

# Freedar.uk

## ADSB Multilateration ('MLAT') User Guide

### Table of Contents

<b>1. Introduction .....</b>	<b>2</b>
<i>Welcome.....</i>	2
<i>What is Multilateration ('MLAT')?.....</i>	2
<i>How does MLAT work?.....</i>	3
<i>Improving the availability of MLAT flight tracks .....</i>	3
<i>What is the advantage for me of setting up MLAT on my receiver? .....</i>	3
<i>Anything else? .....</i>	4
<b>2. Installing the MLAT software on your receiver .....</b>	<b>5</b>
<i>MLAT software compatibility .....</i>	5
<i>Installation on Windows computers (Windows 7, 8, 10).....</i>	6
<i>Known issues .....</i>	10
<b>Important note.....</b>	<b>11</b>

#### IMPORTANT NOTE

Freedar's MLAT network is still in Beta testing and therefore users should be aware that errors may arise and issues are still being resolved at the time of writing these instructions.

If you encounter any issues please report these on the Freedar Facebook page or via live support on the Freedar webpage.

## 1. Introduction

### Welcome

Welcome to the Freedar Multilateration (often shortened to 'MLAT') User Guide. The purpose of this document is to explain what MLAT is, how it works, and how to install Freedar's MLAT software onto your receiver.

### What is Multilateration ('MLAT')?

Unlike commercial airliners, aircraft without full ADS-B mode S transponders (for example light private aircraft or military aircraft) do not broadcast their latitude or longitude, and therefore do not automatically appear on Freedar's radar page.

The Freedar server therefore undertakes a series of complex mathematical calculations, known as multilateration or 'MLAT', of 1090 MHz ADSB transponder signals to calculate the aircraft's location by using time difference of arrival (TDOA) when an aircraft is detected across three or more receivers/ground stations.

Using MLAT, Freedar can take the aircraft's transponder-provided identification and altitude, then determine the latitude/longitude, and plot the aircraft's calculated location on the Freedar radar map.

As an aircraft must be within line-of-sight of three or more Freedar receivers, MLAT is only available inside a subset of our ADS-B coverage footprint. Often, users may be able to visually see an aircraft flying over their home or workplace, but no aircraft shows on Freedar's radar page. This is because there are not enough receivers in that area for our server to be able to calculate the position. More receivers are required in that area before the aircraft can be shown on Freedar's radar map. MLAT positions are effectively real-time, although calculation delays and processing latency is generally 4-6 seconds.

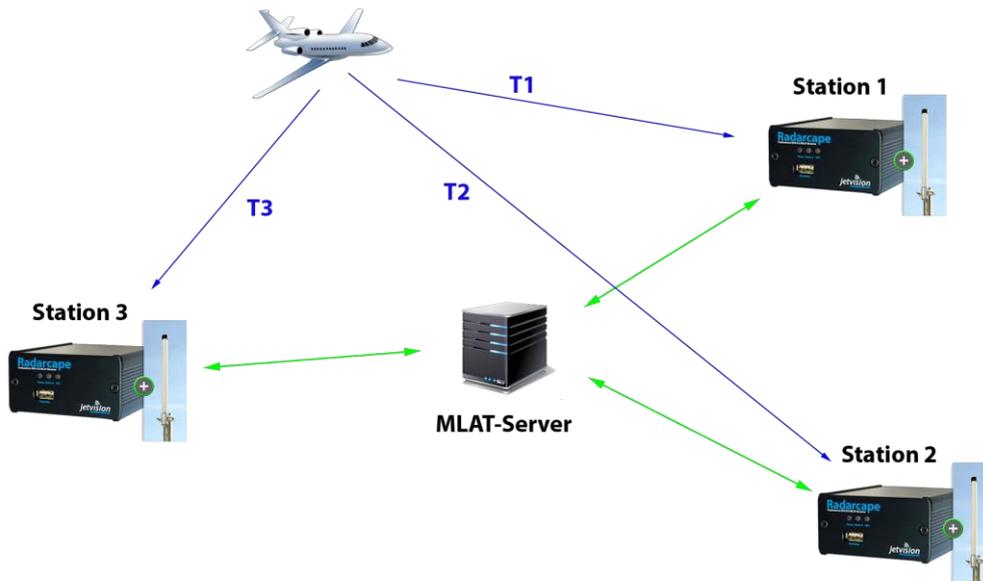


Figure 1 – MLAT example (credit to Jetvision.de). All stations need to be running the mlat-client software.

## How does MLAT work?

MLAT-enabled receivers keep the Freedar server up to date on which aircraft are being received. When a particular aircraft is being received from three or more receivers, the server requests sufficient data from the receivers to sync the time and multilaterate the position of the aircraft.

## Improving the availability of MLAT flight tracks

Many types of ADSB receivers can currently participate in MLAT. Deploying more receivers in an area will directly improve the ability for Freedar to generate MLAT positions. For optimal coverage, receivers should be 10-150 km apart and in a triangular, square, or circular pattern -- not in a straight line like along a road. Recruiting other people in your general area to host new receiver sites is the best way to grow the availability of Freedar's MLAT network.

## What is the advantage for me of setting up MLAT on my receiver?

There are two main advantages for users of setting up MLAT on your receiver.

Firstly, you will be improving Freedar's radar coverage in your area for yourself and all other Freedar users.

Secondly, Freedar provides the calculated MLAT aircraft positions back to users on port 41113 so that users can view the MLAT aircraft picked up by their receiver on their own radar, for example if users are running their own Virtual Radar Server or other similar software on their own computers. These aircraft will not be visible on your own radar program without participating in an MLAT network as these aircraft do not broadcast their locations.

In return for sending the MLAT calculated positions back to you we ask that you use these for your own enjoyment but do not distribute them to any other radar sites. Each radar site runs its own MLAT network and the results of Freedar's MLAT network are not necessarily compatible with other radar sites.

### Anything else?

Yes! Thank you for being a member of Freedar and for contributing your feed / receiver data. Freedar is built and maintained by aviation enthusiasts and we rely on volunteers to run the site and to provide data. Freedar is a not-for-profit organisation. Thank you for your support and for your interest in providing MLAT data to Freedar.

## 2. Installing the MLAT software on your receiver

### MLAT software compatibility

As Freedar's MLAT network is still in testing and is still being developed, it is not currently compatible with all types of receiver. The table below sets out the current compatibility. We are working to make the software compatible with other types of receivers.

Receiver Type	Compatible?	Notes
<b>USB DVB-T Dongle</b> <b>USB Flightaware Dongle</b>	Yes	Compatible with Windows users running Dump1090.  Raspberry Pi computers are not currently supported, unless you already have the mlat-client software installed on your Pi from another radar site.
<b>Airspy</b>	Yes	Compatible with Windows users running Dump1090.  Raspberry Pi computers are not currently supported, unless you already have the mlat-client software installed on your Pi from another radar site.
<b>Radarcape (nonFlightradar24)</b>  <b>Mode S Beast</b>	Yes	MLAT software needs to be installed on a Windows computer, connected to the Radarcape / Beast. The software should not be installed directly on the Radarcape unit itself.

<b>Radarcape (Flightradar24 branded)</b>	No	We understand that Flight Radar 24 deliberately cripple the timestamp output on their branded Radarcape units which makes the output unusable for MLAT purposes outside the FR24 network
<b>Kinetic SBS-1 or SBS-3</b>	Yes	MLAT software needs to be installed on a Windows computer, connected to the SBS unit.
<b>Airnav Radarbox / Radarbox 24 USB sticks and boxes</b>	No	Not compatible

### Installation on Windows computers (Windows 7, 8, 10)

Please follow the following steps to install the MLAT software on your computer and to connect to your receiver.

#### 1. Download the MLAT software

A ZIP file containing the MLAT software and the other required files can be downloaded from <http://mlat.freedar.uk/sync/mlat-client/Freedar%20Mlat%2064bit.zip>

#### 2. Unzip the files from the downloaded ZIP file

Double click on the downloaded ZIP file and extract all of the files to the location of your choice (e.g. onto your Desktop or in 'My Documents'). NB – all files are required in order for the software to work.

#### 3. Configure the software to connect to your receiver

We need to configure the MLAT software so that it knows what type of receiver you are using, how to connect to it, and where your receiver is located.

To do this navigate to the files extracted from the ZIP file in step 2 above. You will see a file called 'EDIT\_THIS\_FIRST\_THEN\_RUN\_THIS\_FILE.bat'. Open this file in Notepad by right clicking on the file and selecting 'Edit', or by opening Notepad and then opening this file from within Notepad (File → Open).

Once opened in Notepad, you will see some lines of code which look like this:

```
mlat-client.exe --user USERNAME --lat 51.000 --lon -1.000 --alt 100 --input-connect 127.0.0.1:30005 --input-type  
dump1090 --server mlat.freedar.uk:41112 --results basestation,listen,41113  
pause
```

This code consists of a number of 'switches' which start with "--", each followed by a value. We need to work through each item and update some of the values as follows.

Switch	Default Value	Change default value to	Notes
--------	---------------	-------------------------	-------

<code>--user</code>	USERNAME	<p>A username of your choice</p> <p>For example,  <code>--user Southend_BF</code></p>	<p>Please choose your username. For simplicity please use your town or village followed by your initials, for example Southend_BF</p> <p>Do not use any spaces or dashes ( - )</p>
<code>--lat</code>	51.000	The latitude of your receiver, in decimal degrees	<p>The lat and lon should both be in the format XX.XXX, for example 50.1234 or -1.2345.</p> <p><b>IMPORTANT: If you are West of the Greenwich Meridian remember to include the minus (-) in your longitude. If you are East of the Greenwich meridian remember to remove the minus (-) from your longitude.</b></p> <p>You can find your lat/lon and height above sea level at:  <a href="https://www.daftlogic.com/sandbox-google-maps-find-altitude.htm">https://www.daftlogic.com/sandbox-google-maps-find-altitude.htm</a></p>
<code>--lon</code>	-1.000	The longitude of your receiver, in decimal degrees	
<code>--alt</code>	100	The altitude of your receiver above mean sea level, in whole meters (no decimals)	
<code>--input-connect</code>	127.0.0.1:30005	<p>The IP address and port of the receiver, Raspberry Pi, or computer running dump1090 or other decoding software.</p> <p>If you are using a USB dongle or other receiver connected via USB, leave this value as '127.0.0.1:30005'.</p> <p>If you are using a Radarcape, Raspberry Pi or other receiver connected via a local network rather than via USB, replace 'localhost' with the IP address of the receiver, for example 192.168.0.2</p>	

`--input-type``dump1090`

4. Save and close the script If your data source is dump1090 running on the same computer as the Freedar MLAT software downloaded in step 1 above then you can keep the default values:

```
--input-connect 127.0.0.1:30005 --input-type dump1090
```

If your data source is dump1090 running on a Raspberry Pi (e.g. Flightaware, dump1090-mutability), change the IP address from `127.0.0.1` to the IP address of the Raspberry Pi on your network.

If your data source is a Kinetic SBS-1 or SBS-3 and you're running BaseStation on the same computer as the Freedar MLAT software downloaded in step 1 above then you'll need the following:

```
--input-connect 127.0.0.1:30006 --input-type sbs
```

Finally, if you have a Radarcape connected via a network connection you will need the following:

```
--input-connect 192.168.0.2:10003 --input-type radarcape_gps
```

Remember to replace `192.168.0.2` with the IP address of your actual Radarcape unit, and also remember to enable port 10003 in the Radarcape web-based settings!

Having made the changes above, please save the updated file and close Notepad.

#### 5. Run the script

The final step is to run the script. To do this simply double click on the updated 'EDIT\_THIS\_FIRST\_THEN\_RUN\_THIS\_FILE.bat' file that we updated in step 3 above.

If the script has been updated correctly in step 3 above, you should see the following screen appear after a few seconds:

#### 6. Check that the Freedar server is receiving your data

To confirm that the Freedar server is receiving your MLAT data, visit <http://mlat.freedar.uk/sync> and look for your username in the table.

If you see your username in the table, please confirm that your receiver is syncing with other receivers and shows green or yellow boxes in your column in the table. This may take a couple of minutes to appear. If the column with your username remains totally grey after several minutes, or if your username does not appear in the table at all, please verify that your receiver is receiving aircraft and that your MLAT software is set up correctly in step 3 above.

## 7. Final point

You will need to keep the MLAT software open and running to keep feeding data to Freedar. If you close the MLAT software (the black window in the screen shot above) your feed will stop and Freedar will no longer receive any MLAT data from you.

You need to run the MLAT software each time you log on or restart your computer, or set it to run automatically each time you log in.

## Known issues

### 1. Error appears – Reconnecting

If a 'Reconnecting' or similar error appears then the software has not been set up correctly and is not sending aircraft to the Freedar MLAT server. Please repeat step 3 to check that your receiver details are correct and that your receiver is supported.

### 2. Error appears - “This application has failed to start because MSVCR100.dll was not found. Reinstalling the application may fix this problem”

If this error appears then your computer does not have the necessary Windows config files on it. The config files are included in the zip file downloaded in step 1 above. Double click on the file called 'vcredist\_x64.exe'

Once this file has run and installed, try running the MLAT software again by double clicking on the updated 'EDIT\_THIS\_FIRST\_THEN\_RUN\_THIS\_FILE.bat' file that we updated in step 3 above.

## Important note

As noted above, the Freedar MLAT system is still in testing and therefore bugs can be expected. Please ensure that you have an up-to-date antivirus system installed on your computer and that you back it up regularly. We do our best to ensure compatibility of our software but with our limited resources we cannot guarantee that it will work with every single system and there may be issues that we do not yet know about at the time of writing. We are not responsible for your use of our MLAT software and are not responsible for any adverse issues caused by it. If you are not happy with these possible risks please do not install the MLAT software on your computer.