LOW-COST ADS-B GROUND STATION PROJECT UPDATE

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What am I doing and why?

- Design low cost UAT 978MHz ADS-B ground station

- Provide pilots with safety enhancing information similar to what is being provided in the USA by the FAA (but will NOT be provided by NAV Canada)

- Ground stations can be easily and affordably implemented by COPA Flights, flight schools and airports to create coverage in a crowd-sourced manner

Background 1

- Different countries are implementing various flavours of ADS-B

- FAA is using ground-based stations on 978MHz and 1090MHz

- NAV Canada is using satellite-based system on 1090MHz only

- 1090MHz does not have the bandwidth to provide any additional information – Satellites will only <u>receive</u> information.

Background 2

- Equipment currently available to meet Canadian requirements is in excess of $5k USD plus installation costs

- Similar base station trials are occurring in Denmark, Germany and India however they have all partnered with Garmin to use modified proprietary hardware

- Ideally, <u>NAV/TC would provide this service</u> but this ground-based solution could be the next best thing
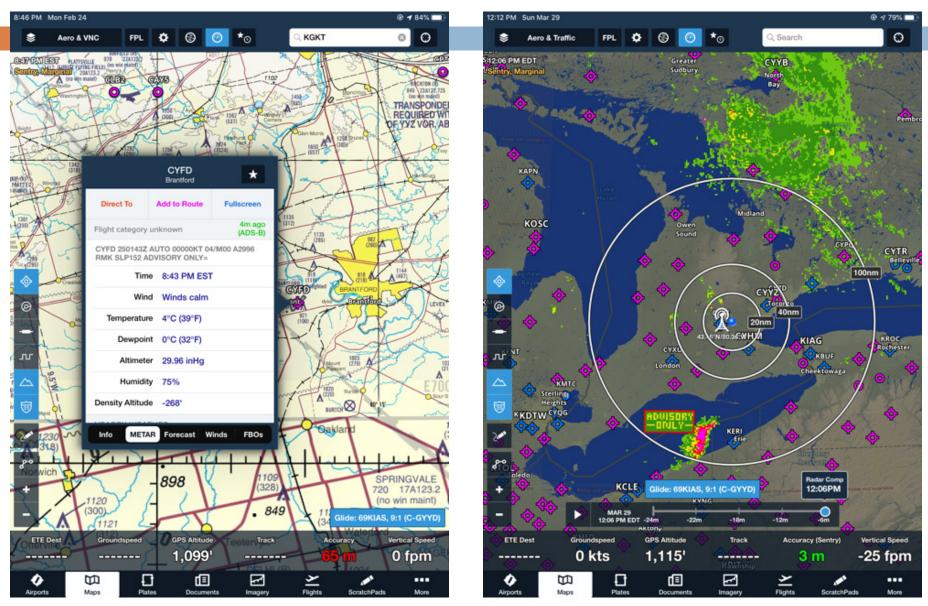
What is Working / Current State

- Operational proof of concept hardware and software setup with 1W amplifier that:
  - Sends timing compliant signals
  - Sends spec compliant data packets
  - Collects and sends NAV Canada METAR and TAF from equipped airports (YKF,YHM,YYZ, etc.)
  - Collects and sends regional radar mosaic from Exeter, Britt and King City radar for most of southern Ontario
  - Collects and sends 3rd party METAR (NemoWX from YFD, CNC4, CNK4, CNC3, CZBA, CNZ8, etc.)

What is Working / Current State

- This information is easily received and decoded by off the shelf hardware and your favourite EFB (such as Foreflight) and you will get this information continuously updated in your cockpit when in range of the ground station.

Actual Images from Foreflight

Working 1W ground station prototype

WAAS GPS for timing accuracy

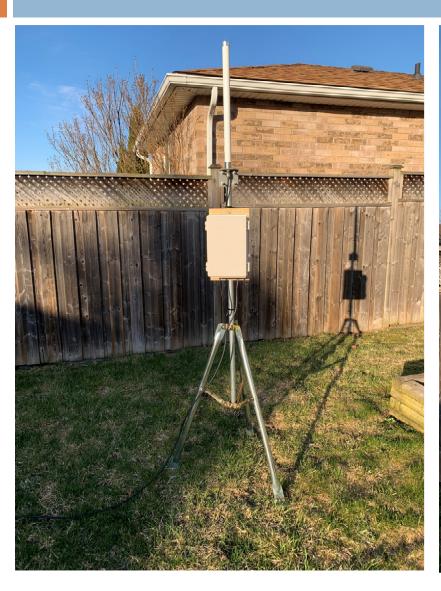Raspberry PI Computer for data collection

CC1310 Radio Transmitter mcu

1W RF Power Amplifier

External antenna connection

Working 1W ground station prototype

Aircraft Equipment Requirements

- ADS-B receiver capable of UAT 978MHz (Sentry, Stratus, Stratux, most on board ADS-B receive capable avionics)

- Most people already have this equipment for flying in the USA and most Americans that would visit us in Canada already have this equipment as well.

- This equipment (assuming pilot already has a tablet) can cost as low as $250

ADS-B Ground Station Requirements

Estimated total cost without weather station = $600

- ☐ Amplifier (~$100)

- ☐ Antenna (~$100)

- ☐ Digital Radio microcontroller (~$75)

- ☐ Cabling and weatherproof enclosure (~$250)

- ☐ Raspberry PI Computer (~$75)

- ☐ Experimental Radio License (~$60/year)

- ☐ Optional Weather Station (TBD)

- ☐ 120v Power source

- ☐ Internet connection

What's left to do?

- Expanded real world range testing - how far can we get with 1W? what about 4W?

  - Note - preliminary testing indicates ranges approx. 9.1nm at 1W and 22.3nm at 4W in less than ideal conditions.

- Software for backend (collecting data) needs to be expanded and optimized, and made user-friendly (web-based configuration)

- Radio firmware needs to have further optimization

What's left to do?

- Work on regulatory matters (Industry Canada license vs how much power we can use)

- Clarification of legal issues (is providing advisory weather an issue?)

- Gauge interest from fellow RAA, EAA, COPA Flights, Airports and Flight Schools to see how many ground stations can be potentially setup and understand coverage areas.

- Transmitting ICAO NOTAMS seems to be a challenge as the current standard is to send domestic/FAA standard (in progress)

Obstacles & Challenges

- NAV Canada or TC objecting to the public use of the unused 978MHz band

- Industry Canada limiting power output (and limiting range)

- Legal liabilities?

Where can we go from here?

- Collect other proprietary traffic (Nemo, flight school proprietary trackers, OGN, Flarm) and transmit known positions to appear as traffic targets on cockpit avionics

- Send icing and turbulence reports, lightning strikes, Sigmet, Pirep, SUA and NOTAMS, upper winds, digital ATIS (when available), cloud tops

- Send national radar imagery

- Create proper schematics and circuit board design to make unit lower cost, more robust and compact

Thank you!

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