

**Obtaining weather and
Traffic Information In-
Flight
LWIS + UAT = "sWISt"**

UAT ADS-B Trial at CYSA

ADS-B

Update for 2020 April 14

Automatic Dependent Surveillance Broadcast

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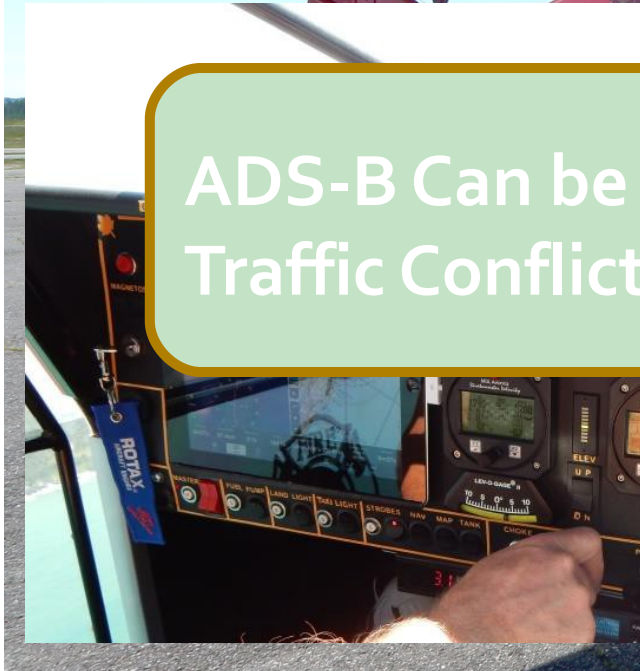
Background – ADS-B Highlander

- 2016: Dan Oldridge needed a transponder for his Highlander to go the COPA AGM at Yarmouth.
 - He chose the **Stratus ESG from Appareo** with the ADS-B bundle (\$7K) so we could do the USA thing.
 - 1090 Antenna installed below. Worked OK but.
 - Was able to negotiate traffic at CYSJ on iPad panel
 - It was a Nav Can flight test aircraft !

Background



ADS-B Can be used to AVOID or NEGOTIATE Traffic Conflicts at a non radar airport!



Background – ADS-B Searey

■ 2017 Dec: Lee r
the Searey to fit

■ Chose an ECHO
B bundle (\$2K) i

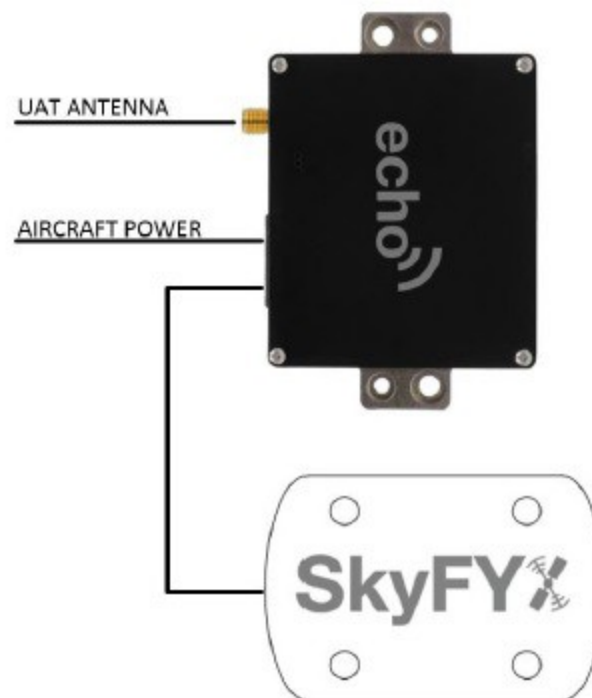
■ UAT Antenna in
1090 & UAT.

■ Worked great fc

▪ Dan was not visi

▪ He had 300W an... only, have...

Typical Configuration

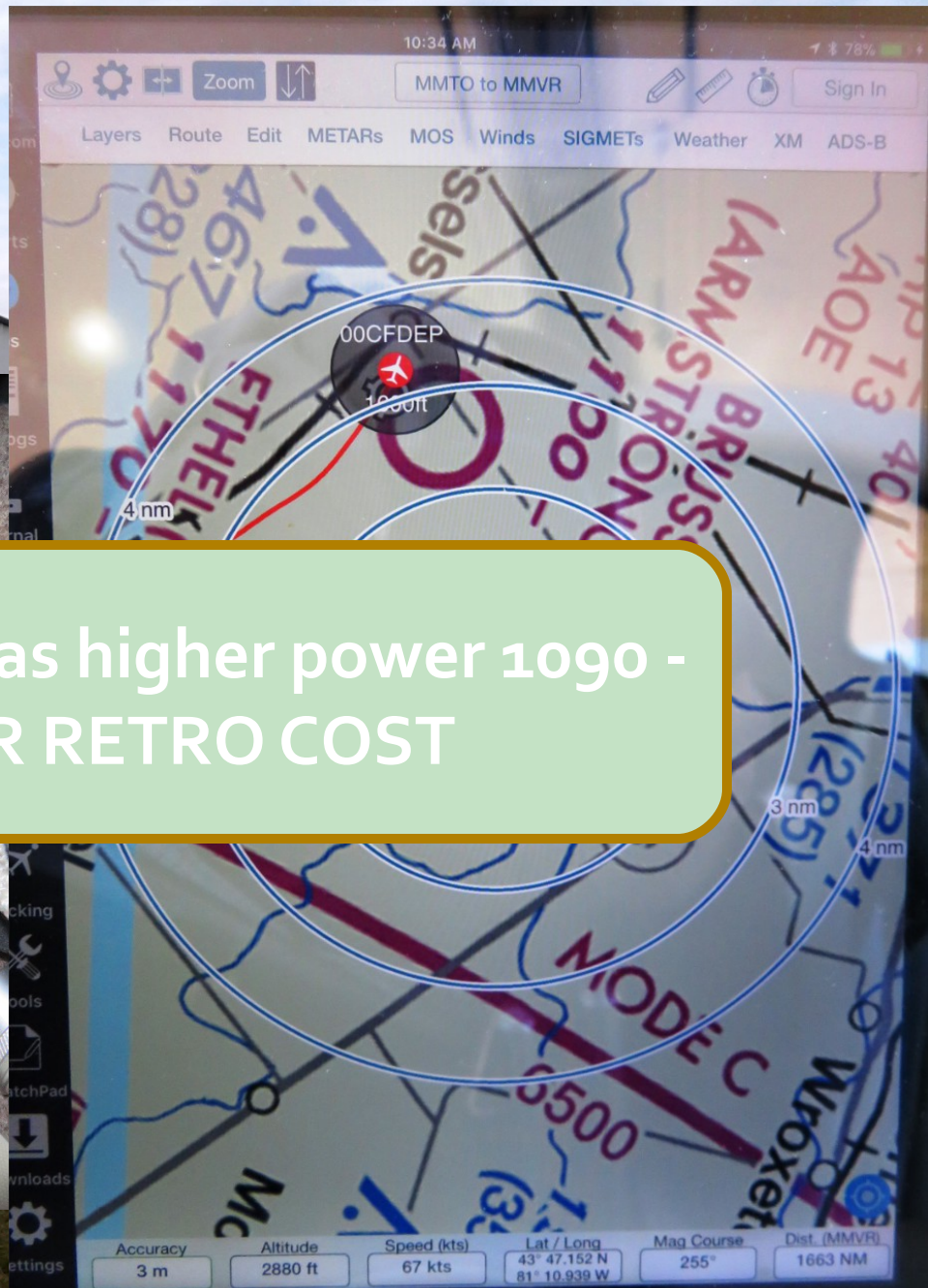


ceiver for
e get WX.

h the ADS-
nsmmitter

ve both

an?



UAT works as well as higher power 1090 -
but LOWER RETRO COST

Background – Antenna

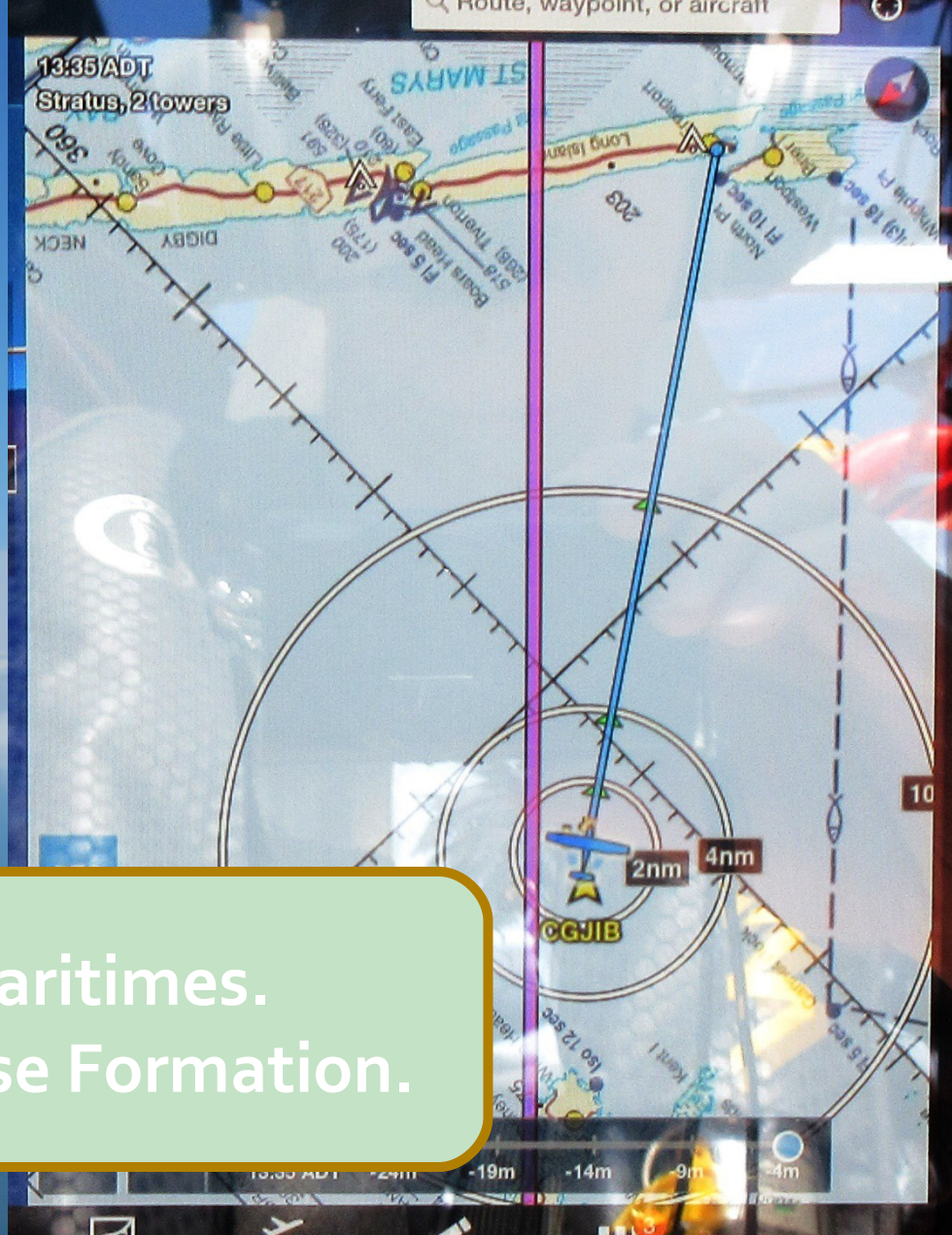
- Discovered that Dan's transponder antenna was obscured by his amphibious gear.
- Moved antenna to top deck with horizontal clear view of other aircraft & ground radars.
 - Improved air to air target detection
 - Improved FIS-B pickup from the US.
 - FAA2020 compliance
 - AIREON compliance

Why is DAN2 ADC DON'T TOP

Top Antenna provided better Air to Air,
with FAA2020 & AIREON compliance.

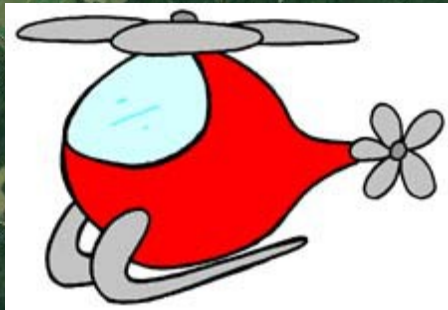


Midairs vs ADS-B



Finding Dan in the Maritimes.
Homing & Staying in Loose Formation.

Sherbrooke PQ – Near Miss Francais



CALLs ?



CALL
OVERHEAD



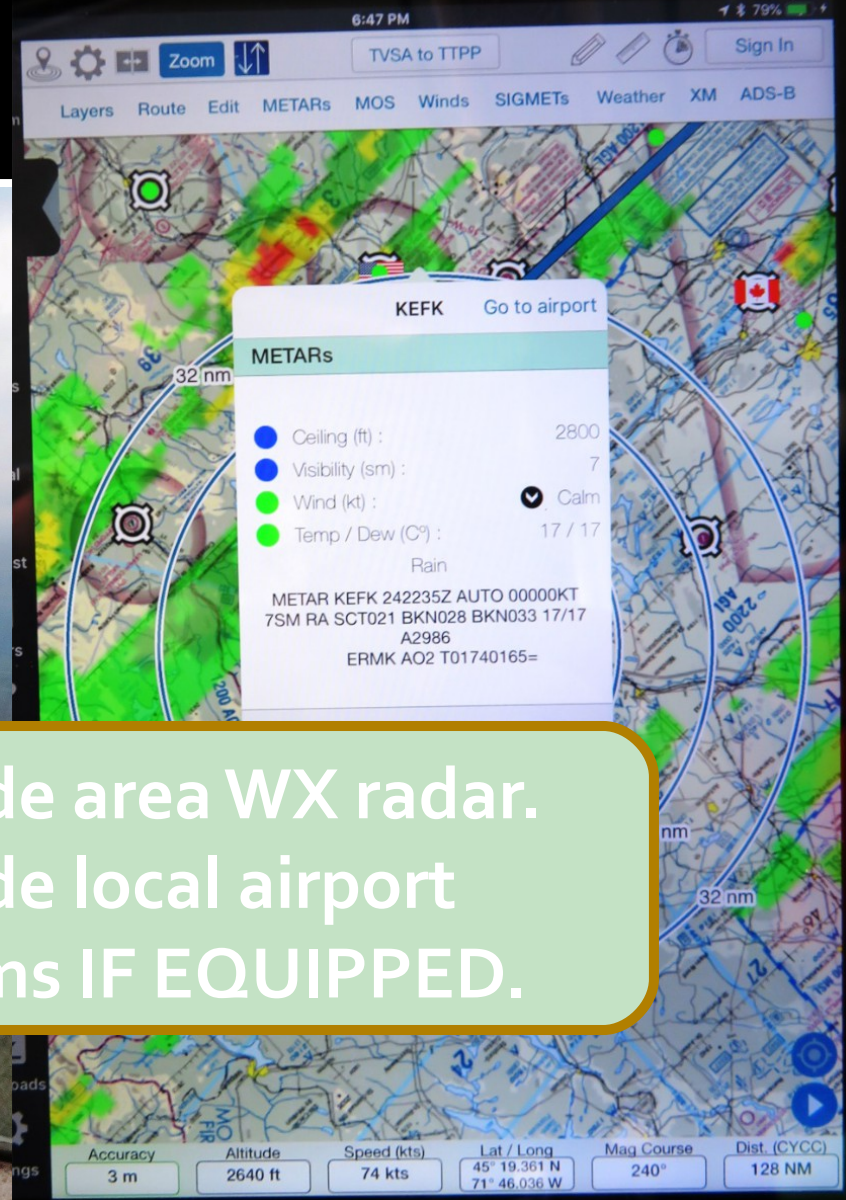
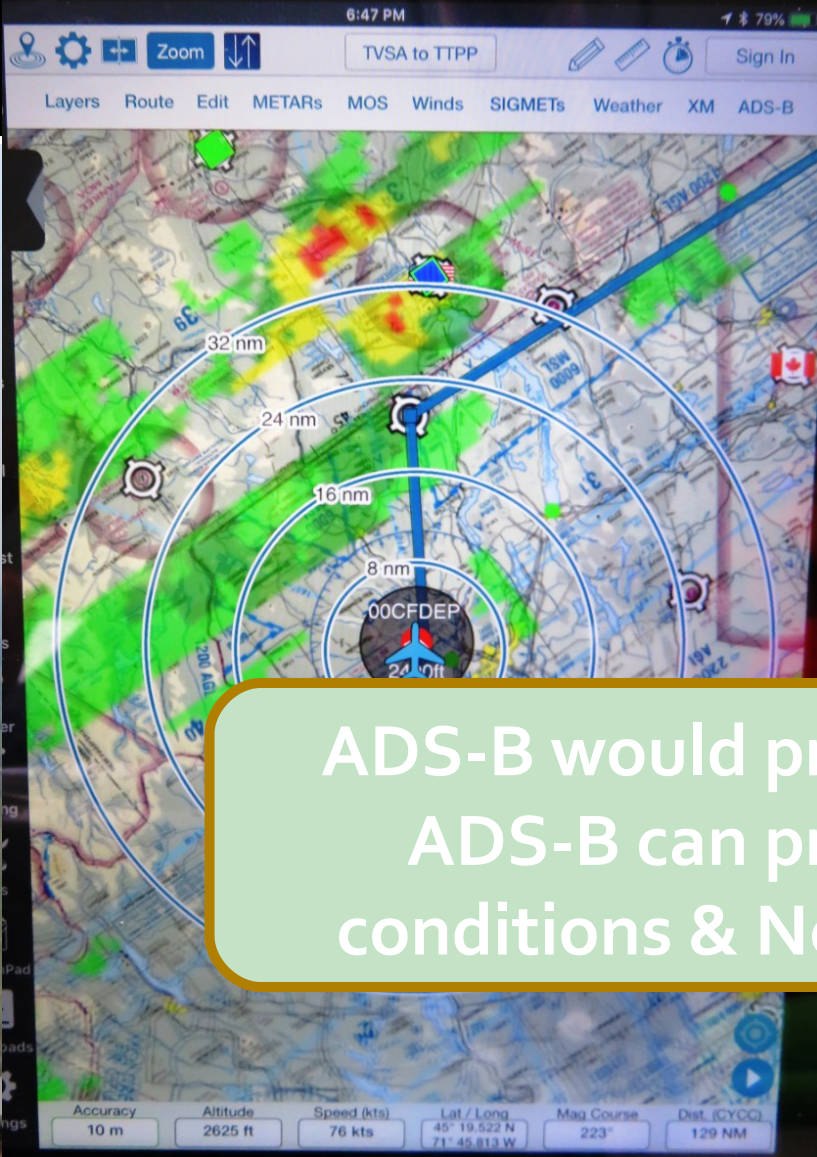
ADS-B can provide traffic information
independent of LANGUAGE &
MISCOMMUNICATION.

■ **Issues: Radio Calls**
doing !

Not saying what you'll really



ADS-B WX



ADS-B would provide area WX radar.
ADS-B can provide local airport
conditions & Notams IF EQUIPPED.

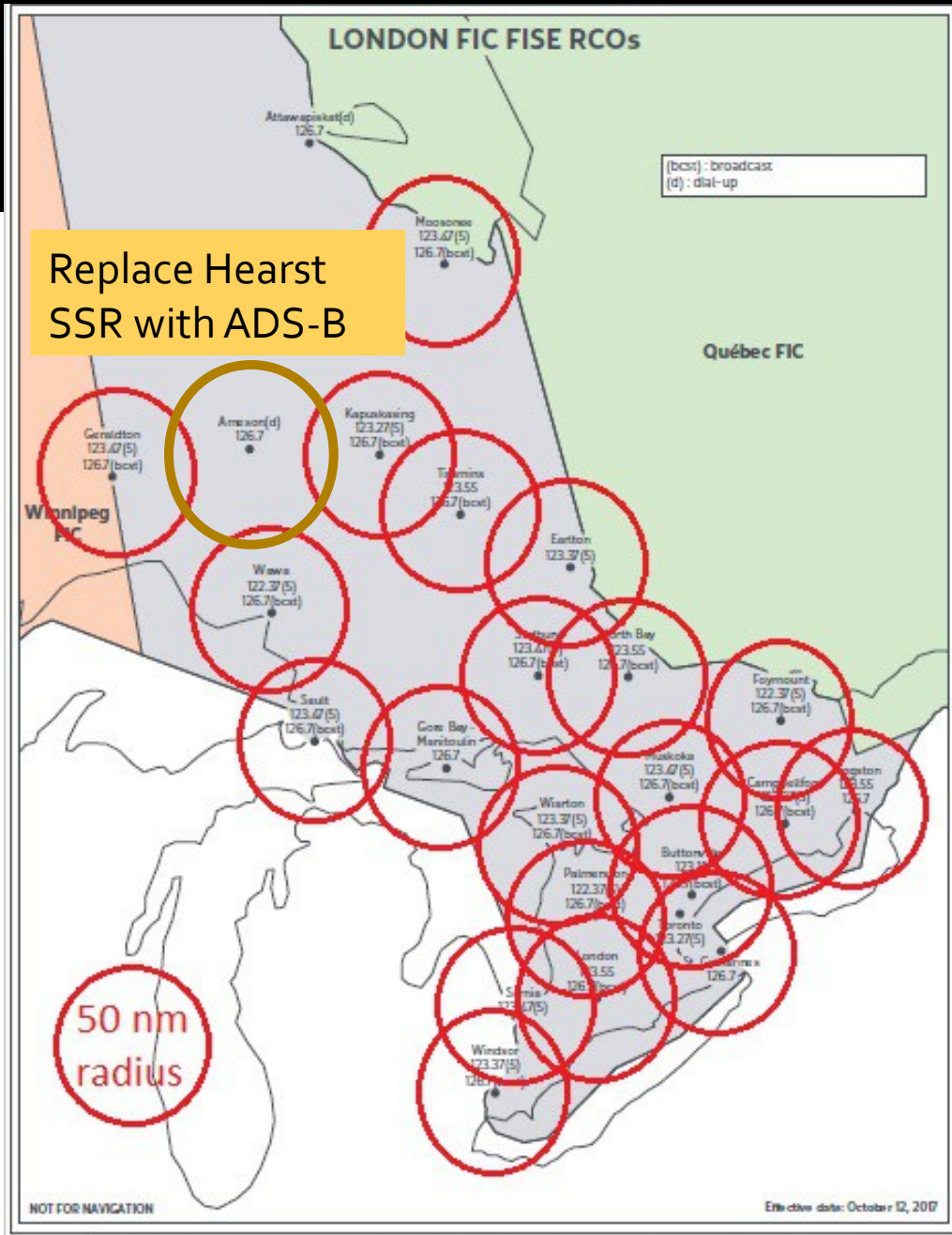
Develop a Plan

- 2018: Created plan with President of uAvionix
 - CYKF or CYSA sites?: Andy Woodam more flexible
- 2018 April: Convince Nav Can to implement a FAA like network of FIS-B and UAT TIS-B.
 - Presented a paper at CYYZ airspace conference
 - Follow-up telecon with NavCan
 - *They spend all their money (our fees) on AIREON !*
 - *But they wouldn't prevent us from doing our own local*

Guidelines for ADS-B

- Potential solutions for GA should be evaluated against the following operational objectives:
 - **Situational Awareness** – Pilots should be able to see the location of surrounding aircraft, gliders, balloons, and drones and have current weather information available
 - **Improved Safety** – Current weather data or maps and critical safety notices on FIS-B (UAT only) and target data on TIS-B (if tracked by ground radar)

What if?



- At each remote RCO or PAL install a ADS-B transceiver
- Receive target reports on 1090ES and 978UAT.
- Transmit FIS-B WX & Notam data, etc
- Transmit TIS-B on selected sites where mixed UAT, 1090 & Radar coexist.

PROJECT OVERVIEW

A proof-of-concept trial to demonstrate Flight Information Service Broadcast (FIS-B) features at the Stratford Airport (CYSA) for a limited period of time.

The service would provide:

- weather and NOTAM information to aircraft within a limited distance from this airport
- (ADS-B) aircraft targets for the UNICOM operator from both 1090ES and 978UAT

~~OUT-scanned aircraft~~

ADS-B OUT broadcasts aircraft position

ADS-B IN receives position info from other aircraft

In the case of UAT, it can also receive weather info

regional airports by encouraging the use of inexpensive ADS-B conspicuity technologies.

This would allow pilots and ground crew to:

- track training aircraft on the ground, in the circuit, near the airport and in the training area**
 - track airport vehicles such as snow plows, maintenance trucks and lawn mowers**
 - track any ADS-B equipped aircraft entering the zone, the circuit, and transiting the aerodrome traffic area**
- See and be seen...

...with the Turned into Something More Conflicts and incursions.

issues to local pilots.

HOW?

The equipment will transmit FIS-B on UAT (978 MHz) and receive UAT and 1090ES targets for display.

Internet weather information will be extracted from the Internet and reformatted as FIS-B messages.

Local winds, altimeter from a new LWIS

weather station.

- Only 978 UAT has the necessary bandwidth to provide the FIS-B weather information pilots want and need in the cockpit; 1090ES does not!

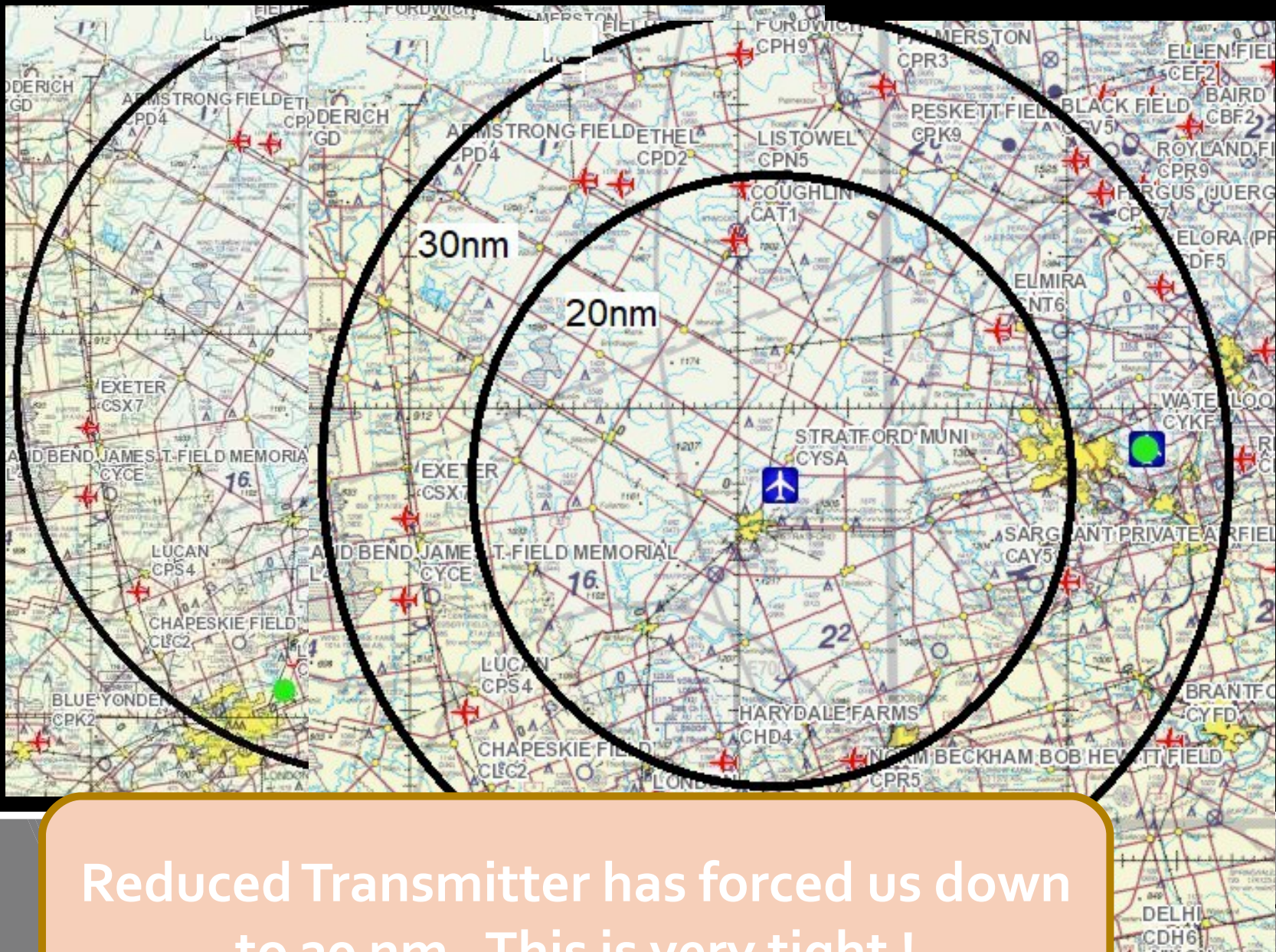
EXPECTED OUTCOME

It is hoped that a successful trial would encourage more owner/pilots to install full UAT ADS-B solutions that include 978 MHz ADS-B OUT in their aircraft making them visible to other aircraft receiving ADS-B signals. It also makes them legal to fly in the USA under the 2020 mandate. (if conditions are met)

To embarrass TC and NavCan into coming up with an ADS-B solution that is compatible with the safety parameters of the FAA2020 approach

without extra cost to GA.

*** Nav Canada has proposed legislation that will make it mandatory to use 1090ES OUT in Class A, B and high E airspace by 2022. (Phased in)**



Reduced Transmitter has forced us down to 20 nm. This is very tight !

Breaking News: 2019 Feb 19th

- *“ I also had a call with the director of COPA who indicated he would not fight for this. ”*
- *“Without any push from COPA or pull from NC/TC, it is hard to justify any investment yet. I still want to have a direct conversation with your POC who wrote the letter. May I do that?”*
 - *Christian Ramsey – President of uAvionix*

What NEXT? No \$, No TX

- Help came from a technical associate of mine who does radar displays: (for Nav Can)
 - VMS (Vern) works out a plan to receive ADS-B targets and display them on a radar display
 - Using the uAvionix Ping Station & PC Linux (at his cost)
 - We investigate a weather station input
 - The CYSA weather anemometer has seized, not even compatible
 - We selected a modern WX station **WITH NO MOVING PARTS** from a recognized manufacturer – Young Co. (~\$3K)
 - The VMS display will calculate the METAR from wind, temp, RH, and station pressure

Transmitter – Developments

■ **VERSION 1 :uAvionix**

- UAT transmitter was 20 W (maybe too much for FAA compliance)
- Very conveniently located at end of Ethernet POE
 - No cabling loss maximizes transmitted power.

■ **VERSION 2: STRATUX**

- Chris Young & Ryan Dewsbury step in
- UAT transmitter is 1 W on 915MHz TESTED.
- Cable Loss issues. Temperature

■ **VERSION 3: UAT by Mike Kay of COPA 26**

- UAT transmitter based upon WiFi chip set (same chip as Stratux)

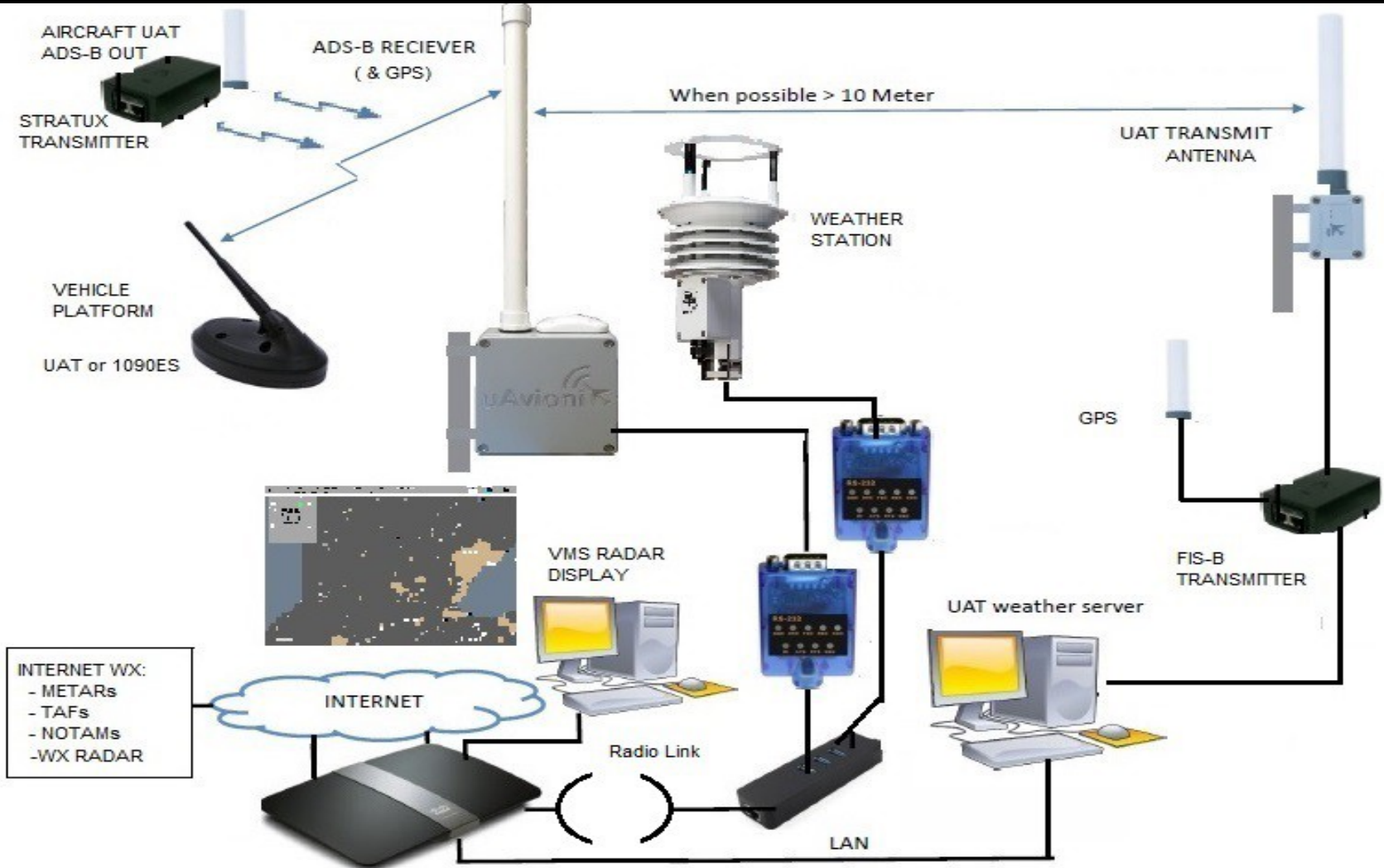
Performance Prediction

- For 1 W at the Transmitter Output:

- 20 W will be marginal with 2.5 dB fade margin

	W	DB	dbm	dBW
978				
TX out	1		30.0	
TX loss		1.25	28.8	
GTx		6	34.8	4.8
FSPL(db)		123.6	-88.9	
GRx		3	-85.9	
RX Loss		1.5	-87.4	
RX In (dbm)	-91	min	3.6	OK

If we had 20 W ?

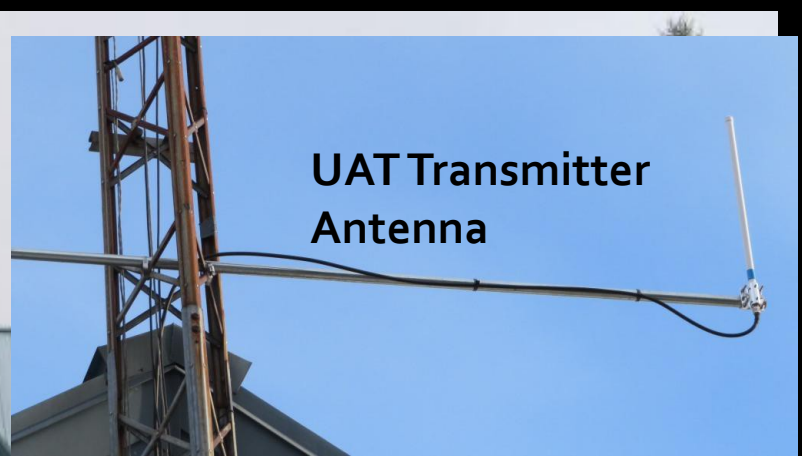


EQUIPMENT

... uAvionix 1090/978 Receiver, Young WX station, VMS Radar display & UAT / FIS-B Prototype Transmitter



Young WX



UAT Transmitter
Antenna



pingStation
Receiver



R. Beacon
Tower

CYSA UAT

100m

40 Line

CYSA Terminal Building (Ramp view) - proposed UAT Transmitter & PingStation Antenna Locations

Approvals Required:

- **Radio License for Ground Transmitter**
 - COPA 26 facilitated with Industry Canada
 - 2019Feb19: Paul Je of Industry Canada has checked with Nav Canada and the FAA, for the 20 W transmitter.
 - FAA assigns channels for possible use at 20W for non-interference. No problem with DME channel 17X +/-.
 - **But our transmitter does not have synchronization !!**
 - 2020Mar: Mike Kay has a working transmitter at 1 W with UTC synchronization !!
 - **NEXT STEP: Make spectrum measurements and apply for experimental license.**

TABLE 1 – FIS Weather Sources: (Approximately 50 nm radius)

Item	Description	Identifier	Notes:	Source	nm
1	Stratford Airport	CYSA	sWIS (LWIS), NOTAM	CYSA	0
2	London (Exeter) Radar	WSO-Exeter	Regional WX Radar	NC	24
3	Waterloo Airport	CYKF	METAR, TAF, NOTAMS	NC	25
4	London Airport	CYXU	METAR, TAF, NOTAMS	NC	25
5	Elora	CZEL	Wind, Temp, SLP	EC	27
6	Brantford	CYFD	LWIS	NS	30
7	Arthur (Walters)	CPC3	LWIS	NS	33
8	Guelph	CNC4	LWIS	NS	34
9	Mount Forest	CWLS	Wind, Temp, SLP	EC	34
10	Delhi	CXDI	Wind, Temp, SLP	EC	37
11	Goderich Harbour	CWGD	Wind, Temp, SLP	EC	40
12	St. Thomas	CYQS	METAR- Advisory	NS	40
13	Hamilton Airport	CYHM	METAR, TAF, NOTAMS	NC	45
14	Hamilton Harbour	CXHM	Wind, Temp, SLP	EC	46
15	Burlington	CZBA	METAR- Advisory	NS	48
16	Burlington Harbour	CWWB	Wind, Temp, SLP	EC	50

FIS WX SOURCES (50 nm radius from CYSA)

LWIS= Local Weather Information Service (Wind, Temps, SLP, PA), NavCanada, Environment Canada, Nemo Scout.

Project Integration Status:

- **2019Dec12: Tested VMS display & Receiver**
 - Tracked a RV7 to north and back to touchdown
 - Bottom mount antenna with 1090
 - Issues with displayed altitude, display location
- **2020Jan17: Flight test of 915 TX on 978 Ant.**
 - 2 Aircraft picked up FIS-B for short range
 - Poor performance because of antenna & TX mismatch
- **2020Feb9: Young WX station begins testing.**
 - Preliminary Calibration Complete on VMS computer
 - METAR Display added Radar display (8 Ethernet)

Funding:

				Low	High
ADS-B Receiver (Ping Station)	VMS	1-On T-Tower	\$1800 US	\$2,556.00	\$ 2,556.00
		2-On RB Tower			
POE Adaptor	VMS	1-On T-Tower	\$300	\$ 300.00	\$ 300.00
		2-On RB Tower			
Weather Station (Young)	LPC	1-On T-Tower	\$2100 US	\$2,982.00	\$ 2,982.00
		2-On RB Tower			
POE Adaptor / RS485	VMS		\$150	\$ 150.00	\$ 150.00
Radio Link – 2 Port	VMS	2-On RB Tower	\$150		\$ -
Radio Link – 2 Port	VMS	2-On T-Tower	\$150		\$ -
					\$ -
UAT Transmit Antenna	LPC	On T-Tower	\$80	\$ 113.60	\$ 113.60
Antenna Coax – Low Loss	LPC		\$70	\$ 70.00	\$ 70.00
					\$ -
UAT WX Server	Stratux M.Kay	Inside	\$300?	\$ 285.00	\$ 785.00
VMS Radar Display	VMS	Inside	\$200	\$ 200.00	\$ 200.00
VMS Radar CPU	VMS	Inside	\$1,500	\$1,500.00	\$ 1,500.00
VMS Software	VMS	Inside	\$1000?	\$ 1,000.00	\$ 1,000.00
VMS UPS (750VA)	VMS	Inside	\$150	\$ 150.00	\$ 150.00
				\$9,306.60	
Airborne ADS-B (UAT)	Stratux	5 Aircraft	5 x \$300?		\$ 1,500.00
SkyDemon, SkyEcho or similar UA	Users	In aircraft	\$1,000		\$ 1,000.00
					\$12,306.60

COPA 26 Has donated over \$1000 to the project to offset costs. THANK YOU

Schedule?: COVID = HOLD

- COVID 19 Dependent ???????
- Ready to test Mike Kay TX
 - Need flight test aircraft with Stratux receivers
 - Re-test FlighAware 978 antenna & coax
- Ready to field test VMS Display & WX.
 - But WX station and antenna inside for integration
- Final installation after satisfactory field testing
 - Install radio link to R. Beacon site
 - Install TX, VMS Display into approved positions

ISSUES: Elephants ?

- **Support from COPA?**
 - **Why has our initiative been suppressed since Feb 2019?**
 - Unable to submit letters or articles to describe project
 - Negative responses from Gervais (to uAvionix)
 - No response from Gervais after his telecon 2019Mar16
 - **Why hasn't COPA asked its members what they want for ADS-B?**
 - **Why hasn't COPA pushed TC for ELT problem investigation?**

OVER TO MIKE KAY

- **UAT Transmitter Details and Tests completed.**
- **This part of the project is the KEY element to make this project WORK !**
- **THANKS MIKE**