

OGN-R PilotAware Uplink – Introduction

Thank you for wanting to help expand the OGN-R Network to provide additional safety for powered aircraft and gliders alike.

To help you with the costs of upgrading or installing a new OGN-R uplink, PilotAware Ltd will whilst stocks last, provide a Raspberry Pi 2B computer, PilotAware Radio Bridge and Case FREE OF CHARGE to supporters who want to increase the OGN-R network in the UK and Europe. In addition, PilotAware will load and configure the software if required to make it even easier for you. If you want to know more contact us at <mailto:OGN@pilotaware.com>

Installing and maintaining an OGN-R antenna does not require a high level of technical knowledge. The OGN-R is a technical innovation but the highly technical parts do not need to be understood by the installer or host and step by step instructions are provided. WE will of course be available on line to help. Most of all you will be making history and its fun.

With the PilotAware subsidy an OGN-R installation will cost about £180 for the parts and will have an effective range of 30km around your site contributing to the OGN-R network.

What Parts are Required

The OGN-R uplink consists of;

1. A Raspberry Pi Single Board Computer (Pi 2B or 3B) Provided Free of Charge
2. A PilotAware Radio Bridge Provided Free of Charge
3. A Case Provided Free of Charge
4. An SD Memory Card
5. An RTLSDR software defined Radio
6. A Raspberry Pi Mains-to 5.2V 2.1A power supply
7. A simple mechanical timer
8. An Ethernet cable to connect to your existing router
9. Coaxial cable to connect the antennas to the electronics.
10. Antenna mounts to support the antennas
11. 2 External antennas available from PilotAware. OGN@pilotaware.com
 - a. **The OGN Antenna** is used to **receive FLARM** signals that are transmitted at **868MHz** from FLARM or OGN tracker equipped gliders and aircraft. This antenna is connected to the Raspberry Pi using a Software Defined receiver (SDR) connected to any one of the USB inputs of the Raspberry Pi.
 - b. **The PilotAware Antenna** is used to **transmit and receive data** to aircraft fitted with PilotAware units operating at **869.5MHz**. The PilotAware antenna is connected to the PilotAware Radio Bridge and Raspberry Pi via a co-axial cable and an SMA connector.

A list of equipment and suppliers is available from <mailto:OGN@pilotaware.com>.

Installation

The installation consists of

1. Selecting a dry location for the electronics with access to mains power and Internet.
2. Installing the external antennas at a suitable location.
3. Making up and running low loss coaxial cable from the antennas to the electronics.
4. Connecting the parts together
5. Configuring the software for the specific site.
6. Power up and test.

Location for the Electronics

- The location for the electronics should be as close to the antennas as practically possible. As short as possible but up to 10 metres is OK. This is to minimise the losses in the Co-Axial cable.
- Mains power is required within 2 metres of the Raspberry Pi for the mains to 5.2v 1.2A dc/dc converter to feed the Pi.
- The Power supply to the Raspberry Pi power supply should be via the switched mechanical timer set to be off from 23.00 to 04.00 daily. This will ensure a timely daily reboot of the system when it is not required.
- An Ethernet cable is required to connect the Raspberry Pi to the router. This can generally be as long as required.
- *If the installation is a long way from the router, then the LAN can be extended over the mains using a power line carrier device such as **devolo** which has been used successfully on several locations. <https://www.devolo.co.uk>*

Location for the antennas

- The antennas should be positioned vertically and as high as possible avoiding obstacles that would get in the way of transmission and reception. The antennas should be a minimum 3 feet apart.
- Each and every installation will be bespoke. A wide variety of antenna mounts are commercially available from Screw fix, Tool station and other suppliers. A list of typical mounts is supplied at the end of these instructions.
- The antennas come supplied with Female N-Type connectors.

Making up the Co-Axial Cables

- HDF 400 (double shielded low loss coaxial cable) or equivalent and N-Type connectors should be used for both antennas.
- This cable is fairly thick and will require a suitable Crimp tool to make off the connectors. If you are just doing the one installation, it may be cheaper to have these cables made up commercially.
- One Male and One Female N-Type connector is required for each cable.
- The Male N-type connector on the Co-Axial cable should be offered to the Female N-Type connector on the antenna and the connectors screwed firmly together. The joint should be weather-proofed using self-amalgamating tape.
- This should be repeated for the second cable

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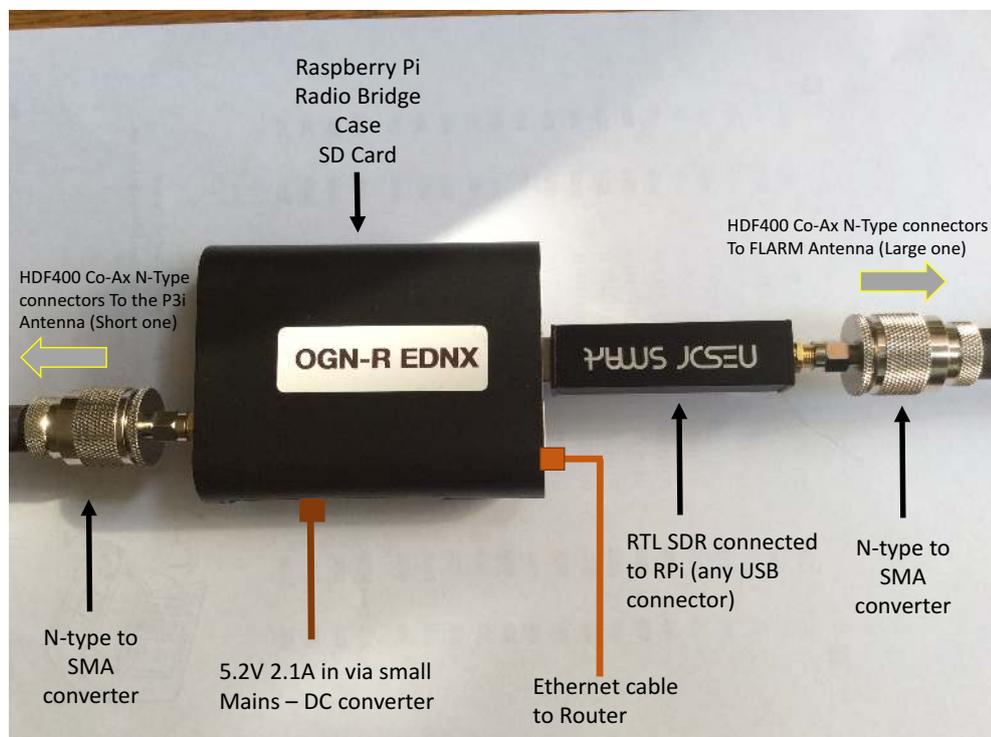
- The Co-Axial cables should then be dressed to the location of the electronics which should be as close as practically possible. (Take care that you know which cable goes to which antenna by labelling the loose ends.

Connecting the Electronics

A good tip is to mount the electronic onto a small wall board to secure the units without putting stress onto the components or cables. The cables can then be secured with cleats.

The electronics are connected to the following interfaces

1. An N Type to SMA converter is screwed firmly into the Female N-Type connector of each Coaxial cable.
2. The Coaxial cable connected to the P3i Antenna (the short one) is connected firmly to the SMA connector on the PilotAware Bridge shown on the left of the following diagram.
3. The Coaxial cable connected to the FLARM Antenna (the long one) is connected firmly to the NESDR SMART RTLSDR shown on the right of the following diagram.
4. The Ethernet cable is connected to the Ethernet port of the Raspberry Pi, with the other end connected to a free port on the local router.
5. The Raspberry Pi power supply is connected to the mains supply via the mechanical timer set to provide power between 04.00 and 23.00 hrs.
6. DO NOT TURN THE POWER ON YET.
7. Make sure that the complete set up is located firmly and that there is no bending moments on any of the components especially the NESDR SMART RTLSDR.
8. Cable cleats and other fixtures should be used to affect a neat installation.
9. The hardware is now set up.



Now you have the hardware set up you can follow the step by step instructions to download and configure the software using the following instructions. Or we can do it for you.

Locating and Naming your Site

Before downloading and configuring the OGN-R software, specific information is required about your site. These are:

1. The Location
2. The Name

Location Information

Before you start you will need to have the unique location information for your station to hand.

This information can be obtained by going to <http://schellenberg.nl/ogn/index-latlon.html> on your computer.

When the program opens, (usually at a location in Europe) drag the red marker to the desired position of your OGN-R installation and you will be given the required latitude, longitude and the height AMSL in metres and Geoidsepar. Only use the 6 digits following the decimal point for the latitude and longitude and remember that the longitude **will be -ve. West of Greenwich**. To get the Geoidsepar click the link button and use the **EMG84** value. Make a note of these values for use in configuring the software for your specific location. A matrix is provided for this on the next page.

It will look something like this.

OGN - Receiver Location Settings

Drag the red marker to the desired position!



Latitude:

Longitude:

Altitude (m): (+ antenna height ;-)

GeoidSepar (EGM2008) [Link](#)

Station Name

The Open Glider Network maintains a naming convention for all sites. Please see the rules at this link on the OGN website. <http://wiki.glidernet.org/receiver-naming-convention> However please keep your station name to a maximum of 7 characters. If it is an airfield it is conventional to give its ICAO code such as EGBW for the example of Wellesbourne. When you have configured your software, this name will be prefixed with PW ie PWEGBW.

You can record your unique configuration here.

Item Required	Description	Record Here
Station Name	See naming Rules above	
New Password	A new station password can be input to replace the generic one. Note if you forget the password it CANNOT be retrieved.	
Latitude	6 digits following the decimal point.	
Longitude	6 digits following the decimal point.	
Altitude	Metres AMSL	
Geoidsepar	Metres using EMG 64	

Downloading and installing OGN-R Software.

To make the installation as easy as possible new software has been produced that steps you through the installation process.

1. Download the latest disk image for the combined OGN/PAW software from <http://pilotaware.lode.co.uk/downloads/OGN/PilotAware-OGN.latest.zip>
2. This will download a zip file with a name similar to ***PilotAware-OGN.20180620***, into the downloads folder of your computer. The numbers after the '.' Indicate the version date.
3. Place ***the contents of this file*** of this zip file into the formatted Micro SD Card. This may require the use of an SD card holder to fit the Micro SD card into the SD slot on your computer.
4. The root of the SD card should contain the following folders
 - defaults
 - os
 - overlaysand many other files.
5. Eject the card from your computer and load the SD card into the Raspberry Pi, power up and leave for about 20 minutes to unpack and self-configure.
6. There will be a permanent red light (Power) and a flashing green light (Disc access) on the raspberry pi as this operation is proceeding.
7. You can watch the unpacking progress by attaching a TV or a monitor to the Pi via an HDMI cable. When it has finished the prompt, 'pi' will be seen. The software has now downloaded and unpacked successfully.

Configuring the Software for your Specific Location.

Shellinabox

The OGN-R software has been developed to make the installation is as simple as possible and provides 3 ways to connect to the program to configure the program for your location.

1. The most direct way to input the above data is to connect a monitor and keyboard to the Pi.
2. If you are competent, you can use a computer that is connected via a wired Ethernet connection to the router to the IP address allocated locally to your OGN-R unit which is wired to the same router.

This is usually done by typing in 192.168.0.1 and looking at the devices connected to your network. To get the actual address you may have to use an advanced menu that is password protected. See your local router instructions. For example, a Sky network router generic log in is '**admin**' and the password is '**sky**'. Then choose LAN IP Set Up. For example, if the IP address allocated for ognpaw is 192.168.0.200 then connect via 192.168.0.200:**4200**.The allocated address will vary from router to router.

3. Additionally, the **ognpaw** software has been developed so that you can run a shell from within a web browser. Google Chrome or Firefox is recommended. When connected on the same network as the Pi navigate to **https://ognpaw.local:4200/** You will probably get a prompt to say that this is insecure - ignore this and continue to the address.

With each connection type, when correctly connected, you will see the following prompts. Your response is the characters in red

```
login: pi
password: 12345678 (This is the default Password)
pi@ognpaw: $ cd rtlcdr-ogn (this changes the disc)
pi@ognpaw: /rtlsdr-ogn ./PilotAware-OGN.config.sh (this runs the configuration program)
```

You may get the message sudo: unable to resolve host ognpaw – ignore this. wait a while and if the RTLSDR is connected you will see Found 1 SDR's.

Note please make sure that the syntax is correct if it is not you will be prompted that there is an error

Now follow the instructions. You will be prompted to provide a new **Password** please do this so no one else can hack your system – they will. Record your password for posterity, it can't be recovered other than a complete new reinstall.

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You will be prompted to change the host name from (ognpaw). Do not change this so answer (n)

You will be prompted to provide a new **Name** for your ground station (Currently this is set at Coventry. Answer (y) and replace it with in your chosen name name).

You may have seen that OGN uplinks are prefixed with PW i.e. PWEBGW. You do not need to prefix your name with PW this is done automatically.

The program will require you to input the Latitude, Longitude, Altitude, Height AMSL and Geoid of your location.

Using the values gained previously from the Schellenberg app and recorded above,

Provide Station **Latitude** (change default value to the value of your station) Return

Provide Station **Longitude** (change default value to the value of your station). Return

Provide Station **Height AMSL** (change default value to the value of your station). Return

Provide **Geoid** (change default value to the value of your station) Return

The software will then install and calibrate the RTLSDR FLARM radio receiver.

This will take about 90 seconds and it will step through 0dB to 50dB.

If all is well a banner will then be shown with your configuration as shown below.

Following this it will show Starting Services. The OGN-R station is now up and running.

```
##### Summary #####
Station Name is      : pawtest1
Station Latitude is  : 52.217521
Station Longitude is : -1.758672
Station Altitude AMSL [M] is : 69
Station Altitude GEOID [M] is : 50.5038
Station SDR PPM is   : 0
Station SDR Gain is  : 45
Station SDR Freq Centr is : 923.400
##### Summary #####

Starting Services
^[[
```

Problems

- a) If the SW cannot see RTLSDR or the antenna the calibration steps through very quickly, This, usually means that there is no connection to the FLARM antenna. Suspect the co-axial cable or RTLSDR connection.
- b) The SW searches for GSM signals for the antenna and RTLSDR calibration. Therefore, you may have difficulty in capturing data in low GSM signal strength areas. So long as some data is collected this is OK.
- c) If after a successful calibration the program states that it cannot “start service”, this may be that it cannot get through the router to the internet and hence to the OGN servers. If this is the case suspect your internet connection. It may take up to 15 minutes to connect to the servers and for them to respond.

When connected to the OGN servers via the internet, it can take up to 10 minutes for the station to appear on the OGN map.

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Testing to see if Your Station is Working

Once your station has registered with the OGN servers it will be displayed on the OGN map. To check this, connect to the internet and navigate to <http://ognrange.onglide.com>

When connected, to see your site Type in PW*Name* where *Name* is the first 7 digits of your OGN-R Station Name, into the Box "Showing All Choose". This should then show your site on the map. As the days' progress, you will see all of the targets that you have captured build. Choosing PW*Name* will show the PilotAware units captured and *Name* will show the FLARM units captured. 30Km+ for PW*Name* 60Km+ for *Name* is normal. Unless you are on a flat plane this will not be symmetrical due to local obstructions etc. It will take several weeks to capture enough data to determine the range of your station.

Checking for real time data by opening the Ports

Ports can be opened for diagnostics and to check that the installation is working. Whilst connected to the same network as the pi using a modern browser such as Chrome or Safari type in.

<http://ognpaw.local:8080>

<http://ognpaw.local:8081>

<http://ognpaw.local:8082>

Note that this starts http not https ☺

Alternatively using the wired connection as in 2 above

192.168.0.n:**8080** (where n is specific to your network)

192.168.0.n:**8081** (where n is specific to your network)

192.168.0.n:**8082** (where n is specific to your network)

Using the data from the Ports to see that its working

1. **Port 8081** will show to which APRS Sever you are connected.
2. **Port 8082** will show when either PAW or FLARM targets are detected in real time.
3. The output of Port 8082 looks like this

Version 20180119 : Date 2018-02-28 22:24:22 : Station PWWilmcot

P3I Packets OK=0 NG=0

ICAO	Type	Dist(KM)	Alt(FT)	Uplink
------	------	----------	---------	--------

The instantaneous, cumulative number and type of aircraft detected will be recorded

Key	
OK	Number of confirmed targets recorded.
NG	Targets Rejected due to not meeting defined requirements.
ICAO	The ICAO of the aircraft being detected
Type	PAW or FLARM
Distance (KM)	Distance from the OGN-R station
Altitude	Altitude in feet.
Uplink	What is triggering the uplink.

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Using a PilotAware Rosetta or Classic Unit to see that its working

To check that the OGN-R station is working power up a PilotAware unit in the immediate location and you should see:

1. The OGN-R station will be recorded in the top right hand of the PilotAware RADAR Screen.
2. The OGN-R station will be shown as an ICON in the centre of the RADAR screen.
3. The PilotAware with ICAO number, Altitude and Distance will be recorded on port 8082
4. FLARM equipped targets will be shown on PilotAware RADAR and also on EasyVFR SkyDemon etc. if the Flight Bag is connected.

Other Apps

There are several Apps that can be used to show historical and real time data from your OGN-R site. On each site zoom into your local area and check your site progress.

The Open Glider Network at <http://ognrange.onglide.com>
Spot the Gliders at <http://live.glidernet.org>

Advice is also available at forum.pilotaware.com

For Advanced users

The disk image operated in a safe mode, which means it cannot normally be written in order to gain write access
\$ sudo /root/mount rw.bash
to write protect
\$ sudo /root/mount ro.bash

The software is running as a service to start/stop the service
\$ sudo service rtsdr-ogn stop
\$ sudo service rtsdr-ogn start

Updating the Software on Your OGN-R Installation

The software used on the OGN-R will be updated when improvements are made. The upgrade can often be made **without** a complete manual rewrite. Within the software is an update script that can be activated as follows

Log onto your OGN site in the normal way ie from a web browser
<https://ognpaw.local:4200>

Your input is now highlighted **in red**

ognpaw login: **pi**

Password: **put your password here (default is 12345678)**

Last login: Tue Mar 6 09:49:33 UTC 2018 from 192.168.0.4 on pts/5

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Linux ognpaw 4.4.38-v7+ #938 SMP Thu Dec 15 15:22:21 GMT 2016 armv7l
The programs included with the Debian GNU/Linux system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*/copyright.
Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.

```
pi@ognpaw:~ $ cd rtlSdr-ogn
pi@ognpaw:~/rtlSdr-ogn $
pi@ognpaw:~/rtlSdr-ogn $ ./PilotAware-OGN.update.sh
```

This script will now run

Stopping OGN Services

Mounting Disk RW

(09:54:49) FILESYS : Mount RW

Download Updates

--2018-03-06 09:54:50-- <http://pilotaware.lode.co.uk/downloads/OGN/OGN-PAW.latest.tgz>

Resolving pilotaware.lode.co.uk (pilotaware.lode.co.uk)... 212.84.169.220

Connecting to pilotaware.lode.co.uk (pilotaware.lode.co.uk) | 212.84.169.220 | :80...
connected.

HTTP request sent, awaiting response... 301 Moved Permanently

Location: <https://pilotaware.lode.co.uk/downloads/OGN/OGN-PAW.latest.tgz> [following]

--2018-03-06 09:54:50-- <https://pilotaware.lode.co.uk/downloads/OGN/OGN-PAW.latest.tgz>

Connecting to pilotaware.lode.co.uk (pilotaware.lode.co.uk) | 212.84.169.220 | :443...
connected.

HTTP request sent, awaiting response... 200 OK

Length: 1500373 (1.4M) [application/x-gzip]

Saving to: '/tmp/OGN-PAW.latest.tgz'

/tmp/OGN-PAW.latest.tgz

100%[=====>] 1.43M
3.03MB/s in 0.5s

2018-03-06 09:54:50 (3.03 MB/s) - '/tmp/OGN-PAW.latest.tgz' saved [1500373/1500373]

Install Updates

/home/pi/rtlSdr-ogn/PilotAware-OGN.config.sh

/home/pi/rtlSdr-ogn/PilotAware-OGN.monitor.sh

/home/pi/rtlSdr-ogn/PilotAware-OGN.update.sh

/home/pi/rtlSdr-ogn/PilotAware-OGN.exe

/home/pi/rtlSdr-ogn/ogn-decode

/home/pi/rtlSdr-ogn/ogn-rf

/home/pi/rtlSdr-ogn/ogn-rf.fifo

/home/pi/rtlSdr-ogn/gsm_scan

/home/pi/rtlSdr-ogn/log_dump

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```
/home/pi/rtlsdr-ogn/gpu_dev  
/usr/local/lib/libwiringPiDev.so  
/usr/local/lib/libwiringPiDev.so.2.36  
/usr/local/lib/libwiringPi.so  
/usr/local/lib/libwiringPi.so.2.36  
/usr/local/bin/GeoidEval  
/usr/local/share/GeographicLib/geoids/  
/usr/local/share/GeographicLib/geoids/egm84-30.wld  
/usr/local/share/GeographicLib/geoids/egm84-30.pgm.aux.xml  
/usr/local/share/GeographicLib/geoids/egm84-30.pgm
```

Mounting Disk RO

(09:54:51) FILESYS : Mount RO

mount: / is busy

Start OGN Services

pi@ognpaw:~/rtlsdr-ogn \$

The update has now been implemented.

Addendum

Parts and Suppliers

There are several inexpensive commercially available antennae mounts available here are just a few examples. Others are available on line to meet your specific application.

https://www.screwfix.com/p/labgear-tv-aerial-stand-off-bracket-9-90874?tc=HB3&ds_kid=92700024374092992&ds_rl=1248154&ds_rl=1245250&ds_rl=1247848&gclid=Cj0KCQiAw9nUBRCTARIsAG11eic35MmxwVB1JF2d8v2ONaZ0cGs15INBii4W0G6m0JDnaeCaNCIDrSYaAqukEALw_wcB&gclsrc=aw.ds&dclid=CImVw422ydkCFY6u7QodGllC5w

<https://www.screwfix.com/p/labgear-29935lab-tv-l-cranked-mast/21470>

<https://www.toolstation.com/shop/Electrical/d190/TV+%26+Satellite/sd3084/TV+Aerial+%26+Satellite+Dish+Pole/p39913>

<https://www.toolstation.com/shop/p69098>

<https://www.wifi-antennas.co.uk/antenna-wall-mount-kit-with-z-bend-stand-off.html>

<https://www.screwfix.com/p/labgear-29924lab-3m-aerial-mast/32094>

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Parts Required Prices and Suppliers

The parts below are recommended and do not include delivery

Part	Supplier
Raspberry Pi 2B	Free of Charge
P3i Radio Bridge	Free of Charge
Case	Free of Charge
NuElec RTLSDR	https://www.amazon.co.uk/NooElec-NESDR-SMArt-Enclosure-R820T2-Based/dp/B01HA642SW/ref=sr_1_2?ie=UTF8&qid=1533244267&sr=8-2&keywords=nooelec+rtlsdr
CoAx Cable	https://www.wifi-antennas.co.uk/hdf400-coaxial-cable-per-metre.html
N-Type connector Male	https://www.wifi-antennas.co.uk/tnc-male-crimp-connector-hdf400-cable.html
N-Type Connector Female	https://www.wifi-antennas.co.uk/n-type-female-crimp-connector-hdf400.html
N-type Male to SMA converter	https://www.wifi-antennas.co.uk/sma-male-to-n-type-male-adaptor.html
HDF 400 Crimp tool	https://www.ebay.co.uk
SD Card	https://www.amazon.co.uk/SanDisk-Standard-Memory-Label-Change/dp/B000UZLOYU/ref=sr_1_3?ie=UTF8&qid=1533245433&sr=8-3&keywords=8gb+sd+cards
RPi Charger	https://www.amazon.co.uk/Raspberry-Pi-Power-adapter-UK/dp/B01CCR5P8U/ref=sr_1_5?s=computers&ie=UTF8&qid=1533245620&sr=1-5&keywords=Raspberry+Pi+charger
Ethernet cable	https://www.amazon.co.uk/CSL-Ethernet-Gigabit-1000Mbit-compatible/dp/B00J3UYNII/ref=sr_1_6?s=computers&ie=UTF8&qid=1533245968&sr=1-6&keywords=Ethernet+cable
Mechanical timer	https://www.amazon.co.uk/PowerMaster-438242-Plug-Mechanical-Timer/dp/B007OUQB48/ref=sr_1_29?ie=UTF8&qid=1533246329&sr=8-29&keywords=mechanical+timer
FLARM Antenna	ogn@pilotaware.com
RPi Antenna	ogn@pilotaware.com