Luftfartstilsynet

Webinar om elektronisk synlighet

Luftfartstilsynet

Webinar om elektronisk synlighet

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Luftfartstilsynet

Introduksjon

Hans Edvard Sunde

- Luftfartstilsynet
- Flyoperativ inspektør
  - GA

Hans Petter Heimro

- Luftfartstilsynet
- Flyoperativ inspektør
  - Droner

Jørgen Hauge Skogmo

- Norsk Luftambulanse Teknologi
- Jobber med infrastruktur i NLA Teknologi .
- Jobber med å bedre luftromssynlighet og sikkerhet.

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Hvilke typer luftfartøy flyr du?

ⓘ Start presenting to display the poll results on this slide.

slido

Hva slags typer elektronisk synlighet bruker du for å sende posisjonen din?

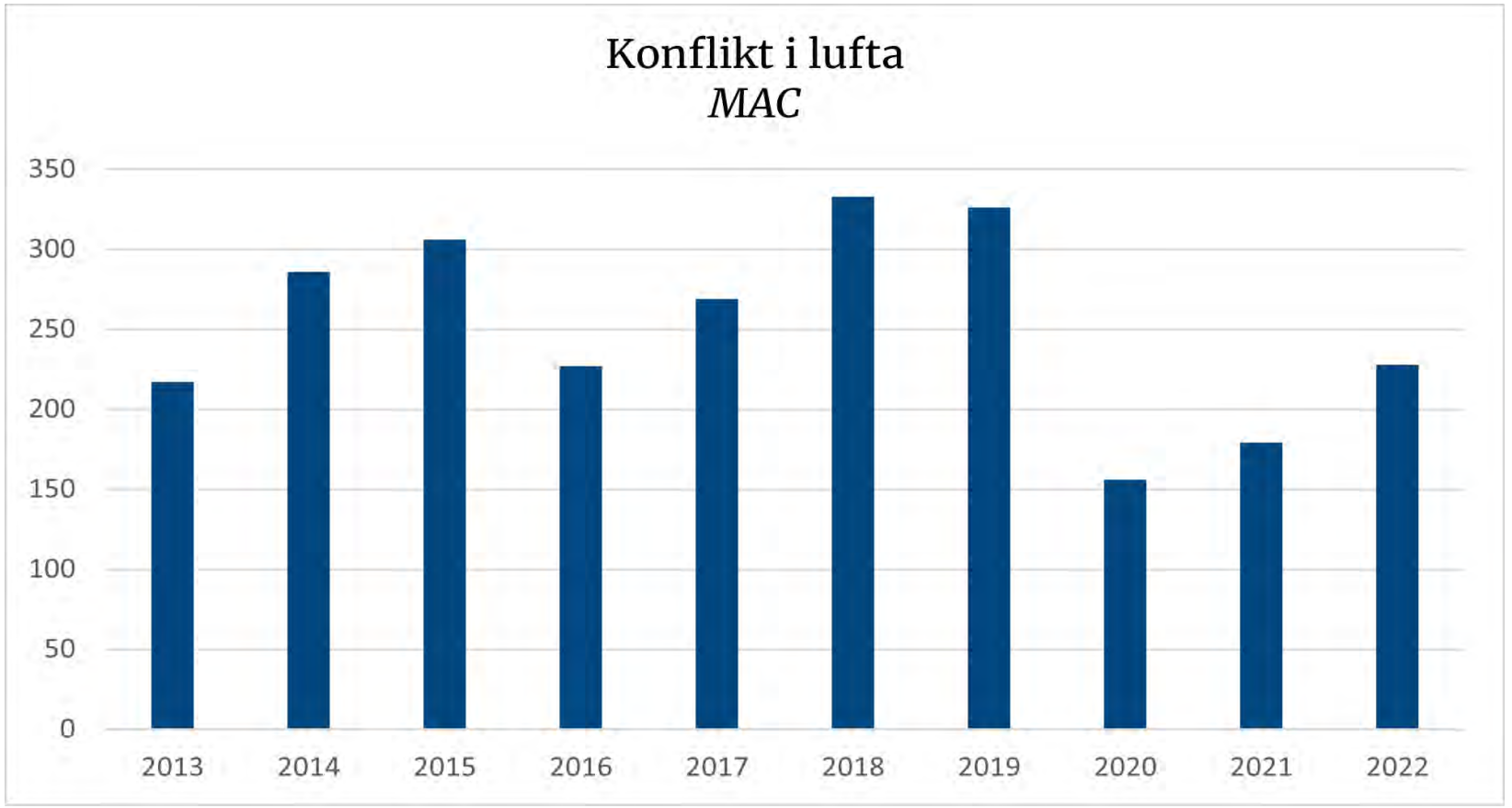
ⓘ Start presenting to display the poll results on this slide.

Luftfartstilsynet

Innhold

- Hvorfor trenger vi elektronisk synlighet?
- Hva er elektronisk synlighet?
- Hva er tilleggstjenester tilknyttet elektronisk synlighet?
- Hva er gjort frem til nå
- U-Space kommer. Hvordan blir dette i fremtiden?
- Videre steg

Rapporterte tilfeller av konflikt i lufta 2013 - 2022



Kilde: Luftfartstilsynet.no - Norske flysikkerhetsresultater 2022

Kollisjoner har som regel fatale konsekvenser

Table 2: European mid-air collision statistics General Aviation MTOM <2,250 kg (all category aircraft)

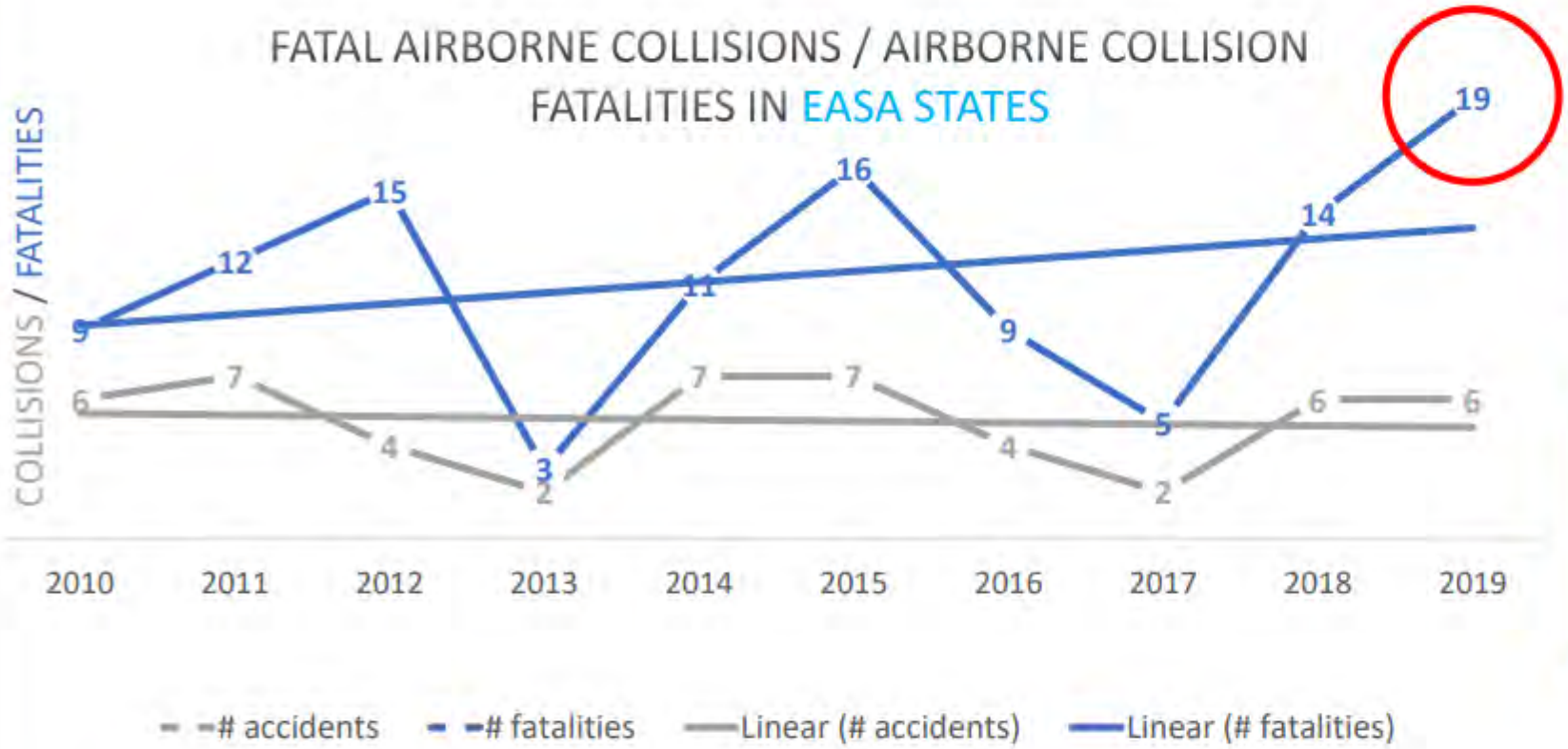
	2006	2007	2008	2009	2010	2011	**Total**
Accidents	15	9	10	18	11	13	**76**
Injuries:							
Fatal	14	12	9	18	9	11	**73**
Serious	2	2	4	2	4	1	**15**
Total	**16**	**14**	**13**	**20**	**13**	**12**	**88**

Table 3: European mid-air collision statistics General Aviation MTOM >2,250 kg (Aeroplanes)

	2006	2007	2008	2009	2010	2011	**Total**
Accidents	0	2	1	2	0	1	**6**
Injuries:							
Fatal	0	3	5	1	0	0	**9**
Serious	0	0	0	1	0	0	**1**
Total	**0**	**3**	**5**	**2**	**0**	**0**	**10**

Kilde: EASA - Research Project EASA.2011/07 - Scoping Improvements to 'See And Avoid' for General Aviation (SISA)

Safety data 2009 - 2019



60 FATAL COLLISIONS ~ 6 PER YEAR

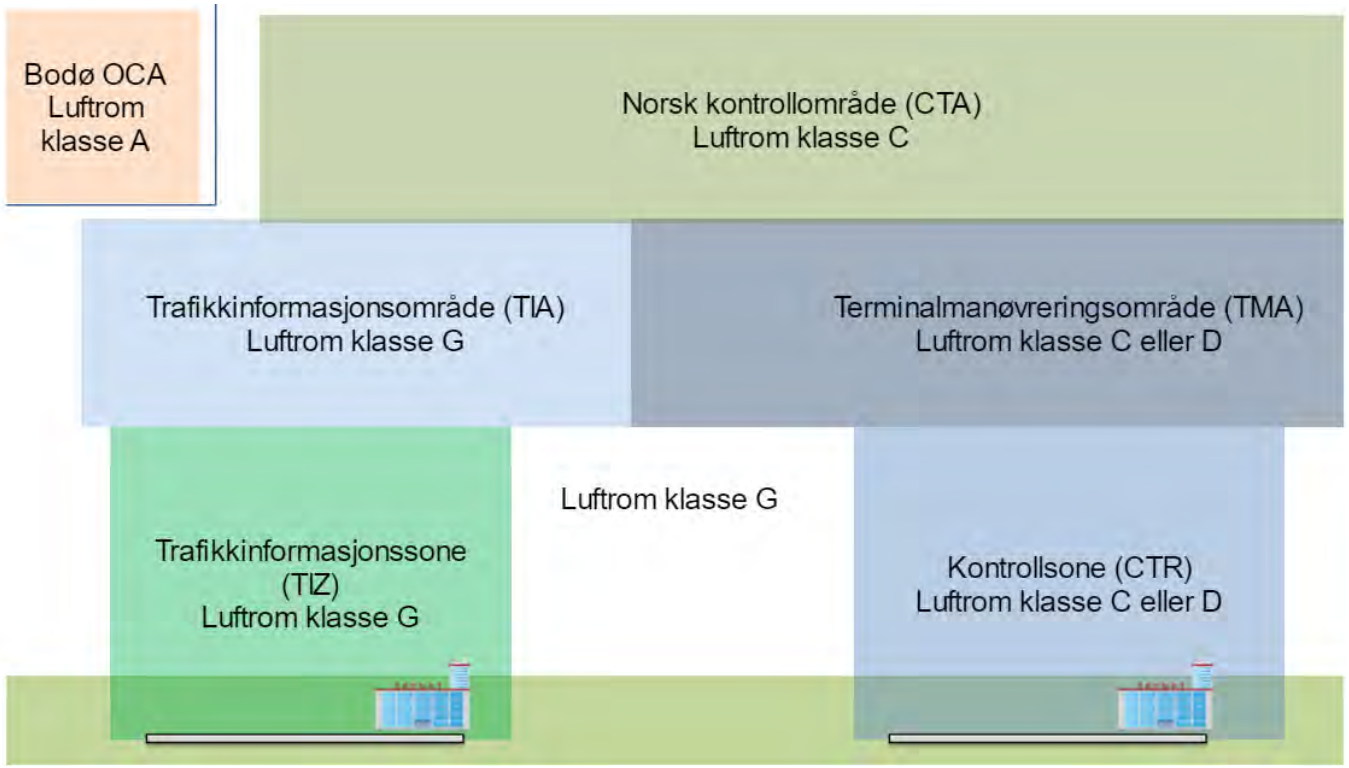
137 FATALITIES ~ 13 PER YEAR

ALL UNCONTROLLED TRAFFIC

ALL SMALL AIRCRAFT*

*MANY ROTORCRAFT

Kollisjoner skjer typisk:

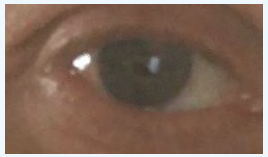


- I ikke-kontrollert luftrom
- Midt på dagen
- God sikt
- VFR
- Uansett erfaringsnivå
- Fartøy under 2 250 kg

Kilde: Research Project EASA.2011/07 Scoping Improvements to 'See And Avoid' for General Aviation (SISA)

Luftfartstilsynet

Synet har sine begrensninger



RESEARCH ARTICLE

Midair Collisions: Limitations of the See-and-Avoid Concept in Civil Aviation

C. Craig Morris

Morris CC. *Midair collisions: limitations of the see-and-avoid concept in civil aviation.* **Aviat Space Environ Med 2005; 76:357–65.**

Introduction: Midair collisions cause loss of life and property and undermine general aviation; they also represent failures of the see-and-avoid concept in air traffic control. This study identifies limitations of the see-and-avoid concept. ***Methods:*** Analysis of National Transportation Safety Board data on 159 U.S. civil aviation midair collisions and limitations of the see-and-avoid concept. ***Results:*** On average, there were 15.6 midair collisions annually from 1991 through 2000. At least one aircraft was maneuvering in 88% of collisions, and both in 70%. There were 77% that involved arrival to, departure from, or flight over an airport, with 61% in the traffic pattern. Head-tail collisions were more frequent in the traffic pattern than out (28.3%, 2.8%, $p < 0.05$). Other horizontal convergence angles were equally frequent in or out of the pattern: head-on (8.3%, 11.0%), obtuse (11.0%, 8.3%), and acute (13.8%, 16.6%). ***Discussion:*** Because the relative bearing to each aircraft on an unaccelerated collision course is constant, pilots sometimes cannot see converging aircraft when climbing, descending, or level. Even if a converging aircraft is unobstructed, it appears small, motionless, camouflaged, and inconspicuous until imminent impact. A statistical model reveals that the probabilities of seeing and avoiding a converging 40-ft aircraft, for an optimal observer or theoretical pilot scanning 2/3 or 1/3 of the time, respectively, are less than 0.91, 0.60, 0.30 at 200 kn; 0.49, 0.32, 0.16 at 300 kn; 0.28, 0.18, 0.09 at 400 kn; and 0.15, 0.10, 0.05 at 500 kn. The see-and-avoid concept has striking physical and behavioral limitations.

Keywords: aircraft, safety.

THERE WERE 15.6 midair collisions each year in U.S. civil aviation, on average, from 1991 through 2000. The National Transportation Safety Board (NTSB) found failure to see and avoid, inadequate visual lookout, or failure to maintain visual and physical clearance, as probable causes in 94% of these accidents. Midair collisions cause loss of life and property and undermine general aviation; they also represent failures of the see-and-avoid concept in air traffic control. According to a 1983 Federal Aviation Administration (FAA) Advisory Circular (5, p. 1):

> "The flight rules prescribed in Part 91 of the Federal Aviation Regulations (FAR) set forth the concept of "See and Avoid." This concept requires that vigilance shall be maintained at all times, by each person operating an aircraft, *regardless* of whether the operation is conducted under Instrument Flight Rules (IFR) or Visual Flight Rules (VFR)."

Typical NTSB findings imply that one or both pilots could have seen and avoided the other aircraft. Yet pilots of aircraft operated legally and proficiently often cannot see each other, or infer each other's trajectory, in time to avoid collision. And sometimes one aircraft operated carelessly poses an unavoidable hazard for other aircraft operated proficiently.

Four NTSB reports on midair collisions have emphasized limitations of the see-and-avoid concept in their analyses, findings, and recommendations. The report on a 31 Aug 1986 collision found limitations of the see-and-avoid concept to ensure traffic separation under the conditions of the conflict as a contributing factor (20). The report on a 20 Jan 1987 collision found deficiencies of the see-and-avoid concept as a primary means of collision avoidance as one of three probable causes and recommended that the FAA "Expedite the development, certification, and production of various low-cost proximity warning and conflict detection systems for use aboard general aviation aircraft" (20, p. 44). Two reports, on collisions on 11 Sep 1992 and 14 April 1993, found inherent limitations of the see-and-avoid concept of separation of aircraft operating under visual flight rules as probable causes (20,21). According to the report on the 1992 collision, a twin-engine turboprop Mitsubishi airplane took off and, 2 mi from the airport, collided with a Piper airplane approaching to land at the same airport. The turboprop was in a climbing right turn at 168 kn, and the Piper was descending straight ahead at 127 kn, when they collided at an angle of 105° at 234 kn. Each pilot had an unobstructed view of the other aircraft for only a few seconds before the theoretical 12.5 s necessary to recognize and avoid it: 4–8 s for the turboprop pilot and 13 s for the Piper pilot. According to the report on the 1993 accident, a military aircraft flying 200 ft above ground level at 468 kn collided at an angle of 59° with an agricultural plane making 96 kn. Neither pilot could see and avoid the other aircraft for different reasons: the angle subtended by the agricultural plane in the military pilot's visual field remained too small to detect until it was too late, while the mili-

From the Bureau of Transportation Statistics, U.S. Department of Transportation, Washington, DC.

This manuscript was received for review in September 2004. It was accepted for publication in December 2004.

Address reprint requests to: C. Craig Morris, Ph.D., Bureau of Transportation Statistics, U.S. Department of Transportation, 400 Seventh Street SW, Room 3430, Washington, DC 20590; craig.morris@bts.gov.

Carl Craig Morris, 2005

…found that motivated pilots, …, detected only **56%** of 64 staged near-midair collisions under favorable conditions

Potential mitigation strategies include: …
7) affordable and reliable collision avoidance technologies in all general aviation aircraft, as the NTSB recommended in 1987.

NTSB recommended live traffic in GA cockpits in 1995.

Omtrent 35 000 droner forventes solgt hvert år i Norge.

- «Market Study – The Norwegian Drone Industry», Drone Industry Insights, rapport bestilt av Samferdselsdepartementet (2022)

Mostphotos.com

Foto: KVS Technologies (nå Field Group)

Kyte/Aviant sin drone. Bilde fra dronedj.com

Foto: Torbjørn Kjosvold / Forsvaret

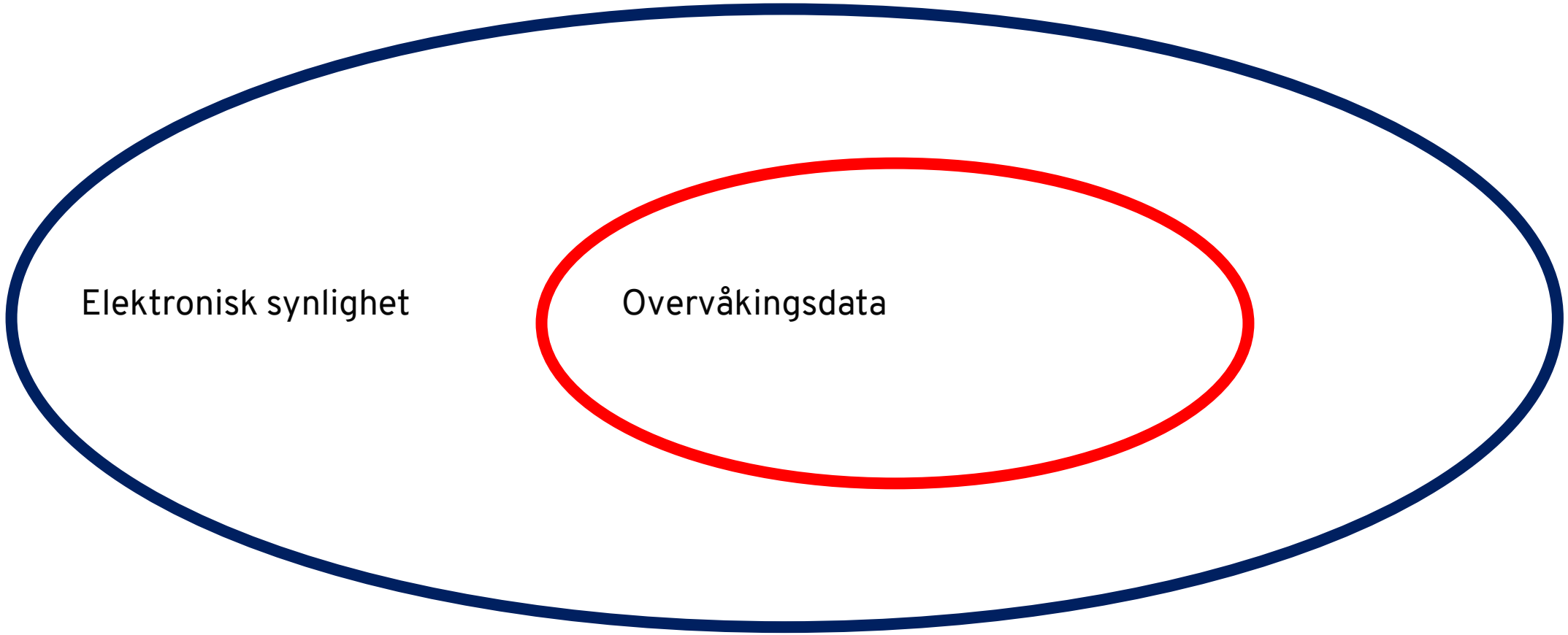
Foto: Politiet

Foto: Tromsø Red Cross Search and Rescue RPAS Team

Hva er elektronisk synlighet?

Illustrasjon: Mostphotos.com

Overvåkingsdata vs. elektronuisk synlighet



XPDR
ADS-B
ADS-L 860
ADS-L MOBILE
FANET, FLARM, OGN
SafeSky, AirNavPro

XPDR
ADS-B
TCAS

Offisielle spesifikasjoner

ADS-B
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TCAS

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ADS-L MOBILE
FANET, FLARM, OGN
SafeSky, AirNavPro

U-Space

Proprietære løsninger (eksempler)

FANET, FLARM, OGN
868 MHz
SafeSky, AirNavPro

RID Network
RID Direct

RID Network

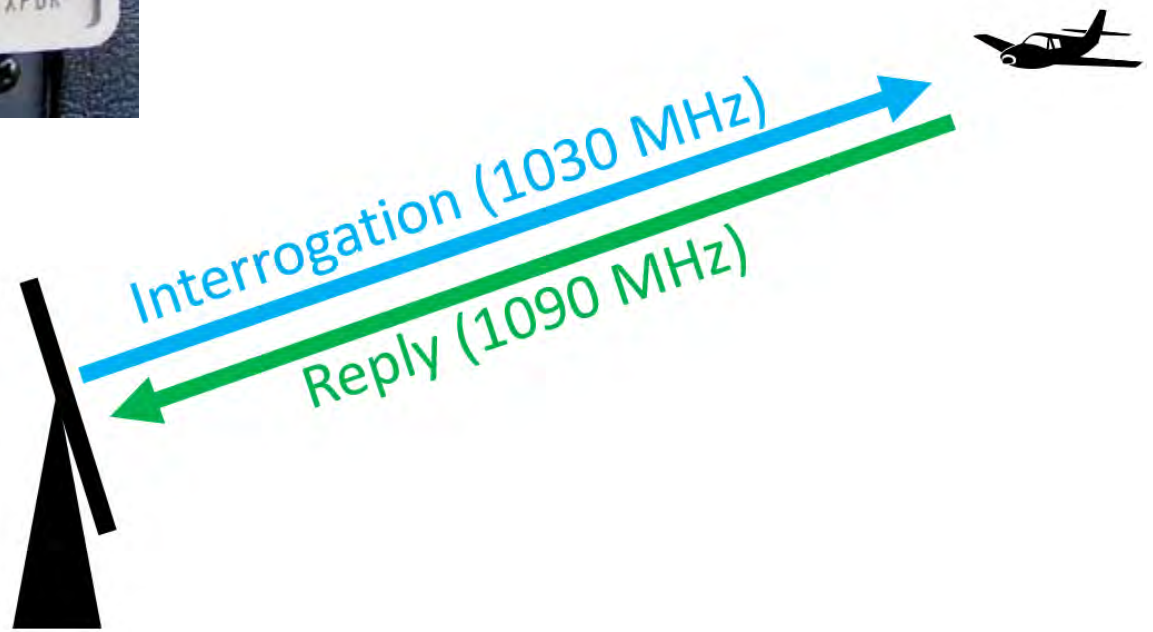
XPDR (SSR)
ADS-B

ADS-B
ADS-L 860
ADS-L MOBILE

Veileder om elektronisk synlighet

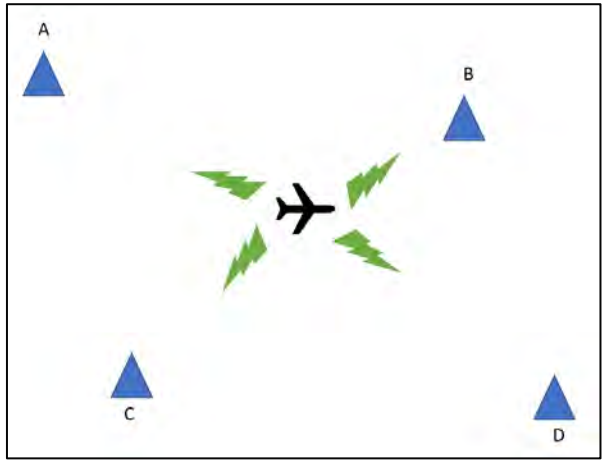
- training.caa.no/Elektronisk_synlighet

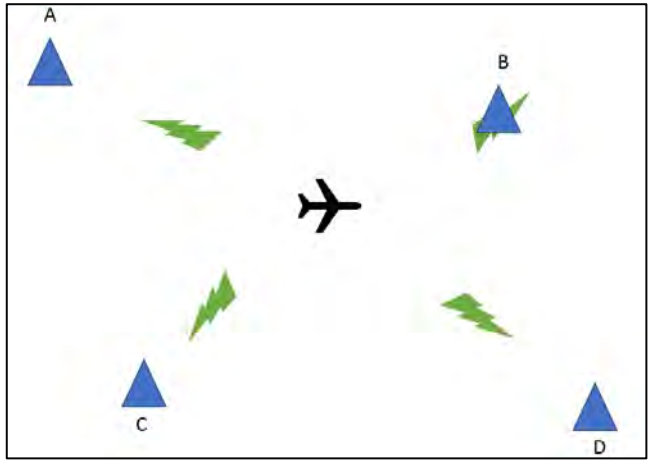
Transponder og radar

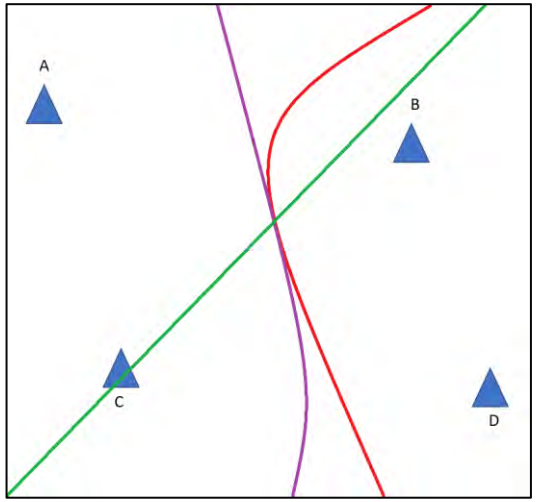


Mode A, C og S

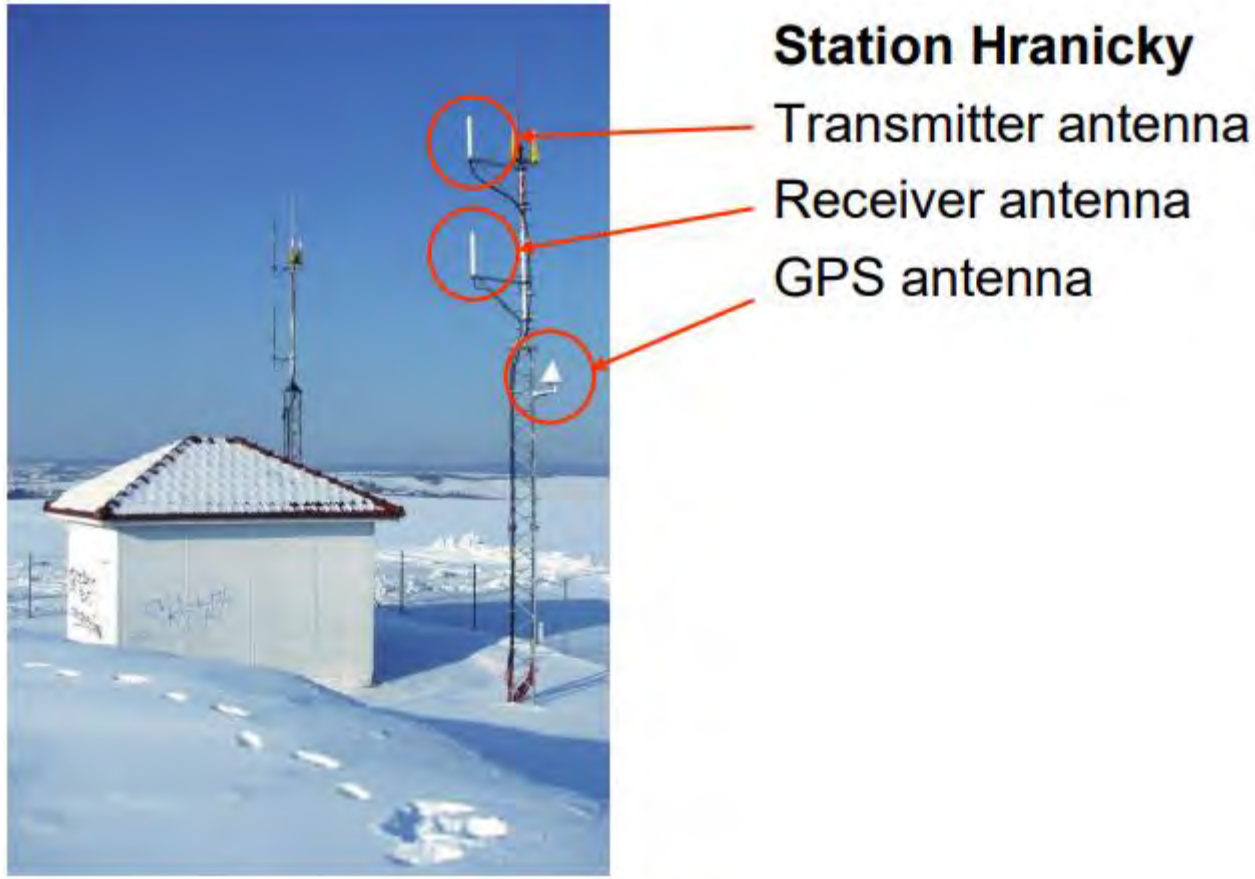
Transponder og multilaterasjon





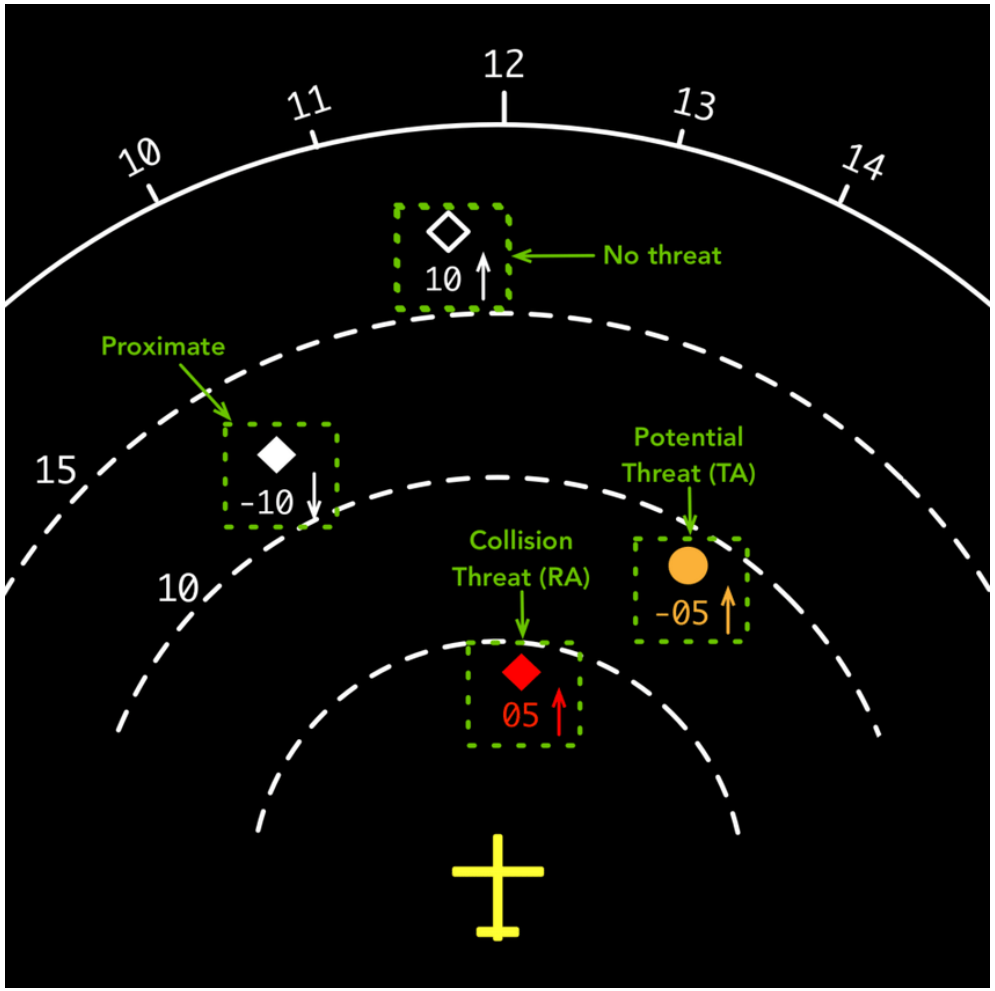


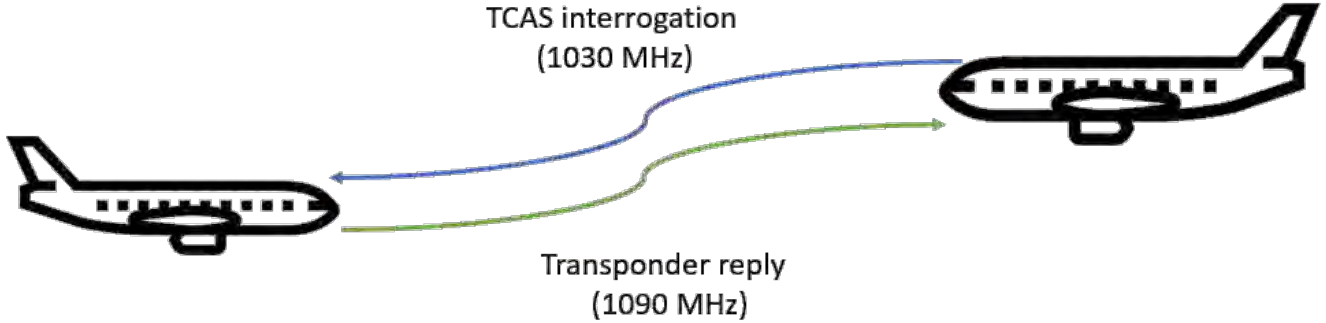
Transponder og multilaterasjon



Avinors nye WAM-antenne levert av SAAB. Foto: Avinor/Finn Reitan

TCAS II er avhengig av transponder for å fungere



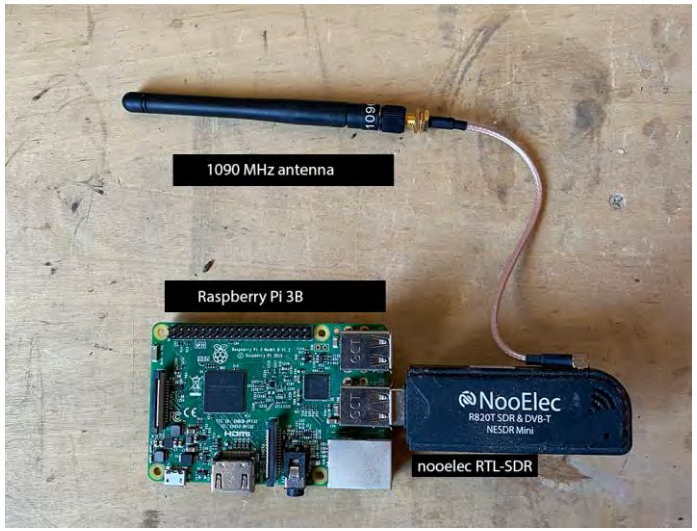


Må ha TCAS II:

- Over 5 700 kg
- Mer enn 19 passasjerer

Mode S-ES (Extended Squitter)

Mode S-ES transponder



Hjemmelaget 1090 MHz mottaker

- Mode S-ES = Mode S + ADS-B
- 1090 MHz
- Alle fartøy over 5 700 kg
- Trykkhøyde

- ADS-B: GNSS posisjon og høyde

1090 MHz non-transponder devices (NTDs)

- ADS-B Ut, uten transponder
- Lufttrafikktjenesten ser dem **ikke**
- TCAS ser dem **ikke**
- ACAS Xa – hvis påskrudd
- Kan **ikke** brukes i U-space airspace

- Frekvenstillatelse fra NKOM
- ICAO kode fra LT

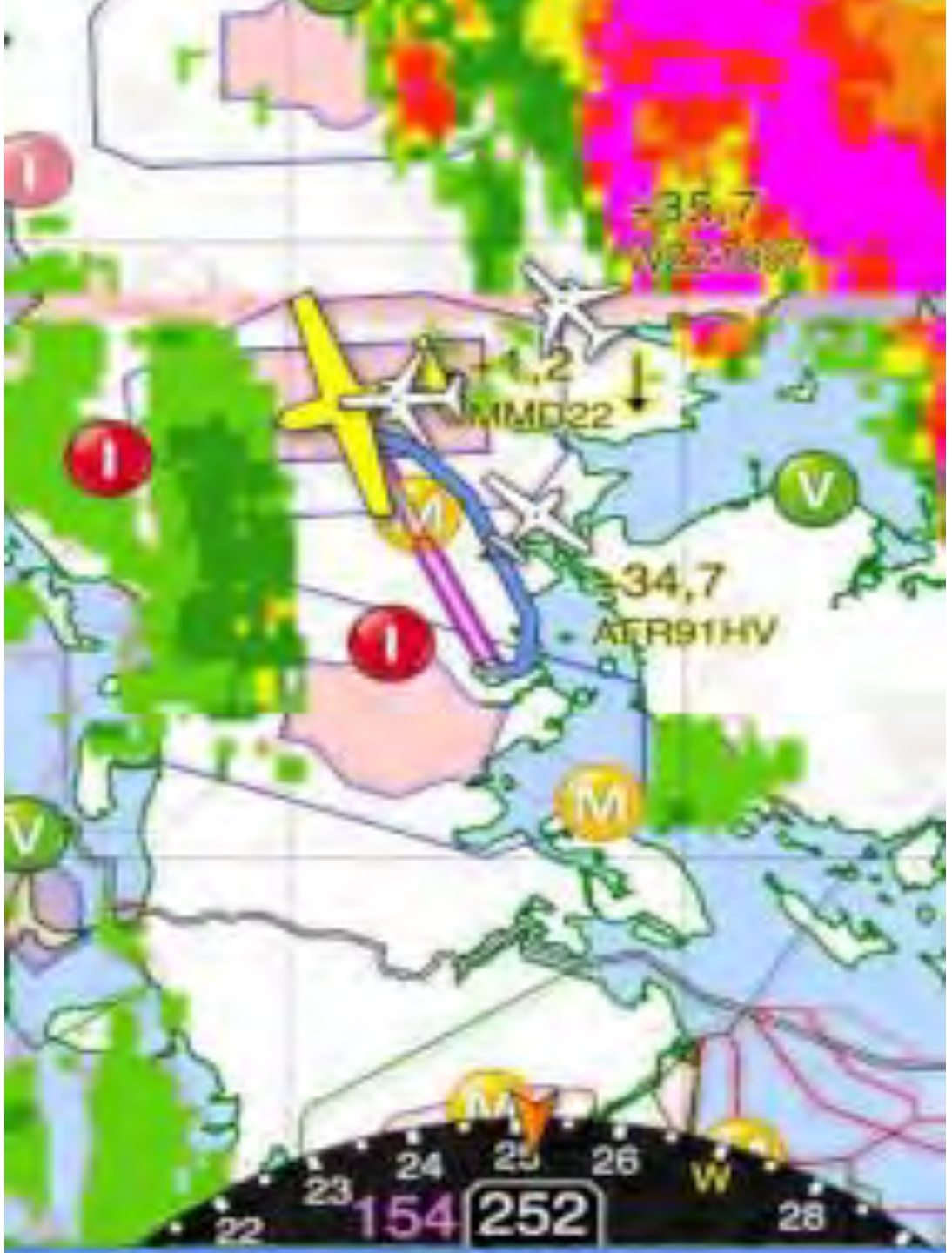
UAT – 978 MHz - tilleggstjenester

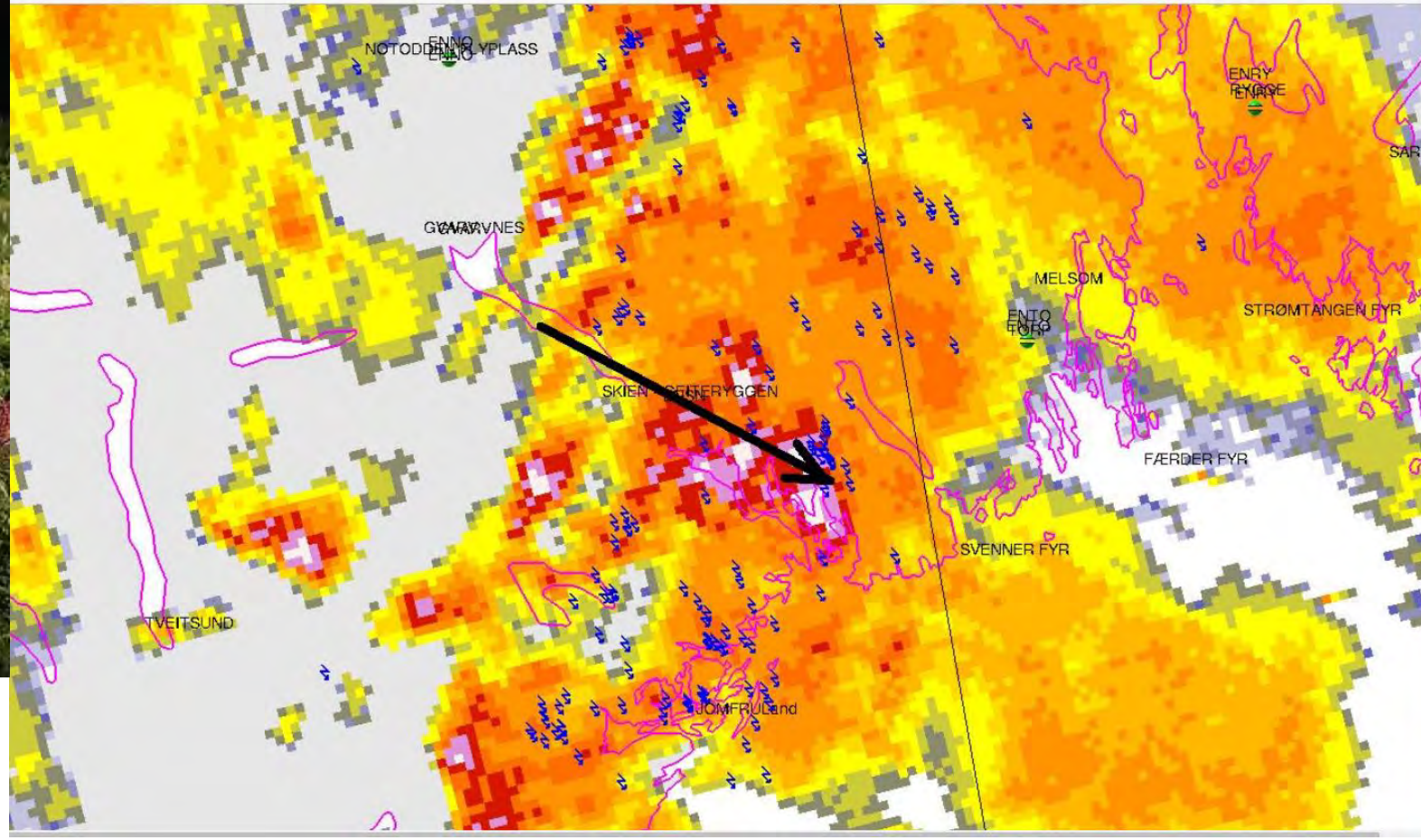
Hvordan få folk til å betale for ADS-B?

FAA svarte:

- Gi dem gratis sanntids trafikk
- Gi dem gratis sanntids vær
- Gi dem gratis sanntids luftrom

Trafikk i sanntid





LN-OGT

Vær i sanntid

Rask omdisponering av luftrom

Luftrom i sanntid

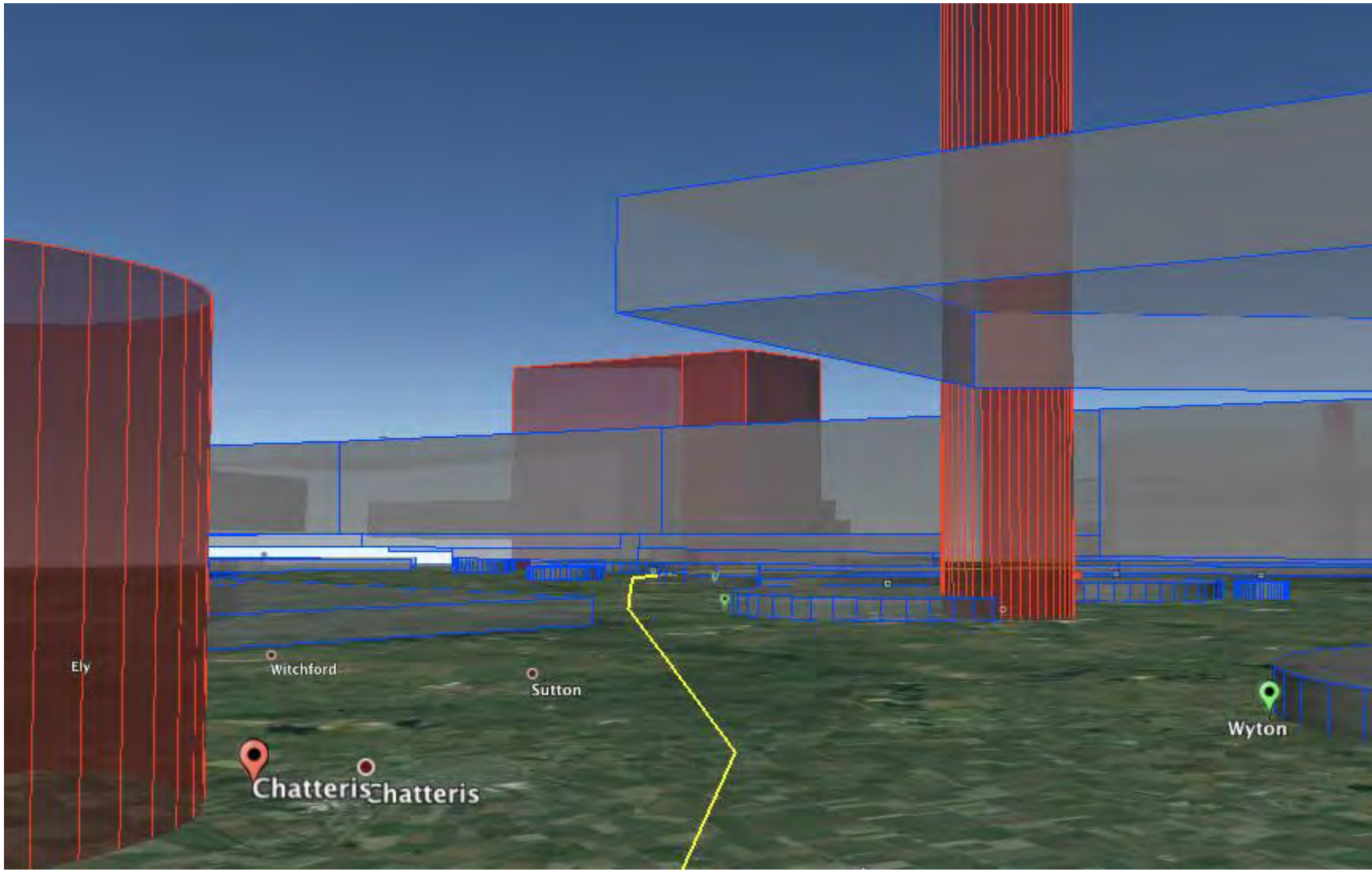


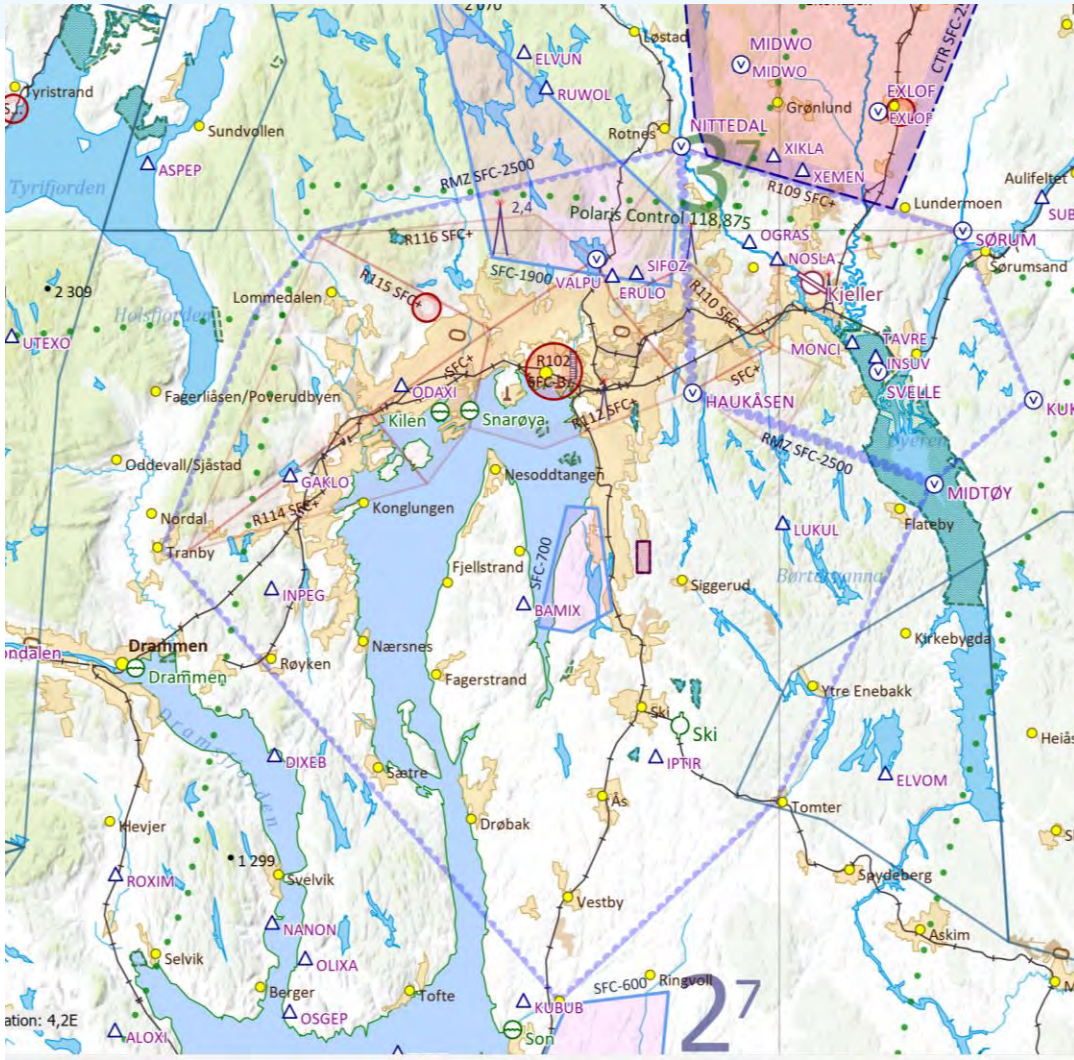
Illustration: oisin.creagh

Statistikken fra FAA er overveldende:

Referanse

Hva er gjort frem til nå?

- Hems WX
- Sensorstasjoner
- G-luft
- Oslo og Kjeller RMZ/TMZ ADS-L
- Værdata, trafikkdata, luftromsdata
- UAT testsendere



XPDR
ADS-B
ADS-L 860
ADS-L MOBILE
FANET, FLARM, OGN
SafeSky, AirNavPro

XPDR
ADS-B
TCAS

Offisielle spesifikasjoner

ADS-B
XPDR
TCAS
ADS-L 860
ADS-L MOBILE
RID Network
RID Direct

ADS-L 860
ADS-L MOBILE
FANET, FLARM, OGN
SafeSky, AirNavPro

XPDR
ADS-B
TCAS

ADS-L 860
ADS-L MOBILE
FANET, FLARM, OGN
SafeSky, AirNavPro

U-Space

Proprietære løsninger (eksempler)

FANET, FLARM, OGN
868 MHz
SafeSky, AirNavPro

RID Network
RID Direct

RID Network

XPDR (SSR)
ADS-B

ADS-B
ADS-L 860
ADS-L MOBILE

ADS-L – "ADS-B Light"

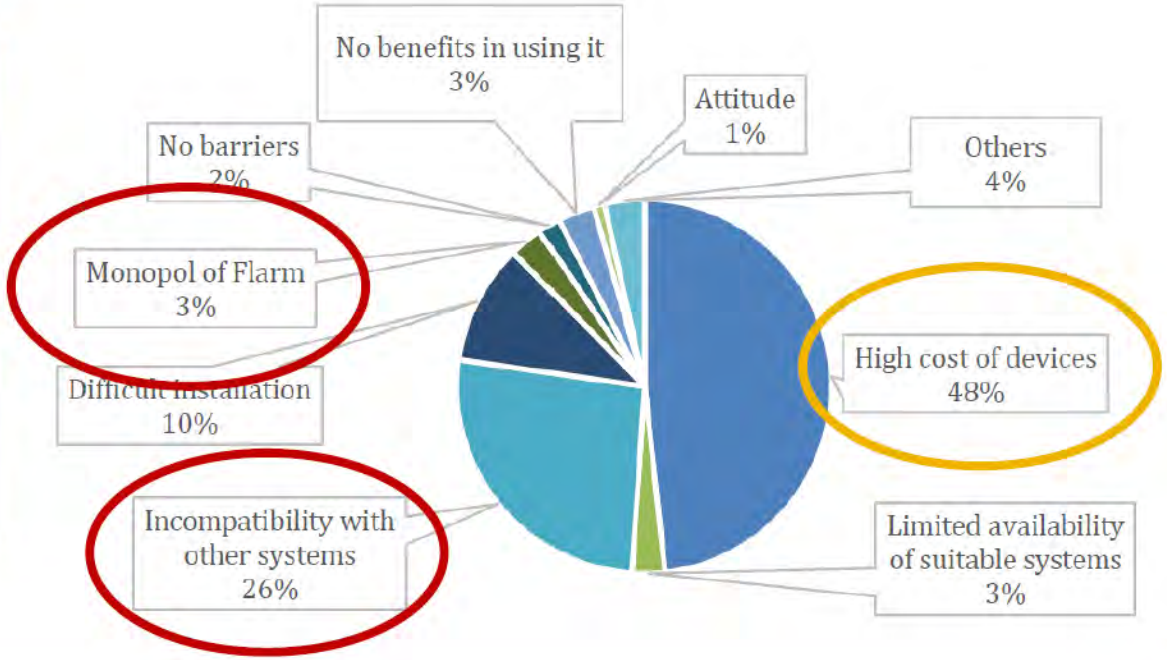
Validation through EASA Pilots' Survey

→iConspicuity

30%
Interoperability

48%
High Cost

What are the main barriers in bigger uptake of traffic awareness/Anti-collision system for GA pilots?



EASA

ADS-L (light)

Affordable

Interoperable

GNSS based

Privacy & Security


EASA

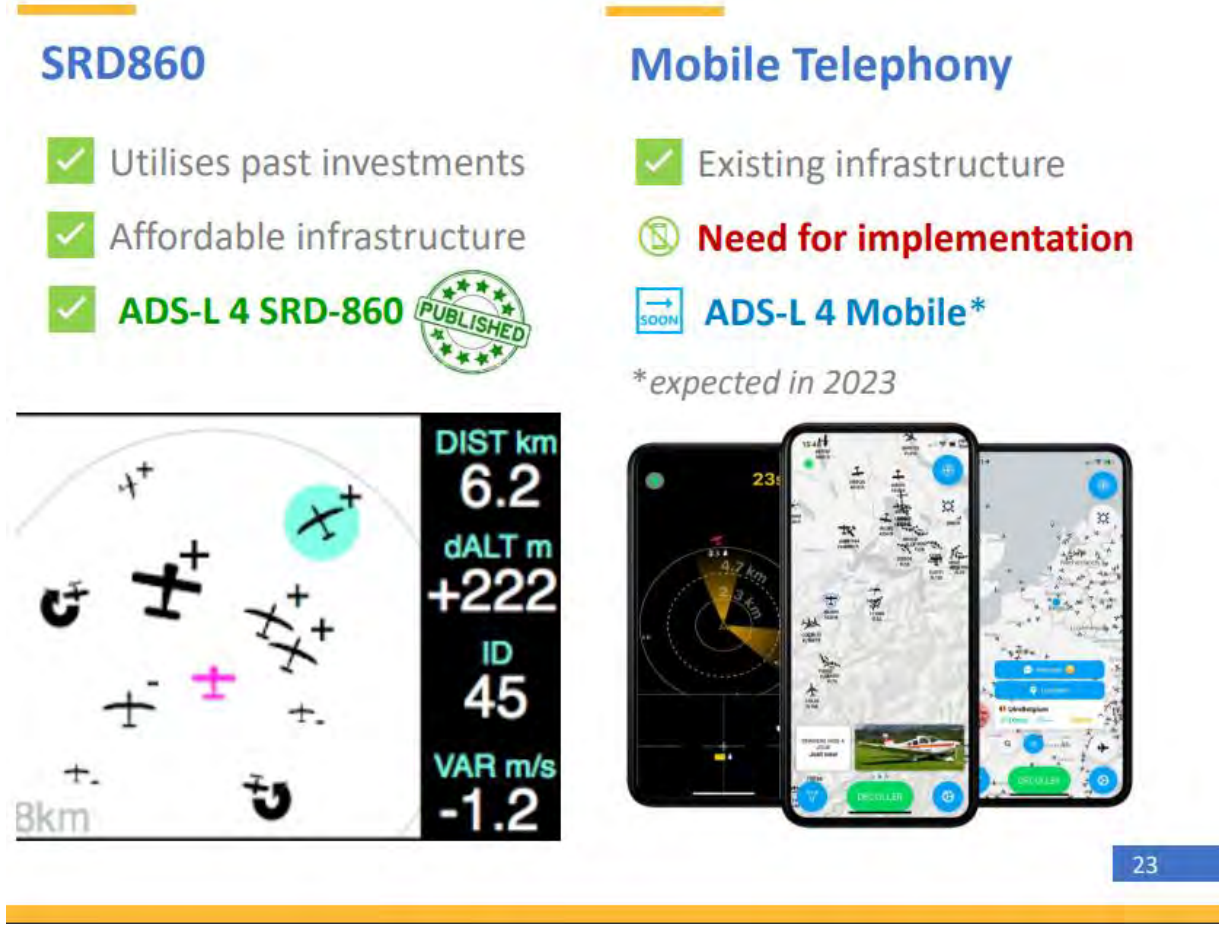
Technical Specification
for
ADS-L transmissions
using SRD-860 frequency band
(ADS-L 4 SRD-860)

Issue 1
20 December 2022[1]

1 For the date of entry into force of this Issue, please refer to Decision 2022/024/R at the Official Publication of EASA.

Page 1 of 30

ADS-L vil ha to utgaver: 868 MHz og mobiltelefoni



868 MHz

- Fribruksfrekvens
- Minst 10 km rekkevidde (over 100 km observert)

Mobiltelefoni

- Publiseres i 2024

Luftfartstilsynet

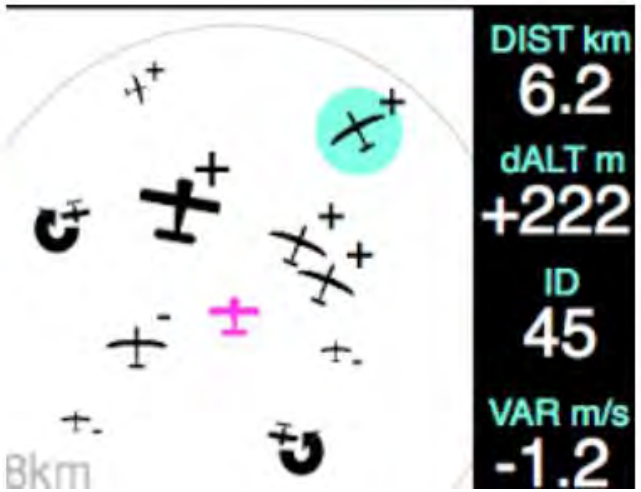
Tre sendemåter for å være synlig

Certified ADS-B out

- ✓ ICAO standard
- ✓ Already used
- ✓ All elements in place

SRD860

- ✓ Utilises past investments
- ✓ Affordable infrastructure
- ✓ ADS-L 4 SRD-860 PUBLISHED



Mobile Telephony

- ✓ Existing infrastructure
- Need for implementation
- SOON ADS-L 4 Mobile*

**expected in 2023*

“To-Be-Seen” 4 U-space

ADS-B Out (1090 MHz)

For certified aircraft, using the **existing certified technology** already installed on board

ADS-L (SRD-860)

Non-certified devices transmitting at low power on the licence-free band SRD-860, in compliance with ADS-L specifications

ADS-L (Mobile telephony)

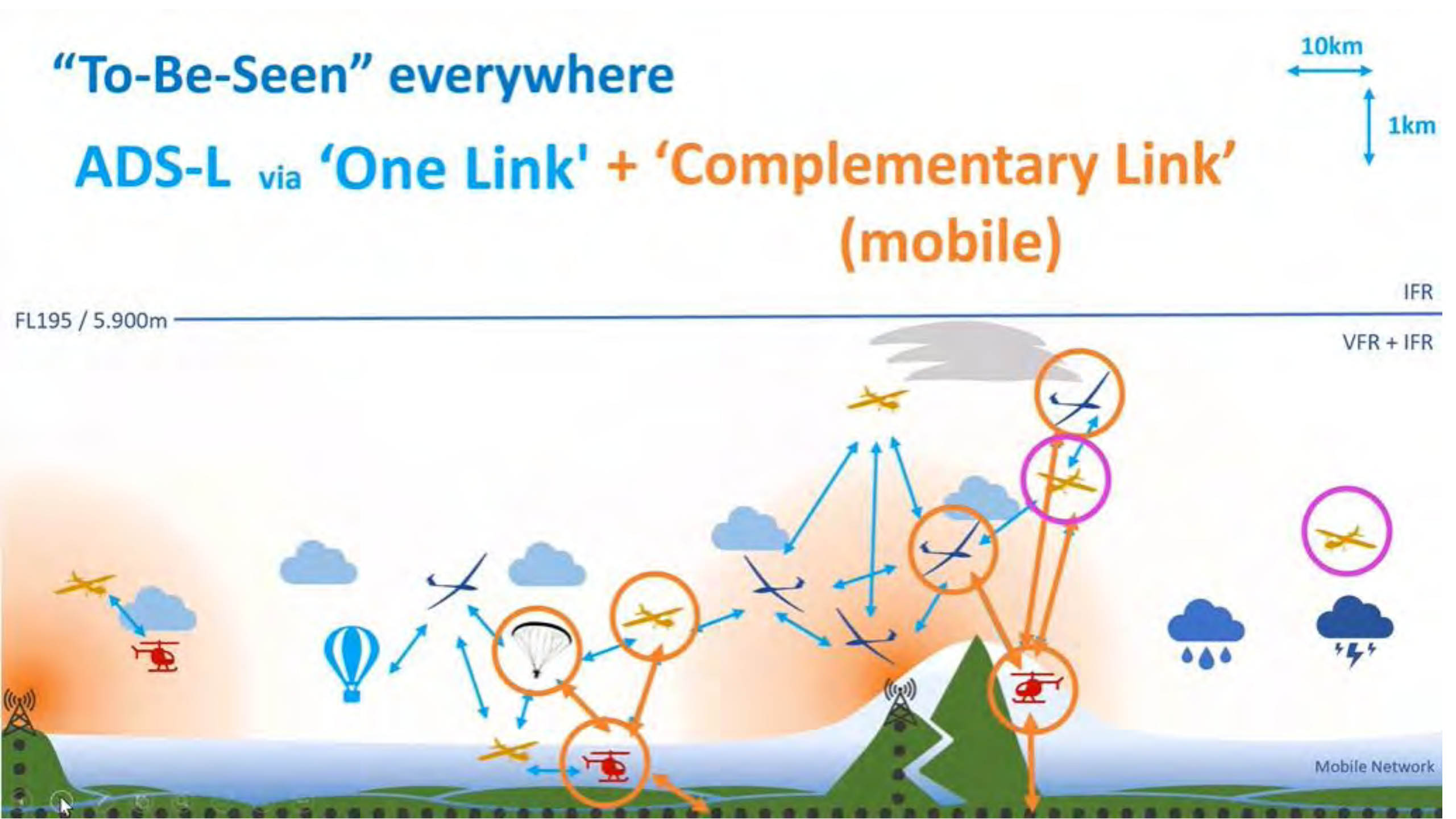
Mobile telephony application transmitting in compliance with ADS-L specifications

2022

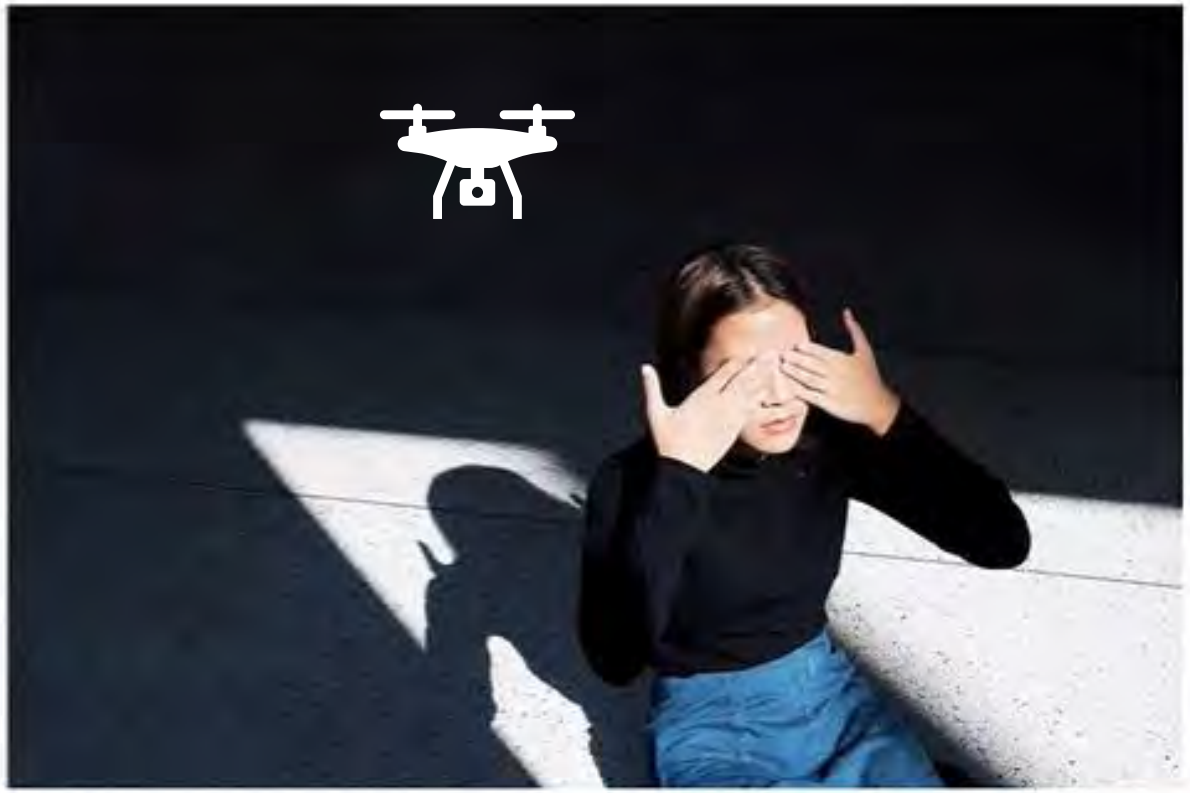
2024
(tbc)

“To-Be-Seen” everywhere

ADS-L via ‘One Link' + ‘Complementary Link’ (mobile)



Where is the problem ?



What is proposed?

U-space Compatible

Expand **ADS-L** *functionalities for GA and Drones*

+

¡Conspicuity Declaration

(Just Culture in General Aviation)

XPDR
ADS-B
ADS-L 860
ADS-L MOBILE
FANET, FLARM, OGN
SafeSky, AirNavPro

XPDR
ADS-B
TCAS

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Proprietære løsninger (eksempler)

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868 MHz
SafeSky, AirNavPro

RID Network
RID Direct

RID Network

XPDR (SSR)
ADS-B

ADS-B
ADS-L 860
ADS-L MOBILE

Graphic: CEN and CENELEC workshop – UAS Direct Remote Identification

Direct remote ID

- Innebygd eller addon
- Wi-Fi eller bluetooth
- C1, C2 og C3
- Alle i spesifikk kategori

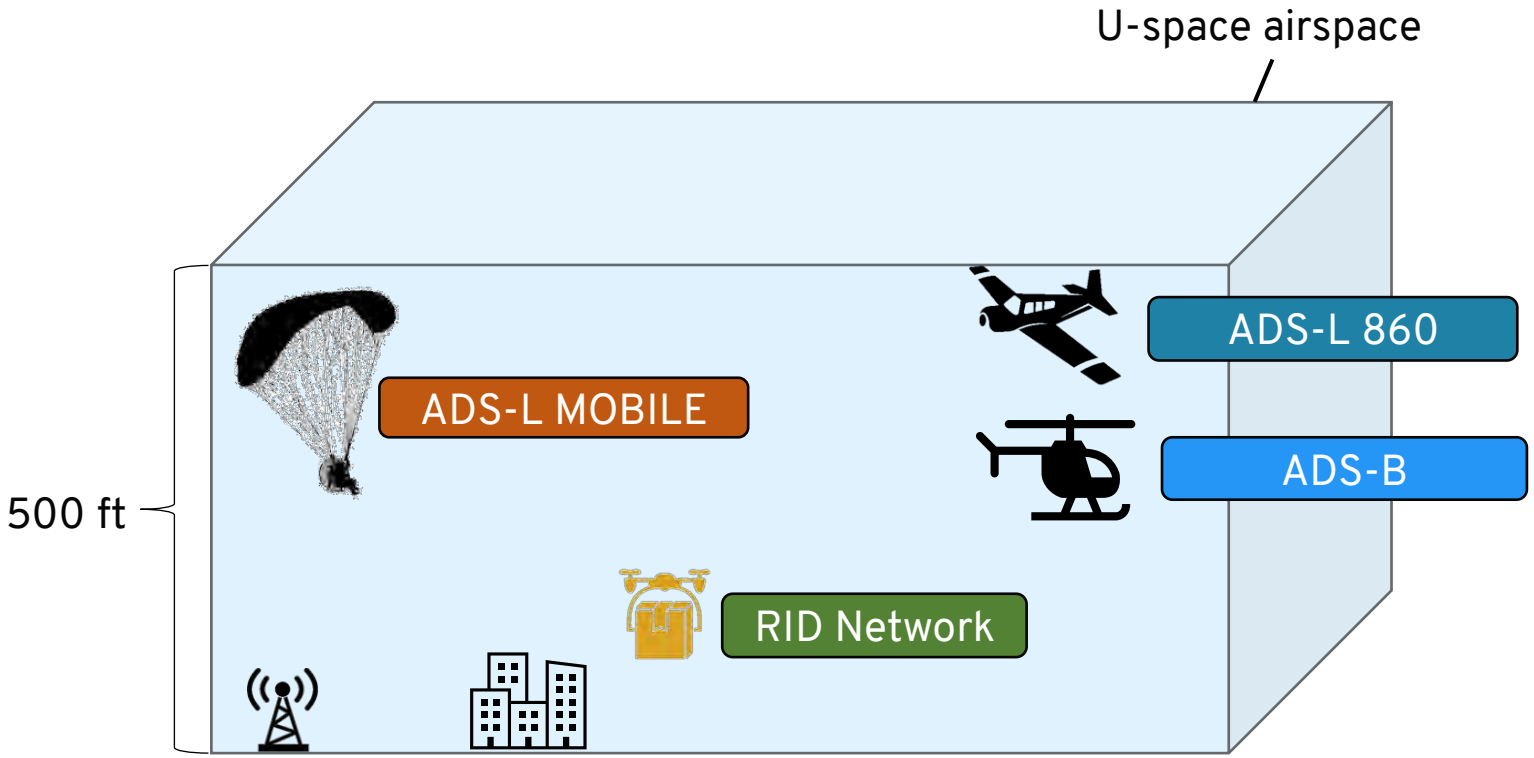
Dronetag Mini add-on device offers Remote ID compliance for older drones

Bruce Crumley - Feb. 3rd 2022 10:05 am PT @BDroneDJ

Photo: dronedj.com

Luftfartstilsynet

U-space vil legge til rette for trygg droneflyging utenfor synsvidde (BVLOS)

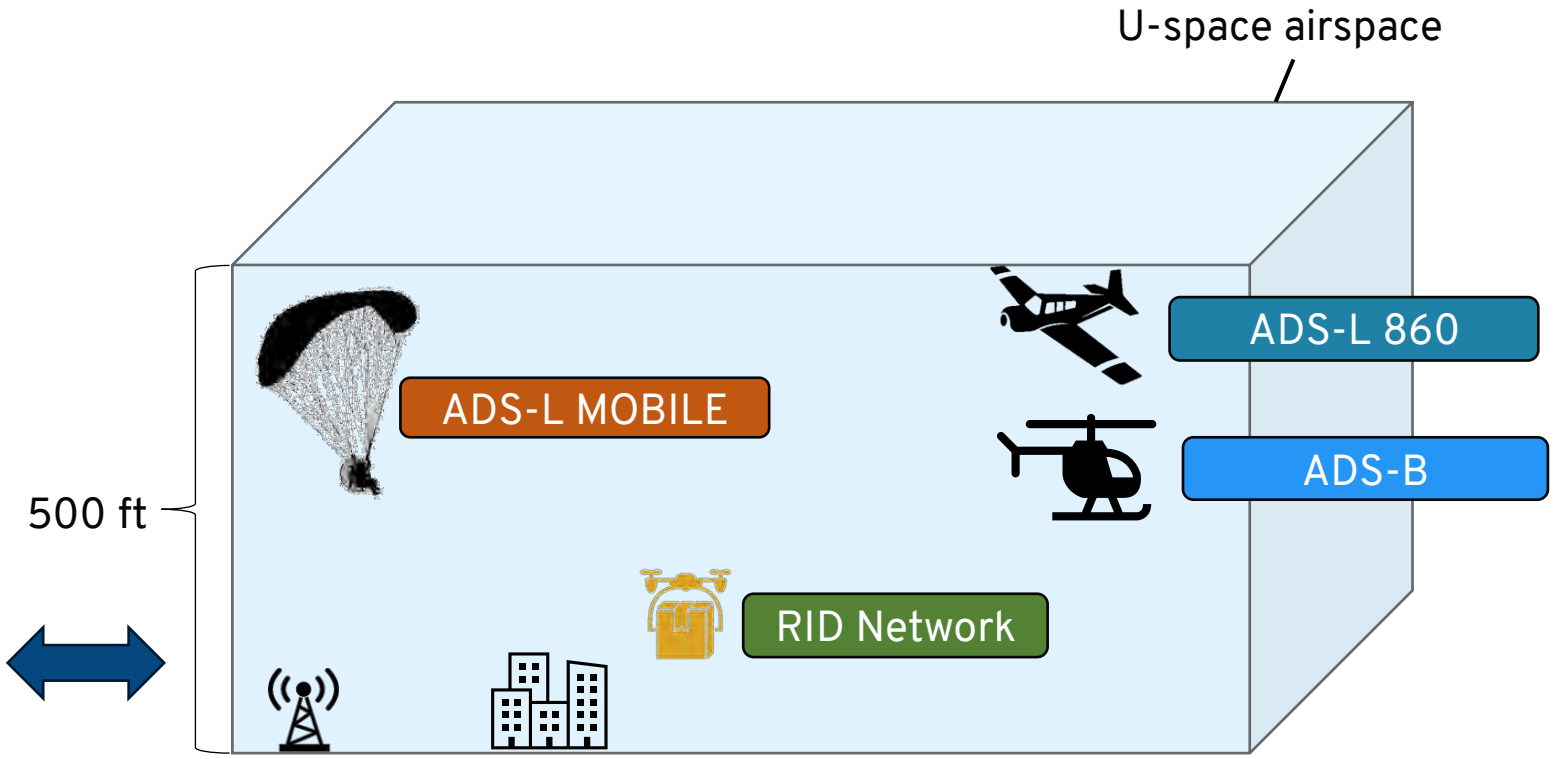


Luftfartstilsynet

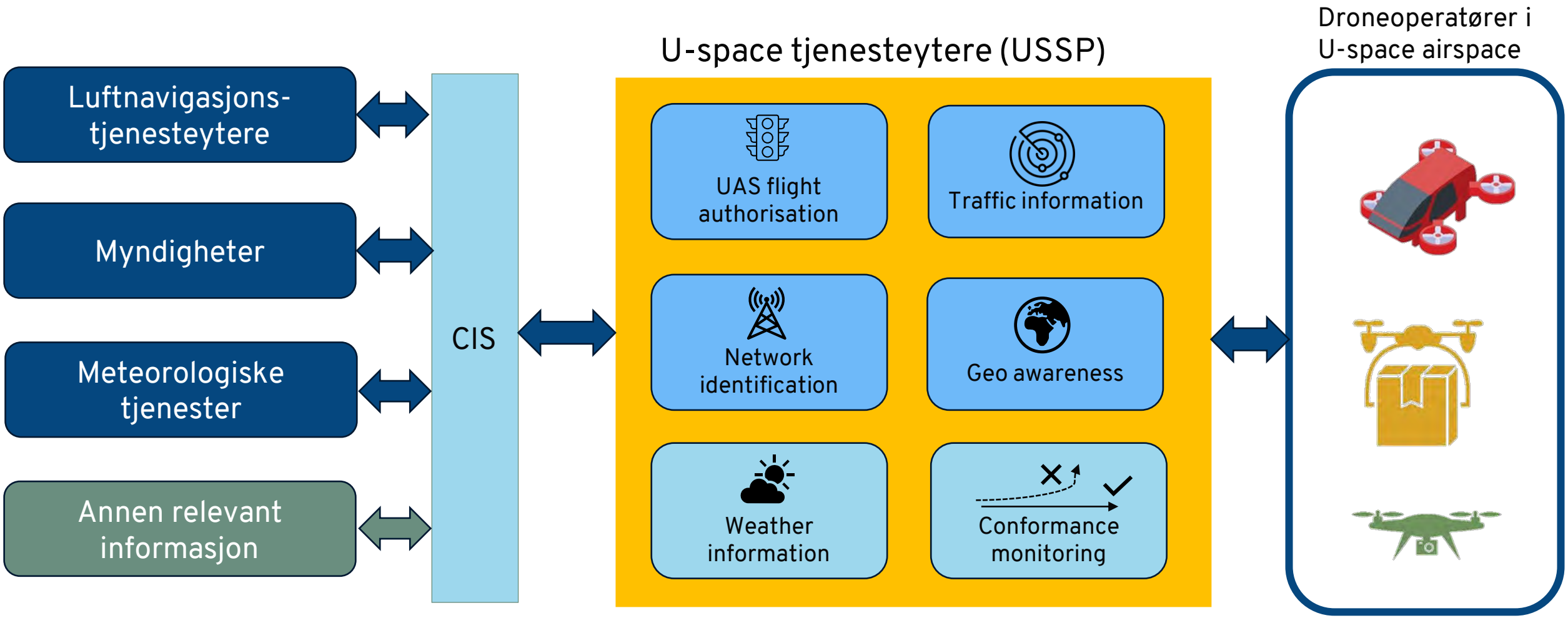
U-space vil legge til rette for trygg droneflyging utenfor synsvidde (BVLOS)

U-space tjenesteytere (USSP)

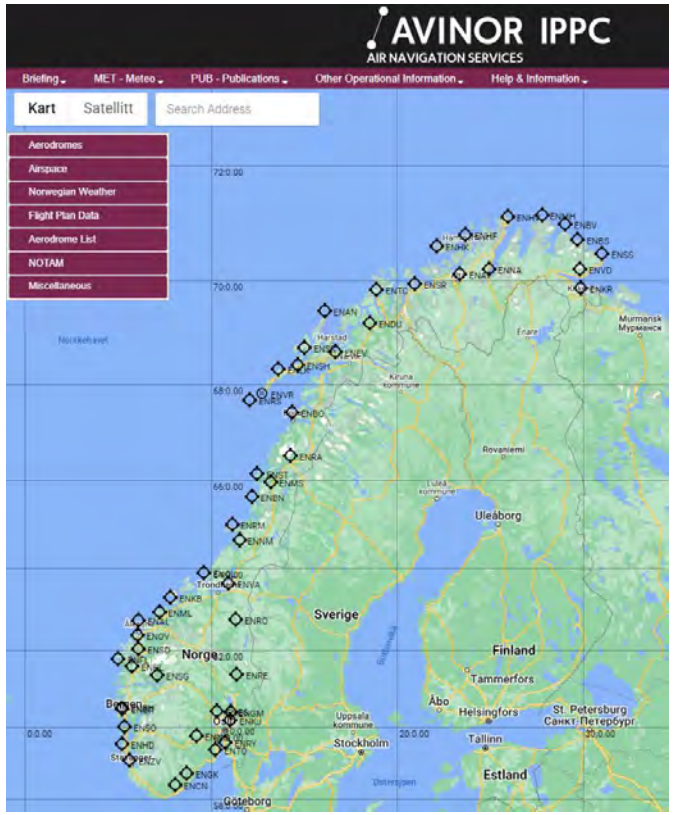
- UAS flight authorisation
- Traffic information
- Network identification
- Geo awareness
- Weather information
- Conformance monitoring



Grunnlaget er CIS – Common Information Services



Første skritt er å etablere Common Information Services (CIS)



Skjermbilde: ippc.no

- **Digital** luftfartspublikasjon
- Informasjonsdeling
  - Soner og områder
  - Kjent trafikk

Høring om U-space og digital luftfartspublikasjon

- luftfartstilsynet.no/horinger

Veileder om elektronisk synlighet

- training.caa.no/Elektronisk_synlighet

Hva skjer videre?

- Testing av sensorsystemets ulike teknologier.
- Sensorsystem og UAT på luftsportsuka 2024.
- Webinar bruk av elektroniske verktøy i cockpit –

Takk for at du fulgte webinaret.

Vi ses elektronisk i fremtiden!

Luftfartstilsynet