# Perl, Raspberry Pi, IOT and Citizen Science

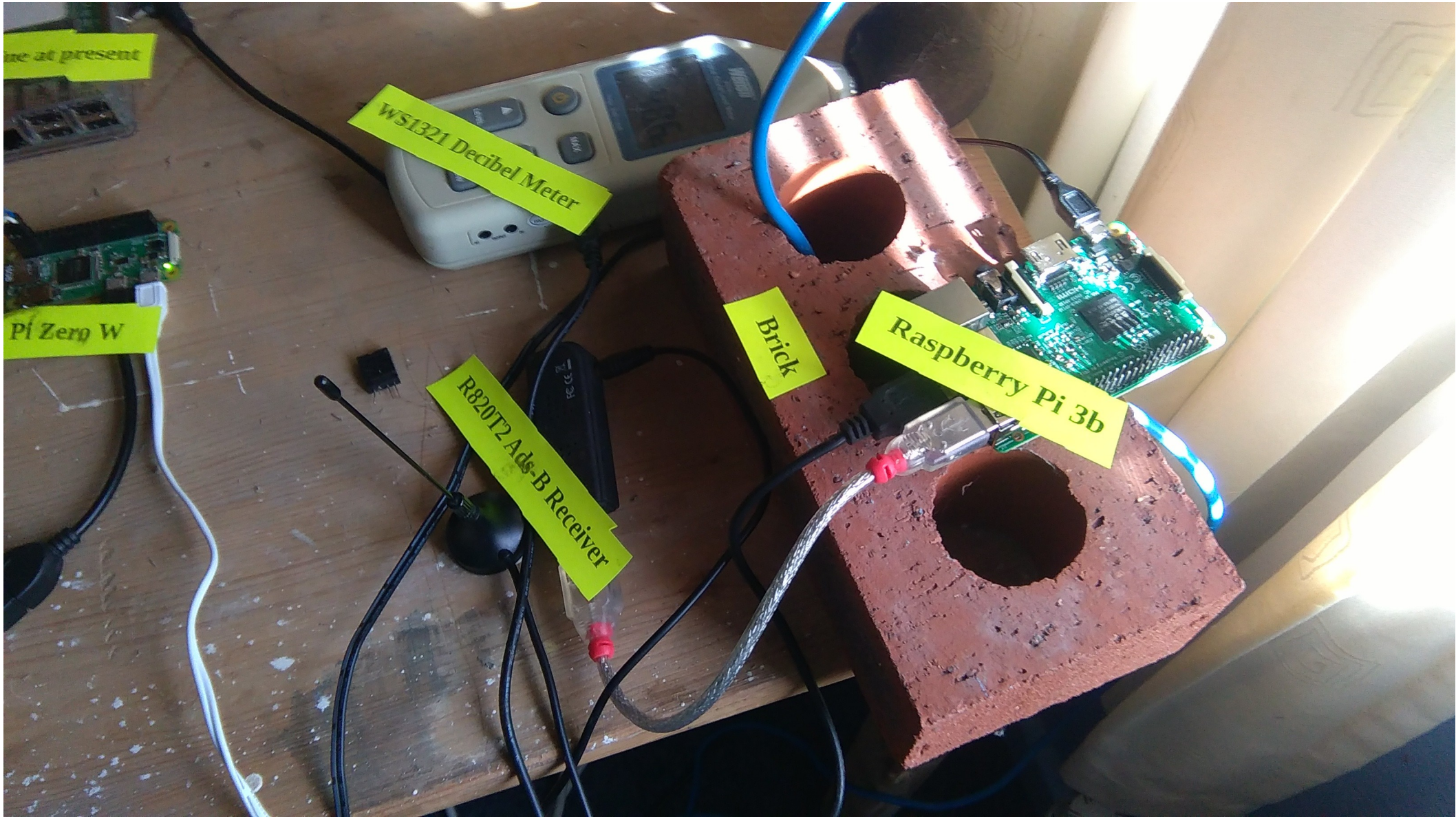
Motivation:

- Airplane noise over my house
- Contact with HACAN and HACAN East
- Part of IoVMT (the Internet of Very Messy Things)
- Citizen Science, why oh why? (Volkswagen, French Chernobyl cloud etc.)

*This will go onto my website later on, with the hyperlinks, so no worries for photos etc.*

# The Very Messy Things Lab

# Hardware for Project



This is a pretty complete **decoded** ADS-B(roadcast) record, but they vary and the subfield order varies too, see decoding ads-b for raw format. Starts with a *

```
*8d40615b99449e8ae82c053a7970;
CRC: 000000 (ok)
DF 17: ADS-B message.
  Capability     : 5 (Level 2+3+4
(DF0,4,5,11,20,21,24,code7 - is airborne))
  ICAO Address   : 40615b
  Altitude : 7250 feet
  Extended Squitter  Type: 19
  Extended Squitter  Sub : 1
  Extended Squitter  Name: Airborne Velocity
    EW status          : Valid
    EW velocity        : -157
    NS status          : Valid
    NS velocity        : -86
    Vertical status    : Valid
    Vertical rate src : 0
    Vertical rate      : -640

*8d4008795825926141fdfc2253fc;
```

# Fit, the First, Initialise

```
#use InfluxDB ;  #open source db, specialised for time series
use InfluxDB::HTTP;
use InfluxDB::LineProtocol qw(data2line line2data); #eek!

# height and decibel cutoffs and defaults, command line can be used
my $cfg = new Config::Simple('/home/pi/aircraft-
sensing/bin/read1090.ini');

my $height = $cfg->param("height");
my $db_min = $cfg->param("db_min");
my $test   = $cfg->param("test");

# general and associated program paths
my $log_path       = $cfg->param("log_path");
my $dump_path      = $cfg→param("dump_path");  #path to dump1090 binary
my $test_file_path = $cfg->param("test_file_path");
my $decibels_path  = $cfg→param("decibels_path"); #path to decibels.py
```

# Fit, the Second, Pipe in, Parse and Decide ( heavily edited to show main features)

```
open( $fh, '-|', $dump_path );  #pipe in from dump1090
.



while (<$fh>) {   # anytime a transponder record turns up

    # start of transponder record with a *
    # only partial parsing to extract useful fields, other stuff thrown away
    # key : value in the 'useful' subrecords

    If (/^\*/) {

    #  ICAO Address   : 40100a
    if ( $key =~ /^ICAO/ ) {
        $ica = $value;
    }
```

# Fit, the Third, Get altitude and decide whether to write to database

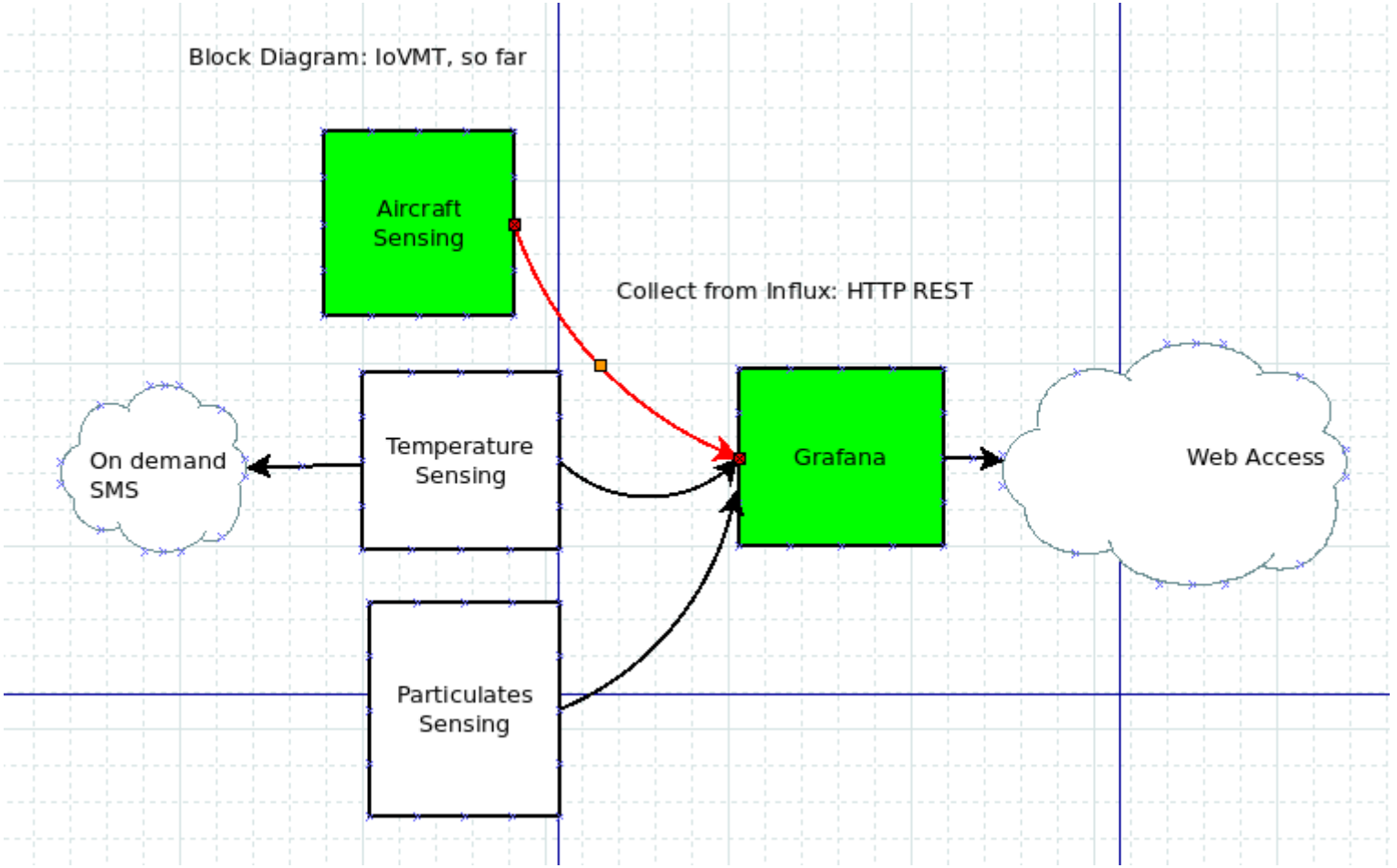
```
#    Altitude        : 24000 feet
    if ( $key =~ /^Altitude/ ) {
        $value =~ s/\s+feet//;
        $alt = $value;

    }
    my $noise = get_decibels($decibels_path);   #calls out to decibels.py
    # if the plane is lower && noisier than set limits, then store data
    if ( $alt <= $height and $noise >= $db_min ) {

 # mysql replaced by influx now, also
 #'near the ground reading ($height- $alt)
         send_points_to_influx( $log, $ix, $ica, $noise, $result->{tail},
             $result->{model}, ($height- $alt) );
```

# Fit the Fourth, Store ( heavily edited to show main features)

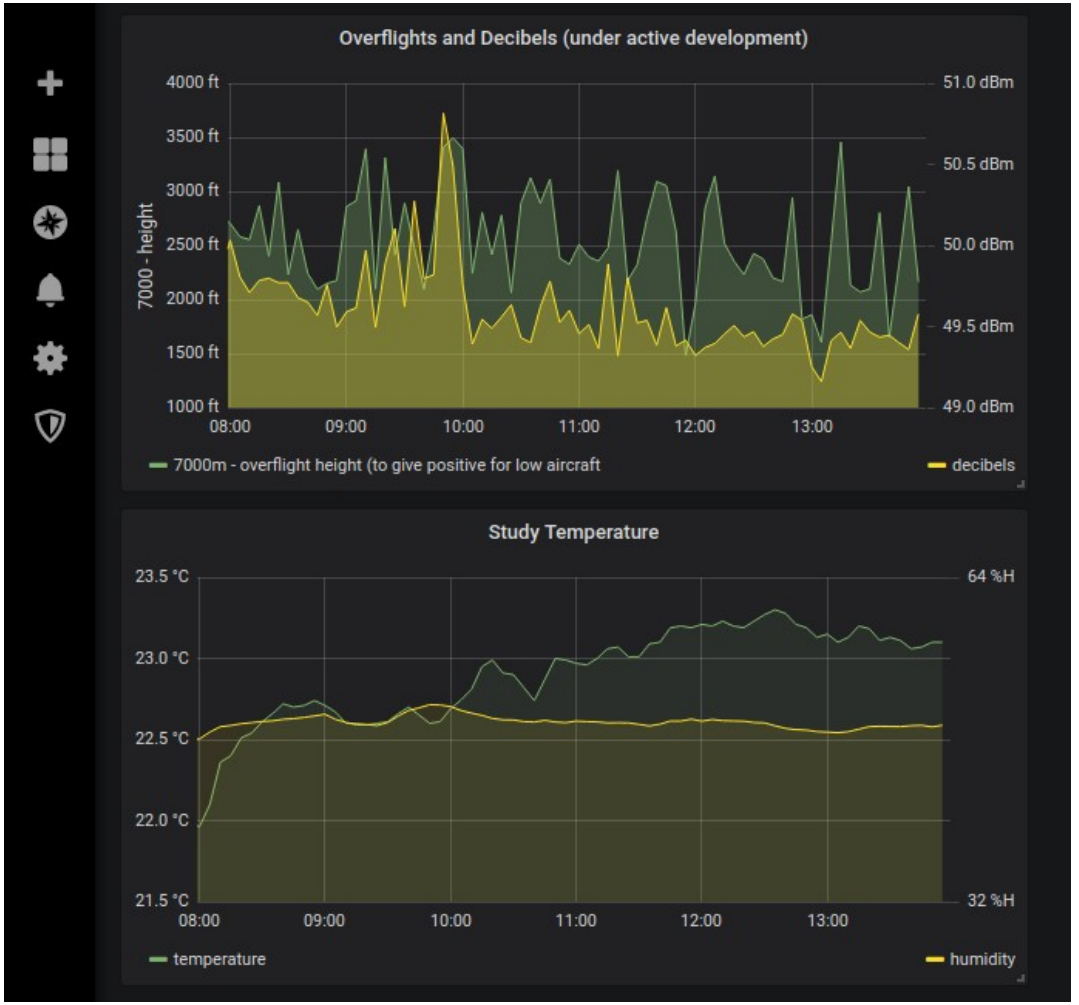
```
sub send_points_to_influx {

    # data2line($metric, $value, $tags_hashref, $nanoseconds);

    my ( $log, $ix, $ica, $noise, $tail, $model, $alt ) = @_;
    my $influx_line = data2line(
        'overflight',
        { alt  => $alt,  db    => $noise },
        { tail => $tail, model => $model, ica => $ica }
    );

# didn't want the bother of http agent etc.
# FIXME: needs to use the configured parameters!
`curl -i -s -X POST http://localhost:8086/write?db=aircraft
--data-binary \"$influx_line\"`;

    return 0;
}
```

And around again, until we are bored….

# Block diagram



# Grafana Result



# Some Takeaways 1

- No point in purity, `dump1090` and `decibel.py` had the 'merit of existing'
- Perl is good at *parsing* and *rich data structures* (I haven't decided yet whether to cumulate one overflight and record a maxima, for example)
- IoT is (my opinion) *keep it simple*, my testing method is basically *bathtub*, let it run for weeks and see whether and why it fails. Rinse and repeat.

# Some Takeaways 2

- *Contingent relation* between the decibels and the overflight, but *when in garden good correlation*
- Preparing tiny computers for unattended operation, anything that fills up storage is turned off, unwanted services off
- Does `systemd` do a good job on monitoring and restarts? Part of current 'research'
- `cron` driven reboots to clear everything out, but how often?

# Some Takeaways 3

- Communication always a problem, Wifi (if poss), SMS dongles (if not, temperature sensing),
- Power supply, power and SD card fails
- *Important!* Make this easy for non-tech to implement, SD image or packaging up. Hence config file, as a 'start' towards this.
- It is citizen science, not nerdy-science
- Other current IoVMT projects, particulates, temperature humidity
- Future: protocol and architecture soup see:
  Summary of Protocols

# Thanks!

- @hughbarnard
- hughbarnard.org for the slides sooner or later
- Sorry, don't do facebook, don't do linkedin