

GNU Radio

Open Source Software and Hardware for Software Radio

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Thought for the day...

The milk of disruptive innovation doesn't flow from cash-cows.

– David S. Isenberg

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Outline

- What's GNU?
- Brief summary of software radio
- Free Software / Open Source
- GNU Radio
- Software ATSC receiver
- Regulatory Issues
- "Broadcast Flag" Proposal

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What's GNU?

The **GNU Project** was launched in 1984 to develop a complete Unix-like operating system which is free software: the GNU system.

GNU is a recursive acronym:

GNU's Not Unix

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Software Radio...

- Get the software close to the antenna
- Turn h/w problems into s/w problems
- Extreme flexibility
- Dynamic spectrum optimization
- Dynamic reconfiguration
- Ride Moore's law

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What is "free software?"

- **"Free as in liberty"**
 - User has **access to the source**
 - User is **free to modify** and is encouraged to contribute the modifications back to the community
- Free Software vis-à-vis Open Source
- Various licenses: GNU General Public License (GPL), BSD, MIT, Mozilla

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Culture: Innovation

- Berkeley TCP / IP stacks
- Bind / DNS (heart of internet naming)
- Sendmail internet mail server
- "The Web"
- Apache Web Server

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Culture: Exploration & Learning

- Nothing hidden, no magic
- Take it apart and see how it works
- See how others solved similar problems
- Don't have to ask permission
- Doesn't cost anything but your time

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Culture: Fix and improve

- If something is broken, you can fix the problem.
- If it doesn't work the way you like, you're free to improve it or tailor it to your needs.
- You're not stuck with somebody else's design decisions.

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Who uses free software?

- World wide community of users
- Publicly traded companies support or distribute free software: **IBM, HP, Red Hat, Mandrake**
- **Google** runs on **GNU/Linux**
- **Yahoo** runs on **FreeBSD**
- **Not a fringe activity**

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Innovation: reality check

- **Incumbents** are **constrained** not to put themselves out of business. It's their duty to their stock holders.
- Incumbents are **anti-innovation** if the **innovation threatens** their business model.

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What is GNU Radio?

- **Toolbox for building** software radios
- A **platform for experimenting** with digital communications
- A **platform for signal processing** on commodity hardware

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Vision

- Create a **practical environment** for experimentation & product delivery
- Expand the “**free software ethic**” into what were previously hardware intensive arenas
- Transmit and receive **any signal**

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Hardware platform

- Commodity PC or embedded system
- RF front end (e.g., TV tuner module)
- Multi-channel applications / wide B/W:
 - High speed A/D (20M – 60M samples/sec)
- Single channel / narrow bandwidth:
 - SoundBlaster, AC97 codec, etc.

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What can GNU Radio do today?

- **Broadcast and narrow band FM**
- **Single and multi-channel** processing
- Signal analysis tools
- Fully functional **ATSC Transmitter**
- Fully functional **ATSC Receiver**
- Free **code** for all this is **available** at distribution sites **around the world**

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Where we're headed...

- Narrow band encrypted digital voice (APCO 25)
- Ad hoc networking
- Smart antennas
- Better tools / improved architecture
- Support for amateur radio users
- Build user and developer base

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Open source hardware

- The “IP” is free to use
- Includes VHDL or Verilog code, board layouts, etc
- Many examples already: ethernet, usb, pci bridges, crypto, dsp, cpu, fpu,...
- Can make money selling implementations, e.g. ASICs, but IP remains free

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Open source hardware

- Under development (the Big Hammer):
 - USB 2.0 peripheral (50 MB/sec throughput)
 - 4 high speed A/D converters (60 MSPS)
 - 4 high speed D/A converters (120 MSPS)
 - 300K gate FPGA
 - Estimated price: \$250 (c.f. \$5000 for existing commercial products)
 - Fully reconfigurable / general purpose

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Regulatory issues: Receivers

- Drop “bans”. They never worked. **Illusion vs reality**. If I **feel safe**, I must **be safe**...
- **Use crypto** if you don't want your communication intercepted.
- **Today's cell phones are crypto enabled**.
- Treat receivers as part 15 **unintentional radiators**, and **allow self-certification** same as computer hardware.

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Regulatory issues: Transmitters

- More **unlicensed** spectrum
- Simple restrictions on power spectrum
- **Smart radios** can fend for themselves
- Lead, follow or get out of the way

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ATSC “Broadcast Flag”

- Not needed.
 - Content providers **are providing** high production value **content today**.
 - Content providers are **free NOT to broadcast** their content.
- Won't accomplish stated goal.
 - A **single** non-compliant **receiver** will **compromise** the entire system. (see Microsoft “Darknet” paper.)

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ATSC “Broadcast Flag”

- **Restricts innovation and choice**
- **Kills all “fair use”**. Note that **fair use** is by definition **“unauthorized”**
- **No open source** software can meet the “robustness requirements”
- **Unconstitutional restriction** of my **First Amendment** protected speech

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GNU Radio resources

- Home page (links to source code)
<http://www.gnu.org/software/gnuradio>
- Mailing list
discuss-gnuradio-request@gnu.org
- Archive
<http://mail.gnu.org/mailman/listinfo/discuss-gnuradio>

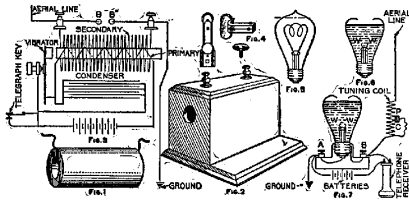
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Open source resources

- Free Software Foundation <http://www.gnu.org>
- Source Forge (> 50K projects, > 500K users)
<http://www.sf.net>
- Why Open Source Software / Free Software?
http://www.dwheeler.com/oss_fs_why.html
- Open source hardware
 - <http://www.opencores.com>
 - PCI bridges, ethernet, memory controllers, etc.

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Questions?



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