CGC Safety Meeting on April 12th, 2025

Holger Klotz

# The Basics

**Collision Avoidance Systems:**

- **TCAS**
- **FLARM**

**Traffic Awareness (only) Systems:**

- **ADS-B**

# ADS-B and FLARM

**FAA Rule, effective January 1, 2020:**

- Any aircraft operating in airspace where a transponder is required, must also have an ADS-B-Out transmitter.

⇨ there are a lot of ADS-B equipped aircraft in the U.S.

**Every couple of seconds …**

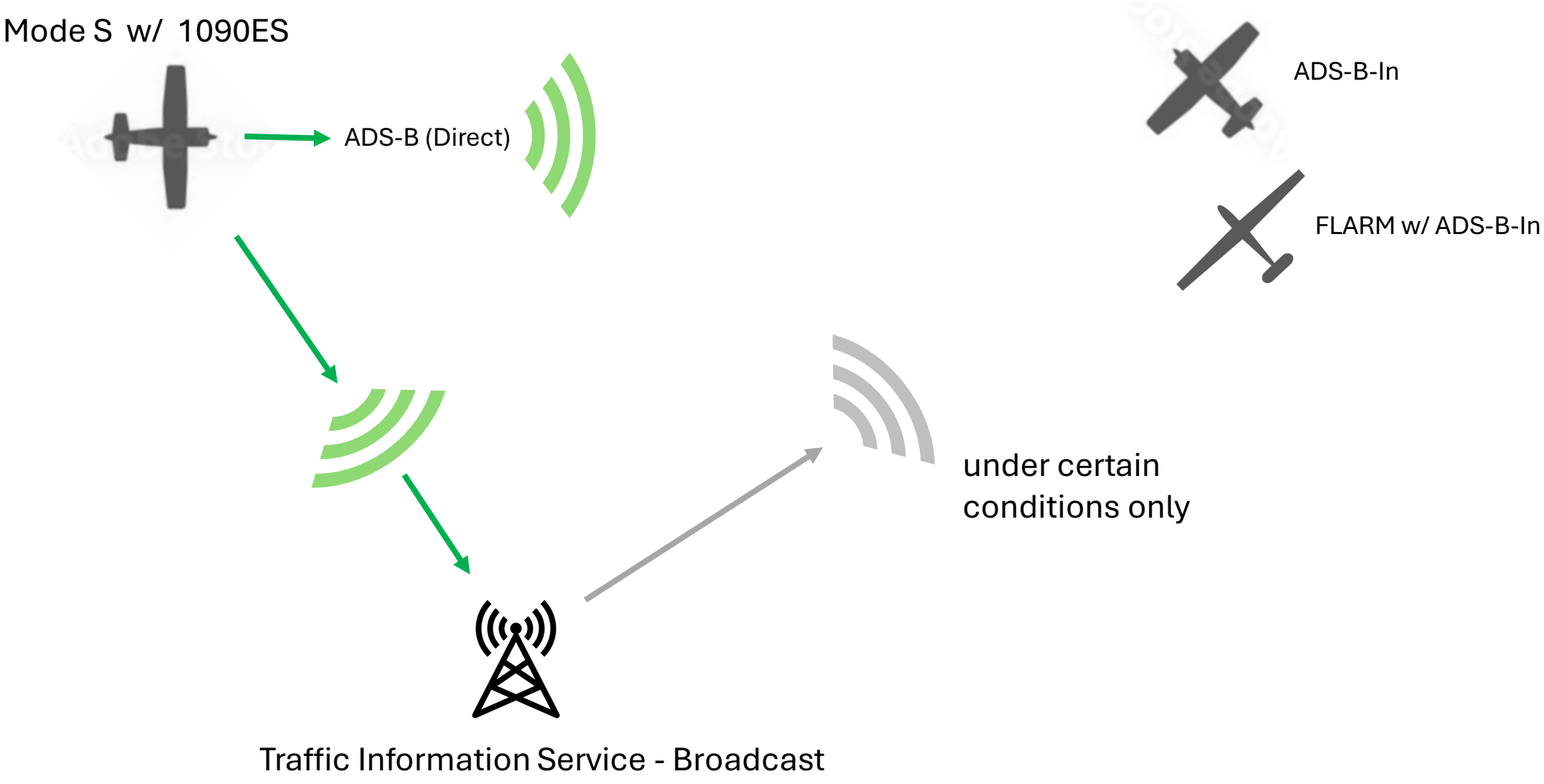
… ADS-B-Out autonomously broadcasts an aircraft's identification and position information.

**In the U.S., FLARM uses ADS-B data:**

- FLARM systems in gliders in the U.S. receive ADS-B data and process it to enhance traffic awareness and collision avoidance.

⇨ ADS-B data is effectively an integral part of the FLARM system here in the U.S..

**ADS-B data is either broadcast directly from one aircraft to other aircraft, or relayed via TIS-B ground stations**



# ADS-B in a nutshell

- ADS-B is an aircraft surveillance “umbrella” system which involves interoperation of many different pieces of equipment.

⇨ there is no ADS-B unit, equivalent to the FLARM Power Core unit.

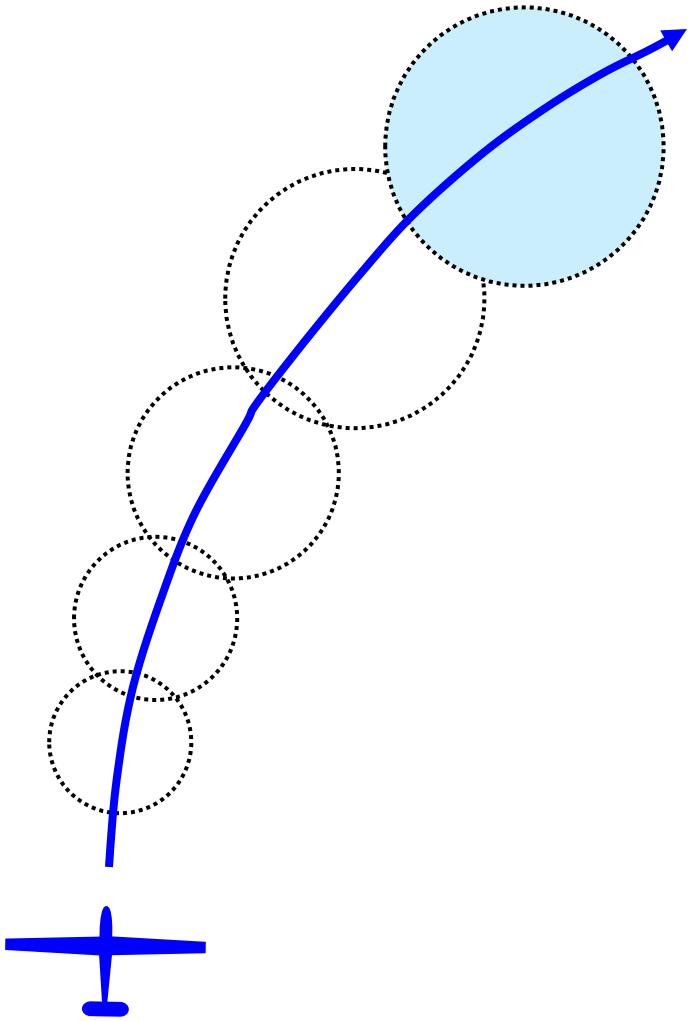
- the FAA only requires the ADS-B-Out functionality. The use of ADS-B-In and traffic display equipment is optional.

- ADS-B is for traffic awareness, not for collision avoidance.

# So, what does FLARM do?

- FLARM implements the same basic idea as ADS-B with automated transmission of "position and track" data directly between aircraft, but then, unlike ADS-B, FLARM also performs a collision risk analysis and issues warnings.

# FLARM – Autonomous Collision Threat Analysis



**[1]** (blue glider)
FLARM knows its position (GPS) and it calculates a likely course 20sec into the future

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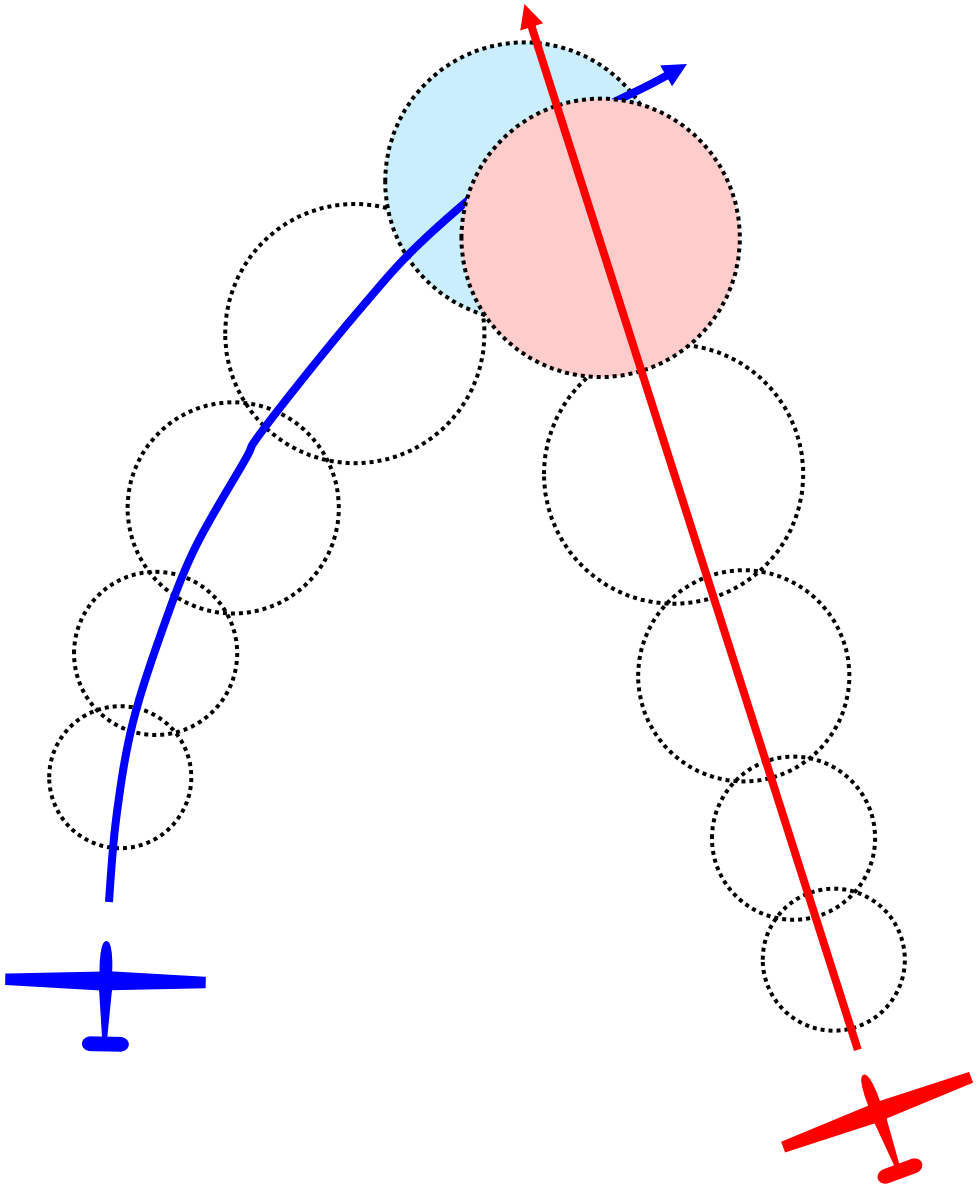

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FLARM knows its position (GPS) and it calculates a likely course 20sec into the future

**[2]** (red glider)
Its FLARM does the equivalent calculations as in the blue glider

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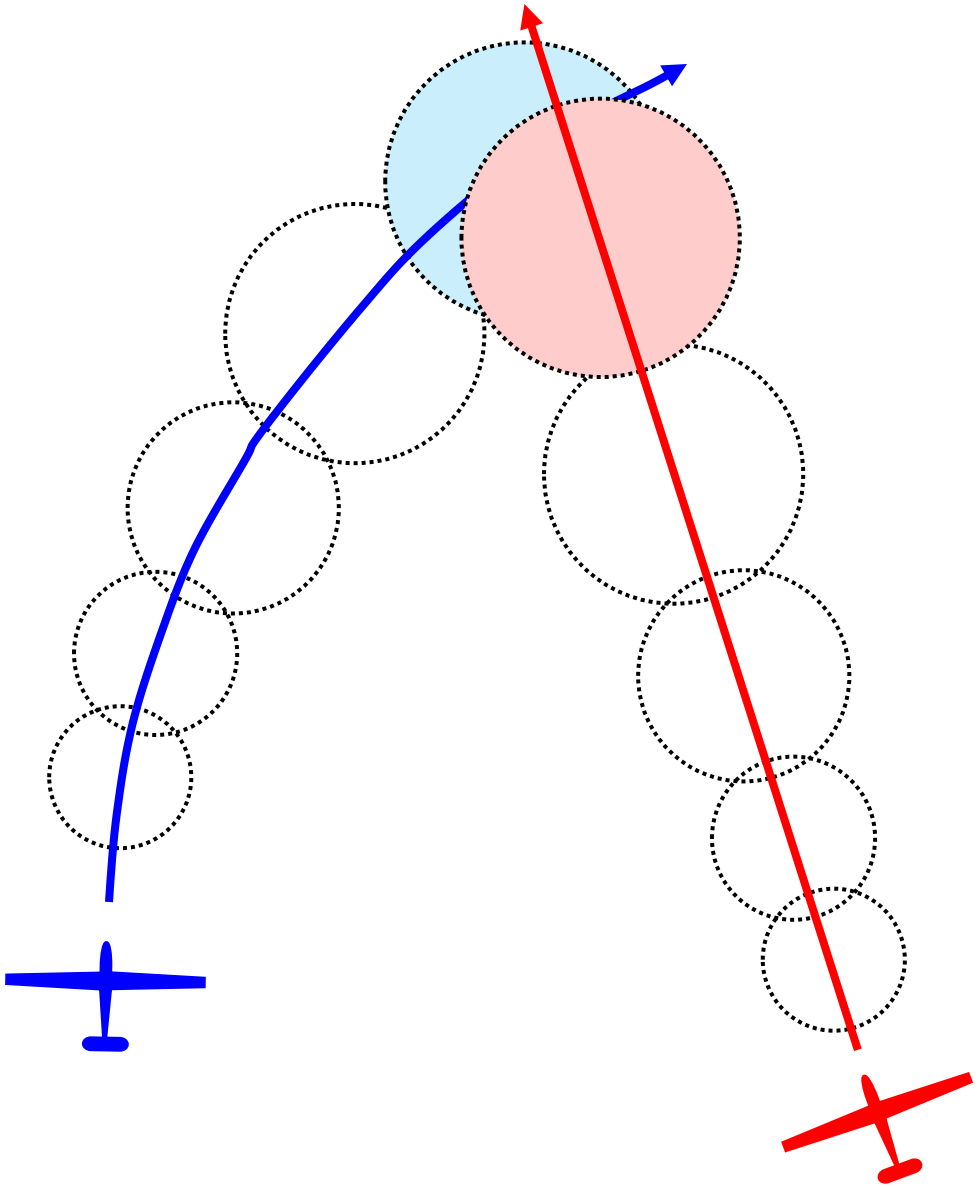
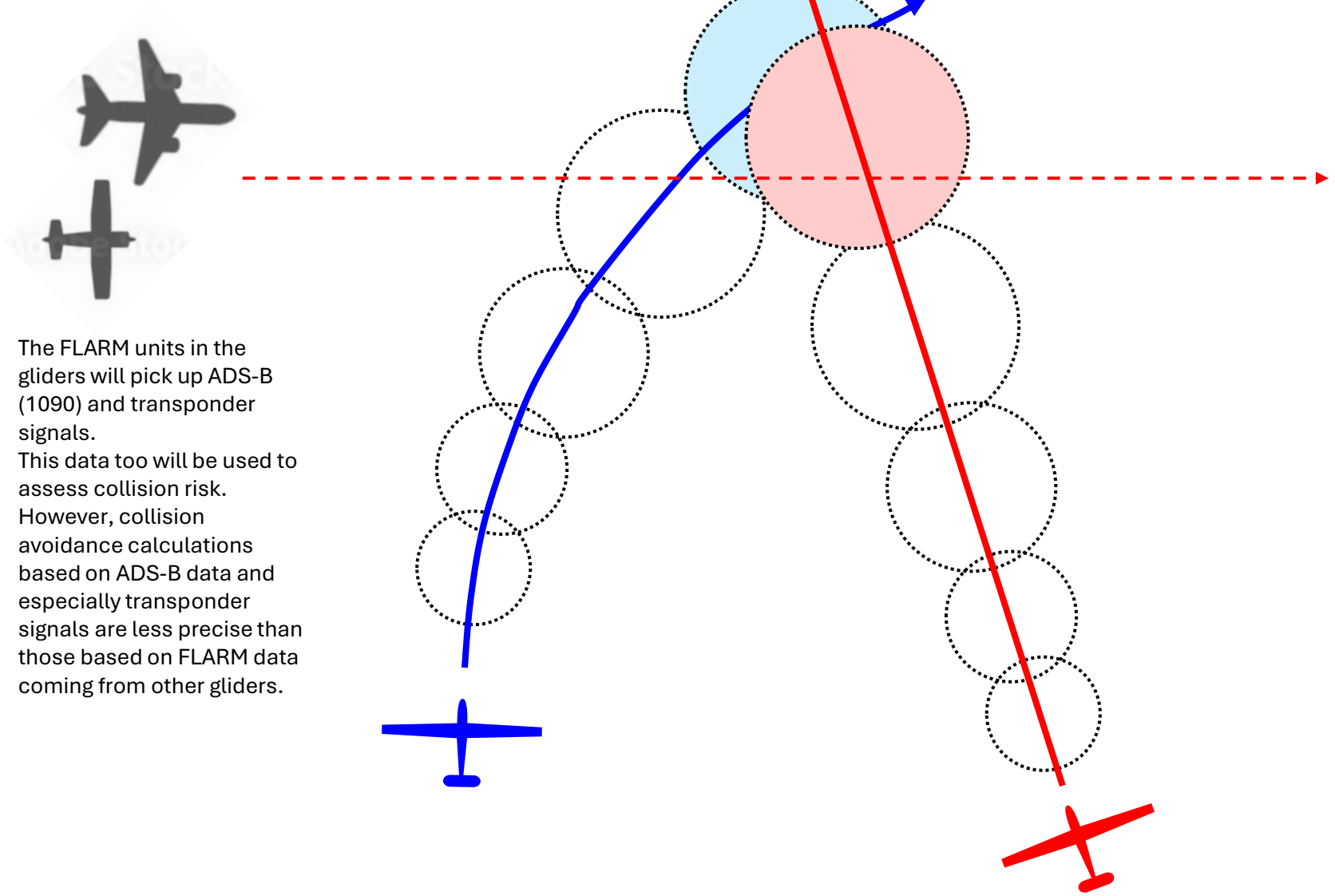


**[1]** (blue glider)
FLARM knows its position (GPS) and it calculates a likely course 20sec into the future

**[2]** (red glider)
Its FLARM does the equivalent calculations as in the blue glider

**and finally …**
**[3]**
The FLARM units “talk to each other” and if there is a risk for collision, a warning is issued in both the blue and the red glider

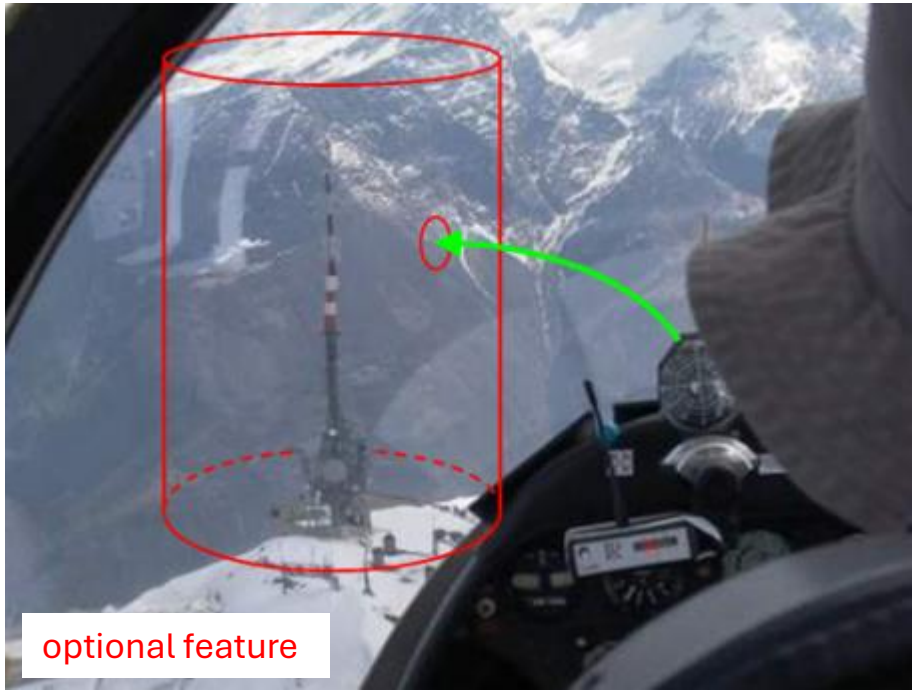
# FLARM – Autonomous Collision Threat Analysis



The FLARM units in the gliders will pick up ADS-B (1090) and transponder signals.
This data too will be used to assess collision risk.
However, collision avoidance calculations based on ADS-B data and especially transponder signals are less precise than those based on FLARM data coming from other gliders.

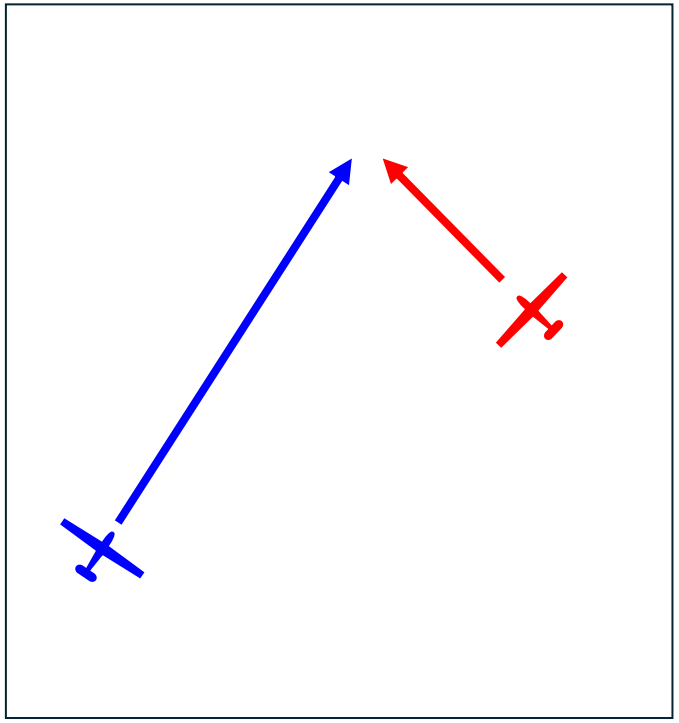
# FLARM – Autonomous Collision Threat Analysis

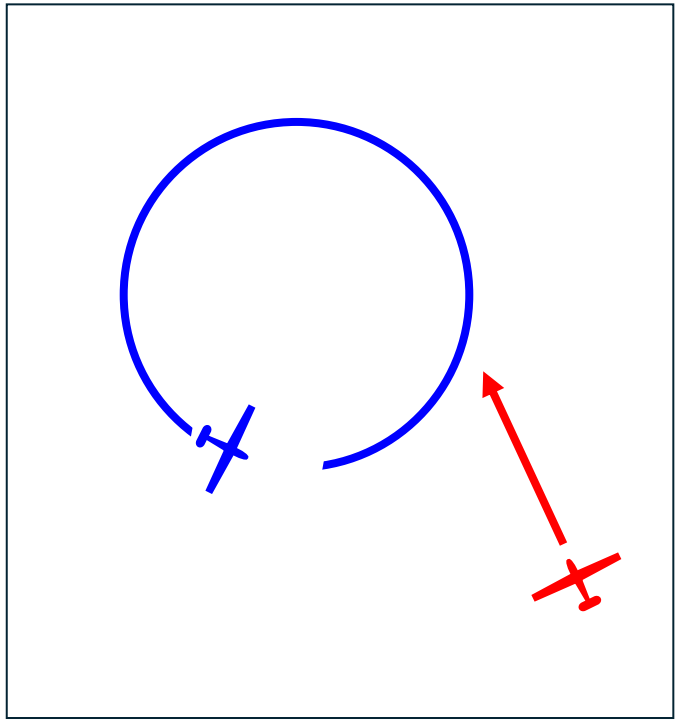
FLARM even has an obstacle data-base. It can warn of collision risk with radio-towers, power-lines, gondolas, etc.
**Note:** It is optional and not currently available in the U.S.

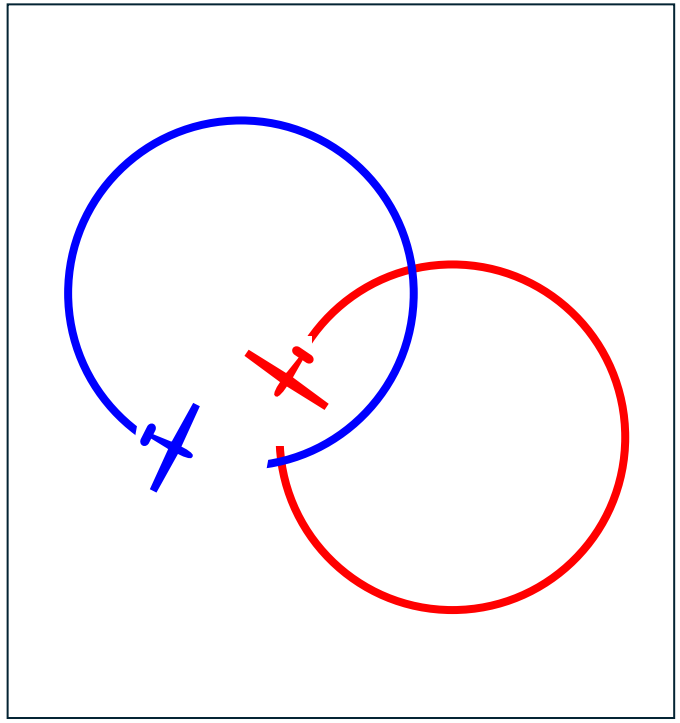


# Autonomous Collision Threat Analysis – Optimized for gliders

FLARM is optimized for gliders. It can distinguish between straight line headings and thermalling (i.e. circular flight).
Therefore, FLARM collision warning/avoidance will work even if one or both FLARM equipped gliders are in a thermal … as shown in the examples below.







# FLARM Displays @ CGC

Commonly used FLARM displays (“FLARMView”) are on the smallish side.
They are able to display a lot of data and detail, but it can be challenging to read them for those among us who do not have perfect 20/20 vision


“FLARMView” can also be set to the Classic view which shows a lot less data but may be easier to read.

This example warns of a glider approaching from 4 o’clock. It is only 3ft (1m) above and only 225 ft (68m) away.


This example shows a transponder signal approaching (commercial aircraft perhaps??).
The vertical distance of the transponder equipped aircraft is 250ft (75m) and it is 1.25 miles (2 km) away.
Note that FLARM cannot determine the direction where transponder signals come from. It can only “sense” whether a transponder signal is increasing or decreasing in strength.

# FLARM Displays @ CGC

The new 80mm displays (“TrafficView”) are very bright, comparatively easy to read, and they have arguably intuitive displays with animation, etc.

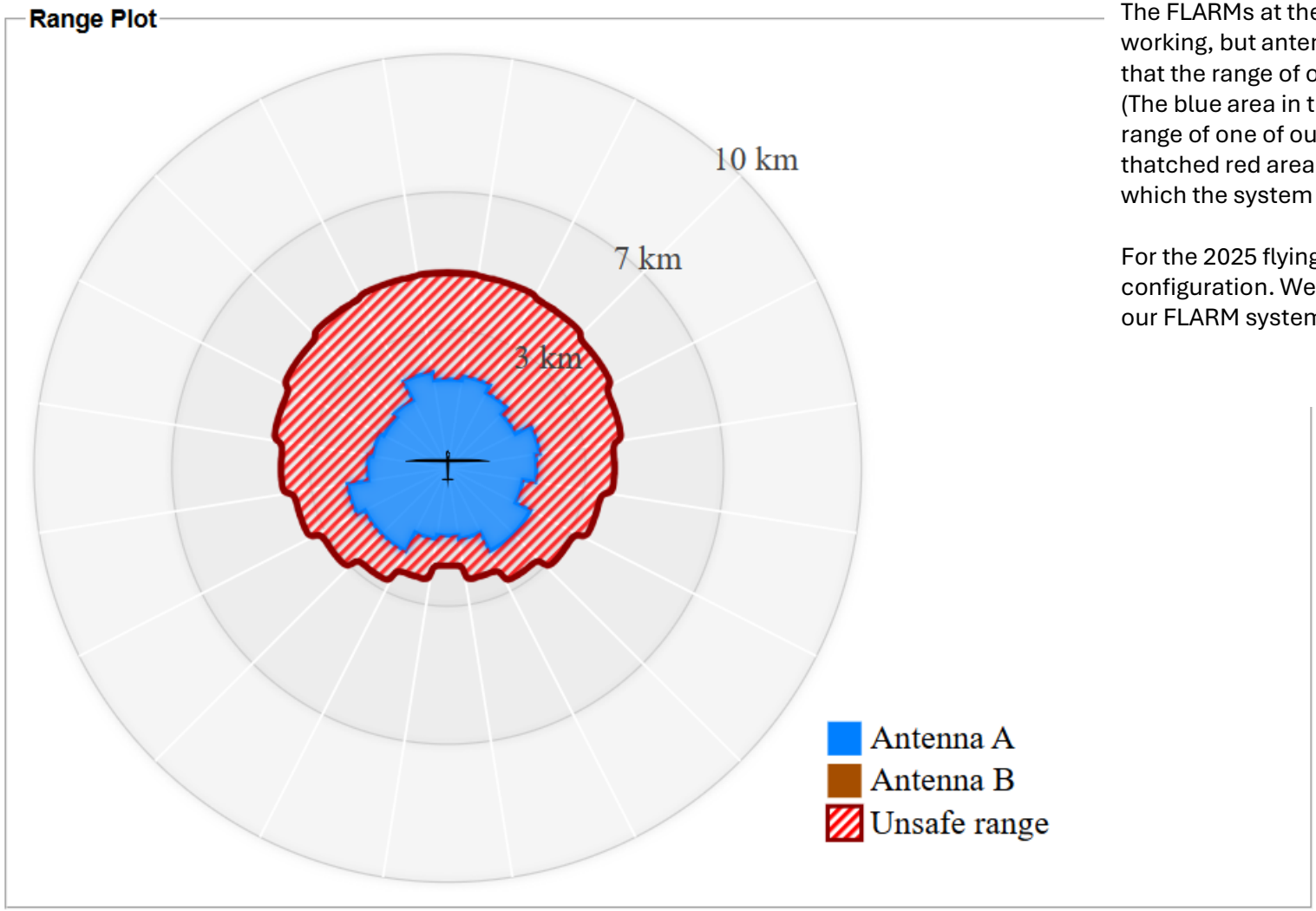
The Chicago Glider Club has installed those in N521CG (Blue 21) and in N511TW (Discus CS).

One more will be installed in the Pawnee.

The Red 21 (N621CG) might be next … but that is t.b.d.

# Challenges and Room for Improvement

## Range Analyzer Results




For FLARM to work properly, it is important to install its antennas carefully and, also, to optimize the FLARM SW configuration.

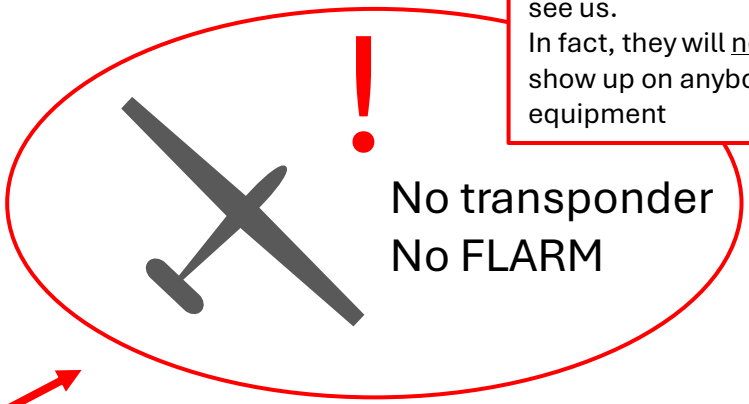
The FLARMs at the Chicago Glider Club are working, but antenna pattern analyses indicate that the range of our FLARMs is low.
(The blue area in this figure shows the actual range of one of our glider's FLARMs. The thatched red area indicates the minimum range which the system should have.)

For the 2025 flying season, we finetuned the SW configuration. We expect the performance of our FLARM systems to improve.

# I see you and you see me – Or do we … really see each other?

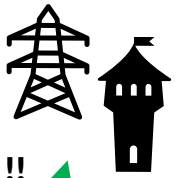
A commercial jet will pick up our transponder signal. They can see us and their TCAS will work.

Our FLARMs cannot see them, and they have no equipment to see us.
In fact, they will not show up on anybody's equipment

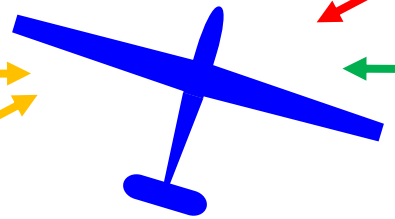



transponder
w/ or w/o 1090ES
**and**
ADS-B-In

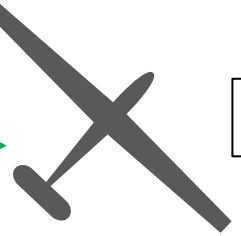
We can see ADS-B signals and transponder signals. It sort of works for collision avoidance, but it is not very precise



**maybe !!**



**best !**



FLARM etc.

A GA aircraft with ADS-B-In will pick up our ADS-B-Out and will see us just fine.

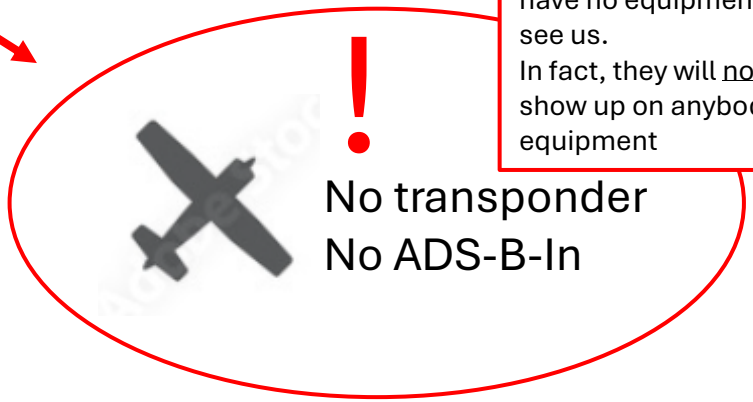
**This is a typical CGC Glider with**

Mode S w/ 1090ES
**and**
FLARM w/ ADS-B-In


A GA aircraft without ADS-B-In will not see us … but at least our FLARM will see their transponder.

transponder
w/ or w/o 1090ES

Our FLARMs cannot see them, and they have no equipment to see us.
In fact, they will not show up on anybody's equipment



If there were only **1 Thing** to take away from today's presentation …

"Supplement"

**not**

"Substitute"