

Software Radio

David Malone

`<dwmalone@{nuim.ie,maths.tcd.ie,FreeBSD.org}>`

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What is Software?

Software: the programs (and sometimes data and configurations) that run on computers.

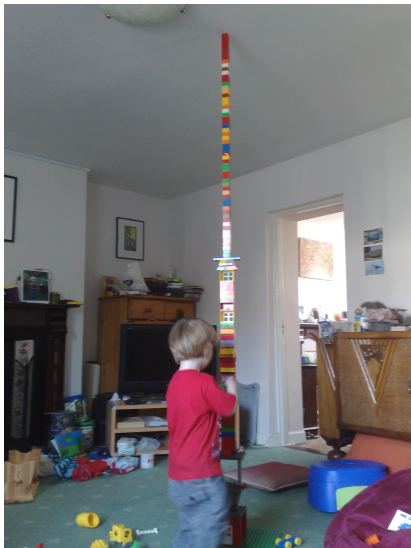
```
10 PRINT "Hello World"  
20 GOTO 10
```

What is Software?

```
#include <stdio.h>
main(t,_,a)char *a;{return!0<t?t<3?main(-79,-13,a+main(-87,1-_,
main(-86,0,a+1)+a)):1,t<_?main(t+1,_,a):3,main(-94,-27+t,a)&&t==2?_<13?
main(2,_+1,"%s %d %d\n"):9:16:t<0?t<-72?main(_,t,
"@n'+, #'/*{}w+/w#cdnr/+, {}r/*de}+, /*{*+, /w{%+, /w#q#n+, /#{l+, /n{n+, /+#n+, /# \
;#q#n+, /+k#; *+, /'r : 'd* '3, }- {w+K w'K: ' +}e#'; dq# 'l \
q# ' +d'K#! /+k#; q# 'r}eKK#}w'r}eKK{nl} ' /#; #q#n' ) { }#}w' ) { }{nl} ' /+ #n'; d}rw' i; # \
) {nl} !/n {n#'; r {#w'r nc {nl} ' /#{l, + 'K {rw' iK{; [{nl} ' /w#q#n'wk nw' \
iwk{KK{nl} !/w{% 'l##w# ' i; : {nl} ' /*{q# 'ld; r' } {nlwb! / *de} 'c \
; ; {nl} ' - { }rw} ' /+, }##* ) #nc, ', #nw} ' /+kd' +e}+; # 'rdq#w! nr' / ' ' ) }+ } {rl# ' {n' ' }# \
} ' +}## ( ! ! / " )
:t<-50?_==*a?putchar(31[a]):main(-65,_,a+1):main(( *a=='/')+t,_,a+1)
:0t?main(2,2,"%s"): *a=='/'||main(0,main(-61,*a,
"!ek;dc i@bK' (q)-[w] *%nr+3#l, { } : \nuwloca-0;m .vpbks,fxntdCeghiry"),a+1);}
```

Software is Flexible

Changing hardware is hard. Changing software is simple(r).



What is Radio?

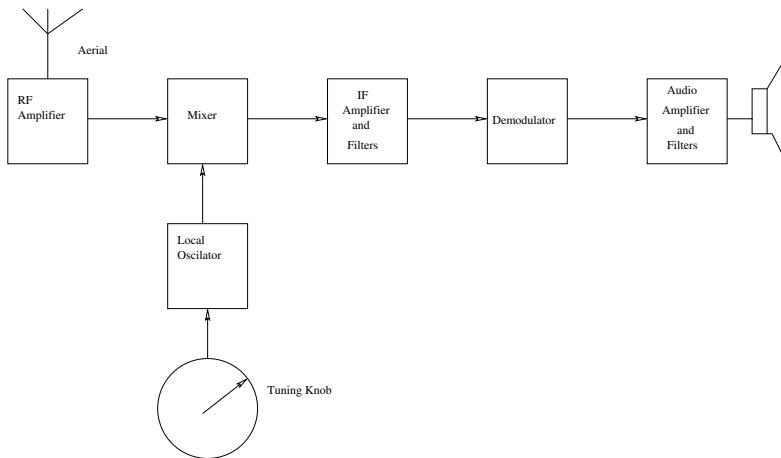
Transmitting Information using Electromagnetic Waves.



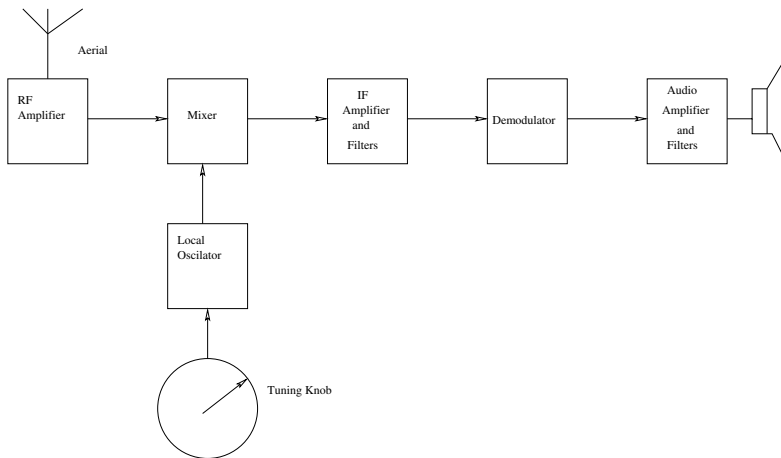
Electromagnetic Waves

- Waves have a frequency.
- Electromagnetic, so related to electricity.

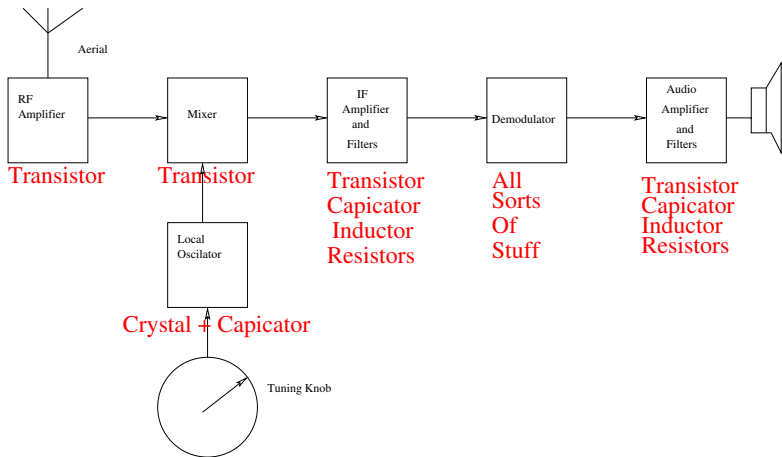
How does radio work?



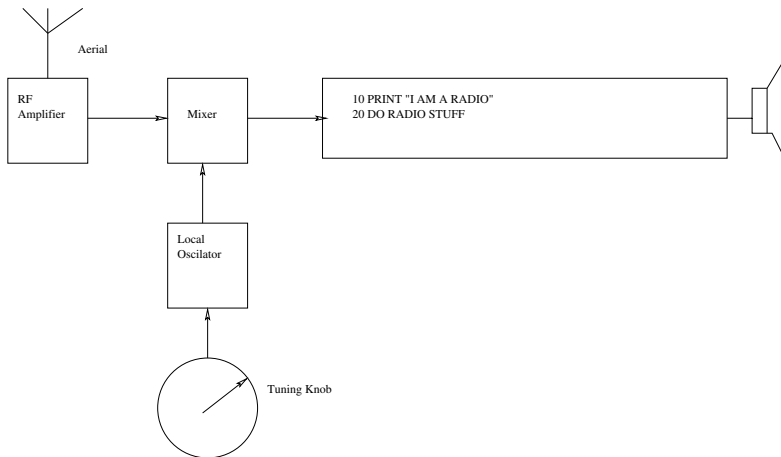
How does radio work?



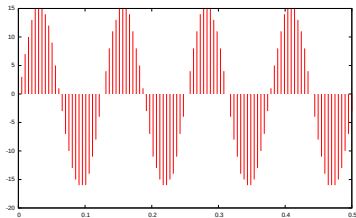
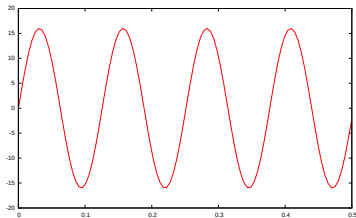
How does radio work?



How does software radio work?



Analogue to Digital



0 3 7 10 13 15 15 15 14 12 9 5 1 -3 -7 -10 -13 -15 -16 -16

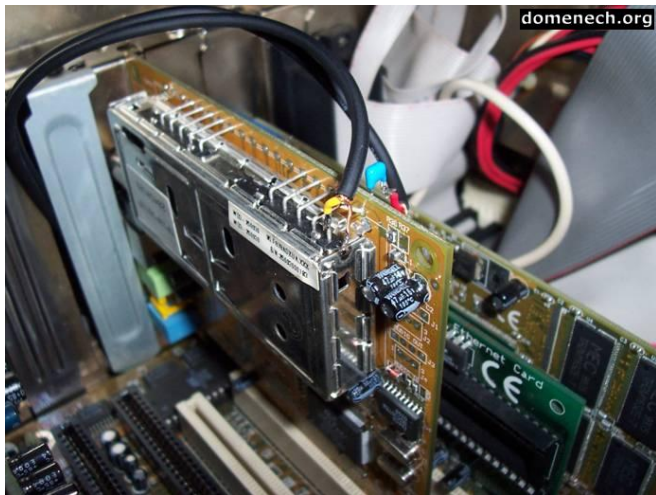
Software Defined Radio

- Modern radio often about new modulation.
- Old way: design a circuit, fabricate it, test it.
- New way: code it up, see what happens.
- Cognitive Radio: do this on the fly.

Good for researchers — what about Joe Public?

Homebrew Software Radio

All you need is a fast A2D converter.



Fourier Transform

You to pick out those Frequencies.

$$f(x) \mapsto \hat{f}(\omega) := \int f(x) e^{-i\omega x} dx.$$

Which can be turned into software.

```
int main(void) {
    double w;

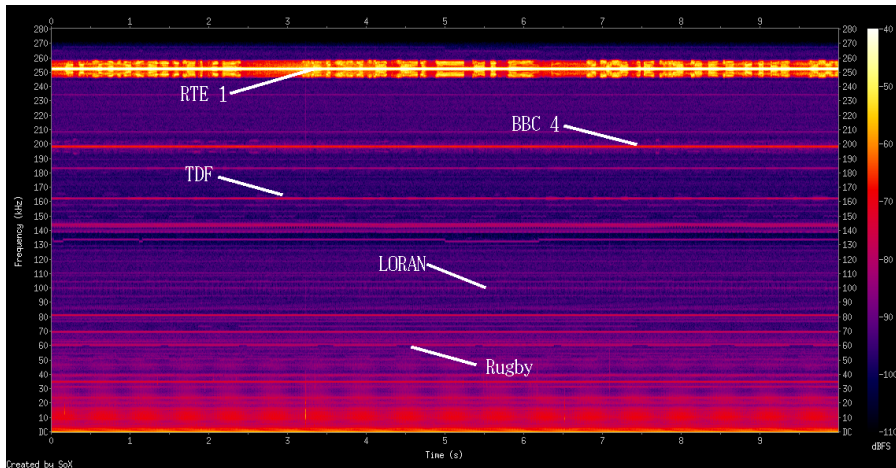
    for( w = -4.0 ; w <= 4.0 ; w += 0.01 ) {
        double x;
        double val;

        val = 0.0;
        for( x = 0.01 ; x < DELTA*STEPS ; x+=DELTA )
            val += cos(x*w)*f(x);
        printf("%f %f\n",w,val);
    }
}
```

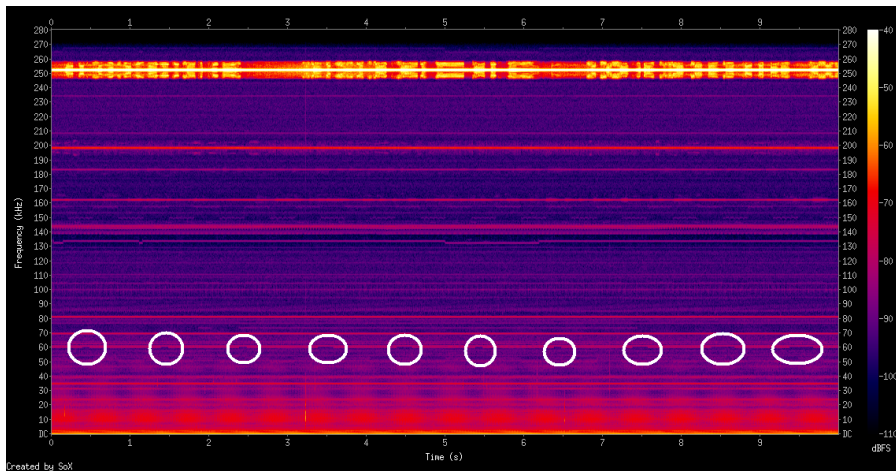
Aerial



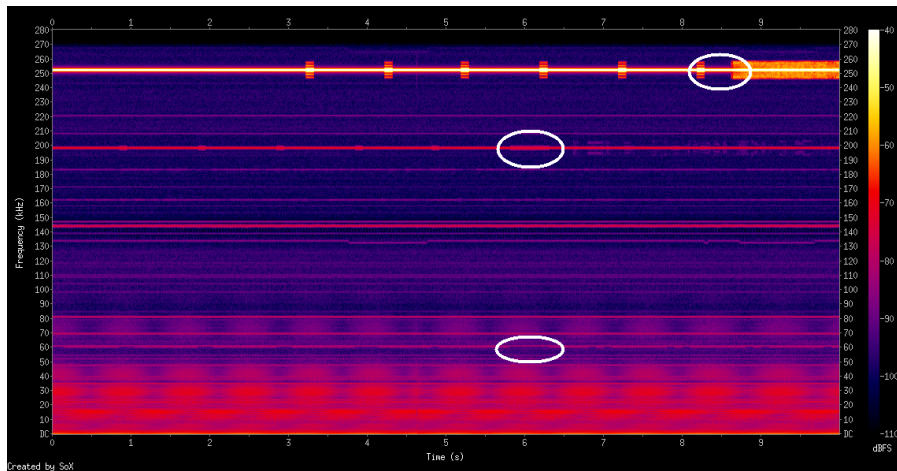
Radio Spectrum



Tick Tick Tick



Tick Tick Tick



In Summary

Software Radio = Radio - Tricky Bits + Software

Available in your back garden.

Watch those pips!

Thanks