
# Report on Trial of ADS-B Obstruction Beacons on 978Mhz UAT

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## Contents

## Executive Summary

The CAA's Airspace Modernisation Strategy calls out a requirement for electronic Obstruction Beacons.

This report documents a trial of these beacons operating on 978MHz UAT ADS-B from the point of view of the operator and other airspace users. The trial was undertaken at 13 glider winch launch sites, hang-gliding/paragliding sites and model flying sites. Feedback was gathered verbally, by email and via an online feedback form from beacon operators and pilots and also from two post-trial online review meetings with beacon operators.

978MHz UAT is not currently in general use in the UK so familiarity with UAT is low. The number of aircraft equipped/configured to receive 978MHz UAT ADS-B broadcasts is limited. Going into the trial it was recognised these facts would influence the trial in terms of the general level of readiness to receive beacon broadcast data. Therefore, the main focus of the Trial was on the transmission side; on the setup and use of the beacons and proving that the beacons do function as intended.

The operational period of the trial ran for 12½ weeks, from 10th September 2022. All 13 beacons were used whenever weather conditions permitted site flying activities. Although the time of year was not ideal - this was outside of the project's control - data was successfully gathered showing examples of effective reception of broadcasts from beacons and presentation of obstacles to GA pilots on Electronic Flight Book (EFB) systems. Having been planned to run for two months, CAA requested a one month extension to the operational period of the trial, which continued until 30th November 2022.

*"Transmitting sites that are a danger to aircraft is an excellent idea, especially glider sites."*

Feedback showed that 978MHz UAT ADS-B Obstruction Beacons do deliver their function as intended and in a usable manner. This was the case even given a GA environment not especially supportive of UAT. Since the end of the trial a ***Joint Statement from CAA/DfT on the Development of a National Standard for Electronic Conspicuity*** has been published that sets out a change in policy formally introducing 978MHz UAT to the UK. This will have a material beneficial affect on the future use of these Obstruction Beacons as GA community receptiveness to UAT increases.

There are some aspects of a voluntary site-by-site broad roll-out of individual beacons which can be improved upon. This improvement would be achieved by adopting a networked approach to the 'system', with centralised coordination/management and local site operator input. Because the technologies are so closely related, the hardware could be provisioned in a form that can adapt over time to deliver other AMS aspirations for Flight Information Services (FIS). This improved architecture is the recommended implementation model for 978MHz UAT Obstruction Beacons.

Support for, and presentation of ADS-B obstacle emitter category data is variable among the various Electronic Flight Book systems and would benefit from a review.

It is possible that some obstacles would benefit from an element of scale in their definition and presentation. ADS-B line and cluster obstacle emitter categories may offer a potential solution.

# Introduction

This report documents the trial of ADS-B Obstruction Beacons on 978MHz UAT carried out in the UK by uAvionix Limited in the late summer and autumn of 2022. It describes the trial, methods, findings, conclusions and recommendations.

Although the trial was interested in the reception and display of the ADS-B Obstruction Beacon broadcasts – the entire system entails transmission, reception and presentation of the Obstacle Beacon data – the reception and presentation elements of the system were entirely outside the control on the project. As 978MHz UAT is currently unused in the UK, understanding of UAT is limited, ability to receive the broadcasts is limited and those that could potentially receive the broadcasts may not be setup to do so. Therefore, the main focus of the Trial was on the transmission side, on the setup and use of the beacons. The FAQ published for the Trial is available in Appendix F.

The trial was undertaken in support of the CAA's Airspace Modernisation Strategy, which has proposed the use of electronic obstruction beacons to warn airspace users of the location of certain aerial activities while they are in progress to enhance situational awareness and help mitigate the risk of mid-air collisions. Example activity locations are:

- Glider Winch Launching Sites
- Hang Glider & Paraglider Flying Sites
- Model Aircraft Flying Sites

The electronic obstruction beacons took the form of a ground-based 978Mhz UAT ADS-B transmitter broadcasting an ADS-B Emitter Code for a Point Obstacle, which were only activated when flying activities were in progress at the site.

The aim is that active ADS-B Obstruction Beacons would improve situational awareness for GA pilots flying in the vicinity of these sites and help reduce the risk of mid-air collisions (MAC). Studies have shown that MAC risk is high over and in the vicinity of airfields and gliding sites.

Records kept by the British Gliding Association show frequent instances of overflights while glider winch launching is underway. The Beacons can also aid UAS 'Detect And Avoid' technologies to enable UAS operations to remain clear of these sites when active. Some model flying sites are permitted to have large model aircraft up to 150kg flying sometimes at 200mph up to 1500ft AGL, and have ongoing NOTAMS issued for their operations yet still have manned aircraft passing close by.

The CAA Airspace Modernisation Strategy Support Fund sponsored this project to assess obstruction beacon functionality prior to a potential full introduction.

## Stakeholders

uAvionix worked with the aviation associations related to the three activity categories and 13 of their club sites in order to formulate and manage the trial. The associations are:

- British Gliding Association (BGA)
- British Hang Gliding & Paragliding Association (BHPA)
- British Model Aircraft Flying Association (BMFA) & Large Model Association (LMA)

BGA, BHPA and BMFA/LMA contributed to the specification of the scope of this trial.

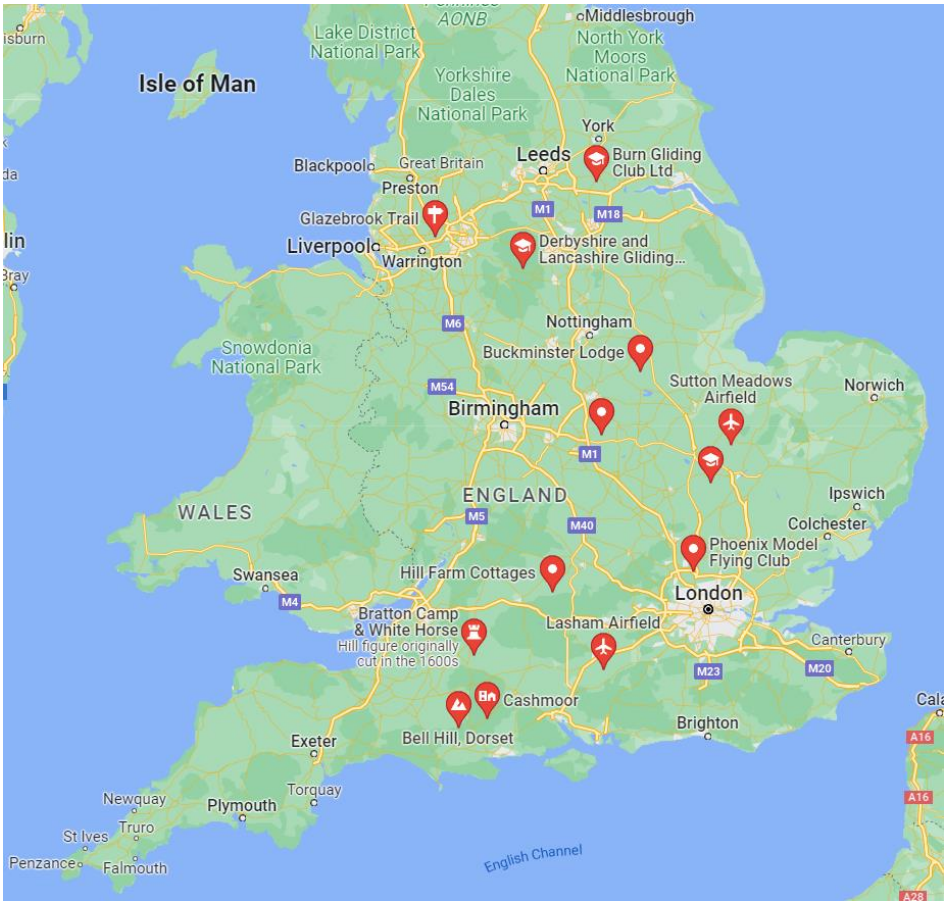
# Method

## Trial Club Sites

The participating club sites were:

| | |
|---|---|
| BGA | • Burn GC, North Yorkshire<br>• Cambridge GC, Gransden Lodge<br>• The Gliding Center, Husbands Bosworth<br>• Lasham Airfield, Alton, Hampshire<br>• Derbyshire & Lancashire GC |
| BHPA | • Challow PC, Wiltshire<br>• Wessex HGPG<br>• Avon HGPG<br>• Cambridge Aerotow Club |
| BMFA/LMA | • LMA North West Site, Culcheth, Lancashire<br>• BMFA Buckminster, Lincolnshire<br>• Wimbourne Model Aero Club<br>• Phoenix Model Flying Club, London Colney, Hertfordshire |

These club sites were recruited by the associations to give a good geographic spread.



## Technology

Each of the sites was provided with a 978MHz UAT ADS-B Obstruction Beacon transmitter, a portable 12V battery power pack to power the Beacon and a SkyEcho 2 dual frequency ADS-B transceiver. The Obstruction Beacons were pre-configured and tested prior to shipment to sites. The SkyEcho was provided to enable sites to verify their Beacon transmissions.

The 978MHz UAT ADS-B Beacons used in the trial are re-purposed uAvionix VTU-20 devices. The VTU-20 has been designed for the original purpose as an airport ground support or emergency vehicle ADS-B beacon, to enhance situational awareness of airport airside ground movements. The VTU-20 was selected for the trial for the following reasons:


- Firmware was easily adaptable to transmit the obstacle beacon configuration including the appropriate emitter category, beacon ID, and altitude offsets.
- The enclosure is inclusive of a SIL 3 aviation GNSS position source appropriate for ADS-B transmissions
- The enclosure is proven to be weatherproof, meeting environmental requirements defined in SAE J 1455 as specified in the VTU-20 User and Installation Guide.


To repurpose the VTU-20's for the trial, uAvionix amended the firmware for the trial use case. Each Beacon had its own bespoke version of the firmware, which was customised prior to delivery with the unique settings for the site where it was to be used.

## How the Beacons Worked

CAA specified that the Beacons would broadcast 978MHz UAT ADS-B messages with an Emitter Category of 'Point Obstacle'. The location broadcast by the Beacon were based on the geographical position of the Beacon as reported by the Beacon's built-in GNSS position source. The altitude broadcast was a fixed altitude in feet above mean sea level (AMSL) defined based on the operating procedures for the site, e.g. as defined in the AIP (rounded to the nearest 25ft as per the UAT standard). Placement of the Beacon was the responsibility of the site operator.

The Beacons, presenting electronically at a fixed point in space, would be there to provide pilots and other airspace users with situational awareness of the risk of collision with aerial activities at the site in the vicinity of that fixed point in space. 'In the vicinity' can mean above, below and in the area around that fixed point in space. For example, for glider winch launch sites the altitude AMSL of the Beacon broadcast were the maximum altitude of the winch launch cable, though gliders usually hope to climb higher than that after release from the cable. Model aircraft flights typically remain within the site boundaries. Hang gliders and paraglider flights may remain in the vicinity of the site or may choose to fly further afield. So the Beacons were there to offer helpful real-time situational awareness of live activities but they do not depict the full volume of airspace occupied by those flying activities.

## Technical Characteristics of the Beacon's 978MHz UAT ADS-B Messages

The following technical characteristics of the Obstruction Beacon messages were agreed with the CAA prior to the commencement of the trial.

### Emitter Category Field Encoding

The Emitter Category field was set to 19 (decimal), indicating a Point Obstacle.

### Address Qualifier Field Encoding

In accordance with DO-282, Beacons broadcast an Address Qualifier value of 5, meaning the Address Type is 'Fixed ADS-B Beacon', using a non-ICAO, state assigned unique 24-bit address.

### 24-bit Address Field

As qualified by the above, each Beacon broadcast a fixed non-ICAO 24- bit address (Hex Code). These were assigned on a fixed basis for the duration of the trial. The values used were 000001 – 00000D (1 – 13 decimal).

### Beacon IDs

Each Beacon broadcast its own unique ID. All Beacon IDs were 8 characters long. IDs conformed to the format described in the following table.

| Naming Convention for 978MHz UAT Obstruction Beacon IDs | | |
|---|---|---|
| **Character Positions** | **Value** | **Description** |
| 1 & 2 | "UK" | United Kingdom |
| 3 & 4 | "WL" | Beacon for Gliding Winch Launch Site |
| | "HP" | Beacon for Hang Gliding and Paragliding Site |
| | "MF" | Beacon for Model Flying Site |
| 5 – 8 | 4 Alphanumeric characters | Indicative of the site name |

### Spectrum Licensing

Innovation & Trial licenses were acquired from Ofcom to permit transmission on 978MHz at the 13 sites. An extra month was licensed as a contingency, which was subsequently utilised at CAA request.

### Promulgation of Information

Communications to maximise awareness and understanding among GA pilot community and other interested third-parties was undertaken via a multi-channel approach using both official and unofficial channels. The following means were used on an ongoing basis:

- AIS Briefing Sheet (see Appendix A)
- NOTAMS for all sites
- Dedicated project page on uAvionix website ( https://uavionix.com/projects/ukobsbeacon/ )
- Notices sent to all CAA Electronic Conspicuity Working Group members
- GA Magazines website and print coverage
- GA Associations website and magazine coverage
- Social Media posts (Facebook UK GA groups, LinkedIn)

Regular updates and engagement with CAA, associations and sites were maintained throughout the trial.

## Operational Period

The originally planned operational period for the trial was for two months, from 1st September 2022 until 31st October 2022. Actual start date was slightly delayed until 10th September due to equipment delivery delay in UK customs. However, this was more than made up for by extending the trial period by an additional month, to 30th November 2022. This extension was requested by the CAA AMS SF Programme Board in early October and supported by uAvionix and all the participating sites.

## Training & Setup

Site operators were provided with a user guide for the obstruction Beacons (see Appendix U) plus email and telephone assistance where requested to assist in setup and verification of the beacons.

## Operation of Beacons

Trial sites were instructed to activate their Beacon prior to the commencement of activities and deactivate the Beacon during any cessation of activities and after the conclusion of activities each day. The beacon was not to be switched on unless the site was active.

## Liaison with Electronic Flight Bag (EFB) Suppliers

Prior to the trial a number of popular EFB suppliers were contacted to advise of the trial and to request status of support for Point Obstacle ADS-B messages.

## Feedback

Feedback was solicited from the beacon operators on their experience using the beacon and from the GA community on their thoughts and any experience of the beacons. Feedback was gathered via telephone, email and online meetings plus via an online feedback form on the uAvionix website (https://uavionix.com/projects/ukobsbeaconfeedback/). Two post-trial online review meetings were also held with beacon operators.

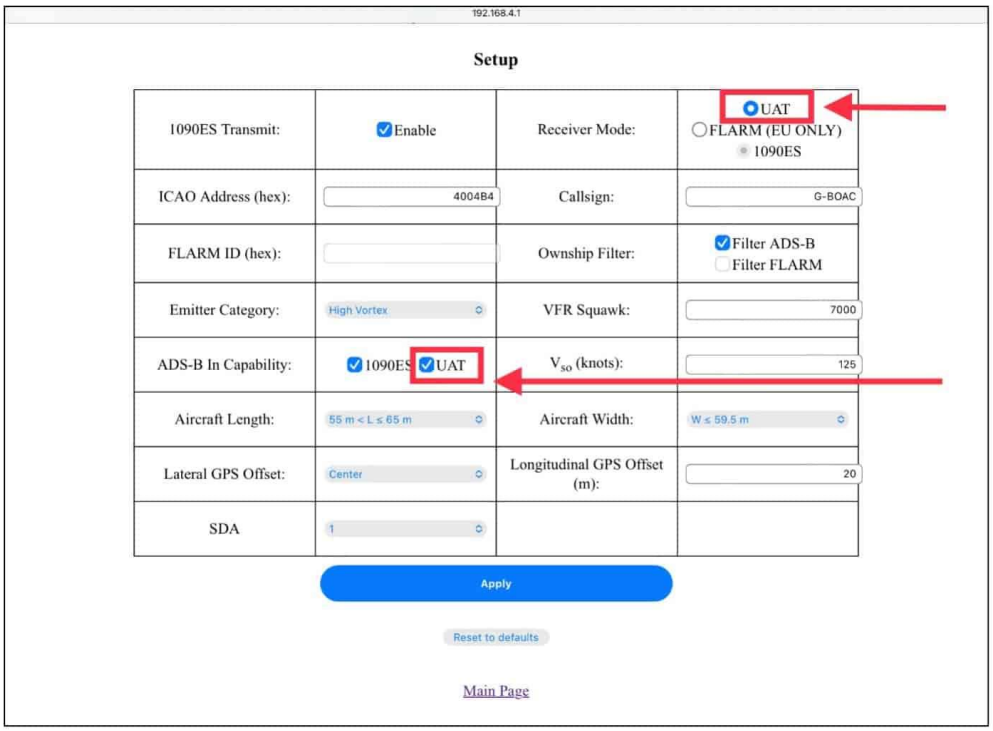
## Receiving the Beacon Broadcasts

Airspace users equipped with 978MHz UAT ADS-B In within range of these broadcasts were able to receive real-time alerting of site activity from the ADS-B Obstruction Beacon if their avionics/Electronic Flight Bag (EFB) application receives 978MHz UAT ADS-B In data and supports the display of 978Mhz UAT ADS-B Point Obstacles. Some avionics/Electronic Flight Bag applications may not yet correctly display ADS-B Point Obstacles. Gathering feedback on such matters was one objective of the trial.

The non-exhaustive list of ADS-B transceivers/receivers below can receive ADS-B In on 1090MHz and 978MHz, and were thus potentially able to receive the Obstruction Beacon broadcasts.

- uAvionix SkyEcho, SkyEcho2, SkySensor, pingUSB
- Foreflight Scout, Sentry Mini, Sentry, Sentry Plus
- Avidyne SkyTrax100B
- Dynon DRX, SV-ADSB-470, SV-ADSB-472
- GRT Discovery
- iLevil 3 & iLevil Astrolink
- Appareo Stratus 1, 2, 2S, 3
- Garmin GDL 39, 39R, 50, 50R, 52, GNX 375, GTX 345
- Dual XGPS170D
- Stratux Dual Band ADS-B receiver

The uAvionix SkyEcho 2's second receivers must be set to receive 978Mhz UAT. See SkyEcho 2 Setup screen below.




## CAA guidance to GA pilots

CAA provided the following guidance for GA pilots, which was published on the uAvionix project webpage:

> *"Pilots observing the electronic depiction of an ADS-B Obstruction Beacon during the trial, should recognise that associated flying activities are underway, assess the location and vertical extent of the activity, avoiding the immediate vicinity of the beacon in accordance with their avoidance techniques when observing the depiction of such activities on a chart or via NOTAM notification."*

# Findings and Discussion

## Online Feedback Questionnaire – Closed Question Responses

The analysis of the closed questions from the online feedback form are presented in the following table.

| Question | Yes | No | Don't Know |
|---|---|---|---|
| Do you have a good understanding of 1090MHz ADS-B?<br><br>Among this self-selecting group of respondents this shows a reasonable level of confidence in their understanding of ADS-B. | 83% | 17% | |
| Do you have a good understanding of 978MHz UAT ADS-B?<br><br>Even within the ranks of the group motivated to provide feedback, nearly one third feel they do not have a good understanding of 978MHz UAT. | 69% | 31% | |
| Do you believe your friends/colleagues/associates have a good general understanding of 1090MHz ADS-B?<br><br>This response suggests that 1090MHz ADS-B is still poorly understood in general. | 21% | 41% | 38% |
| Do you believe your friends/colleagues/associates have a good general understanding of 978MHz UAT ADS-B?<br><br>This response suggest that 978MHz UAT is likely barely understood at all in the aviation community at large. | 4% | 61% | 36% |
| Do you understand the rationale for and purpose of the 978MHz UAT ADS-B Obstruction Beacons?<br><br>This positive response suggests the AMS objective to introduce Obstruction Beacons, together with the information published for the trial is clear and comprehensible. | 100 % | 0% | |
| Do you understand what an active 978MHz UAT ADS-B Obstruction Beacons indicates?<br><br>As with the previous question, this is a positive response to the AMS objective and the published trial information. | 97% | 3% | |
| Do you understand how the 978MHz UAT ADS-B Obstruction Beacons should present to those receiving them?<br><br>Another positive response. | 86% | 14% | |
| Do you understand what pilots should do if they encounter a Beacon on their flight path?<br><br>Another positive response for the AMS objective. | 93% | 7% | |
| Do you have the means to receive alerts from the 978MHz UAT ADS-B Obstruction Beacons?<br><br>This question to pilots, again found a positive response. However, this being from the self-selecting motivated respondents may not be borne out across the wider population. | 88% | 12% | |

| | | | |
|---|---|---|---|
| Do you have the means to be presented with alerts from the 978MHz UAT ADS-B Obstruction Beacons?<br><br>Another question for pilots. Same as previous question. | 82% | 18% | |
| Have you received a broadcast from one of the 978MHz UAT ADS-B Obstruction Beacons?<br><br>Another question posed to pilots. As anticipated, actual in-flight exposure to an Obstruction Beacon was only partial among the GA pilot respondents. Nevertheless, 46% exposure was a reasonable proportion. | 46% | 54% | |
| Was the Beacon easy to use?<br><br>For Beacon operators, understanding of operating the beacons was straightforward. | 92% | 8% | |
| Was the Beacon convenient to use?<br><br>For Beacon operators, the Beacons fitted into their own procedures. | 100 % | 0% | |
| Did anyone from outside your club make mention of the Trial or the Beacon to you?<br><br>This question for Beacon operators suggests only limited spread of information among outside associates of the clubs. | 25% | 75% | |
| Do you believe the Beacon was effective in alerting airspace users to your site's flying activities?<br><br>This question posed to Beacon operators is subjective and and difficult to evidence, but a small majority of respondents assessed the beacons to be effective. Gliding and hang/paragliding sites were split, while all model flying site responses were positive. The limited preparedness among GA aircraft to receive 978MHz UAT will have had a bearing.<br><br>Some sites wondered about the consequence of the trial NOTAMs while other sites, that have long had their own separate site activity NOTAMs, dismissed this view, having past experience of the ineffectiveness of NOTAMs in warning off GA aircraft.<br><br>Effectiveness of the beacons will be improved as GA community receptiveness to UAT is boosted by the formal introduction of UAT services following the CAA/DfT publication post-trial of a joint statement on the Development of a National Standard for Electronic Conspicuity. | 55% | 45% | |
| **For those pilots equipped to detect the Beacon** | **Min** | **Max** | **Avg** |
| At what range did you first detect the Beacon?<br><br>The minimum reported detection range instance of 1nm was a single outlier. The 7.25nm average (calculated including the 1nm instance) provides sufficient prior notice for alerting, offering over 4 minutes warning for a typical GA aircraft flying at 100kt.<br><br>This exceeds the typical purely visually acquisition range of another aircraft that likely only becomes visible at 2nm range or less, offering just 72 seconds prior notice at 100kt. | 1 nm | 15 nm | 7.25 nm |

## Online Feedback Questionnaire – Free-Text Responses

The free-text responses fell into these five themes:.

| | |
|---|---|
| Communication and ease of understanding. | These comments related to the communication of information about the technology and its use. Requests for guidance and information to be presented in as straightforward, non-technical language were made. Comments suggested that whilst pilots recognise the concepts to be essential to developing and enhancing pilot safety; expectations need to be managed with clear explanation of the realistic capabilities at this time. Attention to this aspect was suggested more likely to ensure ongoing engagement and compliance.<br><br>Further, it was identified that challenges in accessing guidance regarding the beacons must be simplified. Accessibility issues combined with information presented in complex terms was felt to be a deterrent; with risks potentially heightened when some pilots perhaps mistakenly felt they had understood the scope and capability of the equipment. |
| Compatibility with other EC systems. | Comments relating to the use of alternative systems suggested both a possible lack of understanding of UAT and hesitancy in embracing a new system. Concerns were raised that this would involve a reduction in awareness of hazards. When considered alongside the equipment they currently use, the efforts which would be required to change appeared to some as not worthy of deep consideration, despite some acknowledgement that this might eventually prove inevitable should CAA policy on the use of UAT change. Some respondents did not wish to reassign the second receiver on their SkyEcho device from Flarm to 978MHz UAT. |
| Visual presentation on EFBs | Respondents commented on how the beacon is represented on the equipment they use, with one person explaining how this differed between different systems. Requests for more explicit symbols including words alongside a symbol e.g. “Active Winch”; “Active Paragliders”; contrasted with others suggesting a more simplistic approach with symbols of different colours to denote whether or not the beacon was operational, in order not to complicate the visual impact. Comments also referred to the importance of accurate altitude information alongside the beacon symbol to inform safe flying in the vicinity, with some concerns that this was not always included. |
| Operational Model | Comments from trial sites indicated appreciation for the necessity to have agreed guidelines regarding notification that the beacon was in use. However suggestions for what these guidelines should be differed.<br><br>Some pilots proposed that beacons should be permanently active. Others stated they were concerned that permanently active beacons would create unnecessary cockpit distraction. It was also suggested that leaving a beacon switched on may lead pilots to assume over time that the site users had simply forgotten to switch it off. Another suggestion was that switching off beacons could be seen as a gesture of cooperation to other airspace users, and that leaving a beacon permanently switched on may provoke suspicions of a lack of cooperation with |

| | |
|---|---|
| | others. Alternative proposals included leaving the beacon permanently switched on, but reducing the altitude to ground level when the site was not operational. |
| Acknowledgement of potential safety benefit. | Comments received demonstrated appreciation of the aims of the trial, and being party to its delivery. There was awareness amongst the participants of the potential risks associated with the different types of aircraft that could engage with the trial; alongside an appreciation of the potential safety benefits which may be gained from use of the beacon. Additionally comments acknowledged the importance of the trial in enhancing safety for all airspace users. |

## On the Ground – The Beacon Operator's Perspective

### Setup of the Beacons

All sites successfully setup their Beacon, mostly without any difficulty. One site initially fitted the beacon to a mast with the base of the beacon oriented vertically rather than horizontally, but this was quickly identified and rectified. Most utilised the portable battery as a power source. Some sites integrated the beacons into their existing onsite 12V power system. One hang-gliding/paragliding site also successfully powered their beacon from an in-car 12V power socket, with the beacon situated on the car roof.


*"The beacon itself was easy to set up and operate; it appeared to have a good range and did exactly what it was intended to do."*

As part of initial setup, onsite verification of the beacon broadcasts was undertaken utilising an EFB connected to a SkyEcho 2 ADS-B transceiver. Early on, some of the model flying clubs, due to lack of familiarity with the transceiver and EFB software, encountered some hurdles but these were soon overcome and all sites successfully verified their beacon broadcasts.

### Hardware modifications for the trial

To repurpose the VTU-20's for the trial, uAvionix amended the firmware for the trial use case. Each beacon had its own bespoke version of the firmware, which was customised prior to delivery with the unique settings for the site where it was to be used. This simplified setup and rollout for the participating sites, meaning there was no ADS-B configuration requirement for the site operators to undertake. This hard-coded, pre-configured model would not be suitable for a national rollout of Obstruction Beacons, were the trial to be deemed a success and the CAA/DfT decided to bring 978MHz UAT Obstruction Beacons into widespread use.

For the trial, switching on and off the Beacon was a site operator responsibility and, in this pre-configured form, their only concern was applying power to, or removing power from, the device.

## Firmware and Beacon configuration

Bespoke hard-coded firmware is clearly not a flexible system. A basic user-controlled system would utilise a programming mechanism whereby the Beacon user would be able to set some of the Beacon characteristics. Emitter Category would be fixed but Beacon ID and altitude would be programmable by the user.

Some naming convention rules could be imposed to ensure compliance with a defined format, but it would not be possible to prevent Beacon ID duplication with another site.

Altitude entry validation could be imposed to ensure the set altitude was below a pre-define limit, say 5000ft AGL, 5000ft above device GNSS altitude, or whatever limit was deem appropriate

It would not be possible to validate that the correct Beacon ID or altitude had been set for the site where the Beacon was to be used.

## Operational Procedures

Unsurprisingly, with sites for three different types of airborne activity, site operational procedures varied, so each site integrated beacon operational procedures in a manner that best suited them. A few sites, with constantly changing responsible personnel, encountered minor issues achieving consistent activation/deactivation discipline, but most had no concerns. Sites with a single fixed installation location or with reliance on fewer people to activate/deactivate the beacons had advantage in this respect.


Some of the hang-glider/paraglider clubs operate from multiple sites, e.g. different nearby hillsides for different wind directions, which is an additional factor affecting operations for them.

## Effectiveness of the Beacons

Some sites wondered about the consequence of the trial NOTAMs while other sites, that have long had their own separate site activity NOTAMs, dismissed this view, having past experience of the ineffectiveness of NOTAMs in warning off GA aircraft. In permanent use NOTAMs would not be issued.

> *"A noticeable reduction of low level overlying .most aircraft diverted around us and those who went overhead were higher than normal. We used the flight radar app to check the height of aircraft to be sure our assumptions about them being higher and above our 1500ft ceiling was correct."*

*"Our major concern it now the beacon is switched off pilots may assume our activities are no longer taking place and therefore there could now be an increased risk of an Airprox.*

*We would prefer it if the beacon could become a permanent fixture as it clearly worked and we are concerned about the risk increasing now it is switched off."*

*"I was impressed with [the beacon] and can see it could be very useful. We have some military activity in our location and it's unclear if the military are equipped to receive it? No aircraft encroached on the flying site for the duration of the trial but cause and effect are difficult to determine."*

### Suggested Improvements

It was suggested that the ability to laterally offset the electronic obstacle from the physical device, in a fashion not dissimilar to how TIS-B works, would be advantageous, especially for hang/para-gliding clubs, where they would benefit from a permanent beacon installation that could be selectively configured to broadcast an electronic obstacle for one of a set of nearby locations ( e.g. alternate local hillsides chosen based on the day's flying conditions).

Another suggestion was for beacons that could run 'off-grid' supported by battery, solar charger and mobile phone network connectivity, providing remote control.

## In the Air – The Pilot's Perspective

### Beacon broadcasts

The trial has successfully demonstrated that GA pilots with appropriate equipment have been presented with obstacle information from the beacons at range sufficient to take avoiding action. The average reported range of first detection was 7.25nm.

### UAT reception devices

A list of devices known to support UAT is presented above and in Appendix F. During the trial the following devices were reported to have successfully received Obstruction Beacon broadcasts:

- Garmin GDL50
- uAvionix SkyEcho 2

SkySafe was reported not to have passed details of the Obstruction Beacon to SkyDemon.

## EFB/EFIS support for ADS-B Obstacle Beacons

It has been confirmed that the current version of SkyDemon presents ADS-B Obstruction Beacons (Point Obstacles) as a white 'obelisk'..

*"When it was turned on during our flying on the 14th September it was detected by one of the local microlight pilots who was using Skyecho on an iPad using SkyDemon."*


SkyDemon

Contacted prior to the trial, EasyVFR, SafeSky and RunwayHD all advised they were adding full support for ADS-B Obstruction Beacons (Point Obstacles) but this was not confirmed during the trial. Foreflight advised that they present ADS-B Obstruction Beacons but do so using a default symbol (not as an obstacle), however they stated that addressing this is on their development list. As can be seen, this is a developing area. Garmin 660 and G3X devices were reported to present the Obstruction Beacon as a black diamond (note the green dotted trail that gives the impression of movement).

*"The Presentation on each device was different and screen shots have been provided. None displayed the symbol for an obstruction. RunwayHD and EasyVFR displayed Aircraft Symbols. The Garmin display presented a black diamond which the manual identifies as a non threat, non directional traffic. Each of the presentations therefore show an airborne target and as I was at 2000ft and the traffics was displayed with a height diff of 1500 to 1900 ft above me suggested that I was safe to continue on track as I would pass beneath the obstacle and have a large height safety margin. The clearance altitude for Lasham UKWLEGHL is 3200 feet and so at 2000 ft I would have flown through the cables."*


EasyVFR


Garmin 660


RunwayHD

## Use of Line Obstacle and Cluster Obstacle Emitter Categories

The ADS-B Point Obstacle emitter category data describes a single point in 3D space, meaning that the Point Obstacle has no size or volume. It has been shown that EFBs may not recognise a threat when an aircraft flies sufficient distance directly underneath a Point Obstacle. It may be that this can be addressed by considering the use of the Line Obstacle and/or Cluster Obstacle ADS-B emitter categories. These will be a little more complex to define and configure so clear policy would need to be put in place for their use.

### 978MHz UAT vs 1090MHz

The reason for broadcasting the Obstruction Beacons on 978MHz UAT was explained in the trial publicity. Nevertheless, a number of pilots questioned why 978MHz UAT ADS-B was being used. Comments were also made about not wishing to reassign the second receiver on their SkyEcho device from Flarm to 978MHz UAT. The CAA policy and stakeholder engagement that follows from the ***Joint Statement from CAA/DfT on the Development of a National Standard for Electronic Conspicuity*** will need to address this.

### Trial NOTAMs

Some comments queried whether the NOTAMs published for the trial would themselves have influenced GA pilots to avoid the trial sites. No feedback was received from any pilot stating that they had avoided the sites for this reason.

### Detection Range

The detection range reported by pilots in the trial averaged 7.25nm, maximum 15nm. This is the pilot's reported range from a beacon when the pilot first noticed presentation of the beacon on their display.

The modelled range for a UAT transmitter of the power of the VTU-20 is of the order of 80-100miles. Successful reception of beacon broadcasts requires line of sight between the transmitter and the receiver. The actual detection range is thus very much affected by a number of factors, including the broadcast antenna placement, surrounding terrain, obstructions, altitude of the receiving aircraft, antenna location in/on the receiving aircraft, and any masking from airframe structure or occupants.

### Additional Use Cases

Beyond the three use cases already proposed, additional potential Obstruction Beacon use cases have been identified for airborne risks.

Parachute drop zones are an obvious one. A less obvious use case that was suggested by an operator in this field was for specialist drone operations that may not be able to carry their own electronic conspicuity capability. The specific case in point is small UAVs used for meteorological data gathering. Working on behalf of the Met Office, these small UAV will be performing flight profiles that climb directly upwards to 10,000ft and descend directly too, sensing atmospheric weather conditions as they go.

Furthermore, these Obstruction Beacons may offer a solution for more conventional ground-based obstacles such as cranes, wind turbines and oil rigs.

## Considerations for an Enhanced Obstruction Beacon System

### Suitability of the VTU-20 form factor for production beacons

As the VTU-20 was originally designed for fitment on the roof of a vehicle it may work well for some sites with similar fitment requirements, e.g. on the roof of a building or caravan. It may not be an ideal match for some other sites, e.g. use on the ground. uAvionix considers a more appropriate form factor would resemble the uAvionix pingStation3 for mast-mounted installations.

### Risks to deploying current trial solution as a broader roll-out

Were the CAA/DfT to seek to allow sites to individually purchase obstacle beacons and provide funding in the form of a rebate similar to the existing Electronic Conspicuity rebate scheme, some risks are foreseen:

*Inconsistent configuration*

By leaving individual device configuration up to each site, the risk of misconfiguration of systems is high. As a parallel comparison, configuration of certified ADS-B OUT solutions for aircraft and airports is required to be configured and approved by certified installers and verified by test sets. In the U.S., uAvionix has a large customer base in the experimental aircraft market who are able to configure the devices themselves. Our support team can attest that a much higher instance of equipment misconfiguration occurs with this population.

*Inconsistent management of spectrum licensing*

978MHz remains aviation protected spectrum, which is a benefit for the intended use. However, dispersed responsibility for management of the frequency licensing will likely devolve over time. Individual site points-of-contact (POCs) will change and individual site lessons learned will need to be relearned. POCs will be required to work with OFCOM to apply for, purchase, renew, and monitor each site license.

*Inconsistent use*

If each site is individually configuring, enabling and disabling beacons, incorrect configuration can occur and it is possible that individual site owners may establish differing standard operating procedures (SOPs) regarding daily use. Some operators might leave beacons on indefinitely while others enable/disable daily. Different site POCs may behave in differing manners at the same site location from day-to-day. This would present an inconsistent “air-picture” to the intended recipient, the GA community, and unintended consequences may occur such as a pilot ignoring a beacon that is “always on” because it presents a consistent “false alarm”, or a pilot assuming behaviour is consistent from one site to the next over the course of a cross-country flight.

*Lack of monitoring or data logging*

In the event of an accident or near-miss, the ability to definitively confirm that the beacons were on or off would aid in the AAIB investigation. Without reliable monitoring and logging solutions, this benefit would be lost. Automated monitoring and logging could also be used to manage consistency of use at each site or across sites.

*Insecure sites, vandalism and theft*

Some concerns were been raised about vandalism and theft. The nature of many sites means they are inherently insecure and have suffered theft and damage from vandalism in the past.

*Manufacturer considerations*

While recognising that the current beacon form factor and firmware are not perfect for a broader roll-out, business considerations such as market size and return on investment come into play. While it is understood that there are upwards of 2000 potential sites across the UK, the purchasing decisions are made by each individual site and are voluntary. This presents a business risk to any manufacturer needing to invest in development of a new product.

### Optimising the solution – a centralised service

In order to avoid the risks identified above, it is suggested CAA consider a managed service of the obstacle beacon capability. As a managed solution, hardware, network services via LTE/GSM, centralised monitoring, and centralised spectrum license management would all be provide. The provider would be

incentivised to ensure the solution is efficient from a deployment and support perspective, as well as ensure sites are consistently managed and operated.

*A managed network of Obstruction Beacons*

Although in this scenario they could still, where required, be activated/deactivated by site operator direct action, there is the potential to design an Obstruction Beacon system where the beacons are network accessible with a system-wide network management capability offering centralised control.

Features such as these would be entirely feasible:

- Beacon ID's and altitude could be configured and assured by a centralised management function.
- Centrally managed activation/deactivation capability driven by locally defined schedule.
- Where advantageous, site operators could also be provided with a secure internet interface to facilitate remote real time activation/deactivation.
- GPS position validation to ensure beacons were only activated in the correct locations.
- Central management of remote firmware updates could be applied, enabling future enhancements to functionality.
- For insecure sites, hardware could be located at off-site but nearby secure locations.
- As well as the current altitude offsetting, a lateral offset could be used to position the electronic ADS-B Point Obstacle over the correct location.

Network access to beacons would be via broadband where available or else via mobile phone/LTE network. Systems adaptable for this purpose already exist.

*Readymade nationwide platform for additional functions*

A thousand plus unit deployment could provide the platform for the delivery of additional new AMS infrastructure. For instance, the unit hardware design could be UAT TIS-B/FIS-B capable as well, such that they could be incorporated (by remote firmware updates) into future infrastructure service deployments to augment coverage.

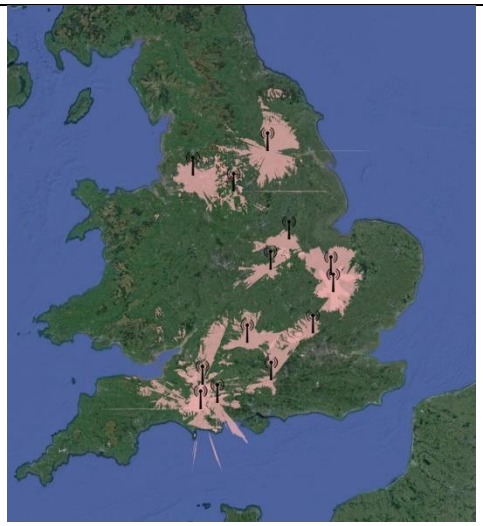
*Service provision, not hardware*

Viewing this deployment as a Network Service Provision, rather than the acquisition of thousands of individually purchased and locally managed hardware units, opens the door to deliver maximum capability, safety enhancement and value optimisation.

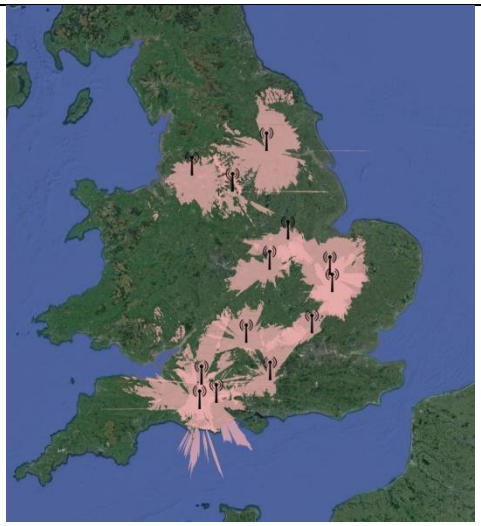
For instance, as a Network Service Provision, alternative financial arrangements could be considered, e.g. as a lease service with perpetual warranty. This could offer greater and more direct accountability to the CAA.

*Service Coverage*

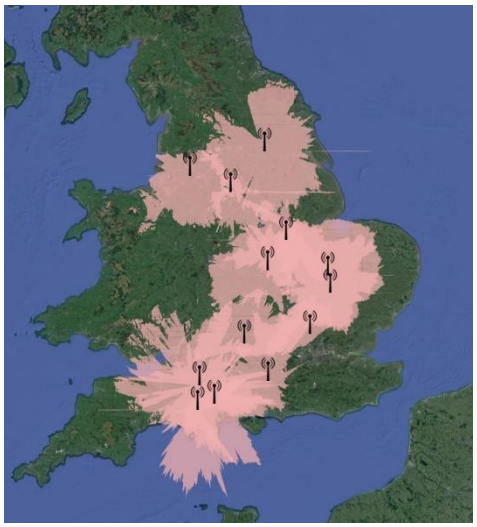
As an illustration, the maps below show in pink the 'viewshed' (i.e. the coverage area in line of sight of transmitters) from the locations of all the 13 sites in the trial, with an assumed maximum transmission range of 80 miles for aircraft at altitudes of 200ft, 400ft, 1000ft, 2000ft, 3000ft and 5000ft.



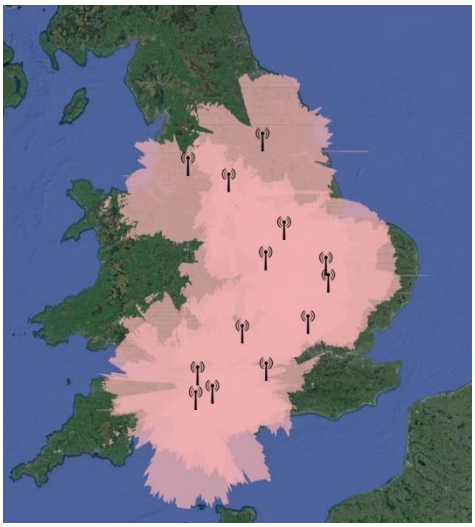
Viewshed at 200ft



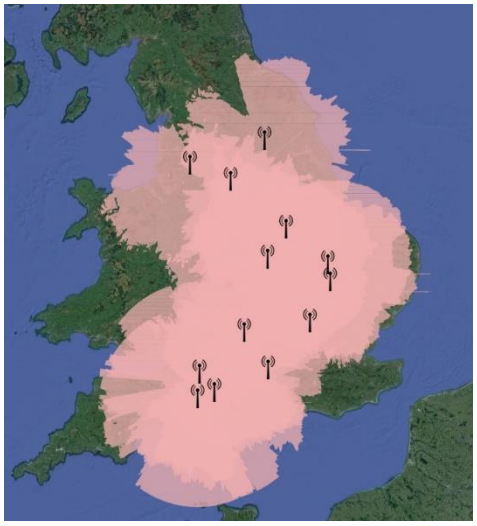
Viewshed at 400ft



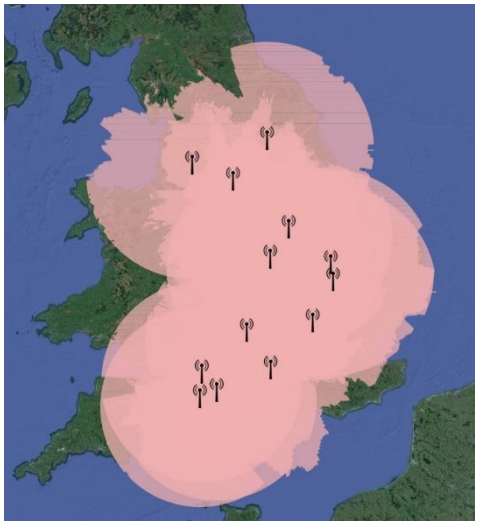
Viewshed at 1000ft



Viewshed at 2000ft



Viewshed at 3000ft



Viewshed at 5000ft

As can be seen, the lower the altitude coverage required, the more broadcast antennae are required. All the above maps assume a broadcast antenna mast height of 30ft AGL. This not representative of the broadcast antenna heights AGL used in the trial, where antennae were placed as best possible by the site operators on top of any existing site infrastructure, e.g. buildings, portacabins or caravans, or on top of vehicles.

## Conclusions

The conclusions from the analysis of the Trial findings are as follows:

1. The trial findings validated the prior expectation that awareness and understanding of UAT in the UK GA community will need to be bolstered if the CAA's AMS UAT aspirations are to be met.

2. The trial has proven that UAT obstruction beacon broadcasts can be received at sufficient range to give meaningful situational awareness of the aerial activity being notified.

3. By formally introducing the use of UAT in the UK, the Joint Statement from CAA/DfT on the Development of a National Standard for Electronic Conspicuity will serve to strengthen the aims of the AMS and the effectiveness of the UAT obstruction beacons.

4. Inconsistent support and presentation of the ADS-B point obstacle emitter category across the various EFB systems is an unfortunate impediment.

5. EFBs that do recognise point obstacles typically treat them just like other traffic, i.e. it is possible to fly 'underneath' an obstacle without triggering a warning. This behaviour is incongruent with the obstruction beacon use cases proposed by the AMS. Line and/or cluster obstacle emitter categories with appropriate height values may help to address this.

6. EFBs that recognise the Point Obstacle emitter category treat them like any other ADS-B conspicuous airborne traffic, rather than as an obstacle attached to the ground, such as a glider winch cable.

7. There are additional use cases for Obstruction Beacons that are worthy of consideration, e.g. parachute drop zones and more conventional ground-based obstructions such as cranes and wind turbines.

8. There are valid circumstances where the ability to remotely control or schedule the activation/deactivation of beacons would be beneficial.

9. A TIS-B style capability where one physical beacon can selectively broadcast multiple nearby electronic beacons has the potential to deliver maximum flexibility. This would enable beacon transmitters to be physically positioned in optimal locations while ‘casting’ their electronic obstruction beacons to their required location.

10. From an architectural perspective, a managed system of network-connected UAT beacons would deliver a more robust, resilient and flexible system that can adapt to the future needs of the AMS.

## Recommendations

The conclusions from the Trial lead to the following recommendations:

1. CAA should proceed with the development of a plan to introduce 978MHz UAT Obstruction Beacons and the necessary supporting policy and stakeholder engagement.

2. The implementation should be architected on a service-based managed system of network-connected UAT obstruction beacons. This will provide the optimum solution for the immediate obstruction beacon requirement whilst putting in place a platform that would deliver additional AMS UAT services.

   As opposed to outright hardware purchases with the attendant drawbacks of disparate local maintenance, monitoring and variable levels of operations standardisation, a Service Contract model with a service provider taking responsibility for availability, reliability, standardisation, and safety assurance would provide higher service levels and better overall value for money.

3. Consideration should be given to the use of all three ADS-B obstacle emitter categories - point, line and cluster - to provide a wider range of options to define the scope of obstacles.

4. CAA should engage with EFB software providers on support for ADS-B obstacle emitter categories to seek alignment with the needs of the AMS.

## Appendix A - AIS Briefing Sheet

# BRIEFING SHEET

## UNITED KINGDOM

UK Aeronautical Information Services
NATS Swanwick
Room 3115
Sopwith Way
Southampton SO31 7AY
aissupervisor@nats.co.uk
http://www.nats.aero/ais
uk978uat@uavionix.com (Content-CAA Airspace Regulation)

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Civil Aviation Authority

## TRIAL OF 978 MHZ UAT ADS-B OBSTRUCTION BEACONS AT 13 GLIDER, HANG/PARAGLIDER AND MODEL FLYING SITES 01 SEPTEMBER 2022 – 31 OCTOBER 2022

1. Between **01 September 2022 and 31 October 2022**, a trial of ground-based 978 MHz Universal Access Transceiver (UAT), ADS-B Obstruction Beacons will take place at 13 locations across England. 5 locations are glider winch launch sites, 4 locations are hang gliding and paragliding sites, and 4 locations are model flying sites.

2. The ADS-B Obstruction Beacons will broadcast as ADS-B Point Obstacles at fixed altitudes (FT AMSL) according on the operational procedures of each site to provide electronic conspicuity of site's aerial activity to enhance situational awareness. The altitude to be broadcast by each ADS-B Obstruction Beacon is listed in the table below. Each ADS-B Obstruction Beacon has a unique digital identification, which will be included in the broadcast from the beacon. The ADS-B Obstruction Beacon identifications are also listed in the table below.

3. The trial is approved by the CAA to evaluate digital Flight Information Service provision as part of the Airspace Modernisation Strategy and is being managed by uAvionix in collaboration with the British Gliding Association, British Hang Gliding & Paragliding Association, and the British Model Flying Association/Large Model Association.

4. The ADS-B Obstruction Beacon at a particular site will only be activated during periods of flying activity at that site. Activation of the ADS-B Obstruction Beacon may take place at any time.

5. Airspace users equipped with 978 MHz UAT ADS-B IN and within range of these broadcasts should be able to receive real-time alerting of site activity from the ADS-B Obstruction Beacon if their avionics/Electronic Flight Bag application receives 978 MHz UAT ADS-B IN data and supports the display of 978 MHz UAT ADS-B Point Obstacles. Some avionics/Electronic Flight Bag applications may not yet correctly display ADS-B Point Obstacles. Gathering feedback on such matters is one objective of the trial.

6. Further information is available here: https://uavionix.com/projects/ukobsbeacon/.

7. Feedback on airspace user's experience of the trial is welcome and maybe submitted here: https://uavionix.com/projects/ukobsbeaconfeedback/.

8. Email contact details for the trial: uk978uat@uavionix.com.

## Appendix B – Beacon IDs and Altitudes

| Site | Beacon ID | Obstacle Altitude Broadcast (AMSL) |
|---|---|---|
| Burn GC | UKWLBURN | 3100ft |
| Cambridge GC | UKWLCAMB | 3300ft |
| The Gliding Center | UKWLHUSB | 3500ft |
| Lasham Airfield | UKWLEGHL | 3625ft |
| Derbyshire & Lancashire GC | UKWLDLGC | 3400ft |
| Challow PC | UKHPCHAL | 1300ft |
| Wessex HGPG | UKHPWESS | 2800ft |
| Avon HGPG | UKHPAVON | 2800ft |
| Cambridge Aerotow Club | UKHPCAMB | 2000ft |
| LMA North West Site | UKMFLMNW | 475ft |
| BMFA Buckminster | UKMFBUCK | 1950ft |
| Wimbourne Model Aero Club | UKMFWIMB | 1840ft |
| Phoenix Model Flying Club | UKMFPHOE | 1775ft |

# Appendix F – Frequently Asked Questions

The following FAQ for the 978MHz UAT ADS-B Obstruction Beacon Trial was published on the uAvionix website during the trial ( https://uavionix.com/projects/ukobsbeacon/ ).

### Why is this Obstruction Beacon trial being undertaken?

The CAA's Airspace Modernisation Strategy (AMS) outlines a range of new digital flight information services, including FIS-B and TIS-B (Flight Information Service – Broadcast and Traffic Information Service – Broadcast). ADS-B Obstruction Beacons are another element of these digital flight information services. Several GA representative organisations have requested that CAA investigate additional methods of promulgating their particular activity. The CAA and DfT have welcomed the trial of ADS-B Obstruction Beacons as a potential method of enhancing safety around these operations.

### Why are ADS-B Obstruction Beacons being considered in support of particular operations?

Notifications of winch cables continue to be missed or ignored by pilots despite existing methods of promulgation. The British Gliding Association (BGA) have requested that the CAA attempt to seek addition means of warning of the presence of winch cables.

Large model flying sites are not routinely depicted on charts but may be listed in the AIP. Notification of planned activity at these sites is normally subject to a NOTAM but again is occasionally missed or ignored by other airspace users. In the case of large models operating in close proximity to a single location, it is not necessary or desirable to make each individual model electronically conspicuous and therefore a generic electronic warning of the presence of these air systems (obstruction) at a point location is what is being evaluated by the use of an ADS-B Obstruction Beacon in these circumstances.

Some hang glider/paraglider launch sites are notified and depicted on the charts but the actual use of the location may not be subject to individual NOTAM. The deployment of a beacon in this case is to act as a notification that launching is taking place at that location and time. Again, it is not intended to replace or supplement electronic conspicuity on individual air systems.

### What is the aim of deploying ADS-B Obstruction Beacons and the aim of the trial?

The aim of deploying an ADS-B Obstruction Beacon would be to supplement and support the existing notification and promulgation of a range of activities at fixed locations with an additional electronic marking.

The aim of the trial is to test and evaluate the practicalities and performance of deploying and operating a battery powered ADS-B Obstruction Beacon in support of a number of different use cases.

### Is this ADS-B Obstruction Beacon trial being conducted by the CAA?

No. The trial is being conducted by uAvionix to evaluate one aspect of digital Flight Information Service provision as part of the AMS Concept of Operations. This is not a CAA trial but is supported by and forms part of the evaluation and deployment of the Airspace Modernisation Strategy.

Each trial location is NOTAM'd. Each NOTAM references an AIS Briefing Sheet giving a basic overview of the trial and contains links to detailed information including the purpose and objectives of the trial hosted by uAvionix. The site also hosts an opportunity to provide feedback/user experience which will be gratefully received.

### How can I access the AIS Briefing Sheet for the Trial?

The AIS Briefing Sheet for the Trial is available here:

https://nats-uk.ead-it.com/cms-nats/export/sites/default/en/Publications/briefing-sheets/TRIAL-OF-978-MHZ-UAT-ADS-B-OBSTRUCTION-BEACONS-AT-13-GLIDER-HANG-PARAGLIDER-AND-MODEL-FLYING-SITES-1-SEPTEMBER-2022-31-OCTOBER-2022.pdf

### Who is funding the trial?

The trial is being funded via the CAA's Airspace Modernisation Strategy Support Fund.

The Airspace Modernisation Strategy Support Fund is funded through the UK State overflight charging mechanism (en-route unit rate) for commercial air transport. It was established as part of the UK RP3 performance plan, and we expect provision to continue in to a new UK performance plan for the period 2023 to 2027, known as "NR23".4 The fund will be collected through the CAA element of the en-route unit rate and administered by the CAA through suitable governance arrangements.

### Who do you want feedback from?

We want feedback form any and all relevant stakeholders, no matter who they are. Feedback on the trial may be provided here: https://uavionix.com/projects/ukobsbeaconfeedback/

### Besides light aircraft and microlights, who are the ADS-B Obstruction Beacons aimed at?

The tactical real-time electronic notification of these 'obstructions' may be useful to a whole variety of operators and systems including low level military operators, emergency services helicopters, and other air systems wholly or partially reliant on detect and avoid to integrate with other airspace users.

### Why are the beacons operating on 978MHz UAT?

To avoid saturation of 1090 MHz these new (to the UK) digital services, together with certain new categories of air system, are likely to be assigned an alternative frequency.

For the purposes of this trial, and pending any other formal announcement, this frequency/mode of operation is 978/UAT. The eventual range of services and air systems utilising the alternate frequency/mode is going to be far broader than just electronic obstruction beacons.

### How were the Trial sites selected?

The Trial sites were nominated by the participating General Aviation organisations.

### Why are the Trial sites NOTAM'd?

Each trial site location has been NOTAM'd purely for the purposes of the trial, i.e. to provide notification of a radio transmission within the aviation spectrum that may, when received, generate an alert and/or depiction on existing aviation systems. It is for this reason that these NOTAMs have been issued.

### If widely adopted, would use of ADS-B Obstruction Beacons be NOTAM'd?

No. Should the concept of ADS-B Obstruction Beacons be widely adopted then the location of each beacon would be notified in the AIP. The operation of that beacon would not be supported by issuing of a NOTAM.

The issuing or not of a NOTAM to support promulgation of an activity would be very much as it is today. Daily activity at a winch launching site is not currently, generally subject to a NOTAM whereas occasional

activation of a large model flying site is. The operation of a beacon in support of that activity is an additional electronic safety net to support existing promulgation.

### Are these beacons intended to replace electronic conspicuity of aircraft operating at the trial sites?

No, they are not. These beacons are Obstruction Beacons. They are not intended to replace electronic conspicuity of individual aircraft where this is desirable or required.

In the case of glider winch launching sites, the ADS-B Obstruction Beacon is providing an additional means of situational awareness that the site is the location of a 6mm steel cable that is being raised potentially over 2000ft into the air. The beacon doesn't necessarily indicate the presence of one or multiple gliders in the immediate vicinity of the beacon or replace individual electronic conspicuity of those gliders.

### Who is responsible for operating the ADS-B Obstruction Beacons?

The Trial site operators/clubs are responsible for the installation and operation of the ADS-B Obstruction Beacons.

### Are all Electronic Conspicuity receivers capable of picking up the ADS-B Obstruction Beacon broadcasts?

Only those receivers that receive 978MHz UAT will be able to pick up the ADS-B Obstruction Beacon broadcasts. Receivers need to be within range and have line-of-sight of a beacon.

### Which Electronic Conspicuity devices support reception of 978MHz UAT?

This is a non-exhaustive list:

- uAvionix SkyEcho, SkyEcho2, SkySensor, pingUSB
- Foreflight Scout, Sentry Mini, Sentry, Sentry Plus
- Avidyne SkyTrax100B
- Dynon DRX, SV-ADSB-470, SV-ADSB-472
- GRT Discovery
- iLevil 3 & iLevil Astrolink
- Appareo Stratus 1, 2, 2S, 3
- Garmin GDL 39, 39R, 50, 50R, 52, GNX 375, GTX 345
- Dual XGPS170D
- Stratux Dual Band ADS-B receiver

### Do all Electronic Flight Book (EFB) navigation apps present the ADS-B Obstruction Beacons?

Currently, most but not all EFB applications will present the Obstruction Beacons, IF they are correctly connected to, and being fed traffic data by a 978MHz UAT ADS-B receiver that is in receipt of Obstruction Beacon broadcasts. Some EFBs may not yet use an appropriate symbol representing an Obstacle. Prior to this Trial, with no ADS-B Obstruction Beacons in use in the UK, some EFB providers had not implemented specific support for ADS-B Obstacles. Due to the trial, EFB providers that do not yet fully support ADS-B Obstacles are looking to add the required updates to their EFB applications.

### Which EFBs support ADS-B Obstacle Beacons?

It has been confirmed that the current version of SkyDemon presents ADS-B Obstruction Beacons (Point Obstacles) as an obstacle. Foreflight have advised that they present ADS-B Obstruction Beacons but do so using a default symbol (not as an obstacle), however they have it on their development list. Prompted by

the trial, EasyVFR, SafeSky and RunwayHD have all advised they are adding full support for ADS-B Obstruction Beacons (Point Obstacles). As can be seen, this is a developing area.

### Is this Trial about the ADS-B receivers and EFBs?

Although we are interested in the reception and display of the ADS-B Obstruction Beacon broadcasts – the entire system entails transmission, reception and presentation of the Obstacle Beacon data – the reception and presentation elements of the system are entirely outside the control on the project (except for the site operators who have been provided with the capability to verify transmissions). With 978MHz UAT currently being so new and little used in the UK, we are aware that understanding of UAT is limited, ability to receive the broadcasts is limited and those that can potentially receive the broadcasts may not be setup to do so. Therefore, the main focus of the Trial is on the transmission side, on the setup and use of the beacons.

### Where can I find further information about the Trial?

Further information about the Trial may be found here: https://uavionix.com/projects/ukobsbeacon/

# Appendix U – User Guide for 978Mhz UAT ADS-B Obstruction Beacons

## Introduction

This Guide explains how to setup and use the Obstruction Beacons for the 978MHz UAT ADS-B Obstruction Beacon Trial.

It is very easy!

## Configuration

There is no configuration to do.

All the unique settings for each site have been hardcoded and pre-loaded into the device provided to that site.

## Components

There are three components which are connected together to make the beacon function:

- The Beacon
  (which is an adapted uAvionix VTU-20 978MHz UAT ADS-B beacon with special firmware)
- A power cable
- A Jackery 12V portable power pack


## Check the charge state of the Jackery power pack

On the Jackery power pack, press the button to the left of the small display panel, which will show the charge state of the battery on the panel. If the charge state is low, put the Jackery on charge using the supplied transformer that plugs into the INPUT socket on the left side of the Jackery.

## Connecting the components

**Connect the beacon to the power cable**

Align the 4 pins and push the connectors together, then twist the knurled parts of the connectors to screw the two parts together.

**Connect the power cable to the Jackery 12V portable power pack**

Push the ‘cigarette lighter’ plug into the ‘cigarette lighter’ socket to the right of the display panel on the Jackery.

### Placement of the Beacon for use

Choose an appropriate location to setup the beacon for use that has a clear view of the sky. It needs to be in an open location. E.g. on a building roof; on the ground; on top of a vehicle or the glider winch. Do not place inside a building or close beside a wall or vehicle that will block the GPS reception or ADS-B transmission. The beacon itself is weatherproof but the Jackery is not so should be protected from rain, sleet, etc. If used on the ground, protect the beacon installation from damage by passing foot or vehicle traffic.

Note that as the VTU-20 was designed to be installed on the roof of a vehicle, with the cable passing through the vehicle roof, the cable comes out of the bottom of the unit which makes it a little awkward to place on a flat surface. A little ingenuity may be required to seat the unit nicely.

### When to switch on the beacon

The beacon must only be activated just before flying activities on the site are about to begin. Please maintain a log of all times when the beacon is switched on. The beacon should remain switched on while flying activities continue.

### Switching on the Beacon

With the beacon placed in the position you wish to broadcast from, with all the connections made and with a charged Jackery Power Pack, press the small button to the right of the display panel on the Jackery. A green LED will indicate that the 'cigarette lighter' socket is powered.


When the beacon is switched on it needs to gain a 'fix' on the GPS satellite constellation. This will take a minute or two. There is a red LED **inside** the beacon at the front under the antenna that will blink until a GPS 'fix' is achieved, whereupon the red LED will go out. When blinking, the LED is visible through the translucent white body of the beacon. It is readily visible in the dark but is harder to see in daylight.

### When to switch off the beacon

The beacon must be switched off once flying activities on the site have ceased, or paused for an extended period. Please maintain a log of the time when the beacon is switched off.

### Switching off the Beacon

To switch off the beacon, press the same small button to the right of the display panel on the Jackery. The green LED will go out and the beacon will cease broadcasting. Depending on your specific installation and whether the Jackery power pack is in an exposed position, you may need to put you beacon installation in storage between uses.

### Verifying the Beacon broadcast

All the beacons being used in the trial have been tested both in the US and upon arrival in the UK and were working correctly.

A uAvionix SkyEcho 2 ADS-B transceiver has been supplied, which can receive the broadcast from the beacon and pass the data to an Electronic Flight Book application such as SkyDemon, which is used by GA pilots. Verification is recommended when first starting to use the beacon to ensure the on-site setup is correct and the beacon is functioning as intended.

## SkyEcho 2

The SkyEcho 2 is relatively easy to use but explaining how to use it is beyond the scope of this guide.


**IMPORTANT!** You must not transmit from the SkyEcho 2 so you must ensure broadcast is disabled in the SkyEcho 2 settings.

The SkyEcho 2 Installation Manual can be downloaded here:

https://uavionix.com/downloads/skyecho/SkyEcho%202%20User%20and%20Installation%20Guide%20REV%20N.pdf

## SkyDemon

Explaining how to use SkyDemon is beyond the scope of this guide.
SkyDemon can be downloaded here: https://skydemon.aero/start/

A free 7 day trial is available, which should be sufficient time to verify the operation of the beacon.

The SkyDemon manual can be downloaded here: https://skydemon.aero/help/manual.pdf

See the section entitled 'Other Traffic' to learn about using SkyDemon with SkyEcho 2.

It is necessary to set SkyDemon into 'Go Flying' Mode in order to begin showing traffic. If the tablet/iPad being used has a built-in GPS, SkyDemon will ask whether to use Location Services of the tablet/iPad or SkyEcho 2/GDL-90 data. SkyEcho 2/GDL-90 data must be selected to start receiving traffic from the SkyEcho 2


When SkyDemon is receiving data from SkyEcho 2 and presenting traffic on the screen and SkyEcho 2 is receiving data from the beacon, then SkyDemon will present the beacon as a white 'obelisk' as shown in this image. The obelisk is shown here overlaying the yellow aircraft symbol because SkyEcho 2 (aircraft) and beacon (obelisk) were close together on the ground.