Is that a LAMP in your Pocket?

Hacking the NSLU2

Boulder Linux Users Group
BLUG
Jim Buzbee
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Background

or just who is this Jim Buzbee?

- I Live in the Denver area, working as a Software Engineer for a major Aerospace company
- Writer/Reviewer specializing in Linux NAS boxes and network multimedia devices
  - Tom's Hardware family of web sites
  - SmallNetBuilder
- Lurker on the BLUG mailing list since 1999
- Running Linux continuously since 1992
- Author of the "BatBox" wrt54g distribution

Jim@Buzbee.net

Lamp

Nightlight

Uses about 7 watts
costing roughly $7 a year

Jim Buzbee

Jim@Buzbee.net

LAMP

Linux, Apache, MySql, PHP

Uses about 4 watts
costing roughly $4 a year

Jim Buzbee

Jim@Buzbee.net

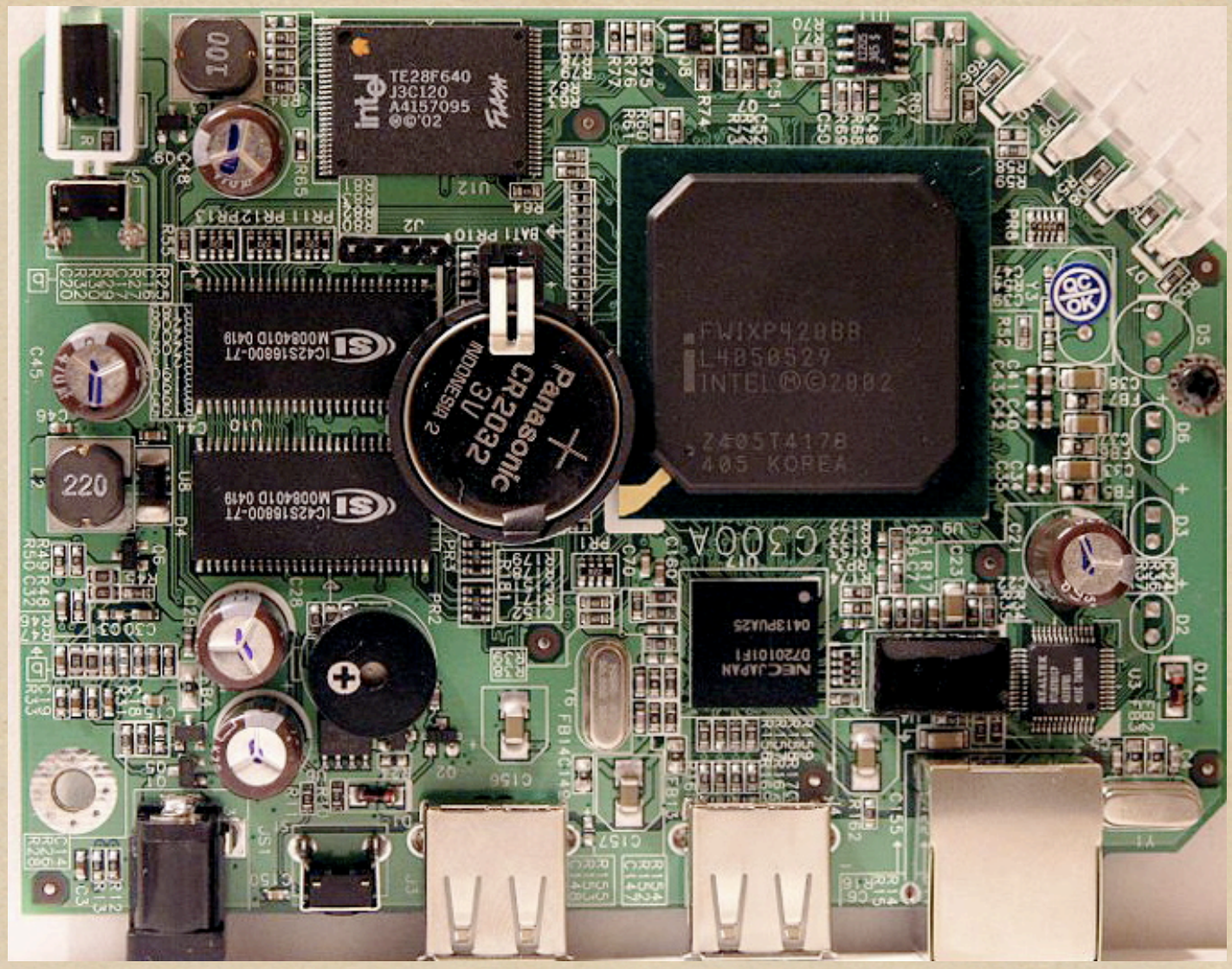
NSLU2 Specs

just what's in that little box?

- 266 MHz ARM Intel XScale IXP420
  - Under-clocked to 133 MHz
- 32 MB RAM
- 8 MB Flash
- Dual USB 2.0 ports
- 100 Mbit Ethernet
- 2.4.22.x Linux kernel with custom distribution
  - Web-based interface for configuration
  - Samba for file serving
  - ext3 and NTFS (read/write) support

Jim Buzbee

Jim@Buzbee.net



NSLU2 Main Board

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NSLU2 History

The Early Days

- Released by Linksys
  - June 15, 2004
- I "Got root"
  - July 11, 2004
- Development community formed
  - July 31, 2004
- My first "Hacking the NSLU2" article
  - August 3, 2004
- I get "Slashdotted"
  - August 18, 2004

http://hardware.slashdot.org/article.pl?sid=04/08/18/031228

Jim Buzbee

Jim@Buzbee.net

Why is the NSLU2 so Popular?

Just what is it about the NSLU2, and why would I want one?

- Widely available embedded Linux box
  - Many big-box stores have carried it
- Relatively inexpensive
  - Can be found online in the $50 neighborhood
- Tiny, silent, little power usage
  - No fan, no heat, 4 Watts
- Powerful enough for many tasks
  - Music, photos, files, printing, sensors, etc., etc.
- Hard to really "brick" when hacking

Jim Buzbee

Jim@Buzbee.net

State of the Hack

Where are we now, in 2008?

- Large development community
  - http://www.nslu2-linux.org/
    - Driving force: Rod Whitby
  - 9000+ members on the general mailing list
- 7-8 custom distributions available
  - Everything from bare-bones to full Debian
  - ARM now third most popular Debian architecture
- Nicknamed the "Slug"

Jim@Buzbee.net

Digging in

It's a Linux box already, but we just can't leave well enough alone can we?

- Boot sequence as delivered from Linksys
  - Starts from Flash
  - Small boot-loader
    - Redboot
  - Kernel, configuration, and root image
    - Loaded into RAM disk
  - Can run without drive attached

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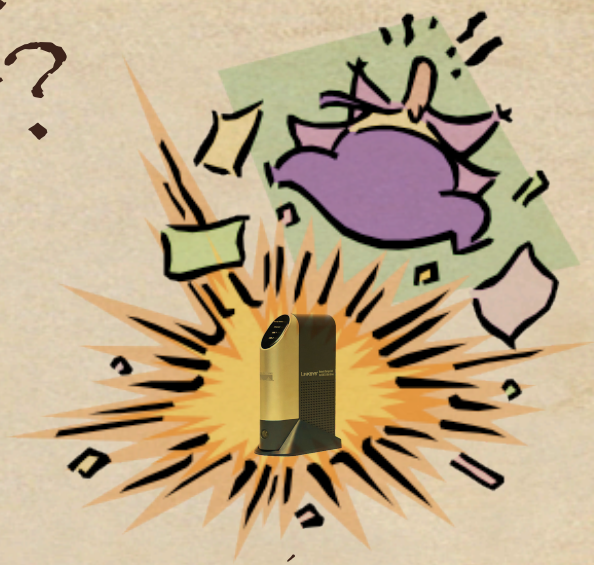
Hack it yourself?



If you really want to get your hands dirty

- Build your own firmware?
  - are you nuts?
- Pre-built firmware images for the Slug are easier
  - and more extendible
- But it can be fun and instructional to do it yourself
  - and it's not as hard as you might think
- You can always go back
  - or install a pre-hacked firmware

Basic firmware recipe

just like Mom used to burn

- Unpack a standard firmware image from Linksys
- See "Slugimage" (splitnslu) command
- Loop-back mount the RAM disk file
- Modify
  - startup scripts, cross-compiled executables, etc.
- Unmount
- Re-pack
- Burn using standard Linksys upgrade method
- My article on building a flash:
  http://www.tomsguide.com/us/how-to-nslu2-hack-pt4,review-312.html

Jim@Buzbee.net

But what If I trash it?

Anyone need a brick?

- You can easily recover from a bad flash
  - See the defined procedure
    - http://www.nslu2-linux.org/wiki/HowTo/RecoverFromABadFlash
  - Intercept the boot sequence early
  - Load a new image over the network
    - See the Upslug2 command

Jim@Buzbee.net

Taking the easy road

Start with a pre-built firmware and customize from there

- NSLU2 Distributions
  - At a High-Level
    - Unslung

    - SlugOS

    - Debian

    - OpenWrt

The Unslung firmware

An add-on to the Linksys baseline

- Starts with a standard Linksys firmware
- Retains all Linksys web user-interfaces
- Allows the addition of new packages
- 800+ packages available
  - ssh, ftp, iTunes server, etc.

Jim Buzbee

Jim@Buzbee.net

The SlugOS firmware

A custom NSLU2 distribution

- No Linksys code used
- Big and Little Endian variants available
- ~5000 packages
  - Designed for embedded use
    - Low memory, but uses glibc
    - Can run without external drive

Jim Buzbee

Jim@Buzbee.net

The Debian Firmware

I want it all!

- Full-Debian distribution
  - Start installation with flash image
    - Bootstraps - like floppy or CD
  - Installs the rest over the Internet
  - Not optimized for small-memory
    - Can be a bit Sluggish - Hah!
  - Needs external drive
    - Can be a flash drive
  - But 17,000+ packages available!

Jim Buzbee

Jim@Buzbee.net

The OpenWRT Firmware

A wireless distribution for a wired device?

- Moving beyond routers
- When *you* really want to go embedded
- Designed for tight memory devices
  - Built to run out of internal flash
  - uClibc for minimal footprint
  - ~2000 packages

Jim Buzbee

Jim@Buzbee.net

What can you really do with a Slug?

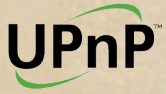
Light on the salt please

I mean, besides Linksys' intended uses.

For starts:

- iTunes server

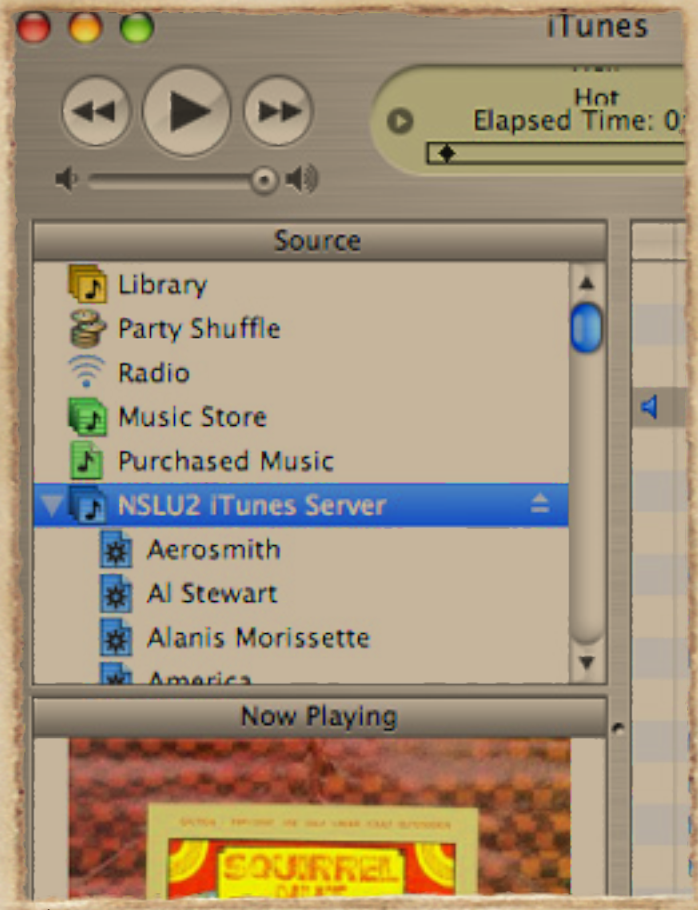
- UPnP A/V server



- Personal LAMP

- Weather station

- Asterisk PBX



http://nslu2-linux.org/wiki/Info/WhatPeopleAreReallyUsingTheirSlugsFor

Jim Buzbee

Jim@Buzbee.net

But I'm a hardware hacker

Hey, not me. But maybe you are.

Are there hardware hacks being done?

- Fat Slugs, Skinny Slugs, even Slugs with chicken pox
  - A "Fat Slug" is a Slug with extra RAM
  - Serial ports - People have added serial consoles
- JTAG - If you're hard-core, you can add JTAG
- Auto power-on
- USB - additional ports plus a device-side port
- De- underclock : Back to 266 MHz please
- Internal wireless

Internal bluetooth

Jim Buzbee

Jim@Buzbee.net

Moving beyond the Slug

It's giving up the ghost!

- Sadly, after 4 years the NSLU2 is at end-of-life
  - Still widely available, but it won't last
  - It had a long life for the consumer electronics world
  - What did Linksys think about all the activity?
    - I didn't know. So I asked:

"While Linksys does not support any of the alternate firmware available for the NSLU2, we are always delighted to see a product gain such widespread acceptance. Like the similar community that emerged to enhance the WRT54G before it, the creativity and ingenuity of Linksys customers inspires us to continually improve our products."

Mike Wagner, Director of Marketing, Linksys.

Jim Buzbee

Jim@Buzbee.net

OK, Now what?

Since the Slug is slip sliding away

- Many other Linux COTS devices available now
  - But can they be "hacked" ?
    - I've "gotten root" on a dozen or so
  - NAS Central tracks Linux NAS boxes
    - http://www.nas-central.org/index.php/Main_Page
- Most are more powerful than the Slug
  - But are also bigger, noisier and draw more current
- Many are based on the Marvell Orion SoCs
  - Mainline Linux/Debian support on the way
  - http://www.linuxdevices.com/news/NS5637467946.html

Jim Buzbee

Jim@Buzbee.net

Slug References

- http://www.nslu2-linux.org/
- http://www.nas-central.org/
- http://batbox.org/nslu2-linux.html

Jim Buzbee

Jim@Buzbee.net

My Slug Articles

Mostly historic now

- http://www.tomsguide.com/us/how-to-nslu2-hack-pt1,review-293.html
- http://www.tomsguide.com/us/how-to-nslu2-hack-pt2,review-297.html
- http://www.tomsguide.com/us/how-to-nslu2-hack-pt3,review-303.html
- http://www.tomsguide.com/us/how-to-nslu2-hack-pt4,review-312.html
- http://www.tomsguide.com/us/how-to-nslu2-hack-pt5,review-323.html
- http://www.smallnetbuilder.com/content/view/24241/77/
- http://www.smallnetbuilder.com/content/view/29774/77/

Jim Buzbee

Jim@Buzbee.net


LINKSYS
Network Storage Link
for USB 2.0 Disk Drives