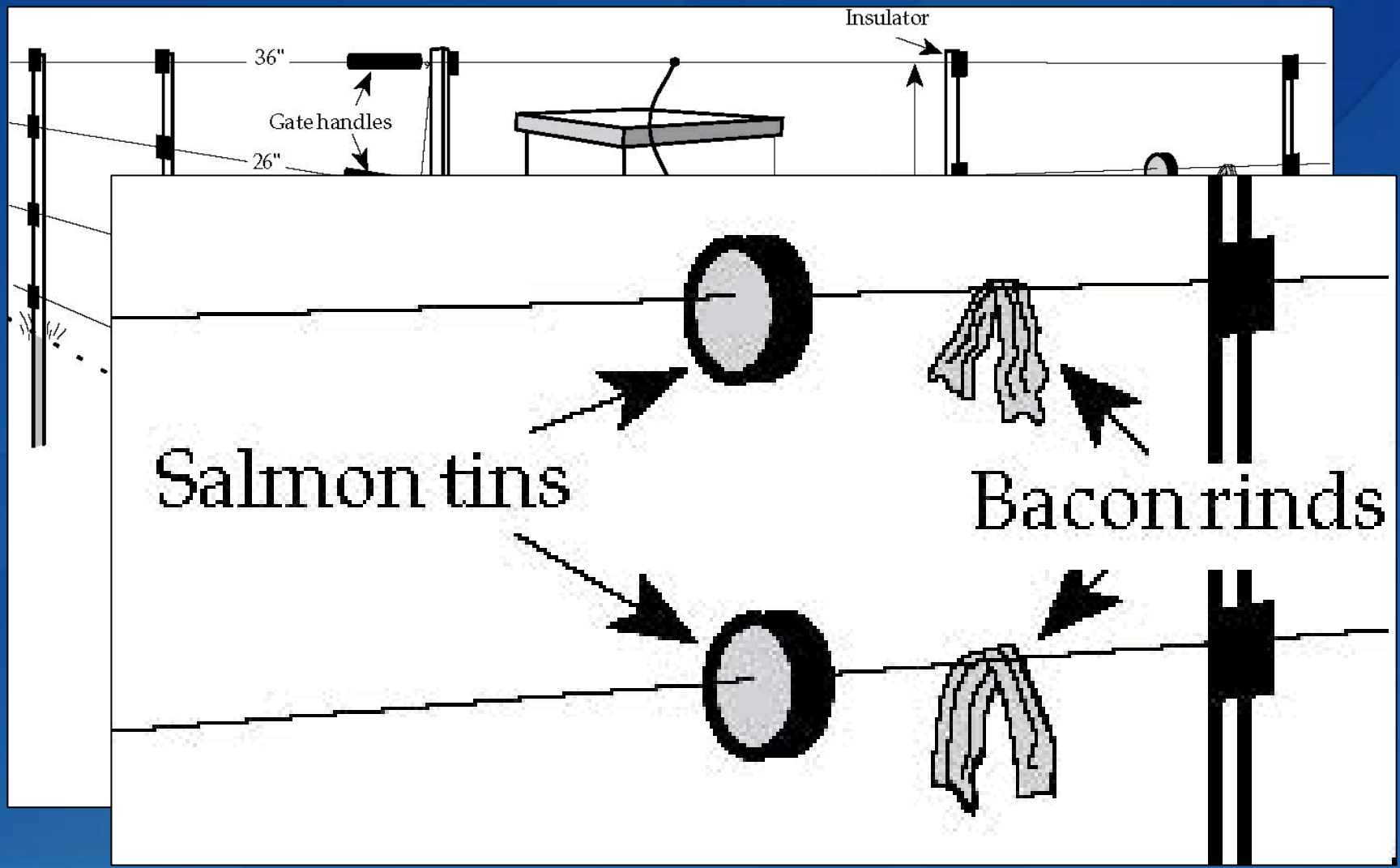
More bear damage photos (Courtesy PSU)

http://www.ento.psu.edu/imagegallery/HBbears-1.htm

The solution: Electric Bear Fence



The solution: Electric Bear Fence




ELECTRIC FENCE
Agway
CONTROLLER
MODEL A-20
Agway, Inc., Syracuse, New York

Apiary/Beekeeper Registration

Purpose
The bee law authorizes the bee inspection and registration program which is designed to protect bees, a resource vital to agriculture. The inspection and registration program is not concerned with the sale of honey, but is conducted as a service to the beekeeping industry. Honey purity is regulated by the Bureau of Food Safety.

- **Inspection for Disease**
  Bee inspectors are employed throughou
  for brood diseases and parasitic mites.
  recommend a treatment procedure. If t
  require that the colony be destroyed. It
  knowingly keep, without proper treatment, any colony of diseased bees or to expose any diseased equipment to flying bees. It is also a violation of the law to sell, receive, or transport any diseased bees.

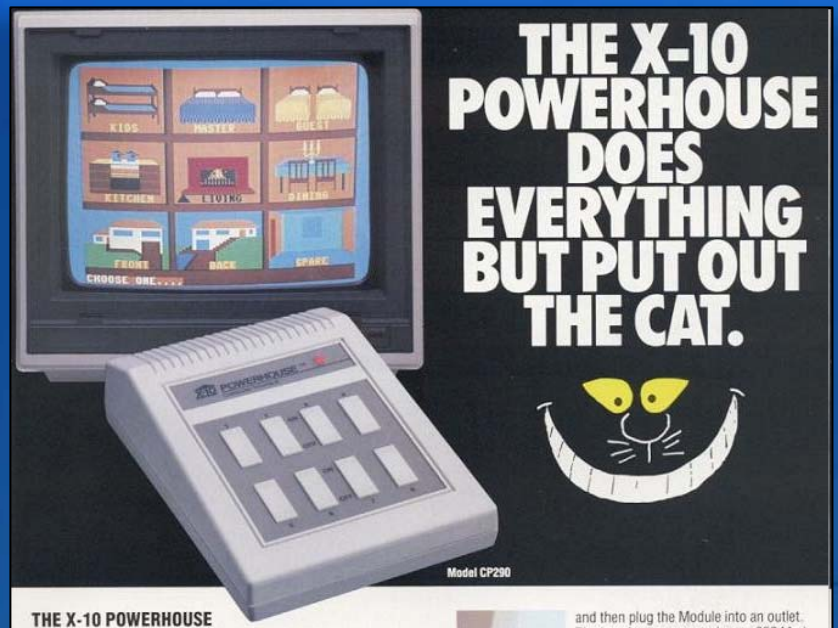
  Bees must be kept in modern type hives with removable frames so combs may be inspected for disease.

- **Requirements to Import Bees**
  Bees transported into Pennsylvania must be accompanied by a certificate of inspection from the state of origin stating that the bees were inspected within 30 days of shipment date and that the bees are disease free.

- **Fines for Violations**
  The fine for a first violation of the act is $100, second violation is $300, third and subsequ
  violations is $1,000.

..bee inspectors… inspect all apiaries for disease and parasitic mites…

pennsylvania
DEPARTMENT OF AGRICULTURE



THE X-10 POWERHOUSE DOES EVERYTHING BUT PUT OUT THE CAT.

THE X-10 POWERHOUSE INTERFACES WITH YOUR COMMODORE TO CONTROL YOUR HOME...FOR SECURITY, COMFORT AND ENERGY SAVINGS.

This remarkable Interface lets you run your home through your Commodore 64 or 128 and a keyboard or joystick.

When you're away, it makes your home look and sound lived in. When you're home, it can turn off the TV at night and wake you up to stereo and fresh brewed coffee in the morning. It can even turn on your air conditioner and control your heating.

SPECIAL COLOR GRAPHICS MAKE PROGRAMMING A SNAP. You simply pick a room from the display screen. Use your keyboard or joystick to position graphics of lights or appliances. Then follow on-screen instructions to program any light or appliance to go on or off whenever you choose. You can even control thermostats, light intensity and more.

THE WAY IT WORKS. The X-10 Powerhouse Interface is cable-connected to the Commodore "User" port and plugged into a standard 110V outlet. After it is programmed, the Interface sends digitally encoded signals through your home wiring to special X-10 Modules. To control a lamp or appliance, you simply plug the electrical device into a Module and then plug the Module into an outlet. The Interface can control up to 256 Modules throughout your home and won't interfere with normal use of lights and appliances.

There are plug-in Appliance Modules, Lamp Modules, Wall Switch Replacement Modules and Special 220V Modules for heavy duty appliances such as water heaters and room air conditioners. Plus Thermostat Controllers for central heating and air conditioning, Telephone Responders to control your home from any phone, and much more.

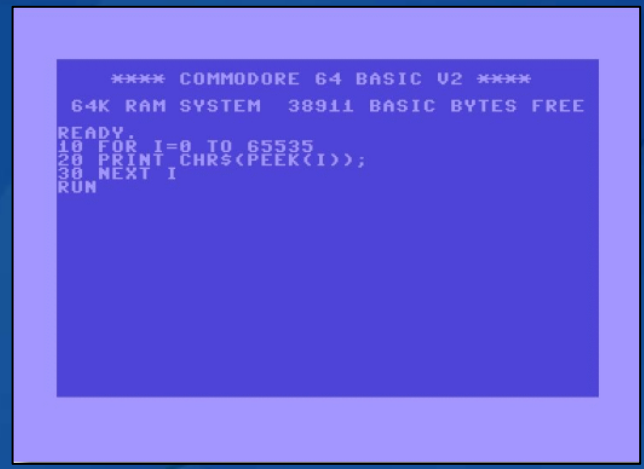
IT WON'T TIE UP YOUR COMPUT
for programming. When you're f
face from the "User" or RS-232 p
any convenient power outlet in y
stand-alone controller with batter
home automatically.

SURPRISINGLY INEXPENSIVE. A
ing the Interface, software and c
than $150. X-10 Modules are less

For the Dealer Nearest You Call: 1-
or, write to: X-10 (USA)
185A Legrand Aven
Northvale, NJ 0764
www.comm

X-10 POWERHO
NUMBER ONE IN HOME CO

Commodore 64 and Commodore 128 are registered



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Fast Forward 20 years: Heyu – Linux driver for CM11A

http://heyu.tanj.com/

```
[root@sma heyu-2.3.2]# ./Configure

This script will create a Makefile based by default on
the output of uname(1), or otherwise on the system type
parameter you enter.

The Makefile has been created for linux.

Note: If you are upgrading from an earlier version,
run 'heyu stop' before proceeding further.

** Now run 'make' as a normal user **
```

Fast Forward 20 years: Heyu – Linux driver for CM11A

http://heyu.tanj.com/

```
# make
gcc -g -O -DSYSV -DPOSIX -DHAS_ITIMER -DLINUX -DHASSELECT -DHASTZ
-DHASCM17A -DHASEXT0 -DHASRFXS -DHASRFXM -DHASDMX -DHASORE -Wall
-c -o info.o info.c
gcc -g -O -DSYSV -DPOSIX -DHAS_ITIMER -DLINUX -DHASSELECT -DHASTZ
-DHASCM17A -DHASEXT0 -DHASRFXS –DH
                                                    …snip…
ASRFXM -DHASDMX -DHASORE -Wall   -c -o oregon.o oregon.c
gcc  -o heyu date.o erase.o info.o message.o relay.o monitor.o
reset.o setclock.o stop.o tty.o x10.o xread.o xwrite.o status.o
cm11a.o eeprom.o process.o sun.o cmd.o config.o x10state.o
poll.o modules.o cm17a.o xsync.o timing.o cm10a.o tty_aux.o
relay_aux.o x10aux.o rfxcom.o digimax.o oregon.o -lm -lc

** Now become root and run 'make install' **

# make install
```

Heyu bare minimum configuration file

```
TTY              /dev/ttyS0

ALIAS   electric_fence          A8      StdAM
ALIAS   queen_incubator         A9      StdLM
```

StdLM: Lamp Module
On/Off/Bright/Dim

StdAM: Appliance Module
On/Off via mechanical relay

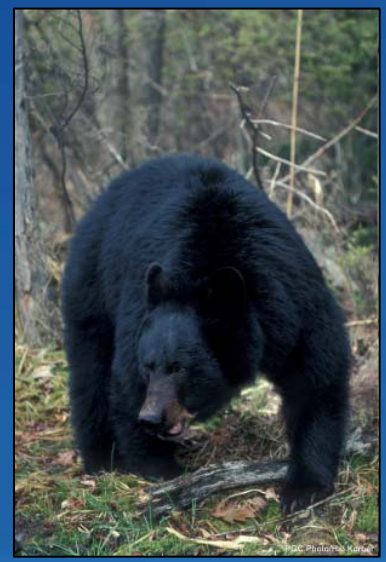
Using Heyu

Appliance Modules:

```
[root@sma ~]# heyu -c /etc/x10.cfg on A8
[root@sma ~]# heyu -c /etc/x10.cfg off A8
```

Lamp Modules:

```
[root@sma ~]# heyu -c /etc/x10.cfg bright A9 1
[root@sma ~]# heyu -c /etc/x10.cfg dim A9 1
```



The Linux-Powered Electric Bear Fence

/dev/ttyS0

CM11A

Linux Box

X10 Appliance Module

Fencer Charger

Sad Bear

Putting it all together:
Cell Control of the Electric Fence

Agenda

Monitoring the Beeyard

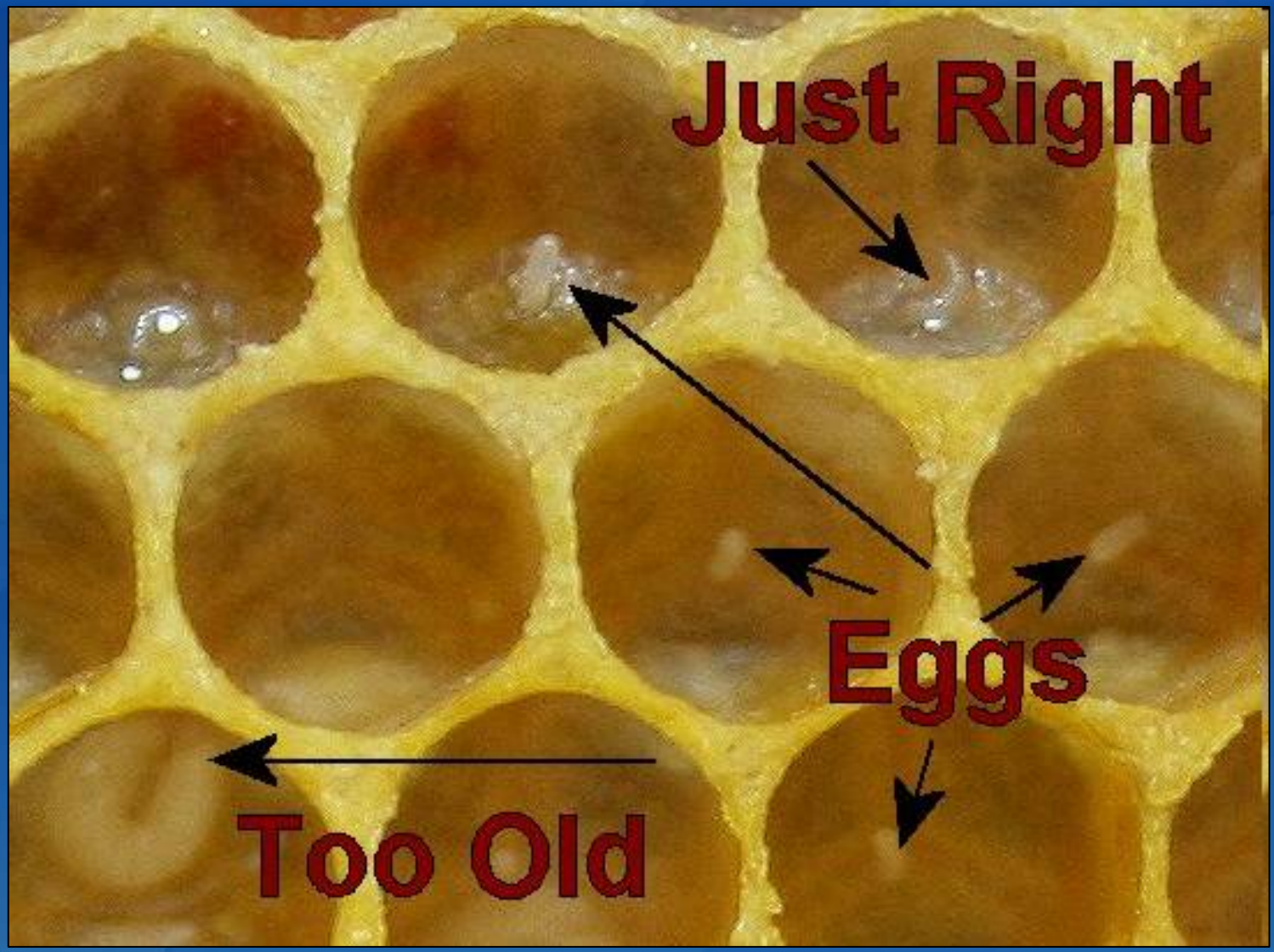
Protecting the Hives

Expanding the Colonies

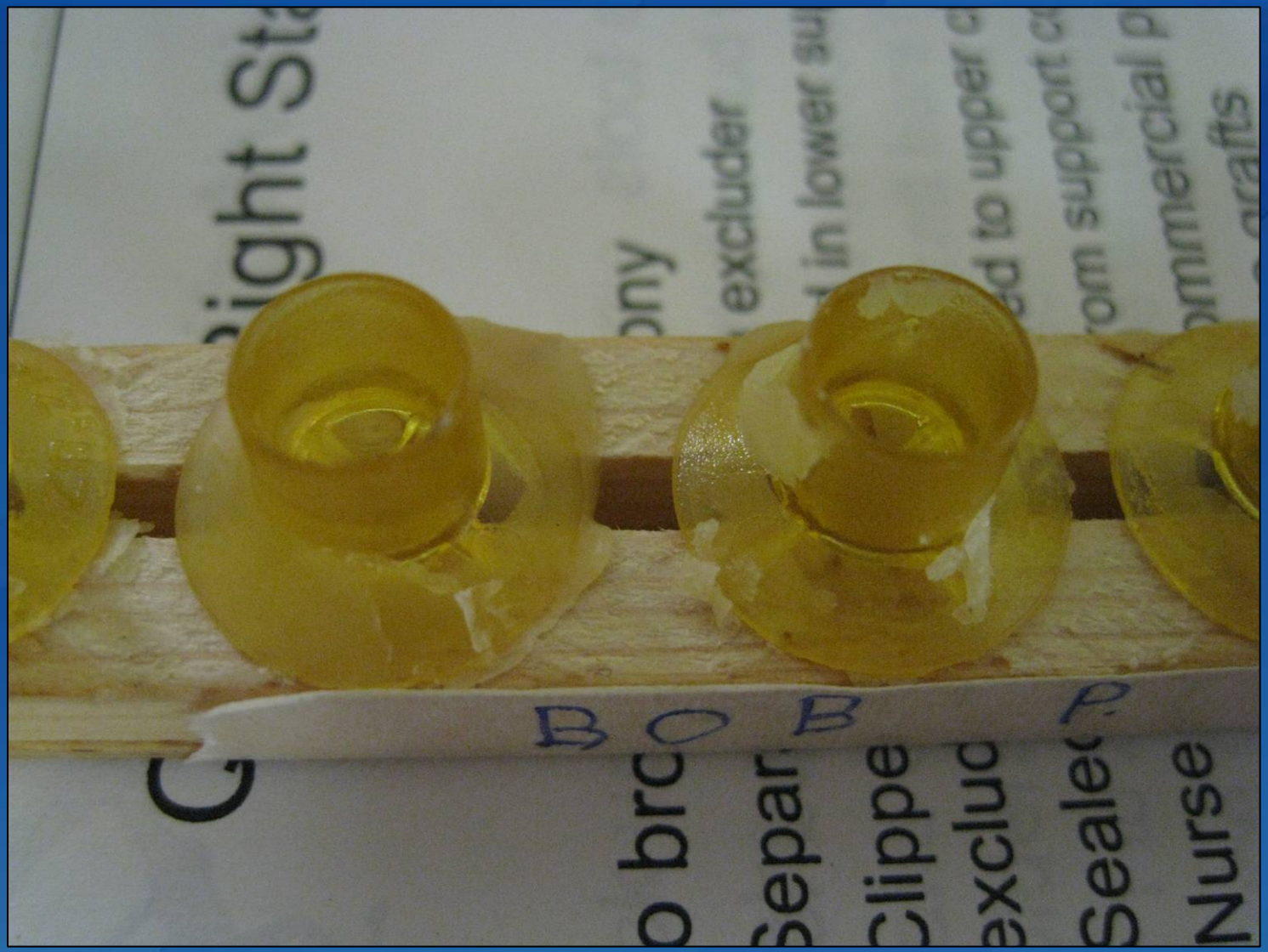
Raising Queen Honeybees

Obtain freshly-hatched honeybee larvae

Locate larvae of the proper age



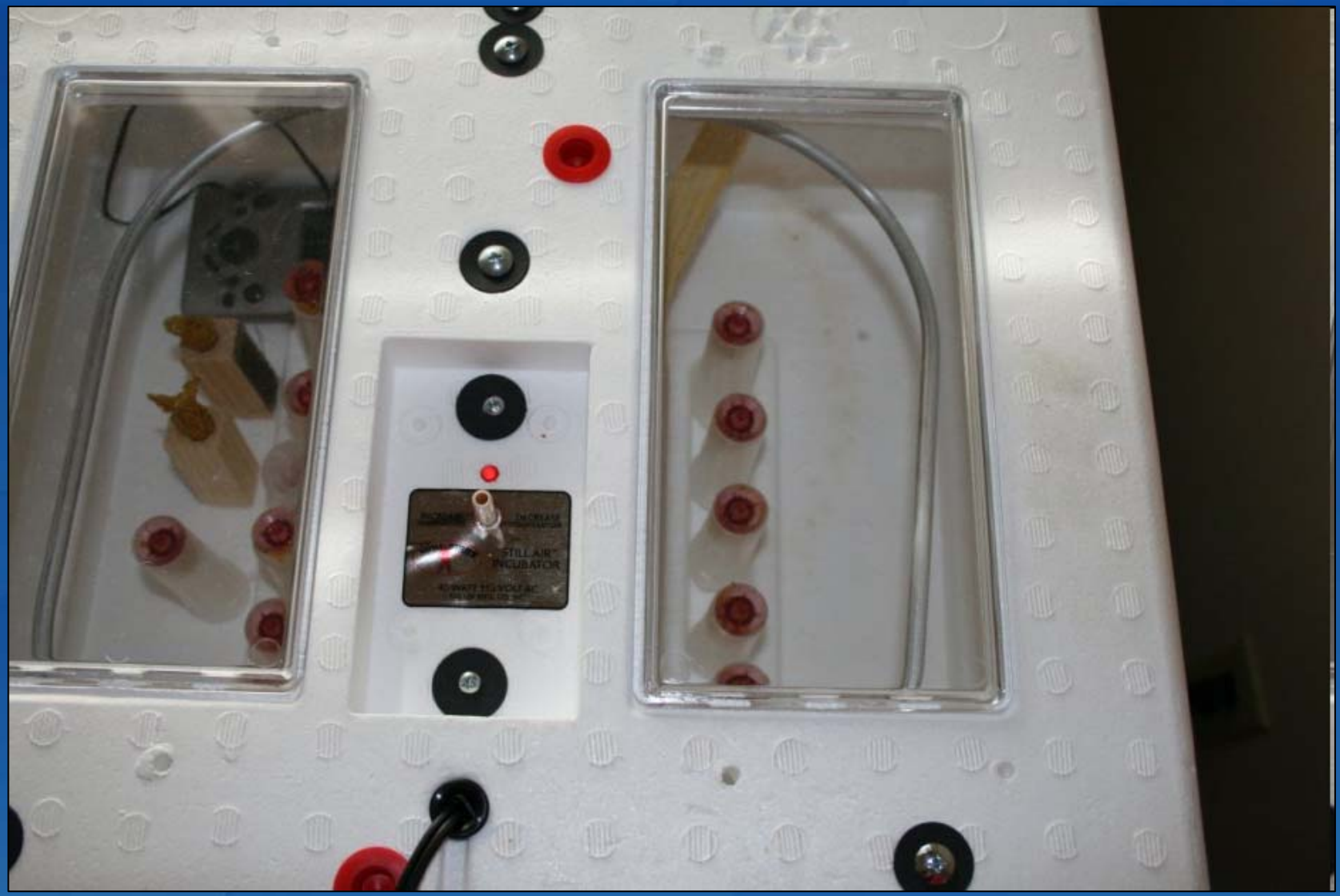
Remove the larvae and place them into plastic cell cups



Place the cell cups into a starter colony

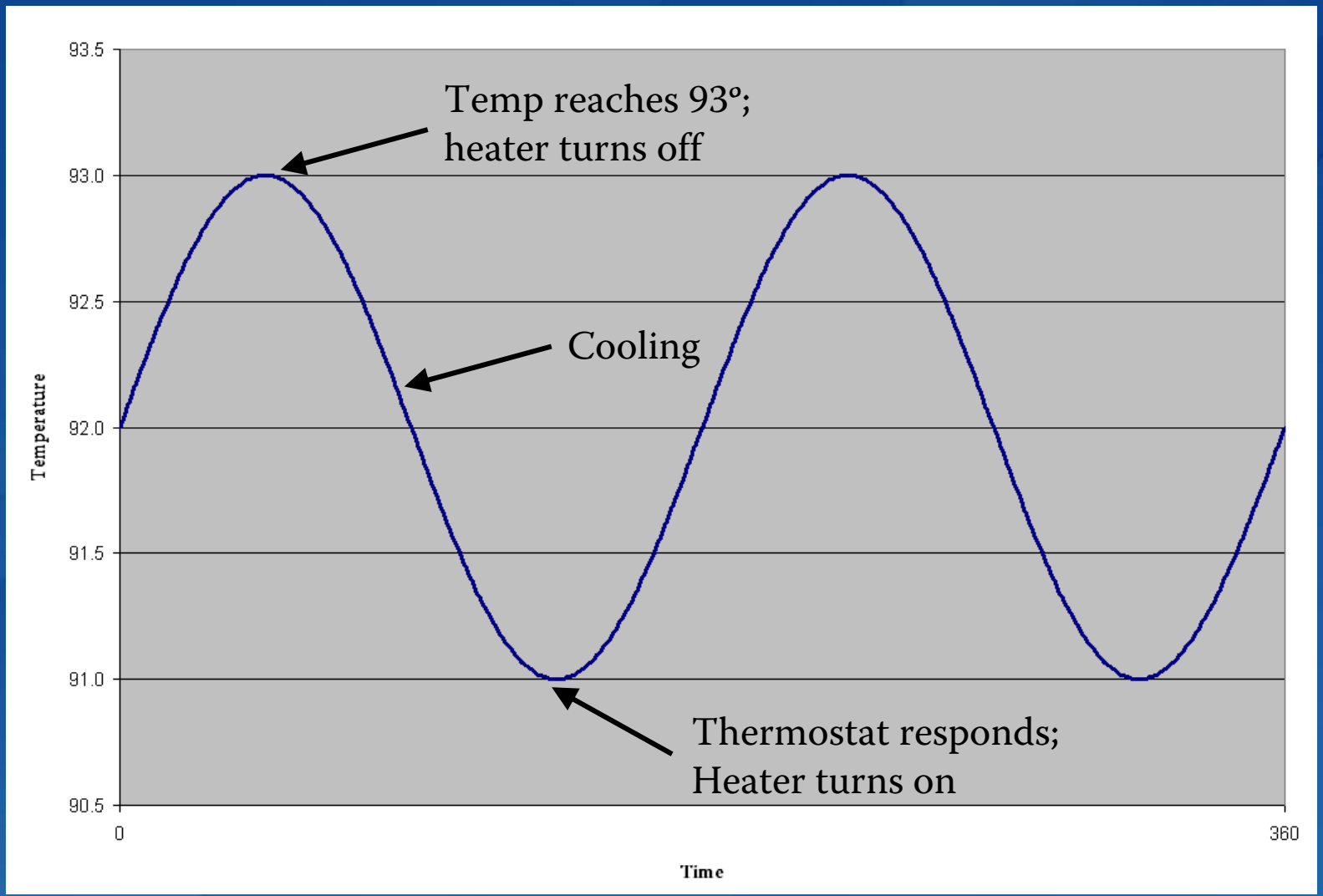
After a few days, the bees will feed the larvae and build cells

The cells are then removed and allowed to hatch in an incubator.



Newly-hatched queens are placed in a small mating colony.

Mechanical Thermostat Woes: What really happens at 93°



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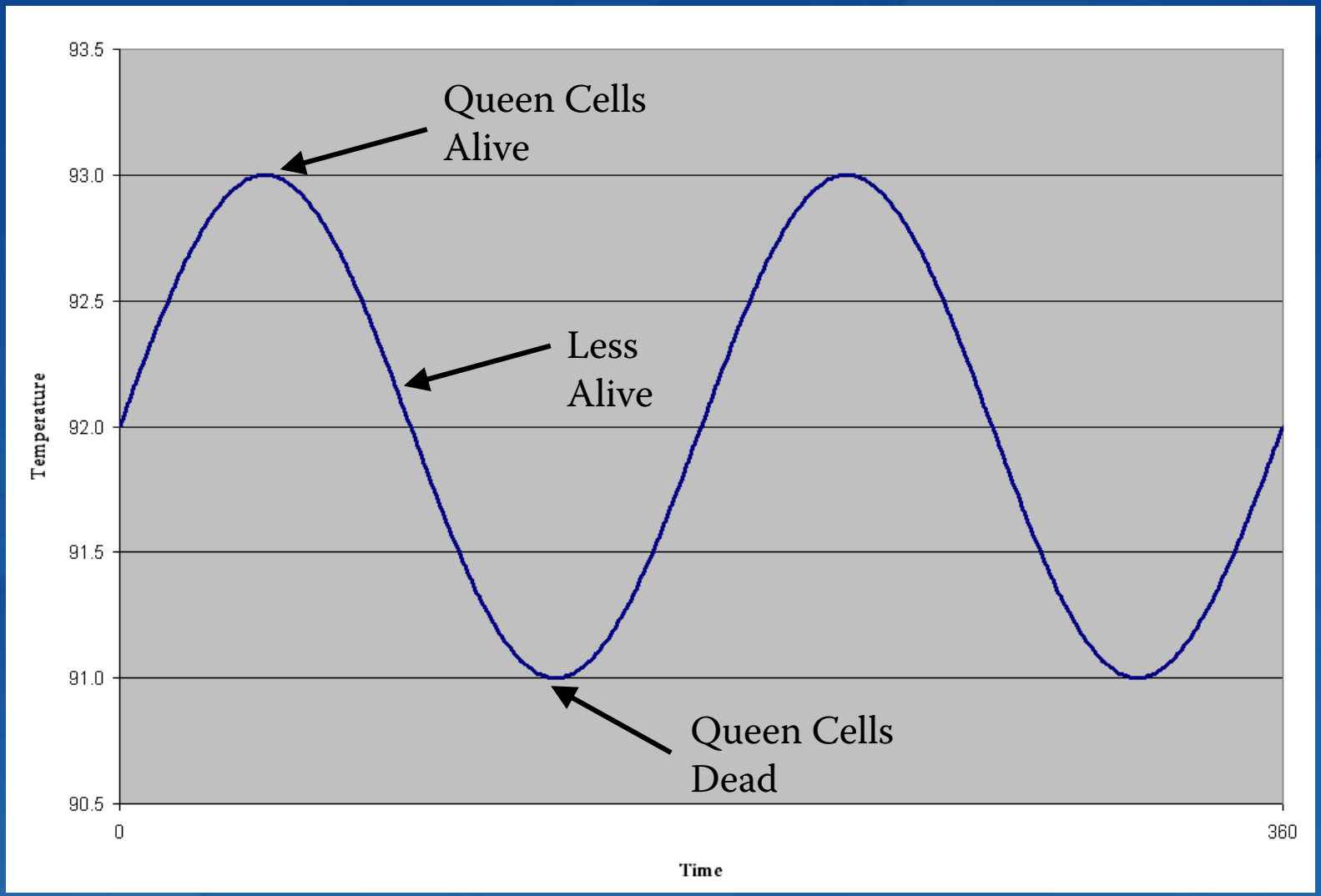
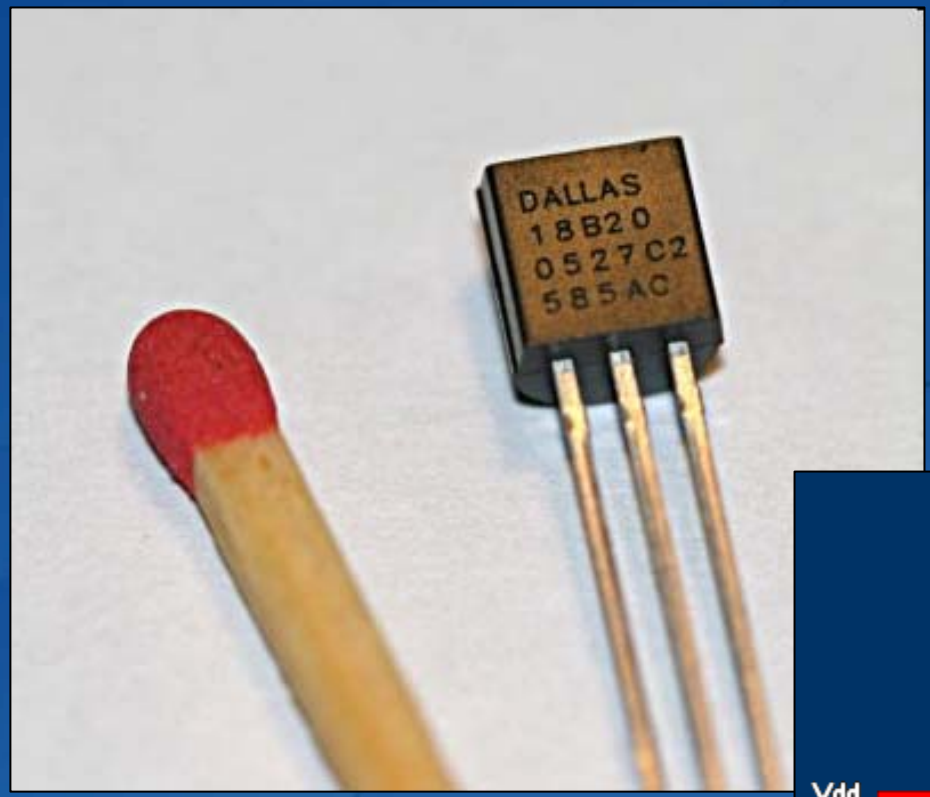
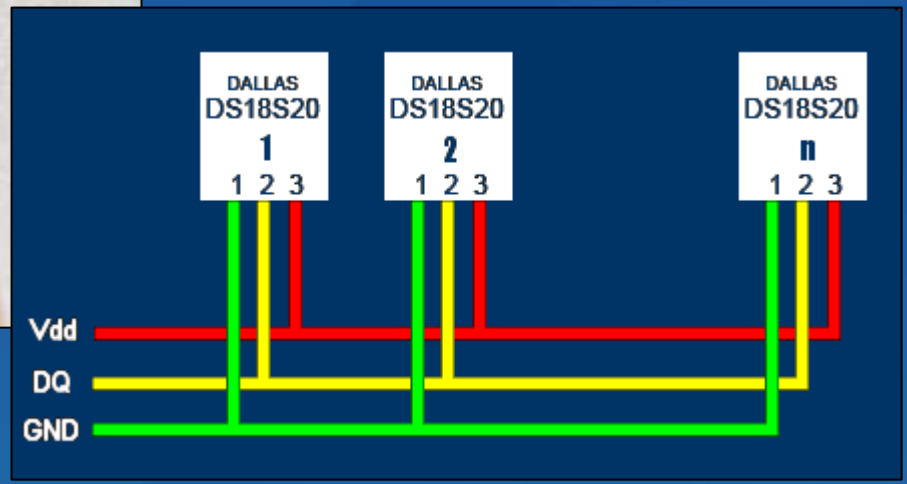


Digitemp One-Wire Temperature Sensors

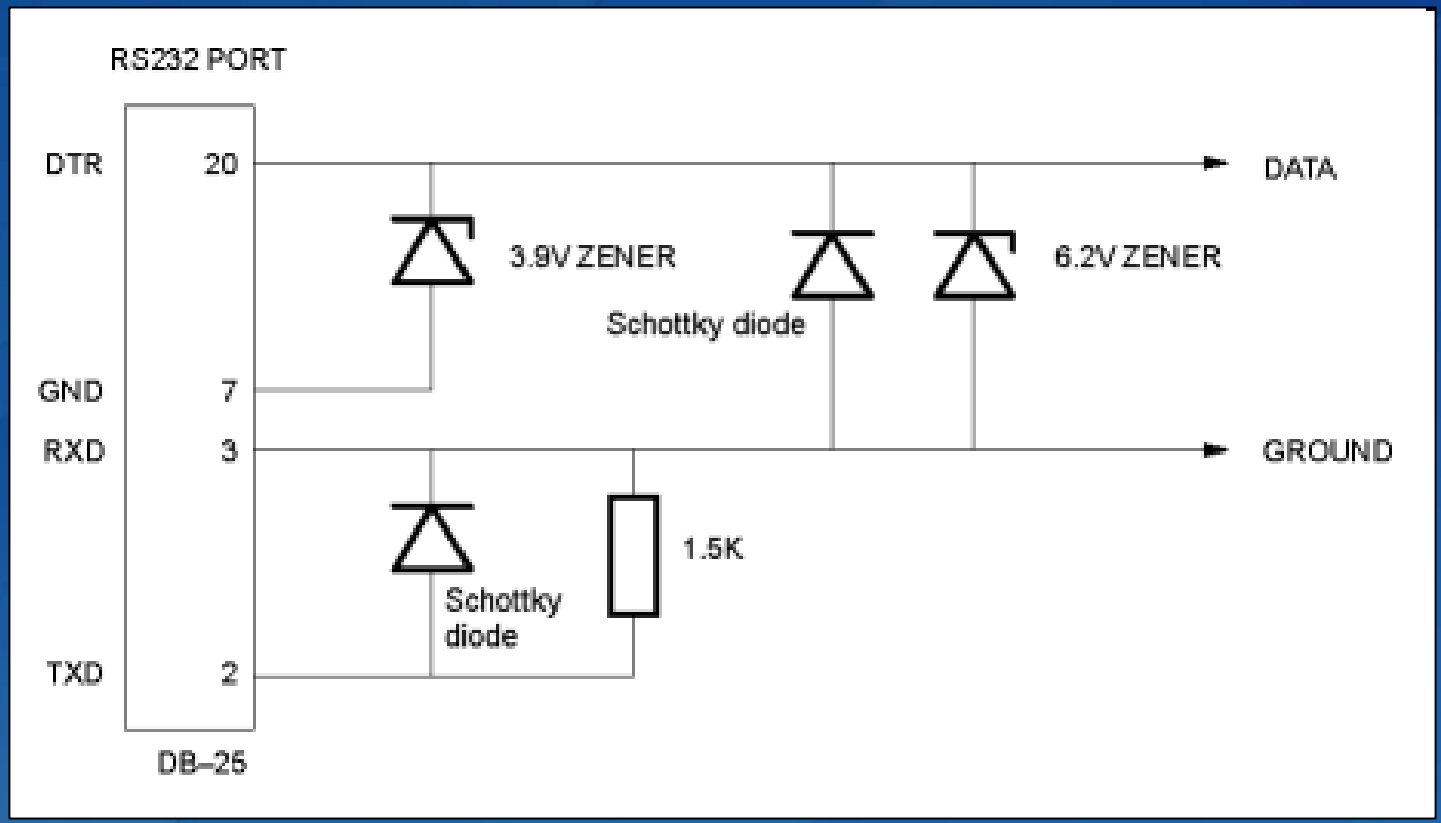
Software: http://www.digitemp.com/ (plus many others)





RS232 to One-Wire Passive Interface: 4 diodes and a resistor

http://public.rz.fh-wolfenbuettel.de/~hamannm/general/digitemp.html



Installing and using Digitemp

1) Compile

```
# make ds9097
# make install
```

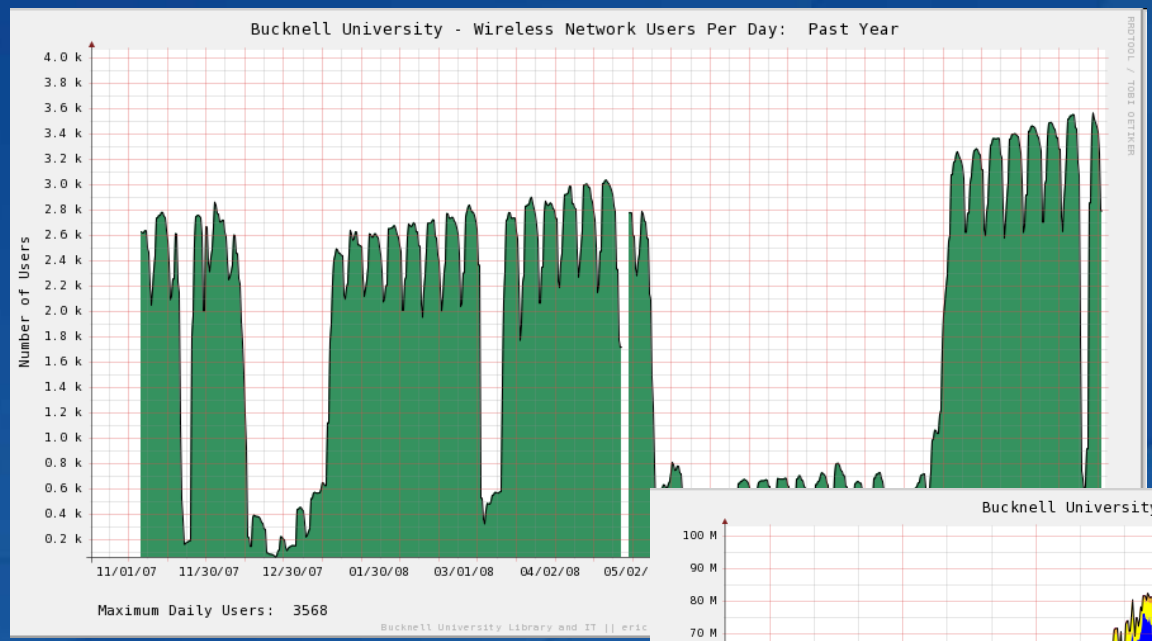
2) Initialize the configuration file

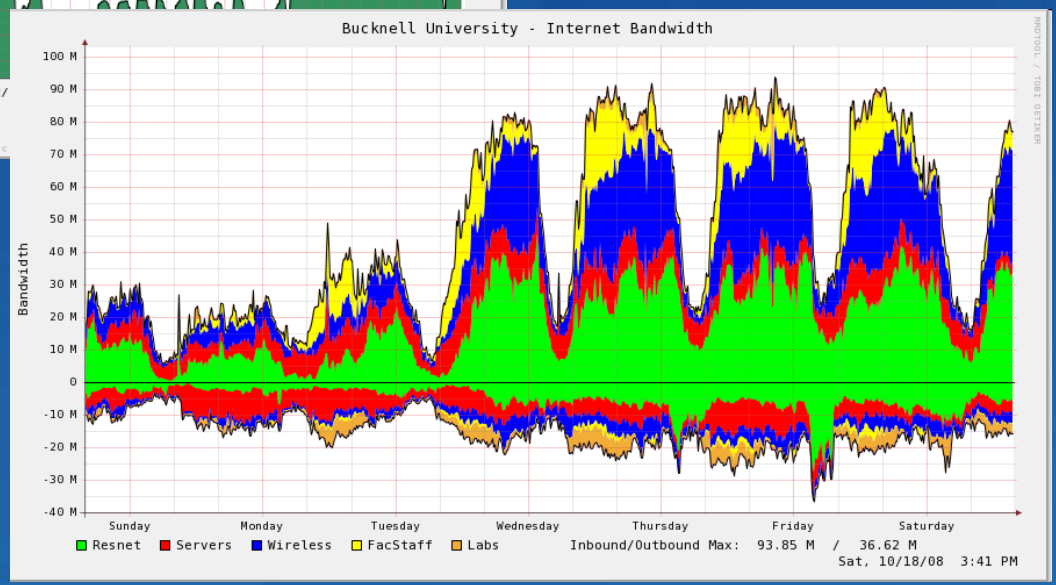
```
# digitemp –s /dev/ttyS0 –a
```

3) Read the temperatures

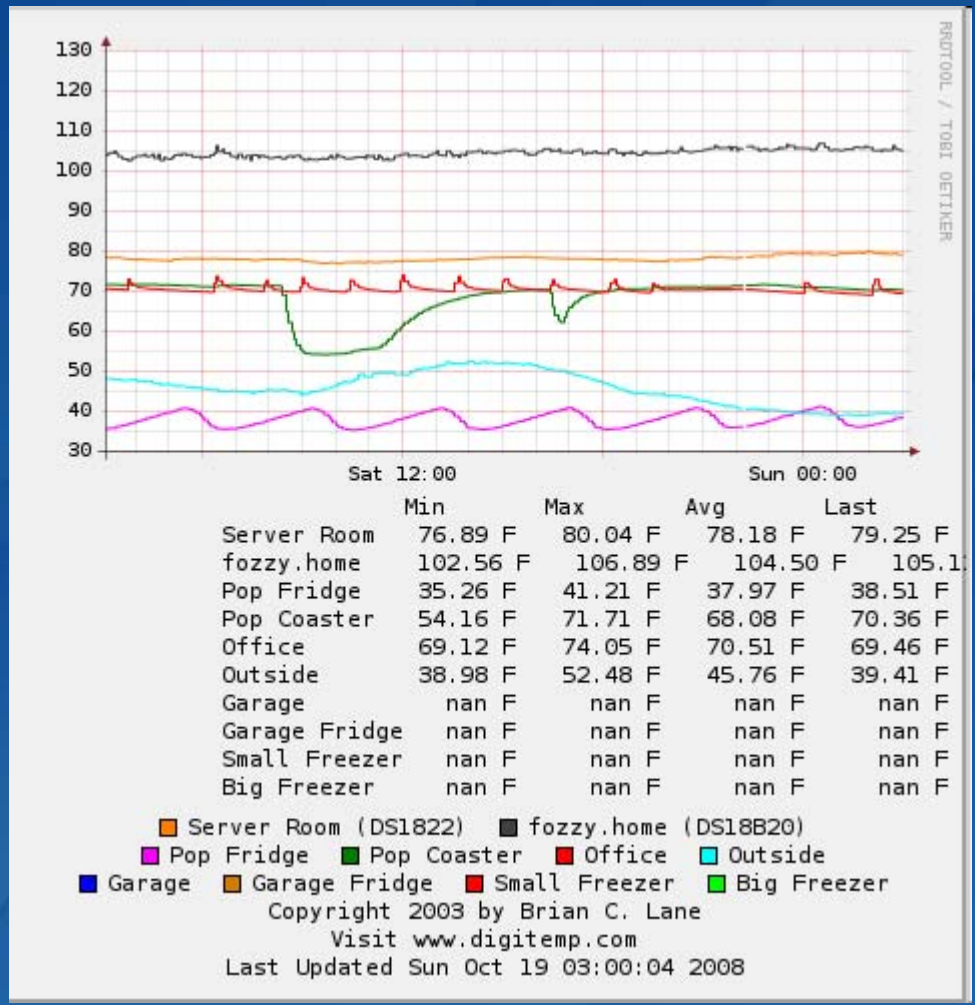
```
# digitemp -a
```

Storing the data: RRDTool: http://oss.oetiker.ch/rrdtool/





Digitemp and RRDTool: Demo



The Linux-Powered Honeybee Incubator

Lamp Module

/dev/ttyS1

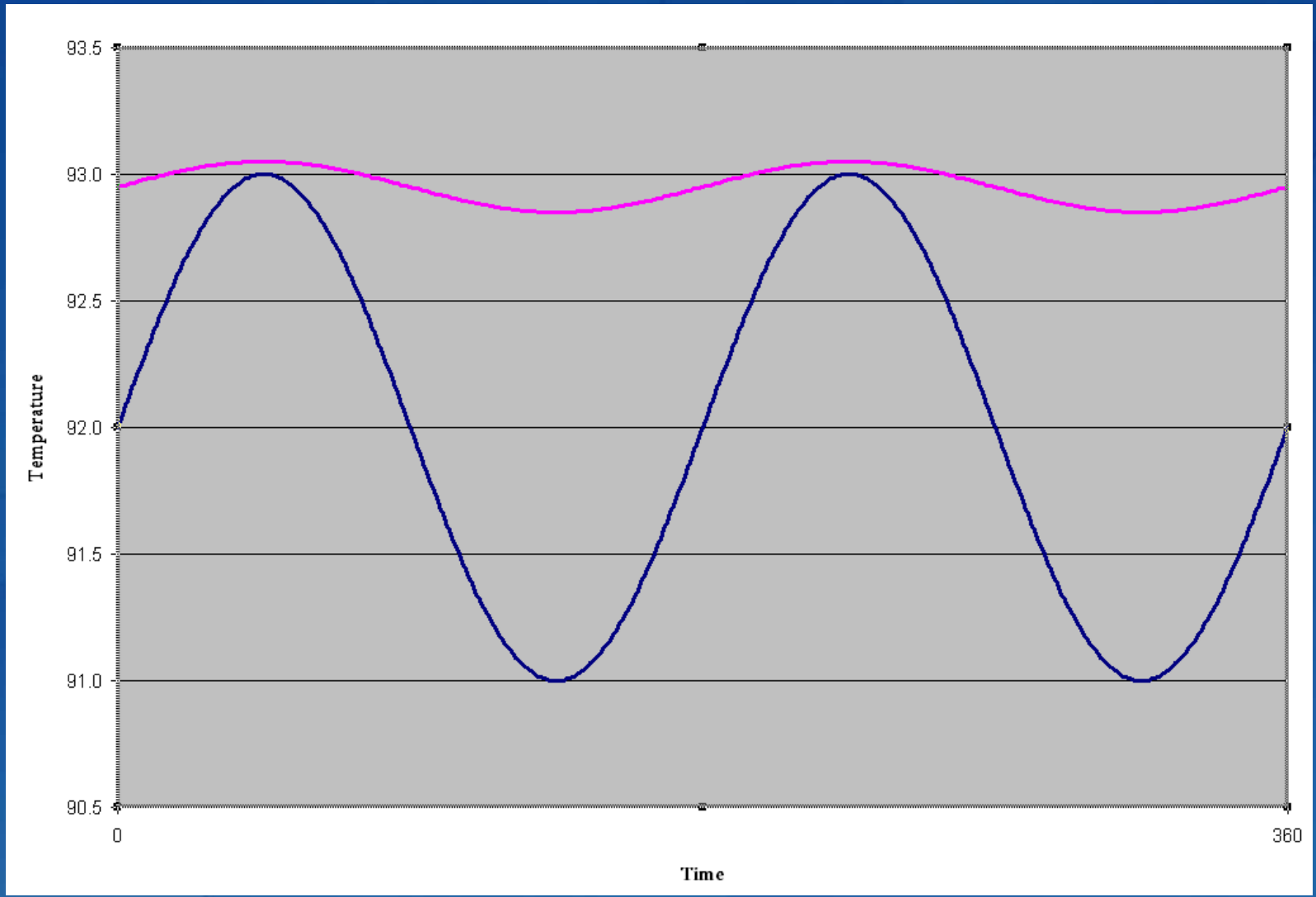
Linux Box

/dev/ttyS0

CM11A

AC Power

Raising Queen Honeybees some equipment photos



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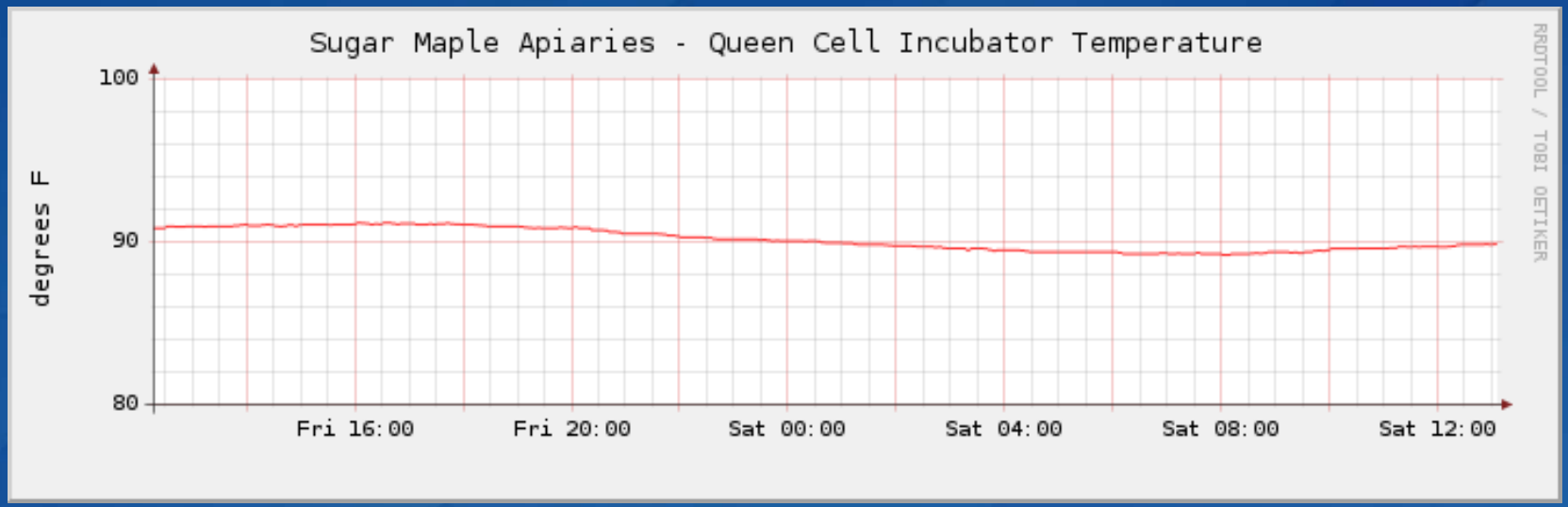
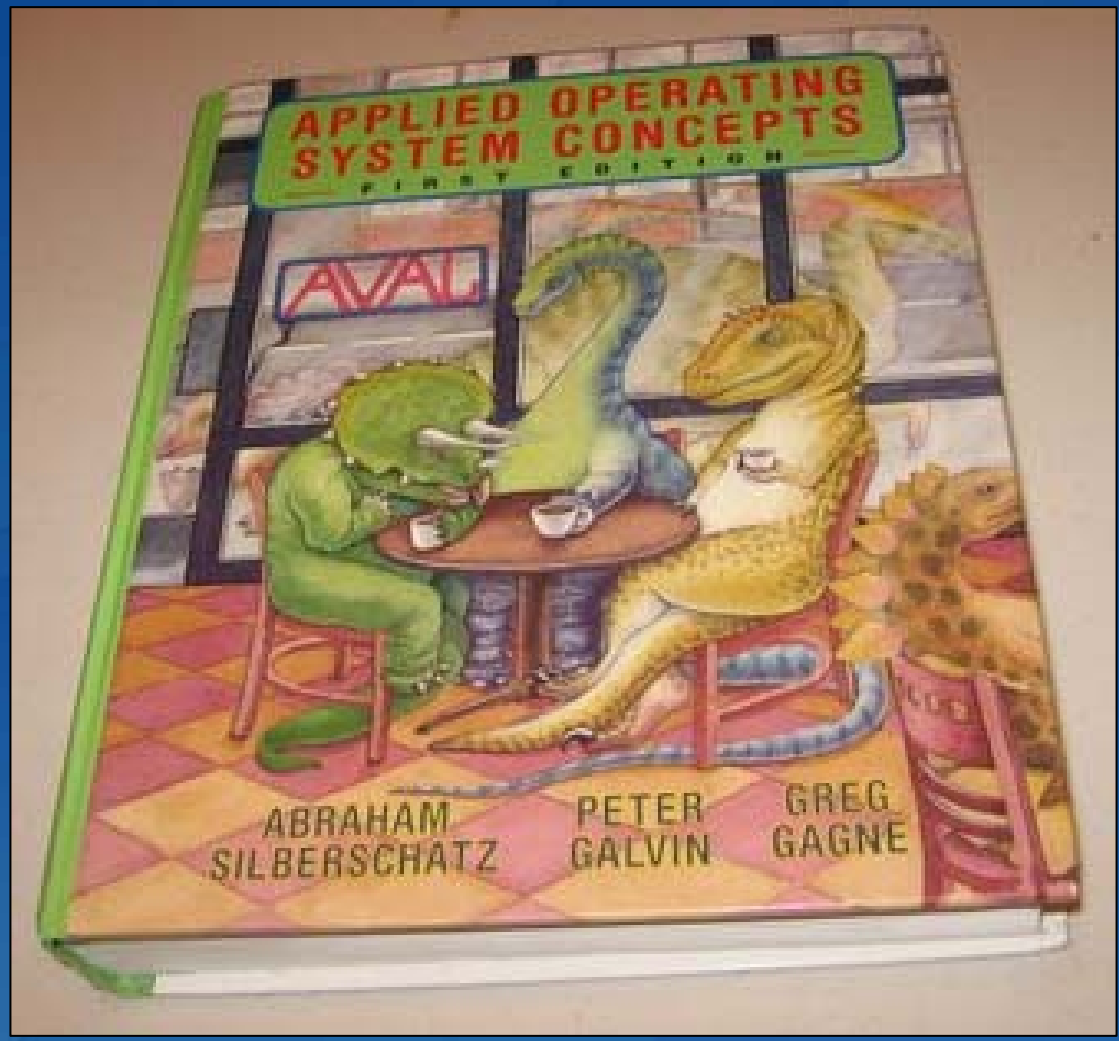


You don’t even need a server..



You don't even need a server...

You don't even need a server...

OpenWRT Linux on Linksys WRT54G{L or v.4}

FFMpeg
- RRDTool
- Digitemp / OWFS
- Apache/PHP/Perl
- Sendmail, SSHD
- Kitchen Sink

Hardware:
- RS232, Wifi, RJ45
- 200MHz, 16M, 4M Flash

Thank you for your attention!

Any Questions?

Slides available at www.pskl.us