

- February 2020 -



Although the Highlander kit came to Cambridge from South Carolina via transport truck, I brought it home via trailer from a nearby business that has a loading dock. I will be starting on it soon and hope to be flying it this summer!!!

President's Message

January was a busy month for a number of us at KWRAA. Lee Coulman has been very busy with the Stratford ADS-B trial and there have been a number of interesting developments.

Lee's letter to the Minister of Transport to address TSB concerns and suggest further investigation of UAT ADS-B has seen no response by the minister or TC to date.

Outside the mandate of RAA, our local COPA 26 Chapter had a strategic meeting and the COPA 26 Captain sent the letter to all the COPA chapters. COPA president, Bernard Gervais, was copied and he responded with some very insulting language after a number of the chapters agreed that nothing sensible was being done for GA. Mr. Gervais has since announced he will be stepping down. Hopefully, the next president will see the shortcomings of COPA in not pursuing a stronger ADS-B strategy that addresses our concerns. Pilot safety has to be a primary driver, not an afterthought. Maybe their mission statement,

which includes 'freedom to fly' should include 'safely' to encompass new technologies as well as more pilot awareness of ADS-B IN and OUT.

With the Stratford ADS-B demo project making headway again and a number of new products hitting the market including the uAvionix tailBeaconX that provides both ground and satellite 1090ES coverage, it could be an interesting year for aviators in Canada. However, in spite of the great promise of the future, there are still roadblocks to implementing a total ADS-B solution and an abundance of educating to do in the pilot community to understand the enormous benefits of ADS-B IN.

There are rumours that Nav Canada may finally be looking at 978 UAT for GA, but time will tell whether they admit their mistake in not considering UAT long ago as Lee and I have been saying they need to do to make GA safer.

2020 is going to be a great year for KWRAA.

- Dan

UAT ADS-B Trial Update – by Lee Coulman

1. UAT Status

- a) There are in-flight weather projects using 978 UAT in Denmark and Germany. AOPA has helped us locate the source of this equipment. Apparently Garmin has been working with the German and Danish AOPAs for these demos. Bill Stone of Garmin Aviation Business Development is the man, but he is very busy and it is difficult to schedule a teleconference. He says they've only been using a modified GDL88 with 5W EIRP, which is about what we can do.
- b) The President of uAvionix had a meeting with Nav Canada. It appears that Nav Canada has increased interest in this topic after a recommendation from UK NATS that they talk to uAvionix. **He now suspects that there will be UAT FIS-B in our future.** Nav Canada and uAvionix may start their own trial later this year.
- c) Letter to Transport re: flight safety with UAT. - no further responses.

2. WX Station

- a) The weather station has arrived and is working well, on my dining room table. It is very light but rugged with no moving parts. Cost was \$2100 USD with \$342 CAD in taxes. Integration with the display system started February 12th.
- b) There are many skill testing questions of how to calculate real altimeter settings and density altitude. We will calculate sea level pressure but will not transmit it. Also, we need to calculate dew point from relative humidity to fit into the METAR.

3. UAT FIS-B Trial on 915 MHz

- a) Ryan hooked the Stratux transmitter tuned to 915 on the UAT 978 antenna. We were only partially successful showing transmission of METARs. Unfortunately, an extreme impedance mismatch to the antenna limited us to about a 1 nm range.
- b) We need to operate on 978MHz. Mike Kay has a solution to this in the works.

- c) I have ordered some test equipment so that we can check our antenna and coax for efficient operations. (It was ordered from China, which currently has corona virus issues so delivery may be impacted!)

4. NEXT STEPS

- a) 978 FIS-B transmitter at 1 W (4 W EIRP)
- b) Define which stations for METARs. 50nm range including sources from Environment Canada & NemoScout NEMOWX.com.
- c) Demo of WX station with the ADS-B display. We hope to conduct these tests within the next few weeks.
- d) Start work on low power transmitters for UAT ADS-B target. Transmit minimal information for tracking at CYSA and not for surveillance.
- e) Verify antenna tuning using new test equipment; a Vector Network Analyzer (VNA). Repair any bad connections or correct other impediments to transmitting a strong signal on 978 MHz.

SUMMARY

A number of issues that limited the first ADS-B FIS-B trial at Stratford are now being resolved.

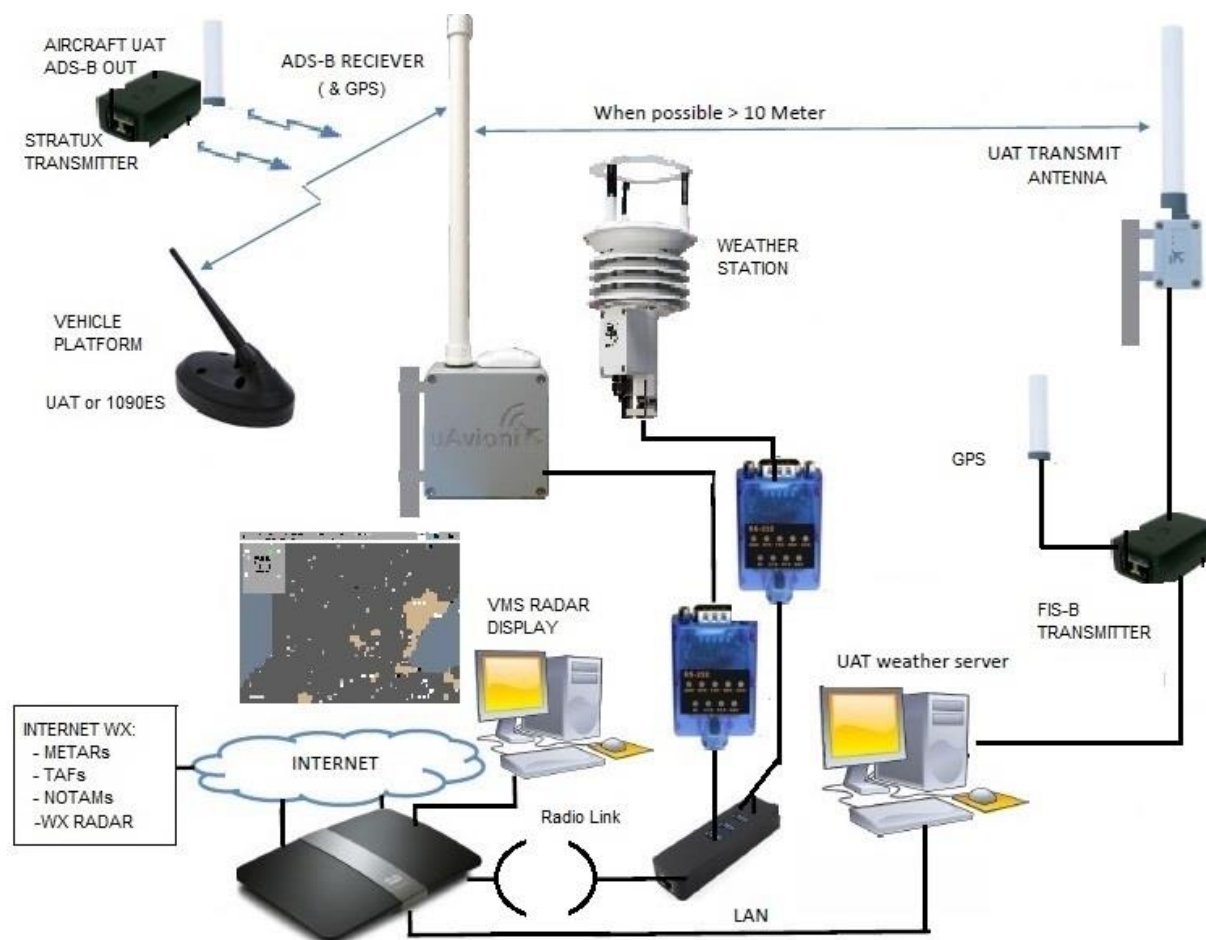
I expect the next practical trial will produce useful results and information we can apply as we move toward a practical and repeatable solution for Canadian pilots wanting FIS-B services.

If Nav Canada and uAvionix eventually pursue their own UAT FIS-B trial, we only see that as vindication that we were on the right track in requesting these services from Nav Canada years ago.

A successful trial by either group will provide cause for exploring a means of rolling out additional UAT FIS-B stations elsewhere in Canada. Either way, we will need to elicit support from other aviation groups in Canada, including RAA, EAA, flight schools, flying clubs, and especially COPA National.

- Lee

The Leading Edge



The basic block diagram of the equipment being employed in the Stratford UAT project is shown here. Beyond the hardware employed, the real magic happens in the software that brings together all of the various sources of data and encodes them for display in the FBO and nearby aircraft that are equipped with UAT ADS-B receivers on board. The primary goals are for pilots to receive FIS-B (local weather information) and the FBO to have a basic TIS-B display that provides traffic awareness and asset tracking.

The Stratford UAT ADS-B trial required a number of components that had to be purchased or donated in order to move the project ahead.

Thanks to a number of donations from the local COPA chapter and a number of interested parties, the trial is moving ahead, albeit a little slower than originally planned.

Additional support was also garnered from our local COPA chapter in the form of a number of additional pilots to assist with the trials.

Preliminary results using basic data were very promising and several additional features have been added by an interested local pilot/friend of Lee's with amazing programming skills.

Work continues on the project with additional live trials, so updated results will be available soon.

Additional donations toward the project are greatly appreciated by Lee and the group overseeing this invaluable project.

If Nav Canada continues to deny the advantages of UAT ADS-B IN, this project could be used to replicate other local UAT sites across Canada. If Nav Canada eventually sees the light and develops a UAT Network for GA, at very least this project will raise awareness of the benefits of FIS-B on UAT and encourage more pilots to install full ADS-B systems, making flying safer for all GA pilots using them.

- Dan

ADS-B Technology Update – Lee Coulman

Nav Canada's decision to require diversity antennas on the 1090ES version of ADS-B OUT while ignoring the benefits of ADS-B IN and the UAT version of ADS-B has rendered most of the equipment available south of the border useless in trying to meet the Canadian mandate.

Luckily, there are still a few ways to meet the mandate and still reap a few of the benefits of ADS-B, albeit the rewards are limited compared to what is available in the USA. Let's look at a few of the options available.

Last summer, uAvionix released their SkyBeacon X, which was a game changer for a lot of pilots looking for a Mode S (1090ES) solution for ADS-B OUT. More recently though, uAvionix released the tailBeaconX, which consists of a self-contained diversity dipole antenna that can operate with ground based radar and ADS-B systems as well as satellite based Aireon. It installs in minutes, replacing the rear tail light common to a lot of aircraft. A serial cable is used to connect a remote control head to the tailBeaconX and also to obtain the pressure altitude from the pitot system.



tailBeaconX replaces an existing tail light to provide 1090 ES ADS-B OUT for satellite and ground stations

If I might digress for a moment, it is a good time to mention that AeroVonics had a couple of great electronic flight instruments the AV-20 and AV-30 that were software driven. uAvionix realized that these instruments had amazing potential and as a result, AeroVonics is now part of the uAvionix family.



The AV-20-S is a 2 ¼ inch FAA-approved Multi-function Display that can control the tailBeaconX and provide a number of other useful functions.

<https://uavionix.com/products/av-20s/>



The 3 1/8 inch AV-30 is another option for controlling the tailBeaconX. Its larger format allows it to operate as a primary flight display and has additional features over the AV-20 including digital precision attitude and directional gyro customizable displays.

<https://uavionix.com/products/av-30/>

Always on the cutting edge of technology, uAvionix developed software to allow the AV-20-S and AV-30 EFIS to provide the necessary

transponder controls and pressure altitude interfaces for their new tailBeaconX. Some MGL and GRT EFIS interfaces will also provide this control function. One of our RAA members was involved in a trial installation of tailBeaconX and is very happy with the ease of installation and the FAA compliant performance. Given the uAvionix track record for FAA certification we can probably expect to see it released in a certified model and eventually approved in Canada too at some point. Be aware that you will have to remove your old transponder if the tailBeaconX is a retrofit on your aircraft.

<https://uavionix.com/products/tailbeaconx/>

tailBeaconX PROS:

- Meets ADS-B OUT for FAA & Aireon
- Light weight
- Low cost (similar to other 1090ES systems)
- Low power consumption
- Full Mode A/C/S with EFIS remote control
- Connected to pitot system for accurate PA
- High quality record for uAvionix

tailBeaconX CONS:

- Will not fit in a lot of aircraft
- Control line is RS-232 and must run full length of aircraft
- Existing transponder must be removed (cannot use two 1090MHz units at once)
- No ADS-B IN (partial solution only)

While this device is a great innovation, it does not fulfill the full promise of ADS-B for GA. Although being compliant with FAA 2020 and Aireon surveillance requirements it does not have ADS-B IN. Without this fundamental feature you will not see other ADS-B aircraft or receive in-flight weather and data. You will still need to install some sort of ADS-B receiver and display in the cockpit. These are the safety features that should be considered essential for safe VFR flight now and in the future.

Ideally, receive and transmit functions for ADS-B IN/OUT target detection should be on the same antenna. This ensures that the coverage volumes are similar to electronically "see and be seen". Adding a portable ADS-B IN solution

does not guarantee predictable performance that matches the coverage of the ADS-B OUT transmit signal. An additional fuselage mounted antennae is likely just a second-best solution for ADS-B IN, but these solutions are often less costly, so you will have to be willing to make this trade-off. One example of this is my new combination of a TRIG TT22 transponder with a uAvionix EchoUAT for ADS-B IN that I am installing in my Searey.

There are a few solutions that do use the same antenna for ADS-B IN and OUT. One possible solution is the Appareo Stratus ESG and Stratus 3 when equipped with the interface cables and external altitude encoder. (Dan uses this combination in Aerial One.) The Garmin 345 with GPS and altitude encoder also uses a single antenna for transmit and receive, but the cost is slightly higher.

tailBeaconX addresses the diversity concerns of the Aireon system as specified in the ADS-B mandate proposed by Nav Canada, but there is still some doubt as to whether a diversity antenna solution is absolutely necessary. From a pure performance perspective, diversity is the best solution as there is a better chance of detecting other ADS-B targets, above and below you. However, the cost can be prohibitive especially for GA.

The second best solution can be far more cost effective and easily achieved on a lot of GA aircraft. We (Dan and I) have tested single top mount solutions for UAT and 1090ES packages and they work very well with FAA radar and ADS-B towers. We were forced into this solution as our two amphibious aircraft had too many obstructions and restrictions to allow a bottom mount. We could barely detect each other at certain angles even at close range.

Top mounting a single ADS-B antenna makes sense when you compare the surveillance radiation power requirements for ground based versus satellite systems. The Aireon system operates on the Iridium satellites that average 483 miles above the earth, whereas the average distance to ground stations is less than 120 miles and Radar can reach up to 250 miles. Radio waves follow an inverse square law: power density is proportional to the inverse square of the distance. Doubling the

distance requires four times the power to get the same signal level. Path loss alone dictates that 4 to 16 times the power is required for satellites vs. radar or ground stations (6 to 12dB difference). This signal level difference is significant enough to make a big difference in the operation of the ADS-B system, especially if the wrong antenna location is used.

Add to this, the shielding effect of a bottom-mounted antenna in a satellite-based system or a top-mounted antenna in a ground-based system, the issues become clearer. Muddying those waters though are the misconceptions about ADS-B and transponder signals, especially the idea that the signals from bottom-mounted antennas under small aircraft somehow spill over and will be captured by Aireon ADS-B satellites. While there may be some scattered signal from nearby metallic objects on the plane, those reflected signals are of such low level that reliable reception by a satellite over 450 miles away is exceedingly optimistic and unrealistic.

The point here is that aircraft antenna systems using a single antenna for both ground and satellite ADS-B will perform much better when the antenna is top-mounted.

With incorrectly placed transponder antennas we noticed that signals were blocked by landing gear, float attachments and other metallic objects attached to our aircraft. We placed our antennae on the top side of our planes in locations that provided a clear view of satellites and positioned to provide the best compromise for horizontal coverage for radar and ground ADS-B. Both of our aircraft passed the FAA ADS-B coverage tests. They also work well on the ground for FIS-B and targets. Sometimes the best solution is to find the best compromise; a top-mounted ADS-B antenna in this case.

Conclusion:

tailBeaconX is great product that addresses the unique problem created by Nav Canada in its pursuit of a purely space-based ADS-B solution and its proposed mandate of antenna diversity. But keep in mind that it only addresses ADS-B OUT, so a means of receiving ADS-B IN will still be required to

realize the benefits of TIS-B (traffic awareness) and FIS-B (weather data) in the cockpit.

The solution you choose will be based on your current equipment, budget and expectations.

Cost Comparison***

1090ES ADS-B OUT Only:

tailBeaconX w GPS w AV20: \$3500 USD (~C\$4700)

Appareo Stratus ESG w GPS w Encoder: C\$4100

Garmin 335 w GPS w encoder: C\$4428

ADS-B OUT UAT*:

Cost of EchoUAT (UAT) w GPS: C\$1945

Cost of TailBeacon (UAT): C\$2780

Cost of Garmin GDL82 (UAT) w GPS: C\$2566

Cost of SkyBeacon (UAT) C\$2571

**(you must have a transponder with encoder)*

ADS-B IN/OUT solutions:

EchoUAT + TRIG TT22 Mode S w encoder: C\$4800 (2 ADS-B antennae)

Appareo Stratus ESG w GPS w encoder w Stratus 3: C\$5300 (one ADS-B antenna)

Garmin 345 w GPS w encoder: C\$7800 (one ADS-B antenna)

tailBeaconX w GPS w AV20 w Stratus 3: C\$5700 (2 internal ADS-B antennae)

Source: ACS Canada, no taxes, not including ADS-B antenna and cables.

****The prices above are estimates and are exclusive of iPads, tablets, etc. used to display FIS-B and TIS-B.*

The new tailBeaconX adds another option to the choice of ADS-B solutions while meeting the Canadian mandate. If it included ADS-B IN it would be an ideal choice, but you will still need to consider the best way to add that functionality externally to get FIS-B and TIS-B.

- Lee

The Leading Edge

The Eagle Has Landed

Originally scheduled for mid-December, my new kit finally arrived mid-January. I had it shipped to a nearby business then went over to pick it up using a trailer in order to bring it home to the Garage Mahal.



The shipping crate was rather unusual in that it was a mild steel frame with an OSB shelf and bottom. I suppose this makes it easier to clear customs since it is see-through.



It was a bit of a challenge getting the garage cleared out enough to make room for the crate. Since building C-FDEP several years ago, I have accumulated a number of woodworking tools and was setting the shop up for doing more woodworking. To top it all off, I had recently completed a number of projects, including my son's cottage reno, so many of the tools and parts were still in boxes scattered throughout the shop. I also had a quantity of items I had bought from Gunter's workshop.



To top off the challenge, C-FDEP was inside the shop too. I used my small chain hoist to offload the crate, one end at a time and got the shop closed up again.



The inventory process went well. The Horner wingtips were the only things missing and I have already contacted Just Aircraft to get things rectified.

I'm already looking forward to getting this build started and have been planning some of the changes I want to make in order to personalize the plane and hopefully make "Aerial Two" lighter, stronger and faster than Aerial One.

Expect to see a number of photos and stories over the next few months as I make progress on this project. I have a rather ambitious schedule in mind but time will tell!

I have heard of Highlanders that were built in less than four months... wish me luck!



- Dan

The Leading Edge

Upcoming Events in 2020: (Highlighted lines are KWRAA Events*)

March 9	-	March Meeting at 7:30 in the Cadet building at CYKF
April 13	-	April Meeting at 7:30 in the Cadet building at CYKF
May 11	-	May Meeting at 7:30 in the Cadet building at CYKF
June 20	-	KWRAA Fly-in at Largo Woods
June 25-27	-	COPA Convention in Saint-Jean, QC (CYJN)
July 4	-	KWRAA Fly-in at Tom Shupe's near Mt. Forest
July 13	-	Zenair Open House – Midland at CYEE - Huronia Airport - unconfirmed
July 20-26	-	Air Venture Oshkosh in Wisconsin, USA
July 25	-	KWRAA Fly-in at Wilf Holyoake's near Fergus
June 27	-	Aviation Fun Day at CYKF – Waterloo Region International Airport
August 5	-	KWRAA Fly-in at – to be confirmed yet
August 8-9	-	Gathering of the Classics in Edenvale
August 14-16	-	UPAC Convention – Lubitz Field, Plattsville
September 14	-	September Meeting at 7:30 in the Cadet building at CYKF
October 19	-	October Meeting at 7:30 in the Cadet building at CYKF
November 9	-	November Meeting at 7:30 in the Cadet building at CYKF
November 27	-	KWRAA Christmas Party – Details to follow later in 2020

* KWRAA events are fly-in and/or drive-in.

KWRAA Executive Contact Information:

President:	Dan Oldridge	(519) 651-0651	oldridge@golden.net
Vice President:	Lee Coulman	(519) 577-5314	lee.coulman@gmail.com
Secretary:	David Wood	(519) 500-8629	david@davidwoodengineering.com
Treasurer:	Mike Thorp	(519) 338-2768	mhthorp@hotmail.com
Director:	Scott Neufeld	(519) 859-7249	scottneufeld@hotmail.com
Director:	Clare Snyder	(519) 886-8032	clare@snyder.on.ca
Director:	Mac McCulloch	(519) 831-0967	macpat@live.ca
RAA Canada:	Gary Wolf	(519) 648-3030	garywolf@rogers.com
