OGN PilotAware Uplink - Introduction

These instructions show how to build and install an OGN (Open Glider Network) receiving antenna and a PilotAware TxRx Antenna. This is being done to improve safety by increasing situational awareness of gliders that are FLARM or OGN tracker equipped to the local aircraft that are PilotAware equipped.

Figure 1

The finished antenna array can take several forms but here is an example of an installation at Wellesbourne Airfield. The OGN uplink is the antenna configuration on the right-hand side of the control tower. The antennas are the white tubes, in this instance mounted using inexpensive L cranked antenna mounts off an existing central post. The OGN receiver is on the left and the PilotAware transmitter-receiver is on the right.

The OGN-PilotAware Uplink consists of; a Raspberry Pi 2B computer complete with an 8GB SD card and a PilotAware Radio Bridge, located in a suitable case powered by a mains-to 5.2V 2.1A power supply and connected to the internet via an Ethernet cable.

To the raspberry Pi Computer, two antennas are connected.

1. ***The OGN Antenna*** is used to receive FLARM signals that are transmitted at 868MHz from FLARM equipped gliders and aircraft. This antenna is connected to the Raspberry Pi using a Software defined receiver (SDR) connected to one of the USB inputs. There are two options to how this is built. (i) using coaxial cable from the antenna to the internally mounted Software Defined Radio Receiver (RTLSDR), (ii) using a USB extension cable to the externally mounted Software Defined Radio Receiver. More about this later.

2. ***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.

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These antennas should be located as high as possible away from obstructions such as trees and buildings with a clear a view of the sky. Height is your friend. How you do this will be bespoke for each installation. Reclaimed scaffold poles and roofs provide good locations for the antennas.

Installing and configuring the software is an easy step by step process that does not require specific skills to implement a basic installation.

Antenna Mounts

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=Cj0KCQiAw9nUBRCTARIsAG11eic35MmxwVB1JF2d8v2ONaZ0cGs15lNBii4W0G6m0JDnaeCaNCIDrSYaAqukEALw_wcB&gclsrc=aw.ds&dclid=CImVw422ydkCFY6u7QodGlIC5w

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

Building and Connecting the OGN-Co linear Antenna for FLARM Reception

The OGN (FLARM and OGN Tracker) Receiver uses a high gain Co-Linear Antenna. This can be home-built using the instructions from the OGN Website or we have pre-ordered a batch of 25 factory-built Co-Linear Antennas. If you want one of these then please email OGN.PilotAware.com.

The RF signal received from the OGN Co-Linear antenna is connected to a Software Defined Radio Dongle and then to the Raspberry Pi via either USB extension cable or high quality Co-axial cable.
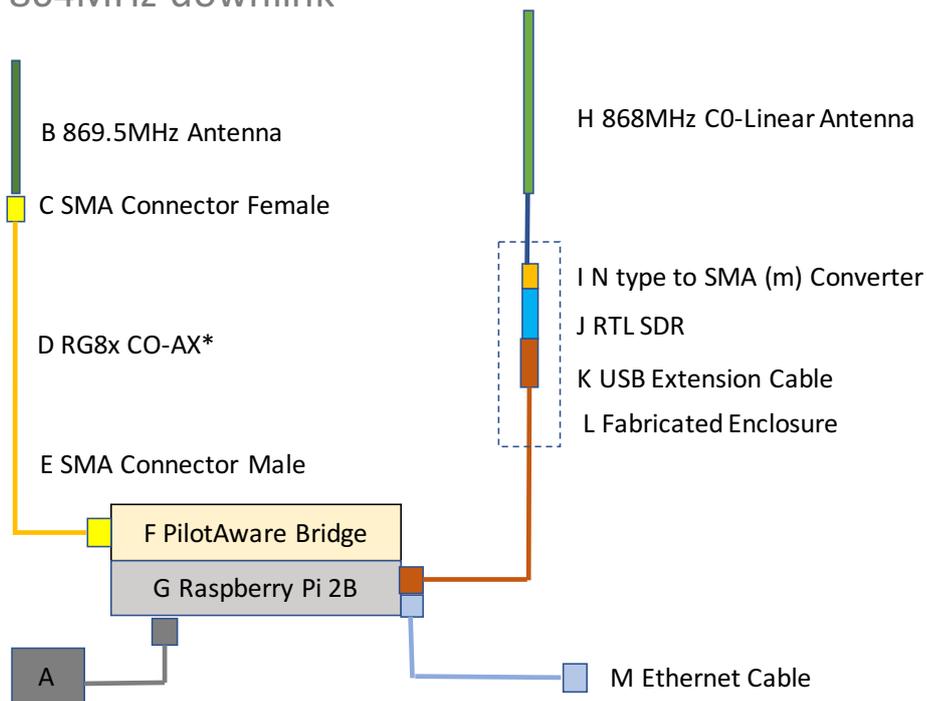
The advantage of using the USB extension cable is that the RTL SDR dongle can be located close to the antenna keeping attenuation in the co-axial cable as low as possible. This is useful if there is a longer distance (10metres) from the antenna to the Raspberry Pi. However, as the active electronics of the RTL SDR dongle and the 10M USB cable are then located outside and close to the antenna, they must be housed in a weather proof container. This container is easily constructed out of 32mm tubing and sealed with self-

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amalgamating tape. An example of how this can be fabricated is shown later in these instructions. Alternatively, for shorter runs co-axial cable can be taken directly from the co-linear antenna pigtail with the RTL SDR dongle then situated inside, connected directly to the Raspberry Pi without the need for a USB extension lead.

OGN –PAW Uplink Component Diagram 1 using a USB extension lead.

OGN – PAW Uplink using USB Extension Cable for the 864MHz downlink

B 869.5MHz Antenna

H 868MHz C0-Linear Antenna

C SMA Connector Female

I N type to SMA (m) Converter

J RTL SDR

D RG8x CO-AX*

K USB Extension Cable

L Fabricated Enclosure

E SMA Connector Male

F PilotAware Bridge

G Raspberry Pi 2B

A

M Ethernet Cable

	Component
A	Power Supply 5.2V 2.1A
B	869.5MHz Antenna.
C*	SMA Connector Female
D	RG8x CO-AX
E*	SMA Connector Male
F	PilotAware Bridge
G	Raspberry Pi 2B
H	864MHz Co-Linear Antenna
I	N type (m) to SMA (m) Converter
J	Noo Elec NESDR
K	USB Extension Cable

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L	Fabricated Enclosure	
M	Ethernet cable	
N	8GB SD Card	

- Please note if the length from the PilotAware 869.5Mhz antenna is fairly long then it is advisable to use HDF400 Coaxial cable and N Type connectors. This will be more expensive but will have less attenuation.
- This can also be used in place of the USB extension cable if it is preferred that the RTLSDR Receiver is mounted indoors next to the Raspberry Pi.

Hyperlinks to components are suggestions only. If you have better suppliers, please let us know at OGN@pilotaware.com. *If you are having difficulties getting the SMA connectors, please let us know at OGN@pilotAWare.com. as we may have a few that we can post locally.

Fabricated Enclosure for the external electronics of the OGN antenna.

The N Type (m) to SMA (m) Converter, the Noo Elec NESDR and the end of the USB extension cable that has the active electronics in it, need to be put into a weatherproof enclosure. This can be done in several ways here is a simple example.

Parts Required.

	Component
A	32mm White Plastic Tubing
B	Self-Amalgamating tape

Cut the 32mm white plastic tubing to a size convenient for your installation. This is so that it is long enough to contain the components but short enough to fit to your chosen antenna mount.

Figure I shows the components that need to fit inside the 32mm Tube, connected together. From right to left they are:

1. Co-Linear Antenna Pigtail
2. N type (m) to SMA type (M) converter
3. Noo Elec NESDL Dongle
4. Active end of the SMA extension cable

Figure 2

Before they are inserted inside the tube and it is sealed, ensure that the connections are tight and then tightly wrap the interfaces with self-amalgamating tape. This has two effects (i) to keep the components (especially the Noo Elec NESDL Dongle and the USB extension lead) attached together during the diurnal heating of the day (ii)keep condensation away from the interfaces

Figure 3 shows how the self-amalgamating tape is used to provide both a cover and a mechanical support for each connection. Don't wrap the tape around the whole length of the Noo Elec NESDL dongle as this is a heat sink and the tape will act as an insulator.

Figure 3

Now make a waterproof 'Bung' for each end of the 32mm tube by wrapping self -amalgamating tape around the exiting cable.

Figure 4

Test fit the tube as you build up the diameter of the bung as the self-amalgamating tape is quite thick and may need delaminating to reduce the size of the 'bung'.

Once a nice fit is achieved dress the outer ends of the tubing to fabricate a watertight end cap.

Figure 5

Finally fit it to the antenna mount. In this instance, the mount is an offset cranked antenna mount to go around a gable end. A hose clip has been used providing a good mechanical hold without crushing the components inside. The USD extension cable can be seen exiting to the left. The tube should be kept white so that it reflects the sunlight and minimises heat absorption.

Figure 6

Building the PilotAware Antenna for PilotAware Reception.

The PilotAware antenna is simply a standard PilotAware end fed dipole antenna (the same as is used in the PilotAware Classic unit). This also needs to be mounted at height so it is extended using 50ohm coaxial cable from the antenna to the bridge on the raspberry Pi. The co-axial cable used must be 50ohms low loss cable.

RG8x cable is good RG8 or HDF 400 cable better. RG8x cable has the advantage of being thinner and cheaper, however the RG8 or HDF cable is lower loss and thus better for longer runs. RG8x cable is easy to install and has been found to be suitable for lengths up to 10 metres. If you want the lowest loss installation, then RG8 or HDF 400 is better but you will need to use N Type connectors and an N-Type to SMA converter .

To house the standard PilotAware Antenna 25mm plastic tubing makes a good external mount. Make sure that the ends are sealed with either 25mm End Caps, self-amalgamating tape or waterproof sealant. This simple antenna the needs to be mounted vertically and as high as possible away from obstructions.

An inexpensive L cranked antenna can be used to make a mount that is offset from the OGN receiver. Instructions on how to make an L cranked Antenna can be found in the addendum to this document. Or construct in your own style and share with others.

Other Useful Hardware Links

L Cranked antenna mount   http://www.screwfix.com/p/labgear-29935lab-tv-l-cranked-mast/21470
Wall Fixing Kit   http://www.screwfix.com/p/labgear-tv-aerial-wall-fixing-kit/96275
Aerial Mast   http://www.screwfix.com/p/labgear-29924lab-3m-aerial-mast/32094

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Connecting The parts

1. Install the antennas as high as possible with as clear a view of the horizon as possible. Height is your friend. Secure the cables into the building where the Single Board Computer (Raspberry Pi) is located.
2. Attach the PilotAware Bridge to the Raspberry Pi 3 ensuring that the 40 pins are all in alignment and not offset.
3. Insert both the Raspberry Pi 3 and the PilotAware bridge into the Raspberry Pi case inserting the 4 screws provided.
4. When the software has been loaded and configured (see next section) insert the SD card into the Raspberry Pi.
5. Attach the coaxial cable from the PilotAware antenna to the PilotAware Bridge using an SMA connector. (An N-type to SMA converter or Pigtail will be required if RG8 or HDF Coaxial cable has been used)
6. Insert the RTL SDR Receiver into any of the USB sockets and connect this to either the Coaxial cable or USB extension lead, depending on which method you have used.
7. Connect the Ethernet cable to your router
8. Have the power lead ready to insert into the raspberry Pi.

Software and Configuration

You now need to load the software onto the 8GB SD card. To make the installation as easy as possible new software has been produced that semi-automates the installation process.

Use a New or reformatted 8GB SD Card

If you are using a previously used SD Card you will need to undertake a **full overwrite format** of the SD card. This will require an SD card holder to fit your PC or mac. This is available here;

https://www.amazon.co.uk/d/Computer-Memory-Card-Accessories/STOREINBOX-MicroSD-Adapter-Converter-Connector/B00S983AGG/ref=sr_1_1?ie=UTF8&qid=1498847719&sr=8-1&keywords=micro+sd+card+converter

If you don't have SD formatter program it can be downloaded here.

https://www.sdcard.org/downloads/formatter_4/

Downloading the OGN-R Software

http://pilotaware.lode.co.uk/downloads/OGN/README.install

This will direct you to download the software at

http://pilotaware.lode.co.uk/downloads/OGN/PilotAware-OGN.latest.zip

When selected the OGN-R Software will be downloaded to your download directory with a filename of PilotAware20170602 or similar, where <<20170602>> is the version dated 02nd June 2017. Don't worry the latest version will be automatically downloaded.

Copy all the files under the top folder onto the SD card. There should be 19 files. Do not just download the high-level folder as the files need to be at the highest level in the directory. Eject the CD holder and CD card and put the CD card into the **unpowered** Raspberry Pi.

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Power up the Raspberry Pi. The files will now be downloaded and the disk partitioned. This will take about 20 minutes to complete. If you want to see the progress you can connect a monitor or TV using an HDMI cable to the HDMI output of the Raspberry Pi.

Shellinabox

The OGN-R software has been developed to make the installation is as simple as possible and provides prompts for the installer to follow.

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. Only use the 6 digits following the decimal point for the latitude and longitude and remember that in the UK the longitude will be negative West of Greenwich. To get the Geoidsepar click the link button and use the **EMG84** value. Make a note of these values for future use a matrix is provide for this on the next page.

Station Name

The Open Glider Network sensibly 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

You can record your unique configuration here for convenience and record.

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.	
Latitude	6 digits following the decimal point.	
Longitude	6 digits following the decimal point.	
Altitude	AMSL	
Geoidsepar	M	

How to connect to configure the program.

1. The most direct way to input the above data is to connect a monitor and keyboard to the Pi.

2. Alternatively, you can use a computer that is connected via a wired Ethernet connection to the router and find out 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 is log in '**admin**' password '**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.

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3. Additionally, the software has been developed so that you can run a shell from within a web browser. Google Chrome or Firefox is recommended.

Connect on the same network as the Pi to **https://ognpaw.local:4200/**
You may get a prompt to say that this is insecure - ignore this and continue
When 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 rtlsdr-ogn**
pi@ognpaw: /rtlsdr-ogn **./PilotAware-OGN.config.sh**

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 reinstall.
Provide a **Name** for your ground station (Currently this is set at Coventry. Replace it with in your name).
You may have seen that OGN uplinks are prefixed with PW i.e. PWBidford. 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
Using the values gained previously 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 AMS**L (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 software defined radio receiver.
This will take about 90 seconds and it will step through 0dB to 50dB
 Following this it will show Start Services. It 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
^[{
```

a) If it cannot calibrate the antenna or this steps through very quickly, this usually means that there is no connection to the antenna. Suspect the co-axial cable or USB extension cable connection.
b) The calibration uses GSM signals so you may have difficulty in very low signal strength areas.
c) If 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.

When connecting to the OGN servers via the internet, it can take up to 10 minutes for the station to appear on the OGN map
http://ognrange.onglide.com

To see your site Type in PW*Name* where *Name* is the first 7 digits of your OGN-R Station Name

The ports can be opened for diagnostics and to check that the installation is working. Whilst connected to the same network as the pi using Chrome type in.
http://ognpaw.local:8080
http://ognpaw.local:8081
http://ognpaw.local:8082
Note that this starts http not http**s** ☺

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Alternatively using the wired connection as in 2 above
192.168.0.n:**8080**
192.168.0.n:**8081**
192.168.0.n:**8082** where n is specific to your network

Testing that your OGN-R Installation is working correctly

1. Check that you are connected to the OGN servers. This can be done by logging onto http://ognrange.onglide.com and if you are connected you will appear on the OGN Map of stations.
2. You can check if you are connected to the server by connecting to port **8081** by one of the methods above and you will see to which APRS Sever you are connected.
3. Connect to **Port 8082** and you will see when either PAW or FLARM targets are connected
4. 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
OK= The number of confirmed targets recorded
NG= The number of targets detected but 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 =

5. To check that the OGN-R station is working power up a PilotAware unit and you should see
   a. The OGN-R station will be recorded in the top right hand of the PilotAware RADAR Screen
   b. The PilotAware with ICAO number, Altitude and Distance will be recorded.
   c. FLARM equipped targets will be shown on PilotAware RADAR and also on EasyVFR etc if connected.

You can then check progress by logging on to

The Open Glider Network at   http://ognrange.onglide.com

Spot the Gliders at http://live.glidernet.org

On each site zoom into your local area and check your site progress.

For further help on upgrading an OGN receiver to an OGN 869.5 MHz Uplink please visit forum.pilotaware.com

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
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]
```

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```
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
/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

Example of how to make an L crank antenna.

How you fabricate your antenna will be bespoke to your installation however here is an example that has been used at a couple of installations where the original OGN antenna is mounted on a vertical pole.

Instructions

Using the components shown in the URL links inserted in the text.

1. Take an L Cranked antenna http://www.screwfix.com/p/labgear-29935lab-tv-l-cranked-mast/21470 such that the shorter end is vertical and the longer end is horizontal with the shorter end pointing upwards.
2. Drill a 1 cm hole in the bottom of the aluminium tube approximately 10 cm from end of the long end of the cranked antenna. This is so the coaxial cable can be threaded through the inside of the aluminium tube and the plastic tubes.

3. Cut the white 25mm tubing http://www.screwfix.com/p/tower-conduit-heavy-gauge-25mm-x-3m-length-white/2411p to 150 cm. This will act as the outer sheath of the Antenna.

4. Cut the black 20mm http://www.screwfix.com/p/tower-conduit-heavy-gauge-20mm-x-3m-length-black/7980p tubing to 142 cm. This will act as an inner strengthener and locator for the P3I antenna
5. Push and glue the 25mm Tube http://www.screwfix.com/p/conduit-couplings-25mm-white-pack-of-2/56704?_requestid=218096 connector onto the short end of the cranked antenna making sure that it goes all the way on to the shoulder in the middle of the connector.
6. Push the 20mm black tubing hard (jam it) into the short end of the cranked antenna
7. Insert and glue the 25mm tube into the 25mm tube connector, making sure that it goes all the way on to the shoulder in the middle of the connector.

8. Use 2 rivets https://www.amazon.co.uk/Am-Tech-Assorted-Rivets-100-Pieces/dp/B008CYPX3A to connect the 2 tubes, 25mm connector and aluminium together and 2 rivets to connect the 2 tubes and 25mm tube connector together. This gives rigidity to the antenna. Drill the holes first but don't rivet until the co-axial cable has been inserted.

9. Gently feed the coaxial cable through the hole, drilled in step (2), making sure that any sharp edges of the hole do not strip the outer coaxial insulation. As it feeds through the short end, use a push me pull me action until about 30cm of coaxial cable can be seen through the end of the white 25mm outer tube. When the cable is through you can line up the holes and fix the rivets at the junction between the aluminium and plastic tubes. Make sure that the rivets go through the black and white tubes and the aluminium tube. The picture below shows the cable passing between the plastic and aluminium tubes before they are riveted together.

10. Connect the female SMA connector to the antenna end of the coaxial cable (check that there isn't a short between the inner and outer conductors) and attach the P3I antenna.
11. Wrap self-amalgamating tape http://www.screwfix.com/p/self-amalgamating-rubber-tape-black-19mm-x-10m/87717?_requestid=442978 just below the female coaxial connector to make a small cone shaped bung that will fit on top of the black tube. (this will correctly locate the antenna and ensure that it is vertical). At the top of the antenna fix some foam or another packing to keep the antenna vertical.

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12. Gently push the antenna and cable back into the white tube until it locates into the top of the black tube. (gently pull the cable through the hole drilled in (2) as the antenna is pushed in).
13. Insert a plastic 25mm end cap http://www.ebay.co.uk/itm/Round-End-Caps-Plastic-Blanking-Plugs-Steel-Alluminium-Tube-Inserts-White- into the end of the outer white plastic antenna tubing.
14. Insert the long end of the cranked antenna mount into the bracket supplied and ensure that the antenna will be vertical when connected to the pole or roof. Tighten up the wingnuts.
15. For a better job replace the wing nuts with 'nyloc' nuts and then saw off the excessive bolt length.
16. To stop the aluminium tube from rotating fix a couple of rivets through the bright steel bracket and aluminium tube. Do this both sides for symmetry.

17. Finish off the bracket by tightly wrapping self-amalgamating tape around the steel bracket to weatherproof it.
18. Cut the coaxial cable to length, connect the male connector and check for continuity and low resistance of the central conductors, continuity and low resistance of the outer conductors, and open circuit between the outer and inner conductors.
19. Connect to the pole using the hose connectors http://www.screwfix.com/p/t-mex-stainless-steel-worm-drive-hose-clips-40-80mm-10-pack/67161 packing the lower edge of the bracket, if required, to ensure that the antenna is vertical. (Bolts would be better if convenient)
20. Dress the connected bracket with self-amalgamating tape to make it waterproof, covering the mild steel, hose connectors and bracket so they don't rust. Use cable ties http://www.screwfix.com/p/cable-ties-natural-300-x-4-5mm-pack-of-100/81146 to dress the coaxial cable to the pole.

If you have any questions on upgrading your OGN antenna to an OGN PilotAware Uplink, please contact OGN@PilotAware.com or for ongoing information please join and visit the forum at forum.pilotaware.com and look on the OGN thread.

Building and installing an OGN-PilotAware Uplink to detect and retransmit glider locations

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