# HackRF
# A Low Cost Software Defined Radio Platform

## ToorCon 14

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The views expressed are those of the author and do not reflect the official policy or position of the Department of Defense or the U.S. Government.

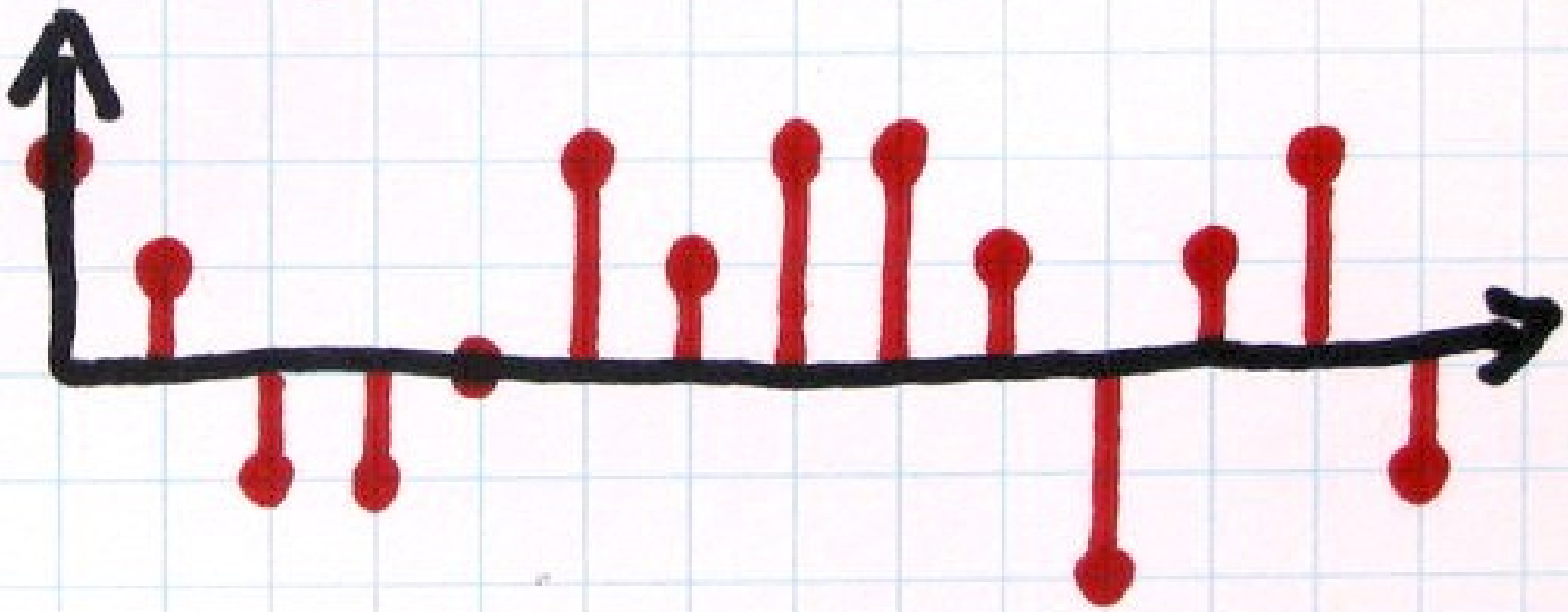
# Software Defined Radio (SDR)

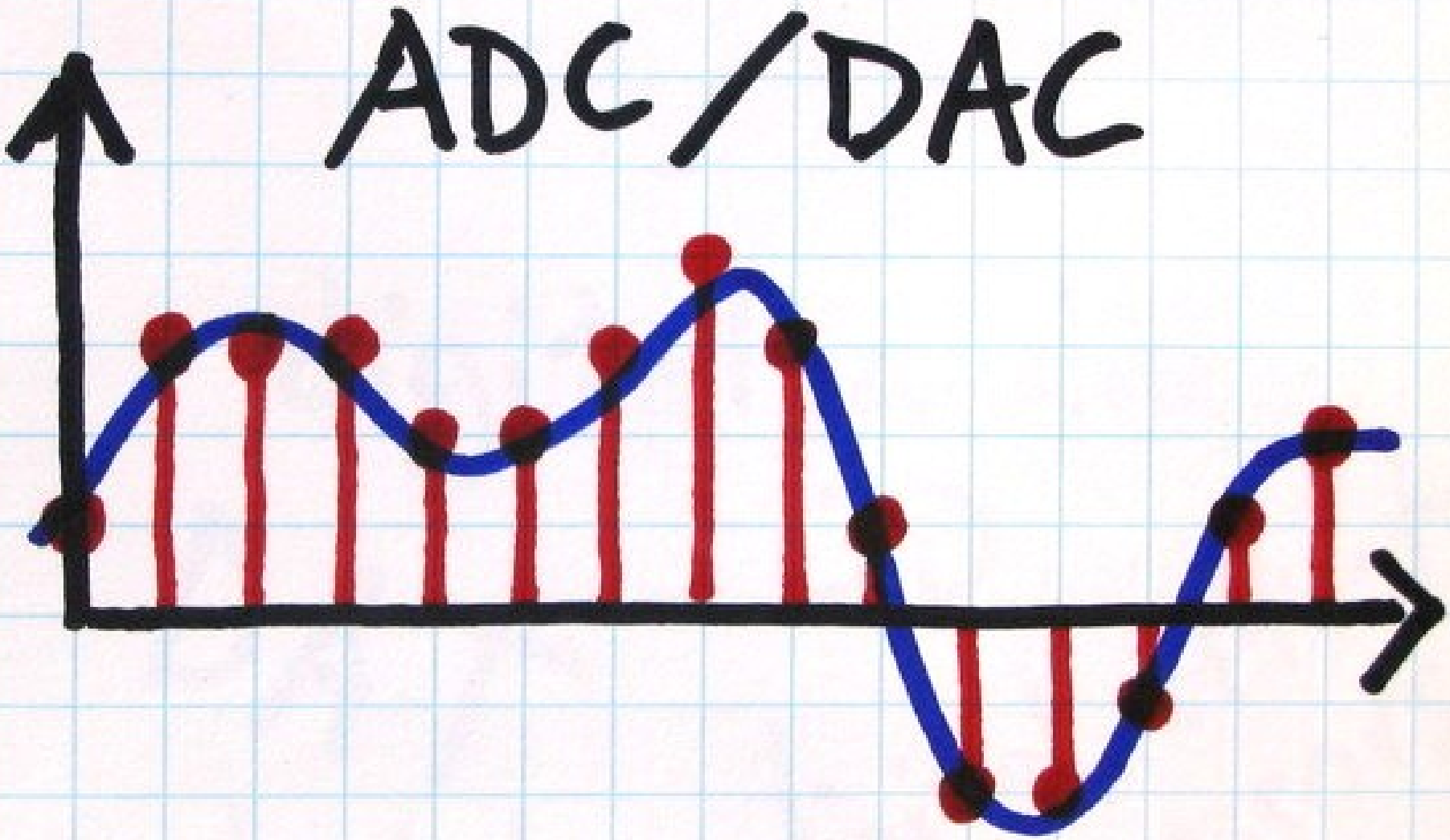
radio by

Digital Signal Processing (DSP)

# digital signals

just a sequence of values




ADC/DAC

# analog audio

vinyl records

tape

synths

Plain Old Telephone Service

# digital audio

DAT

CD

digital effects processors

digital phone switches

synths

hard disk recording

MP3

VoIP

explosion!

P2P

Napster

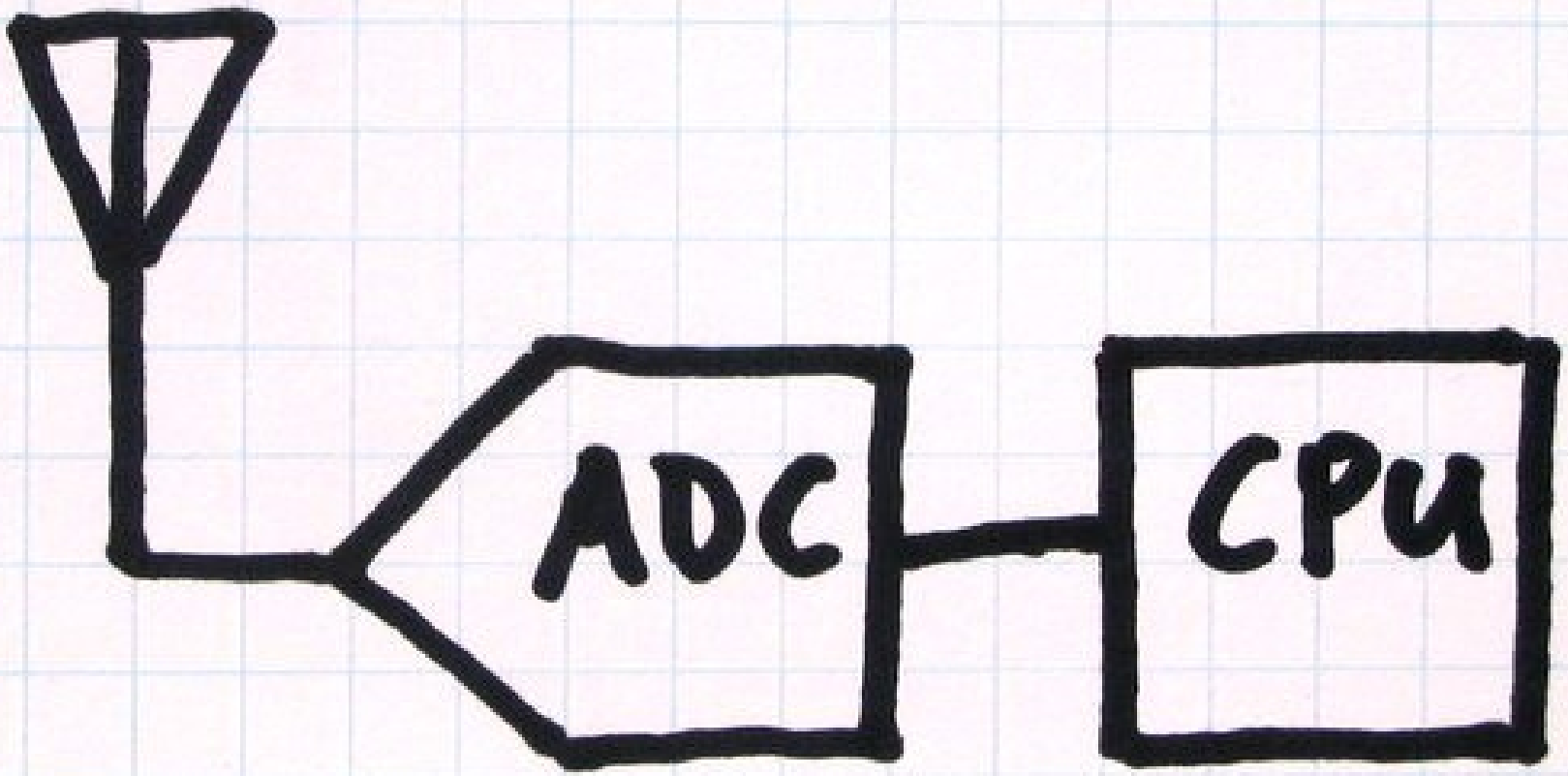
analog modling synths

Skype

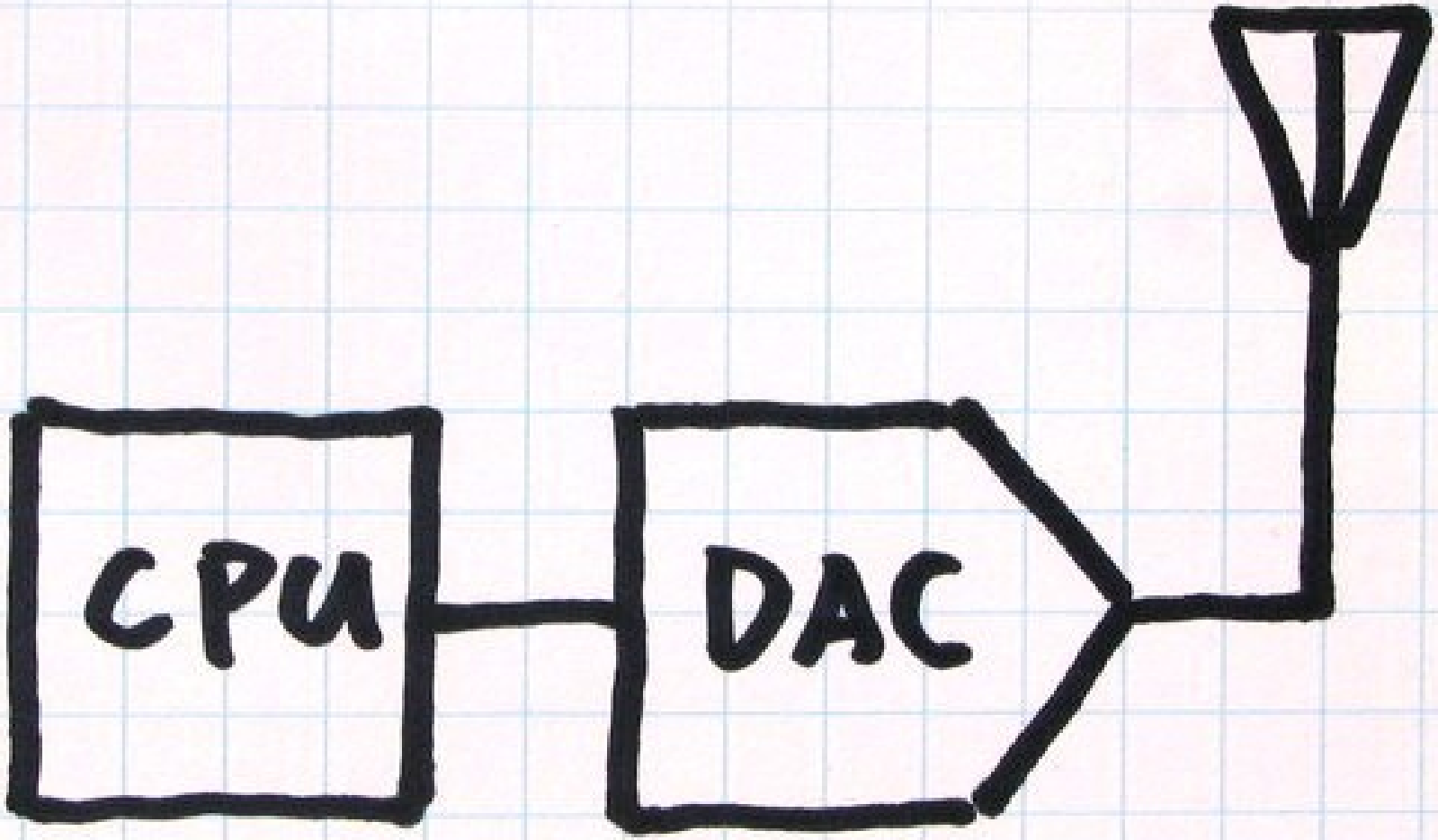
# software ~~digital~~ audio revolution

a
signal
is
a
signal

# ideal receiver



# ideal transmitter



# flexibility

many radios
in one

# reconfigurability

software modification

cost

high quality analog components

or

cheap analog components plus CPU

the future

all radios will be software radios

# the Wi-Fi lesson

what if?

# Information Security

SDR is a proven technology for wireless communication security

http://www.pixelhunt.com.au/2010/12/featured/funtime-friday-its-beginning-to-look-a-lot-like-christmas/attachment/empty-wallet/


Ettus
Research
USRP
Universal Software Radio Peripheral
CLK IN
ROBOTICON


http://michaelkonik.com/the-good-bad-and-ugly/tsa-agent/

# target operating frequencies

0 — 1 GHz: lots of stuff

1 - 2 GHz: DECT, GPS, GSM

2.4 GHz: 802.11, Bluetooth, ZigBee

5.9 GHz: DSRC, WAVE, 802.11

# target bandwidth

0–1 MHz: lots of stuff

1 MHz: Bluetooth

2 MHz: ZigBee, DECT

5 MHz: LTE

20 MHz: 802.11

receive
or
transmit?

# Portability

# Cost

Single device any laptop owner can afford

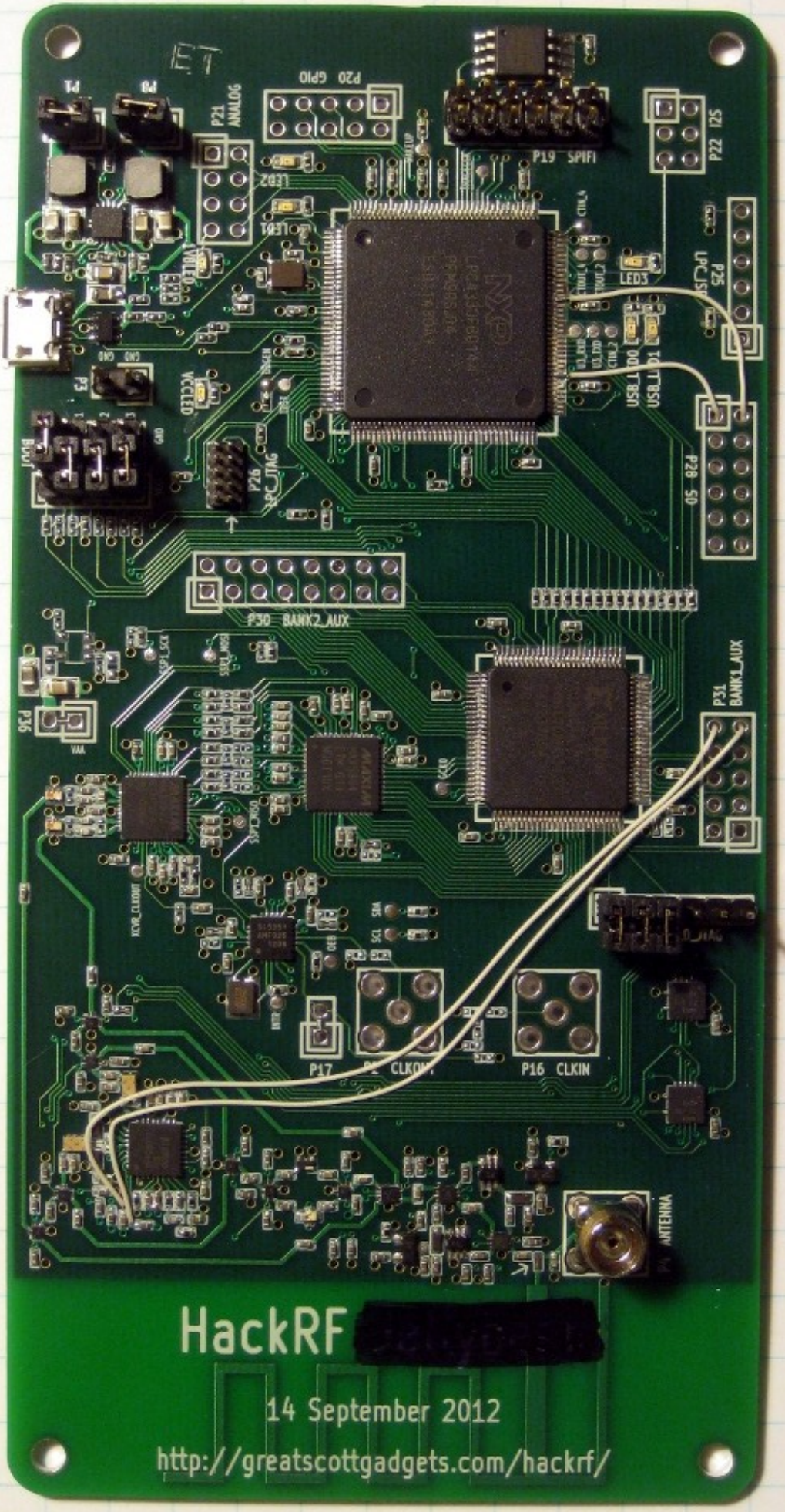
Open
Source

# We Can Live Without...

high dynamic range

DSP

full-duplex


P1
P8
P21 ANALOG
P20 GPIO
P19 SPIFI
P22 I2S
P25 LPC_USB
P28 SD
P30 BANK2_AUX
P31 BANK1_AUX
P26 LPC_JTAG
P36
P17
P16 CLKIN
ANTENNA
HackRF
14 September 2012
http://greatscottgadgets.com/hackrf/

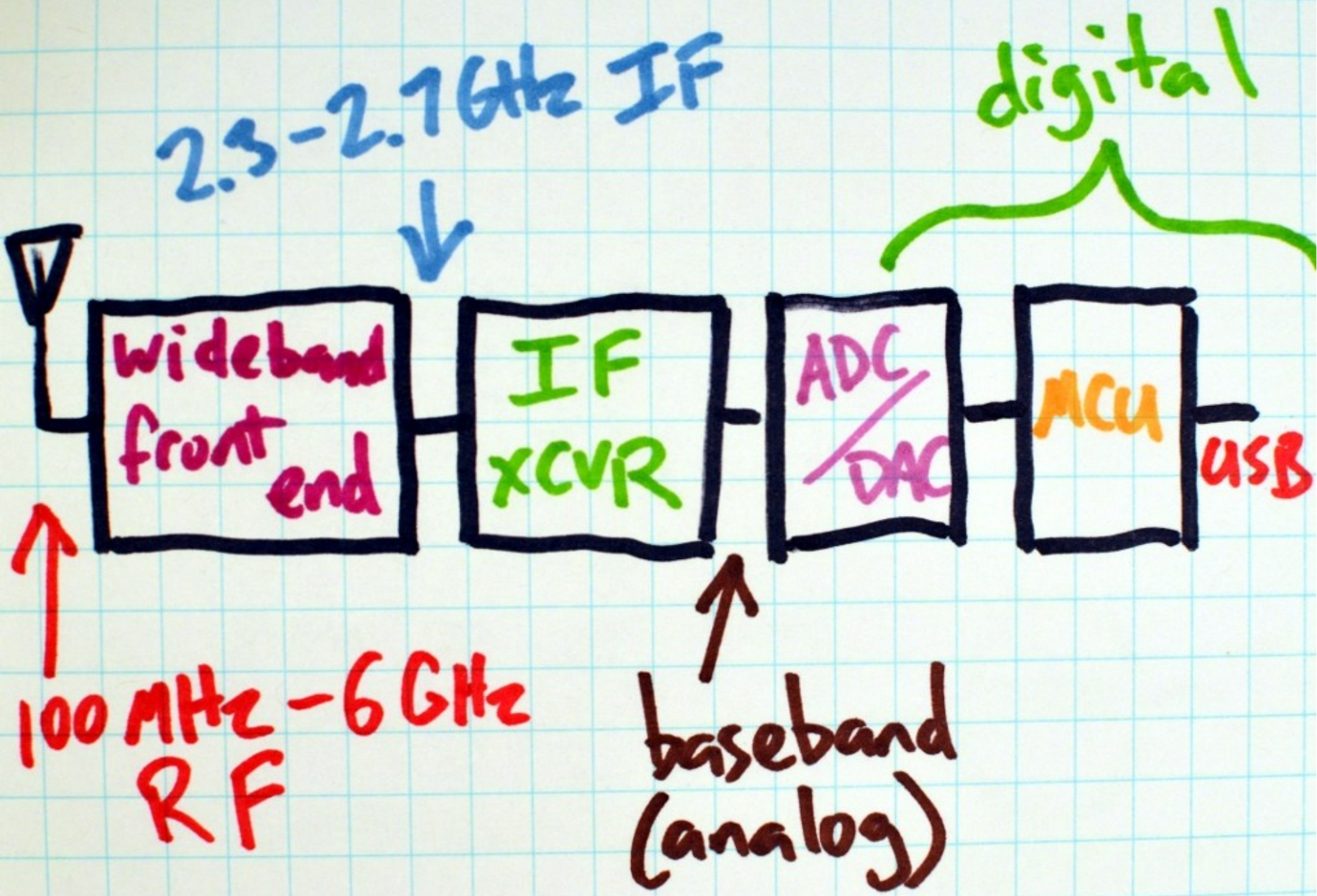
# Architecture

dual conversion

high IF

USB microcontroller

flexible clock generation


2.3-2.1GHz IF
digital
wideband front end
IF XCVR
ADC/DAC
MCU
USB
100 MHz-6 GHz RF
baseband (analog)

# Jawbreaker

High Speed USB 2.0

bus powered

30 - 6000 MHz operating frequency

half-duplex transceiver

15 - 20 MHz max bandwidth

900 MHz antenna or external

5.8" x 2.9"

open source hardware and software

# DARPA

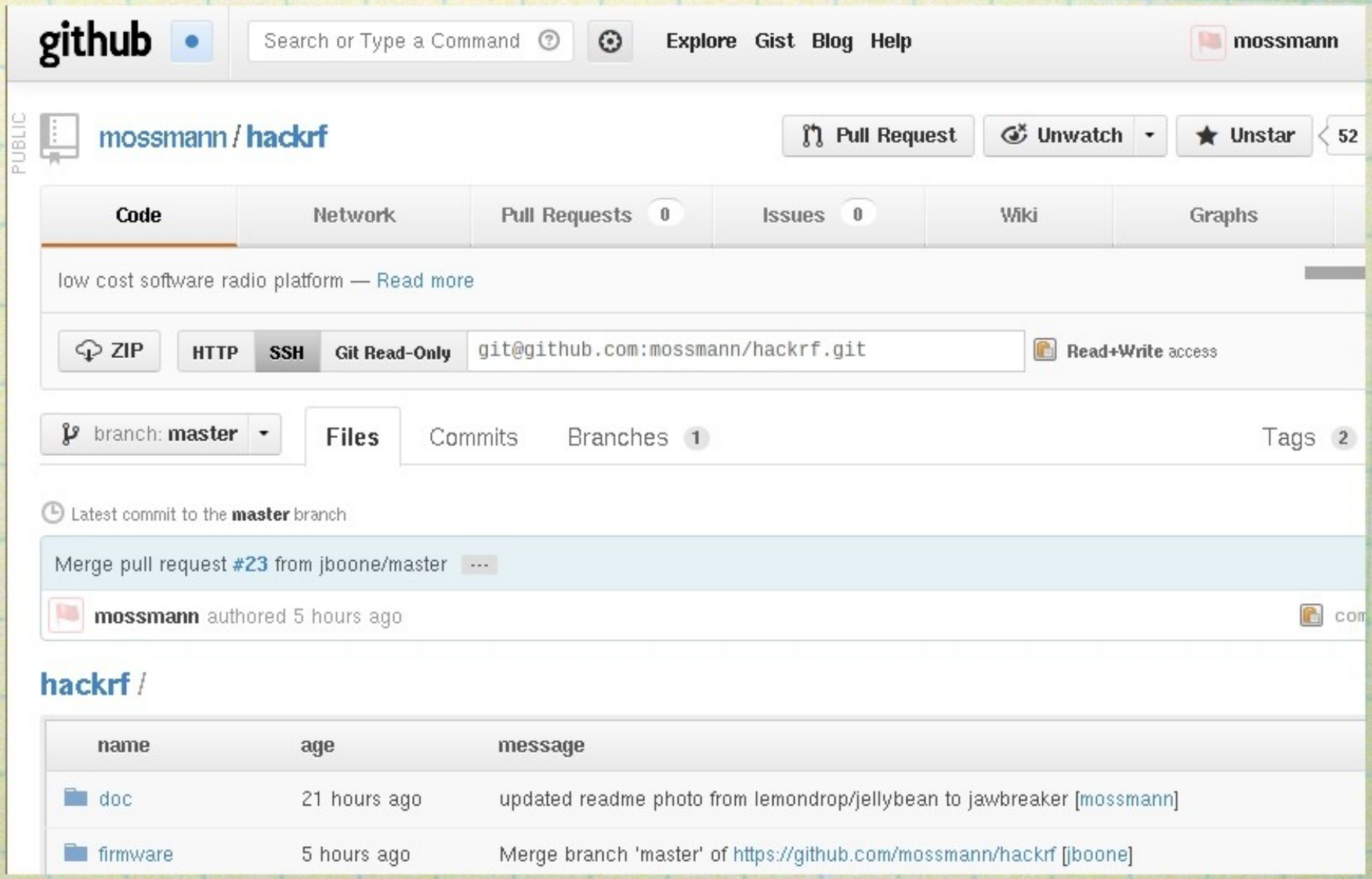
## Cyber Fast Track (CFT)

This is a big
project
for us.

This isn't a
big project
for DOD.

The world needs
open source hardware
for SDR.

# Public process



# Communication

```
mossmann@ardua: ~
http://greatscottgadgets.com/hackrf/
05:59 < sharebrained> But still, the SGPIO interrupt is going to chew a fair amount
                      of the CPU. Time to learn how to program the M0...
05:59 < mossmann> Yeah, DMA may still be helpful there.
05:59 < sharebrained> The M0 can be our DMA engine... :-)
06:00 < sharebrained> Helpful where?
06:00 < mossmann> potentially gaining a few cycles by having it move stuff while the
                  CPU is doing USB setup.
06:01 < mossmann> but I always figured the M0 would be near 100% busy just moving
                  samples around.
06:01 < sharebrained> Move what stuff, though? The SGPIO interrupt is dumping
                      samples straight into the USB buffer. So there's nothing more
                      that needs moving.
06:01 < mossmann> ah
06:02 < sharebrained> And unfortunately, the SGPIO shadow registers are not
                      contiguous or in order. So some smarts need to deinterleave
                      that junk.
06:02 < mossmann> I suggest sticking to the M4 for now.  We can migrate to the M0
                  once we actually have something else for the M4 to do.
06:02 < sharebrained> I think the overhead of asking the DMA to scatter-gather
                      individual 8-word sets with 8 single-word linked list
                      descriptors would be considerable.
06:03 < sharebrained> Yeah, I'm going to keep with the M4 for the next week+. Just
                      mentioning that the M0 might be able to do this work and hide
                      it away.
 [00:33] [mossmann(+Zi)] [3:freenode/#hackrf(+ns)] [Act: 4,5,8,9]
[#hackrf] []
```

Volunteers!

# tools

KiCad

GCC

# hardware design process

Michael
designer

Jared
consultant

modules

100%
NDA
free!

NXP LPC43xx

ARM Cortex-M4 + M0

204 MHz

High Speed USB

FPU

SGPIO

libopencm3

We are not...

we are...

HackRF beta

Thanks, DARPA!

# Thank you!

DARPA CFT

BIT Systems

Benjamin Vernoux

Will Code

David Hulton

ToorCon

http://greatscottgadgets.com/hackrf/