HORVÁTH

Presentation partly revised after workshop based on changes in approach

First Workshop

Interoperability of e-Conspicuity systems for GA

Ulrich Aldinger (Horváth)
Helge Mikuda (Droniq)

Cologne, 04.07.2023

Agenda

We are happy to support EASA in this strategic project

Senior Manager	Consultant	Senior Aviation Manager	Senior Aviation Manager	Business Development & Sales Manager	Managing Director	Managing Director
						
Ulrich Aldinger	*Maximilian Barnes*	*Helge Mikuda*	*Alexander Tummes*	*Nicolas Koch*	*Jan-Eric Putze*	*Ralph Schepp*
Project Manager (Lead)	**Project Team**	**Technical Lead**	**Project Team**	**Project Team**	**SME[1]**	**SME[1]**
HORVÁTH	HORVÁTH	DRONIQ	DRONIQ	DRONIQ	DRONIQ	DRONIQ

[1]SME = Subject Matter Expert

EASA project members

Helder Mendes
Project lead / Flight data expert

Vladimir Foltin
PCM General aviation / ATM Expert

Alain Leroy
Chief engineer

Marco Capaccio
Section Manager - Small Aircraft, Balloons & Airships

Hette Hoekema
Chief Expert - Avionics & Electrical Systems

Dimitri Garbi
Avionics systems expert

Filippos Tymvios
Meteorological Expert (SNE)

Who are you?

2 Minutes per Person

Introduce yourself: Name, Company/ Associations, expert for ?

What is your expectation for this workshop ?

Agenda

Rules of today's Meeting

We would like to ask you to do the following things:

- Neutral, scientific work
- Fair share of speech
- Be open minded and fair

We ask you to not do the following things:

- Commercial-interest input
- Excessive presentation of own products (technical view allowed)

Agenda

Why are we sitting here ?

1. High numbers of mid-air collisions in GA

“

… the other to EASA, to ensure the complete interoperability of the electronic conspicuity systems that it promotes in the framework of the European Plan for Aviation Safety, with the aim of preventing mid-air collisions...

Recommendation from BEA, issued with an accident analysis 2020

”

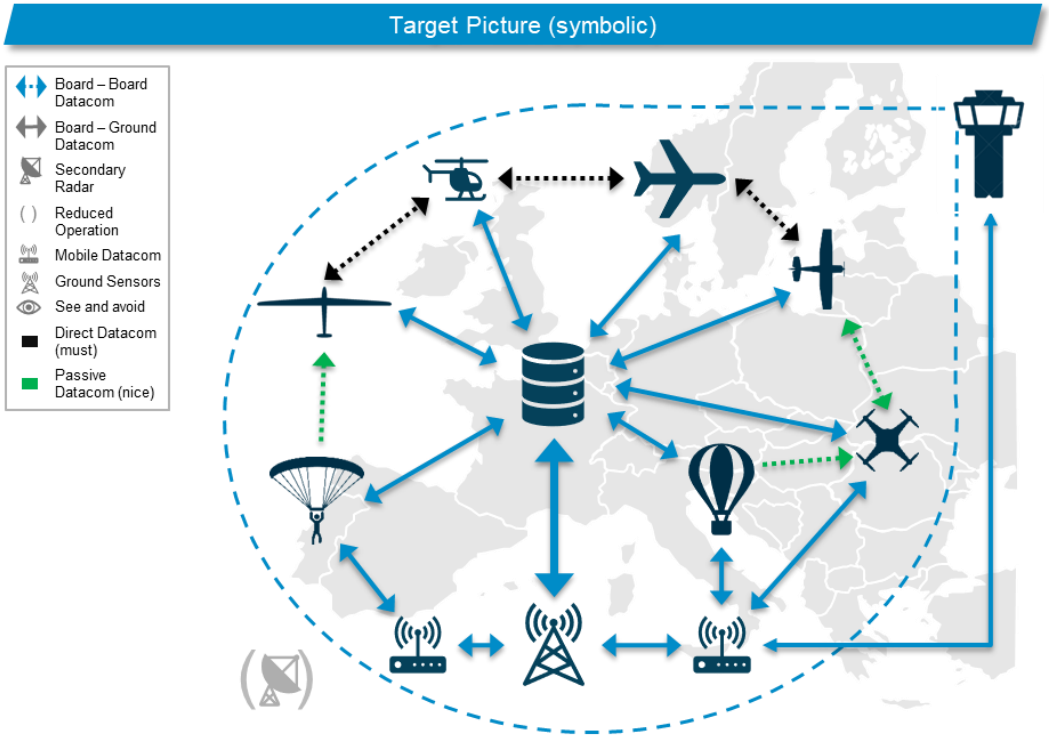
2. SERA 6005 C

“

Manned aircraft operating in airspace designated by the competent authority as a U-space airspace, and not provided with an air traffic control service by the ANSP, shall continuously make themselves electronically conspicuous to the U-space service providers.

”

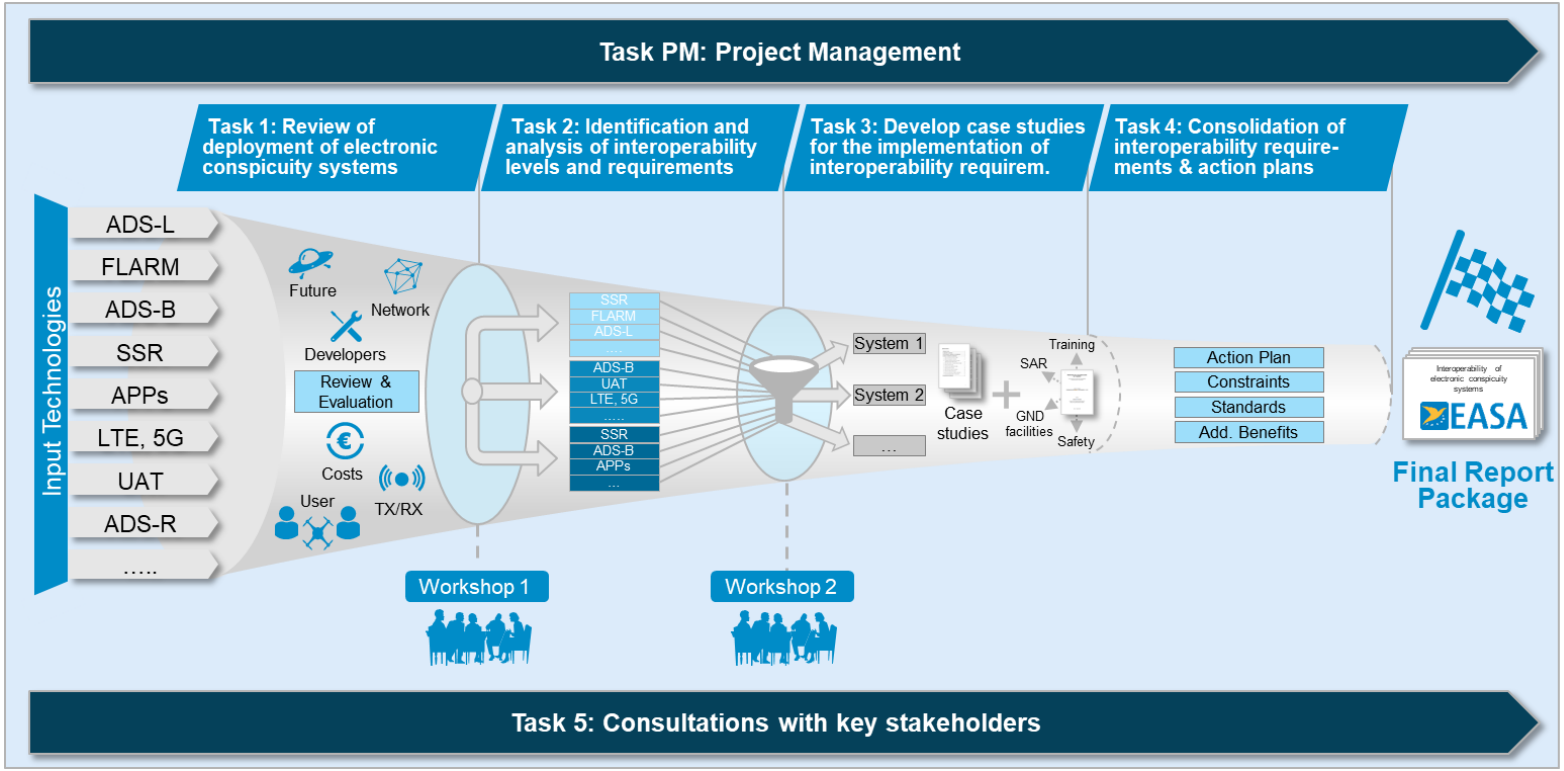
Recap: Objective of the project is to prepare a recommendation for an interoperable communication standard for aircraft



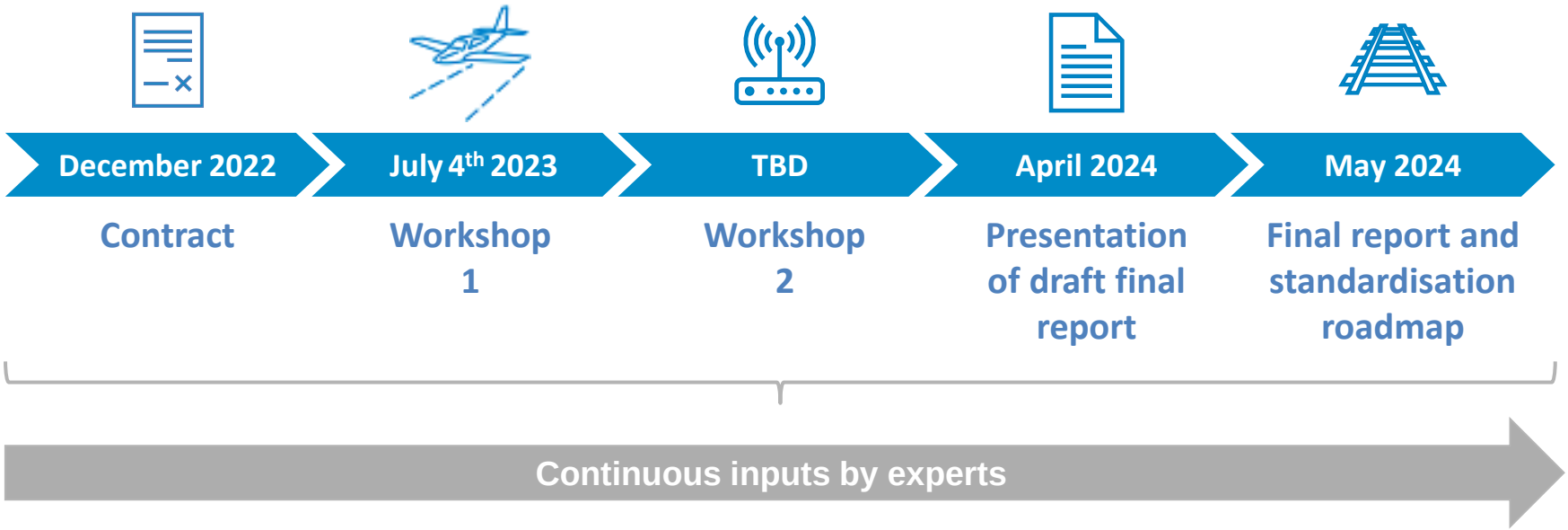
Comment

- Standardized data communication between aircraft and ground stations by interoperable systems
- Airborne collision avoidance for all participants in uncontrolled airspace

Recap: Project Course



Project timeline



Agenda

Workshop Guardrails

1. No evaluation of single systems
2. In WS 1 definition of criteria for and finding of possible system combinations
3. In WS 1 only identification of problem areas; deep dive later in technical meetings and WS 2
4. Evaluation of selected combinations in further course of the project
5. We are talking about electronic-conspicuity, not about air traffic control

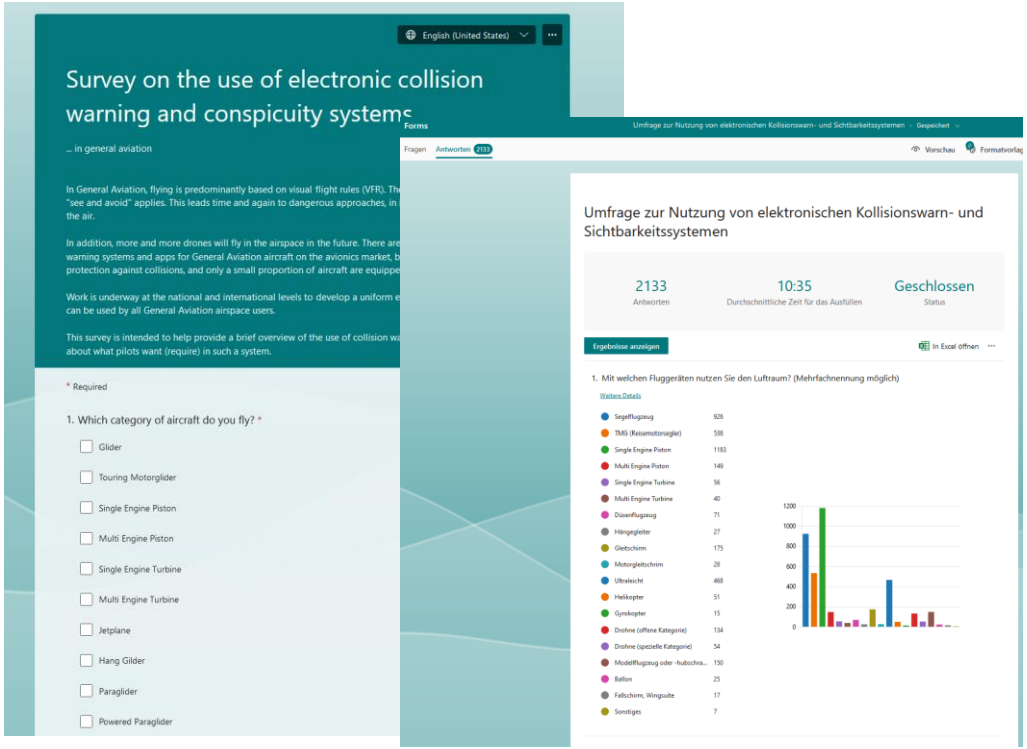
Agenda

Objectives of today’s meeting

- Review of existing and deployed e-conspicuity-systems
- Define criteria for e-conspicuity-system combinations
- Assemble and evaluate e-conspicuity-system combinations
- Point out problem areas in interoperability

Agenda

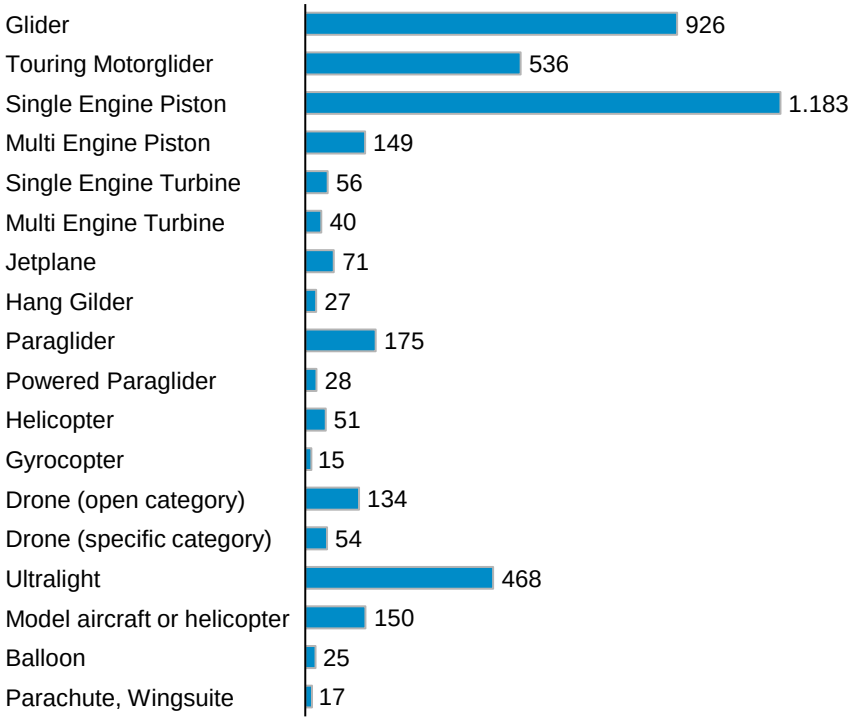
Online General Survey - Overview



Comment

- Online Survey for End-User from April 4th 2023 to May 7th 2023
- 2133 participants in General Aviation
- 93 % VFR
- Survey was about ec-system usage, satisfaction with regard to conspicuity, needs and constraints
- Detailed analysis will be published

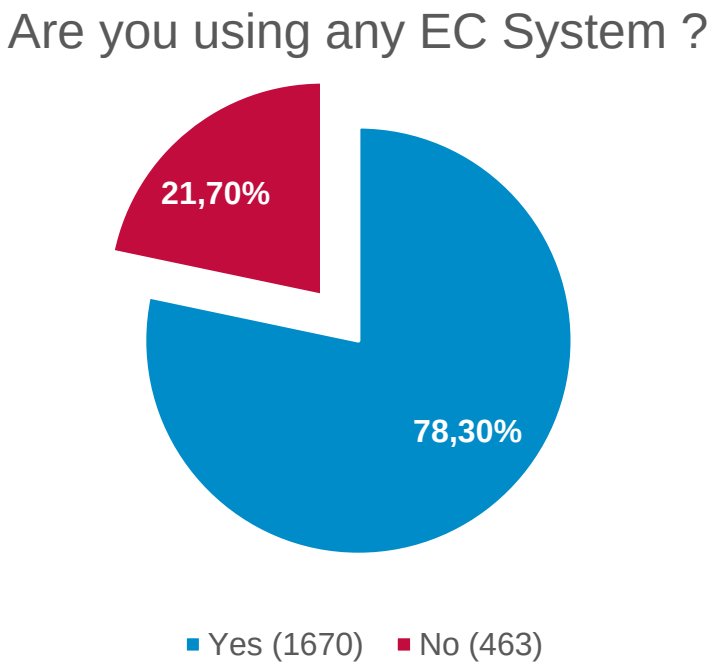
General Survey Analysis – Who participated ?



Comment

- Multiple selection of used aircrafts was possible
- Correlation of single EC systems to a single aircraft type was technically not possible
- Results for gliders, SEP, paraglider and UL are also representative as single choice (trend)

General Survey Analysis – No e-conspicuity system used



Comment

- 86 % of the participants, who are not using an EC system (the 463 participants with “No” as answer), would like to have one
- 53,5 % of them would like to have a mobile solution
- Main reasons for not using an EC system:
  - Costs (39 %)
  - Technical issues (20 %)
  - Not necessary (15 %)
  - Privacy (5%)
- Other reasons (22 %):
  - Lack of information
  - No harmonised solution available in EU (equipage, interoperability)
  - Not available in rental aircrafts

General Survey Analysis – No e-conspicuity system used

Some Comments for not using EC systems…

"Aircraft is owned by our club, to expensive"

"The products are not complete, and those that are at the market are too expensive, and why do we need it when other aircrafts don't need it…"

"On UAS multiple requirements between French and EASA regulations difficult to implement"

"Unclear which system is best/should be used"

"Never thought about it"

"Insufficient coverage"

"Too many apps and none of them are official."

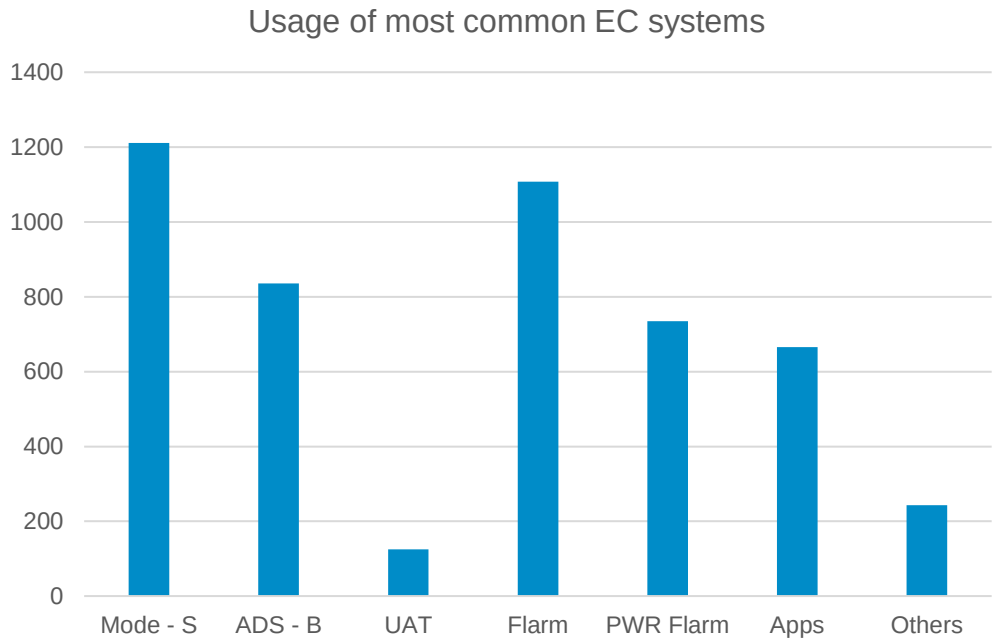
„Currently no affordable, easily installed, system on the market that is compatible (in a single device) with all types of traffic and makes it visible and communicates with it (ADSB, Mode-C, FLARM, etc.)."

"Another device/system to care about... No! "

"No harmonised solution available (equipage, interoperability)"

"I didn't know it exists"

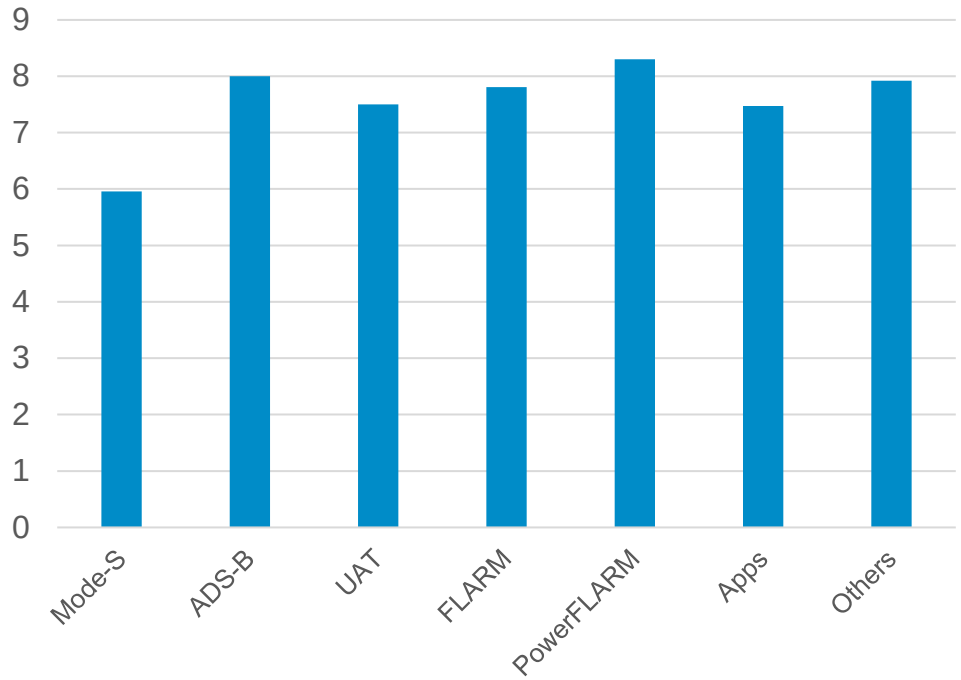
General Survey Analysis – Usage of EC-Systems



Comment

- Preferred Apps: 1. SafeSky 2. SkyDemon 3. ForeFlight 4. XCSoar 5. Pilotaware
- Most mentioned other systems:
  - Haubenblitzer (flash lights)
  - Pilot Aware (also with MLAT for Mode S)
  - Skydemon in combination with Pilot Aware
  - FANET (+)
  - FLARM Data on Navigation System
  - OGN
  - *See and avoid and radio !!*

General Survey Analysis – Satisfaction with used Systems



Comment

- The user satisfaction with regard to e-conspicuity is low with Mode-C and Mode-S transponders (Mode C not mentioned here anymore)
- All other systems are well rated by all users

General Survey Analysis – Used System and Satisfaction

Comments for …

FLARM: very good for gliders / low range / you can't see every traffic / due to a faulty installation, the system can only work with limited functionality / affordable / no interoperability with ADS-B / until 100 – 120 kts good limited functionality / low transmission power (positive for battery usage)

ADS-B: works good / too expensive / should be mandatory / you can't see every traffic / combination with other system like FLARM could be better / further information would be great (weather)

SafeSky: Only sufficient reception up to about 3000 ft AGL / LTE coverage mostly poor / Not all traffic can be seen / Good for anticollision / cheap

UAT: Mandatory like in USA (people who use ADS-B) / not available in EU / FIS and TIS would be good for EU

PowerFLARM: Same as FLARM / better range / combination with ADS-B

Haubenblitzer: good in mountains and under cloud-streets (Wolkenstraßen)

General Survey Analysis – Illusion of the complete traffic picture ?

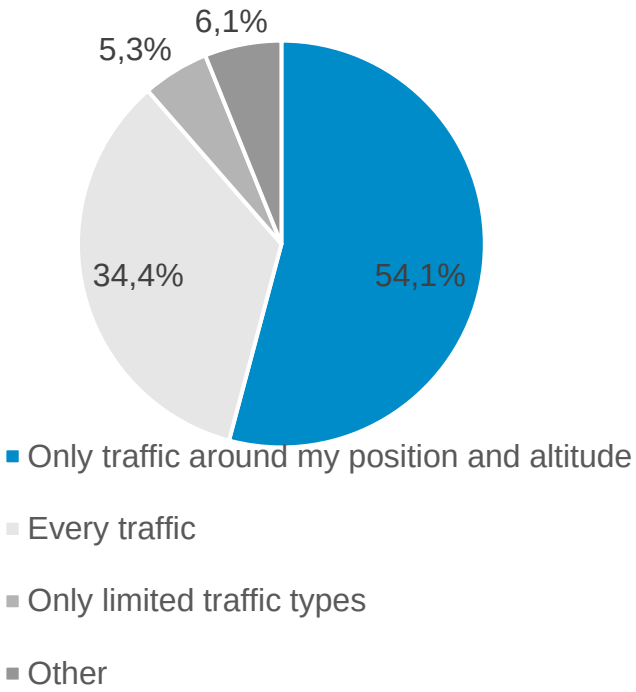
- 11,5 % of all participants think, they could see every traffic
- Most of these are glider pilots
- Mentioned reasons for not seeing every traffic (with EC-systems):
  - 47 % of the participants think, that there are still too many aircraft without any EC system
  - 37 % of the participants think, that the systems are not networking

General Survey Analysis – Further insights

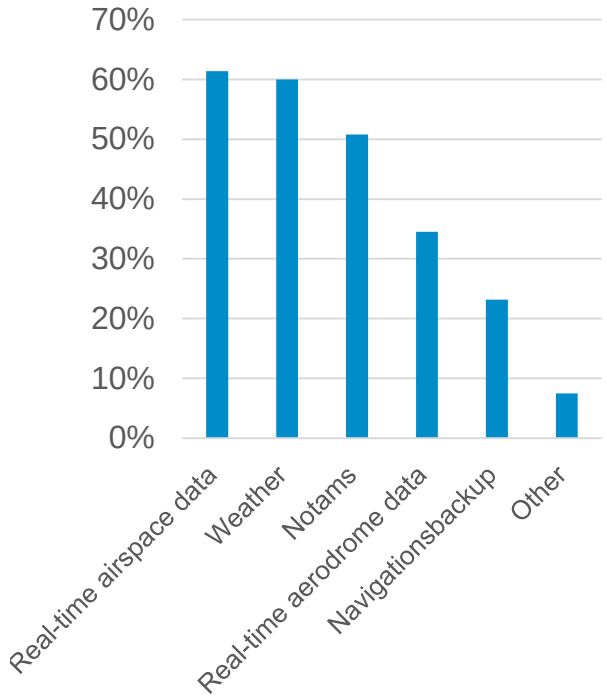
- Linking of the systems Air – Air is considered as sufficient for 48 % of all participants
- Linking of the used systems is deemed necessary for 32% of all participants
- 91% say, that the EC systems should be used in all airspaces and 72 % think, the use will be helpful for Flight Information Service
- The safety gain for the usage of EC systems is assessed as 8.7 of 10

Needs and constraints of end-user groups – Displayed Data

Traffic to be displayed

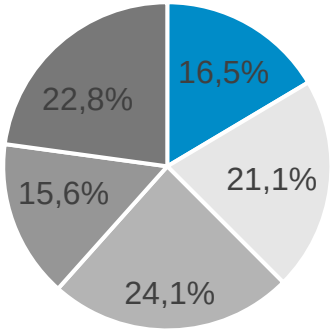


Desired additional information uplink



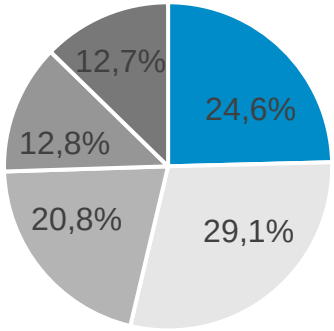
Needs and constraints of end-user groups - Costs

Acceptable costs for a full functional system



- Up to €100 (e.g. use of apps)
- Up to 500 €
- Up to 1.000€
- More than 1.000€
- I already have a system.

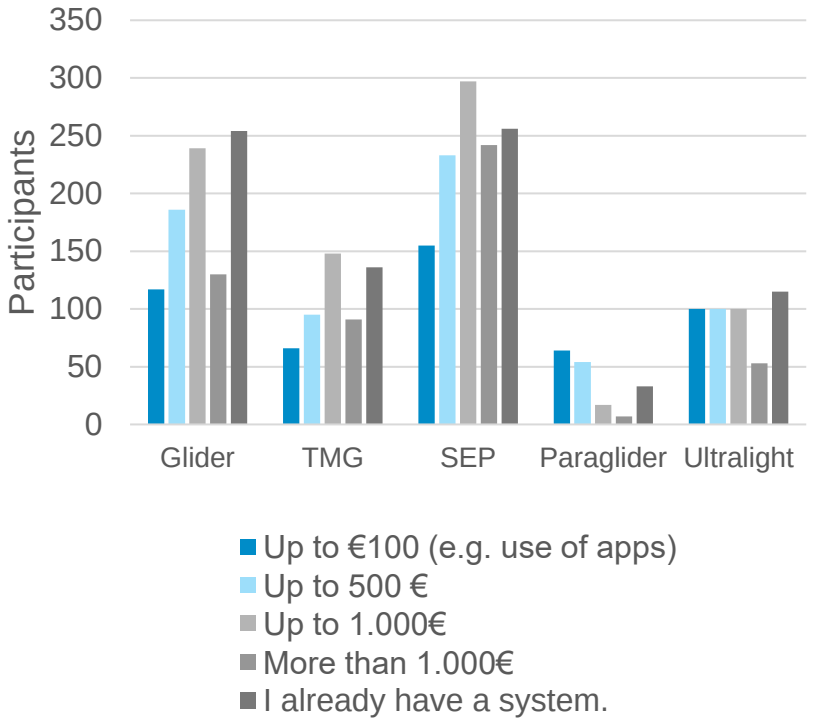
Acceptable costs for an upgrade of existing systems



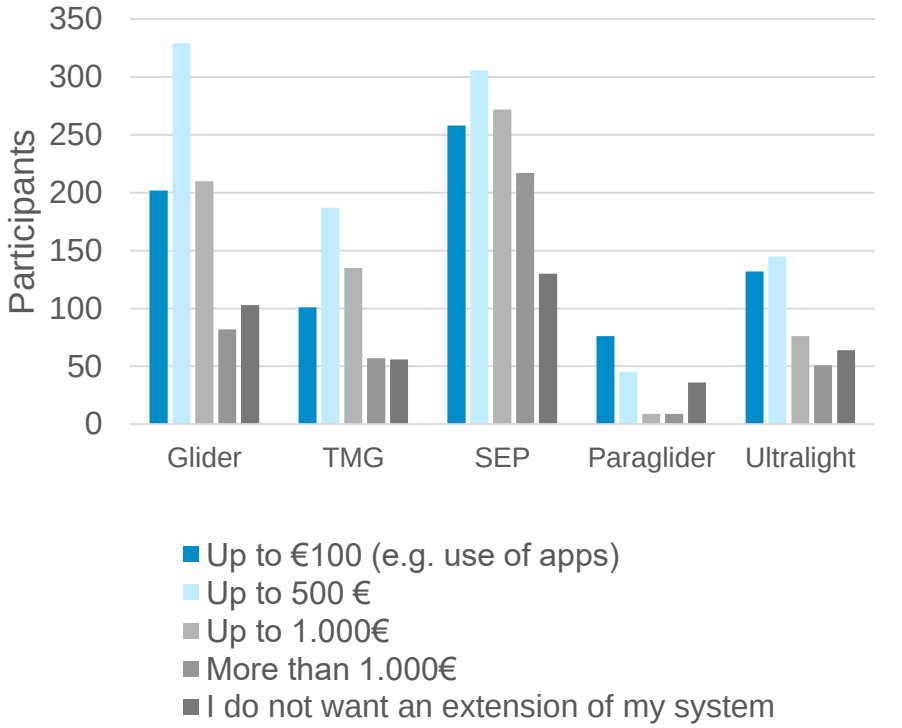
- Up to €100 (e.g. use of apps)
- Up to 500 €
- Up to 1.000€
- More than 1.000€
- I do not want an extension of my system

Needs and constraints of end-user groups - Costs

Acceptable costs for a full functional system



Acceptable costs for an upgrade of existing systems



General Survey Analysis – Resume

- Too many pilots do not use any EC system, but they want to have it
- The Air-Air linkage of the systems is seen as necessary and most important
- Due to the mentioned reasons (costs, technical issues,…) the solutions must be affordable, easy to install and also be available as removable devices
- Privacy reasons are still present and should be taken into account
- **There must be more, easy to understand and better information about e-conspicuity and it's technical implementation**
- **Convince clubs and rentals**

Agenda

Position Papers – EHPU European Hang Gliding and Paragliding Union

(1) It has to be accepted that for hang gliders and paragliders, Electronic Conspicuity is entirely passive. i.e. the hang glider / paraglider pilot does not use it to avoid others, only to allow other types to avoid the hang glider / paraglider.

(2) Creating a legal requirement to carry an Electronic Conspicuity device that currently does not exist will completely ground the sport across Europe. There should therefore be no legal requirement to carry such a device until it is available on the market and established as being fully compatible with hang gliders and paragliders.

(3) Given that there are few benefits to hang glider and paraglider pilots other than to protect them from other users, such protection not having been needed previously, there should be a system of subsidy open to hang glider and paraglider pilots to assist them in purchasing such a device.

(4) The device must be battery powered, lightweight (200g maximum including batteries), have a duration at least 12 hours and be low cost.”

Position Papers – EMFU European Model Flying Union

Type of technology: the type of technology should take into account the particularities of model aircraft and model aircraft operations. This includes:

- Type of operations: model aircraft sites with frequent operations of usually multiple aircraft (typically club airfields or slopes), but also sites with infrequent operations of single or few model aircraft (such as alpine slopes but also individual operations on informal sites);
- The size of model aircraft: model aircraft include small and very light models where the installation of electronic conspicuity technology may be difficult or impossible, but also larger and heavier models where this may be possible. Power consumption and interference issues must also be addressed.

Technology options that could be considered range from **app-based solutions** (temporary blocking small sections of U-Space for model aircraft operations) to **ground-based electronic conspicuity** (e.g. the use of FLARM by model aircraft clubs in Switzerland) to onboard electronic conspicuity (for larger model aircraft that have a bigger range). Different situations may require different solutions and a combination of technological options may be required to accommodate these different situations.

Costs of technology and related services: the operation of model aircraft is a sport practiced by well over 800'000 pilots throughout Europe. Many of the pilots operate on small budgets and clubs as well as competitions are run by volunteers. Moreover, as legacy users of lower airspace, whose rights are restricted due to U-Space, aeromodellers cannot be expected to bear the costs of their continued operation in U-Space areas. This means that the costs of any electronic conspicuity technology must be low. The use of U-Space services must be free of charge.

Position Papers – DAEC / VC / GdF / AOPA (Strategy Paper)

"…Due to the time urgency, the use of approved and tested technology is recommended. These are mainly ADS-B 1090 MHz, ADS-B UAT 978 MHz, TIS-B and FIS-B.

The following conclusions for the affected groups in German airspace result from the described target configuration:

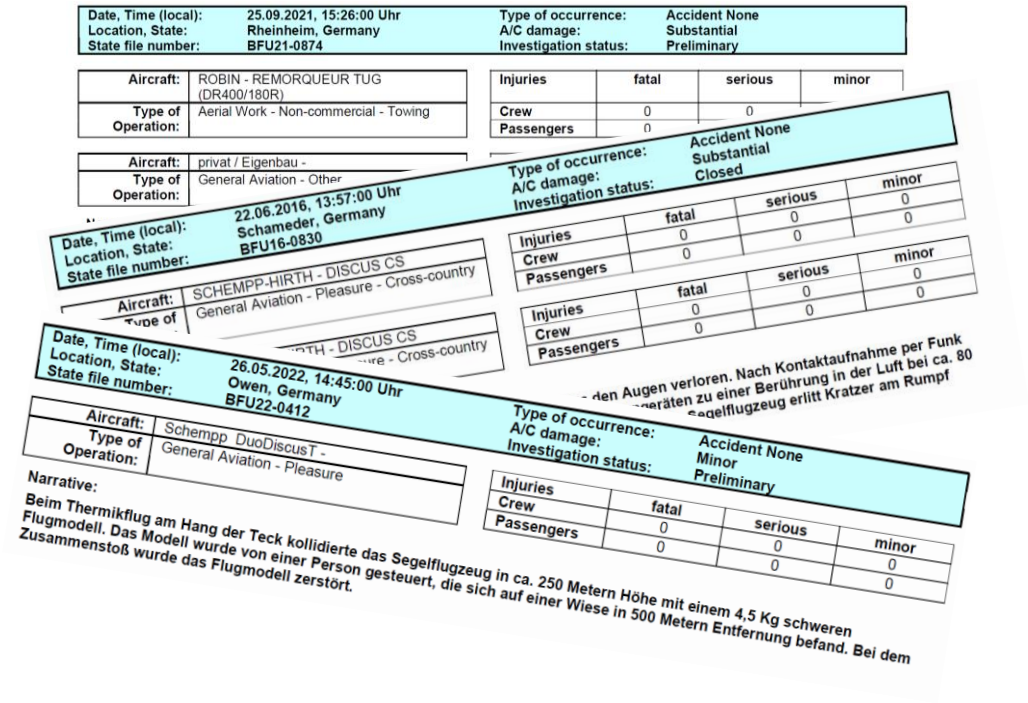
- Conclusion for unmanned aerial vehicles:
  Unmanned aircraft which are not controlled directly by sight from the ground require suitable equipment to enable them to reliably avoid manned aircraft or procedures to reliably separate them from manned aircraft.
- Conclusion for manned aircraft:
  Manned aircraft generally require either an ADS-B-Out solution based on Mode-S or UAT. The installation of a traffic data receiver is strongly recommended. The integration of other low-cost systems specifically for light aviation equipment without an on-board power source requires ongoing early review and implementation.
- Conclusion for the ANSP:
  The display of radar targets needs to be adapted to provide controllers with a configurable air situation picture based on ADS-B data, in which, for example, only certain altitude bands or only relevant VFR targets with conflict potential are displayed. In addition, transmitters are required to broadcast traffic (TIS-B), weather (FIS-B) and AIS data..."

Position Papers - ADAC

- „…Acquisition and broadcast of all available traffic protocols (certified and non-certified data) with cleanup of duplicate signals
- (Almost) gapless coverage of GND up to 5000 ft AGL (optionally up to 10000 ft AGL)
- Redundant data reception (GSM + at least one other frequency, e.g. UAT)
- Guarantee of a ground-air and air-ground data link even in topographically complex terrain (mountains) and in cities with high development (for HEMS landings in urban terrain) e.g. by additional ground stations
- Aircraft detection already on the ground before take-off (from Master Avionics ON), e.g. to be able to indicate an imminent take-off of a rescue helicopter to a USSP or drone pilot in time (lead time at least 2 minutes)
- Free (or at least relatively inexpensive) data reception, so that the majority of airspace participants can use this air situation picture…“

Agenda

Accident / Incident information - 1



Date, Time (local):	25.09.2021, 15:26:00 Uhr
Location, State:	Rheinheim, Germany
State file number:	BFU21-0874
Type of occurrence:	Accident None
A/C damage:	Substantial
Investigation status:	Preliminary

Aircraft:	ROBIN - REMORQUEUR TUG (DR400/180R)
Type of Operation:	Aerial Work - Non-commercial - Towing

Injuries	fatal	serious	minor
Crew	0	0	
Passengers	0		

Aircraft:	privat / Eigenbau -
Type of Operation:	General Aviation - Other

Date, Time (local):	22.06.2016, 13:57:00 Uhr
Location, State:	Schameder, Germany
State file number:	BFU16-0830
Type of occurrence:	Accident None
A/C damage:	Substantial
Investigation status:	Closed

Injuries	fatal	serious	minor
Crew	0	0	0
Passengers	0	0	0

Aircraft:	SCHEMPP-HIRTH - DISCUS CS
Type of	General Aviation - Pleasure - Cross-country

Injuries	fatal	serious	minor
Crew	0	0	0
Passengers	0	0	0

Date, Time (local):	26.05.2022, 14:45:00 Uhr
Location, State:	Owen, Germany
State file number:	BFU22-0412
Type of occurrence:	Accident None
A/C damage:	Minor
Investigation status:	Preliminary

Aircraft:	Schempp DuoDiscusT -
Type of Operation:	General Aviation - Pleasure

Injuries	fatal	serious	minor
Crew	0	0	0
Passengers	0	0	0

Narrative:

Beim Thermikflug am Hang der Teck kollidierte das Segelflugzeug in ca. 250 Metern Höhe mit einem 4,5 Kg schweren Flugmodell. Das Modell wurde von einer Person gesteuert, die sich auf einer Wiese in 500 Metern Entfernung befand. Bei dem Zusammenstoß wurde das Flugmodell zerstört.

Comment

- There are collisions between all types of aircraft
- Also involved paragliders, drones and model airplanes
- There is no guarantee of collision avoidance, regardless of the used system
- We have to take into account that not every incident was / will be reported

Position Papers - EHPU

PUBLISHED: 22 DECEMBER 2021 / LAST UPDATED: 22 DECEMBER 2021

Martinaire Grand Caravan collides with paraglider

On 21 December 2021, Martinaire flight 685, from Houston-George Bush Intercontinental Airport (TX) to Victoria Regional Airport (TX) and operated by Cessna Grand Caravan N1116N (msn 208B0417), crashed near Fulshear (TX), killing the pilot.

It left Houston at 09:10 local time and reached an altitude of 4,800 feet at 09:22. The Grand Caravan remained at that altitude until it entered a sudden sharp descent at 09:25, according to ADS-B data.

The Fort Bend County Sheriff's Office reported that the aircraft had collided with a paraglider. The paraglider was found dead about five kilometres south of the location where the Cessna crashed.

Sadly, the pilot of the Cessna also perished in the crash.

Credit: Steve Nation (airport-data.com)

cessna | crash | air crash | air crash investigation | USA | Cessna Grand Caravan | Martinaire | Ce208B | paraglider

Just some thoughts…

- Costs for e-conspicuity should not be seen as an invest in our aircraft, it is an investment in our safety !
- To build up an effective system of e-conspicuity all airspace users have to take part
- All users must be informed clearly and understandable about the topic !
- DO YOU AGREE ?

Agenda

Further initiatives / cooperations / technologies under development

1. ADS-L
2. SafeSky – Project (Aachen)
3. UAT / ADS-B Ground Station Projects Finland, Norway (IAOPA)
4. Ground Based Apps (e.g. DMFV App)
5. LDACS (L-band Digital Aeronautical Communications System)
6. …

Further initiatives / cooperations / technologies under development

1 ADS-L

History

- August 22nd 2021: Commission Implementing Regulation (EU) 2021/666 published, adding sub-article (c) to SERA.6005:

  Manned aircraft operating in airspace designated by the competent authority as a U-space airspace, and not provided with an air traffic control service by the ANSP, shall continuously make themselves electronically conspicuous to the U-space service providers.

- Dec 16th 2021: NPA 2021-14 published, draft AMC/GM for U-Space, detailing means of conspicuity:
  - ADS-B / 860 MHz / Networked
  - Specifications for message generation, based on ADS-B
- March 2022: Working group started work on ADS-L 4 SRD 860 technical specification
- Dec 20th 2022: ED Decisions 2022/022/023/024 published, along with the AMC and GM to SERA (Issue 1, Amendment 6) and the "Technical Specification" document

Goals

- Open, common standard
- Functional minimalism: Meet U-Space requirements, nothing more
- Low-cost, applicable to wide range of vehicles
- Focus on air/ground transmissions (surveillance), manned aviation users -> air/air and other features deliberately postponed
- Qualification System: No certification (ETSO) needed, responsibility with the operator
- Coexisting with (not replacing) existing systems: PilotAware, FANET, OGN, FLARM.
- Possibility to re-use existing hardware with tens of thousands of installations: PilotAware, FLARM
- Extendable: Protocol can be upgraded with future revisions
- Support for basic security + privacy

Further initiatives / cooperations / technologies under development

1 ADS-L

Radio

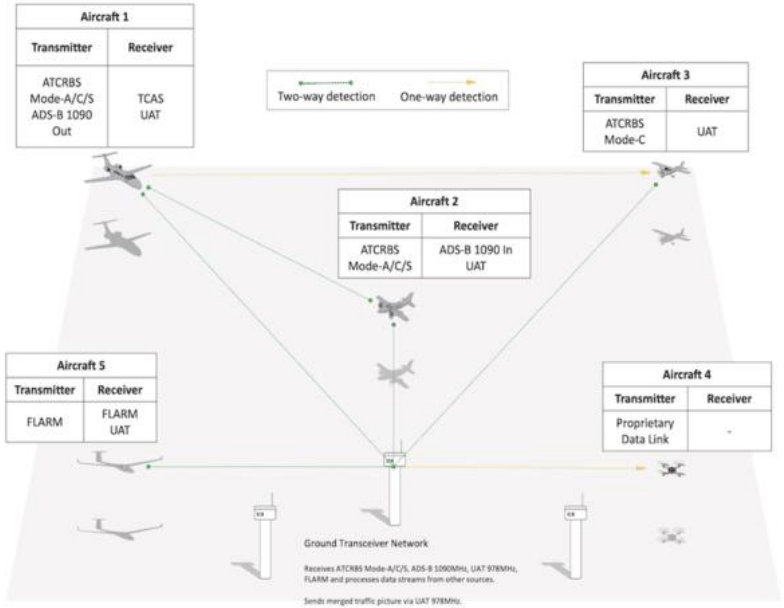
- Use of unprotected spectrum
- Two frequency bands, three channels:
  - M-band: 868.2 / 868.4 MHz
  - O-band: 869.5 MHz
- Different modulation schemes:
  - M-band: FLARM scheme
  - O-band: PilotAware scheme
- Senders may use either channel
- Way less power and range than ADS-B

Payload

- Derived from ADS-B (semantics, not encodings)
- …but simplified: no CPR, full info in every transmission etc.
- Increased address range (vs. ADS-B) of 30 bits
- Address randomization for privacy
- Exponential encodings for large operating range, paraglider to spaceship
- Message scrambling for better error detection and correction

Further initiatives / cooperations / technologies under development

2 SafeSky – Project (Aachen)



Comment

- Project of FH Aachen to build up a Ground Transceiver Network
- Receives ATCRBS, Mode-A/C/S, ADS-B, UAT, FLARM and processes data stream from other sources
- Sends merged traffic via UAT 978 MHz

Further initiatives / cooperations / technologies under development

3 UAT / ADS-B Ground Station Projects Finland, Norway (IAOPA)

Comment

- CAA Norway has recommended the following to the Department of transport:
- 2023: Two UAT test stations. Oslo and Bodø
- We will send UAT@978 MHz. from ground to air. Weather, consolidated traffic and live airspace.
- 2025: Ten stations will cover Norway @ FL 100
- 2030: ADS-B mandatory in all controlled airspace.
  UAT broadcast from approx. 200 of Avinors existing 390 ADS-B out receiver ground stations.
- Trial ongoing with reduced capability 1090 MHZ ADS-B Equipment (Low Power ADS-B for Electronic Conspicuity)

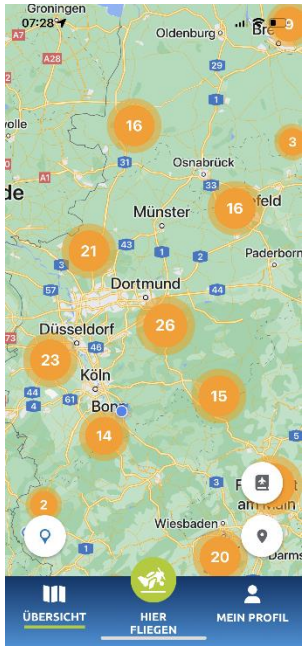
Further initiatives / cooperations / technologies under development

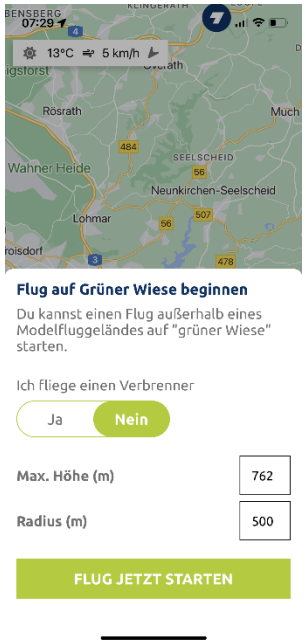
3 UAT / ADS-B TISB & FISB projects in Europe

UK	planning national rollout	CAA / NATS
Norway	planning national rollout	CAA / Avinor
Finland	trial on 2 locations	Xamk, University of applied science
Germany	Project SafeSky	Federal Ministry for Digital and Transport
Netherlands	UAS test and demosite EHWO + GA EHSE	Dutch Drone Centre Aviolanda
Requests from	France, Spain, Italy, Denmark	

Further initiatives / cooperations / technologies under development

4 Ground Based Apps (e.g. DMFV App, DAEC Solution,…)



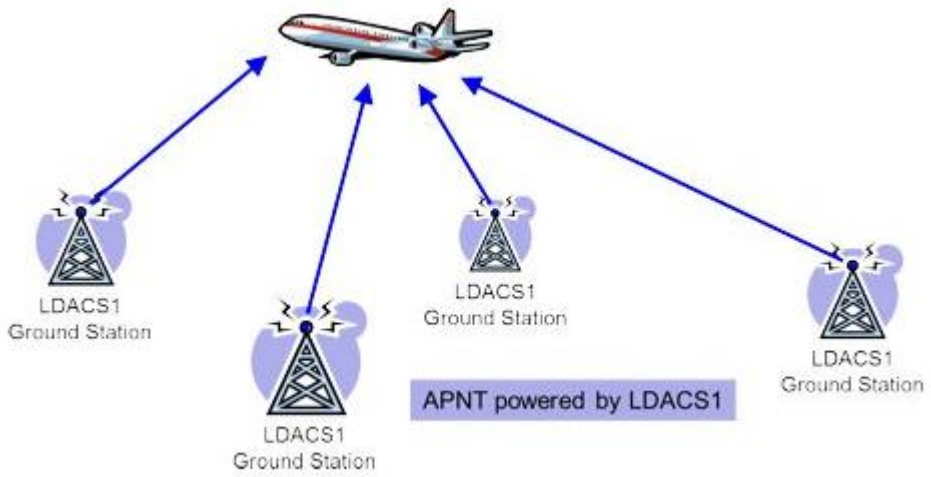


Comment

- Reporting of active model airfields
- Reporting of model flying activities outside of airfields
- Submitting traffic information to UTM

Further initiatives / cooperations / technologies under development

5 LDACS (L-band Digital Aeronautical Communications System)



Comment

- Digital radio and surveillance system
- The system will be operated in the aeronautical part of the L-band, which ranges from 960 to 1164 MHz
- LDACS is currently being standardised within the framework of the ICAO
- The LDACS communication system can also take over navigation and surveillance tasks and act as a backup system there
- The position of the aircraft can be multilaterated by means of several ground stations

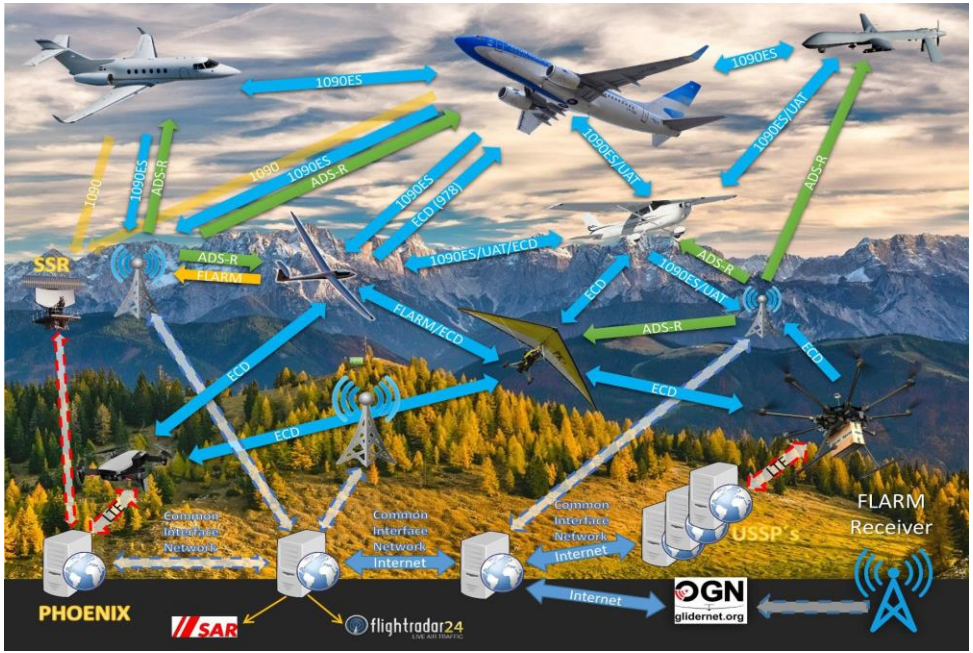
Agenda

Additional Technologies

- Usage of ADS-B out signals in ACAS-X
- BNK (demand-controlled night marking of wind turbines)
- Flash lights
- Camera related systems
- Remote-ID
- Identification, warning and avoidance of Hotspots (Airspace borders, congestion of gliders in thermals… (AI ?)
- Dynamic airspace
- …

Agenda

Interoperability - difficult to pronounce, difficult to implement ?

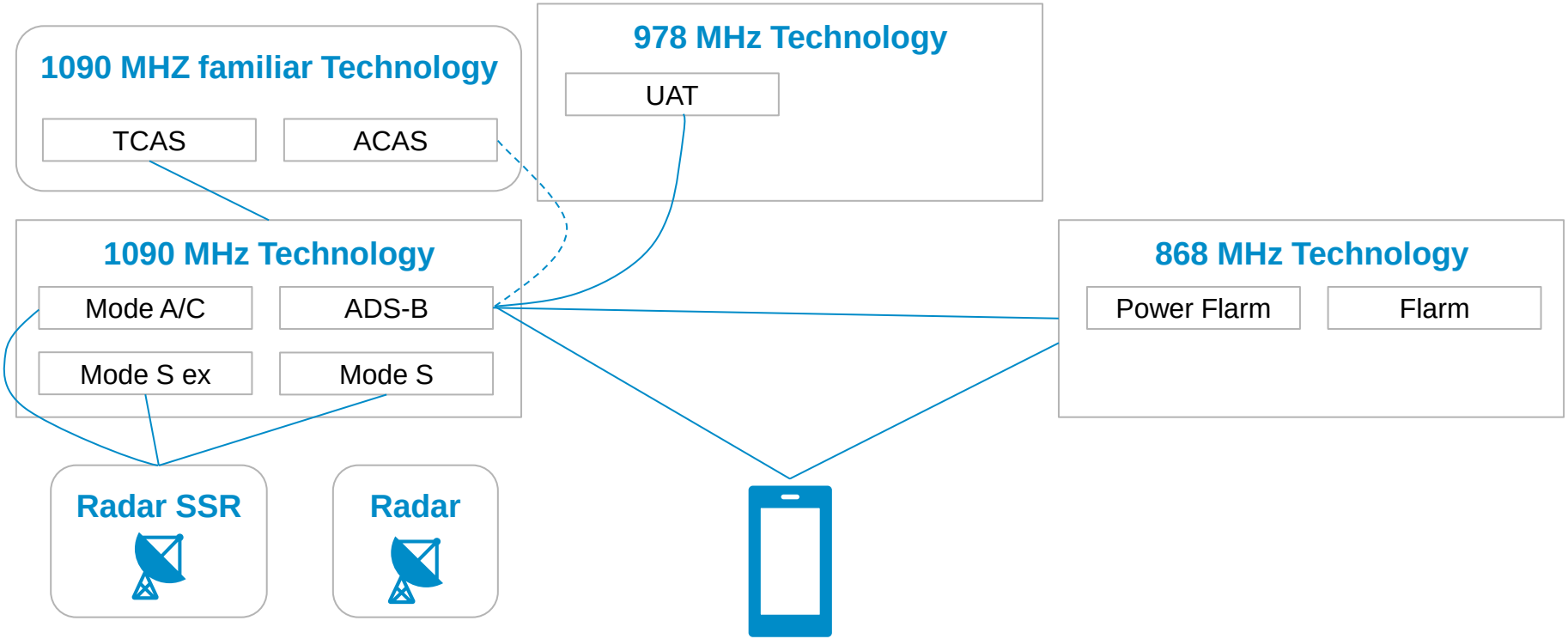


Comment

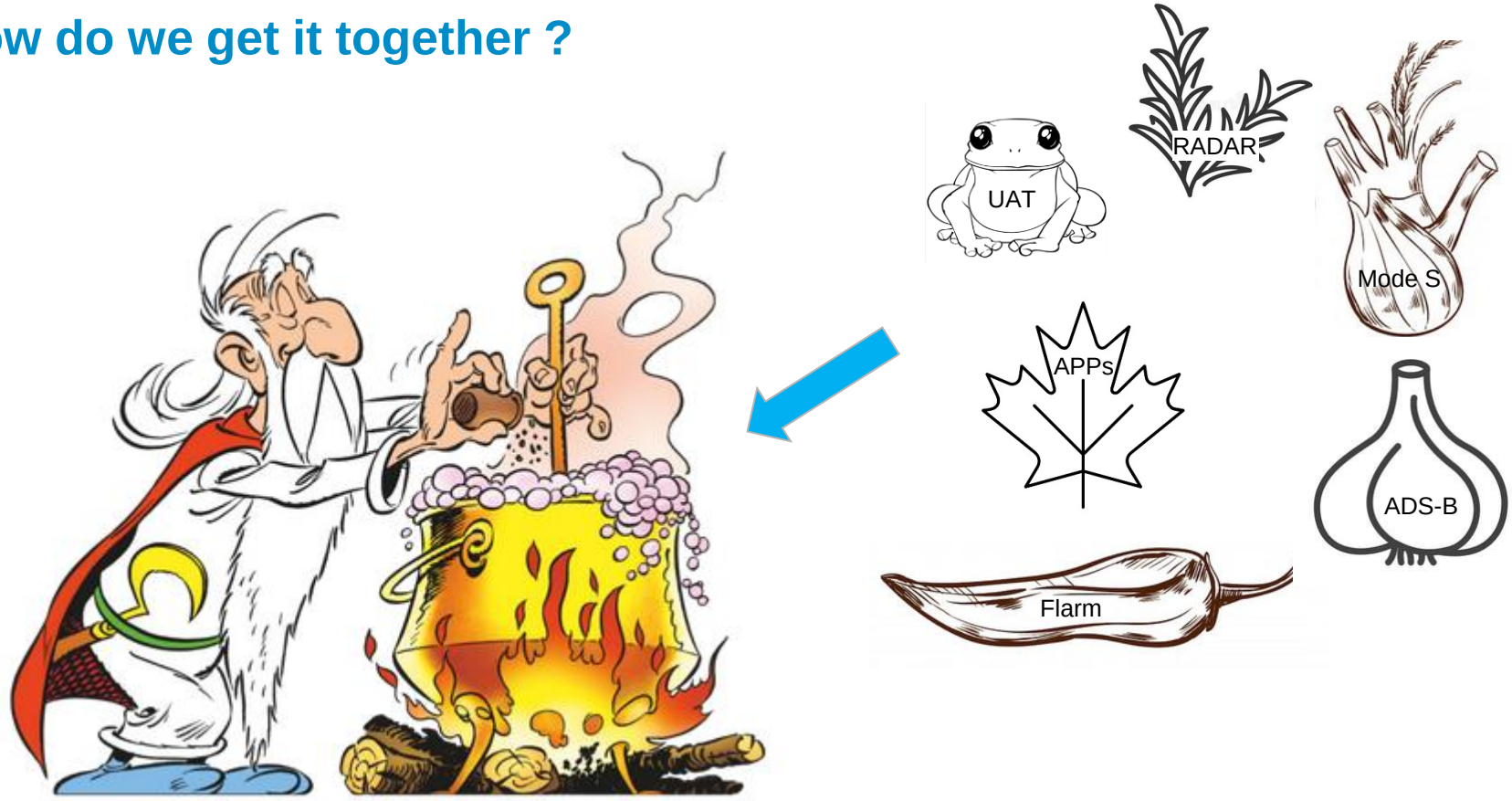
Interoperability:

Interoperability describes the ability for assets to provide services to and from other assets, utilizing common standards to facilitate effective data exchange and system operation.

Actual Interoperability



How do we get it together ?



Agenda

Original planned procedure for criteria finding and system combination was revised during Workshop

1. EASA, Horváth & Droniq agreed to change the approach during the workshop to achieve a better result in terms of use-case view

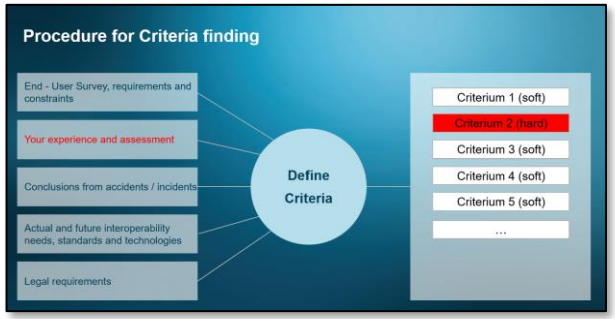
2. On the following slides you find the originally planned procedure followed by the revised procedure and the results

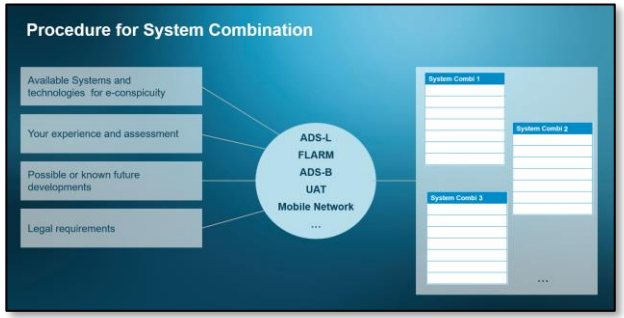
3. Due to the scope change a follow up meeting was set up on July 19th (for details please refer to page 67)

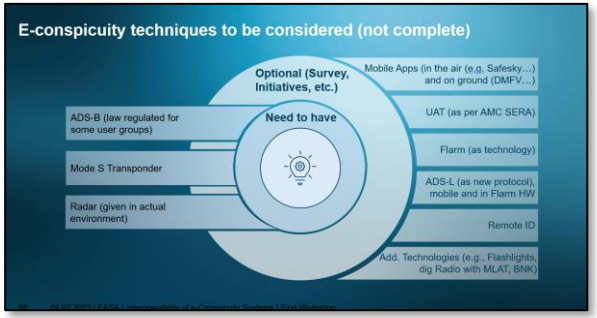
4. The results are attached at the end of this presentation

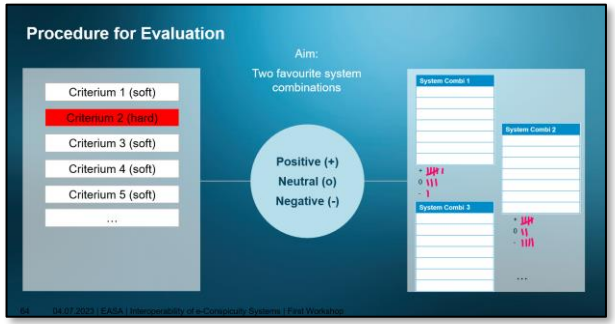
Original planned approach

Original slides to be found in backup









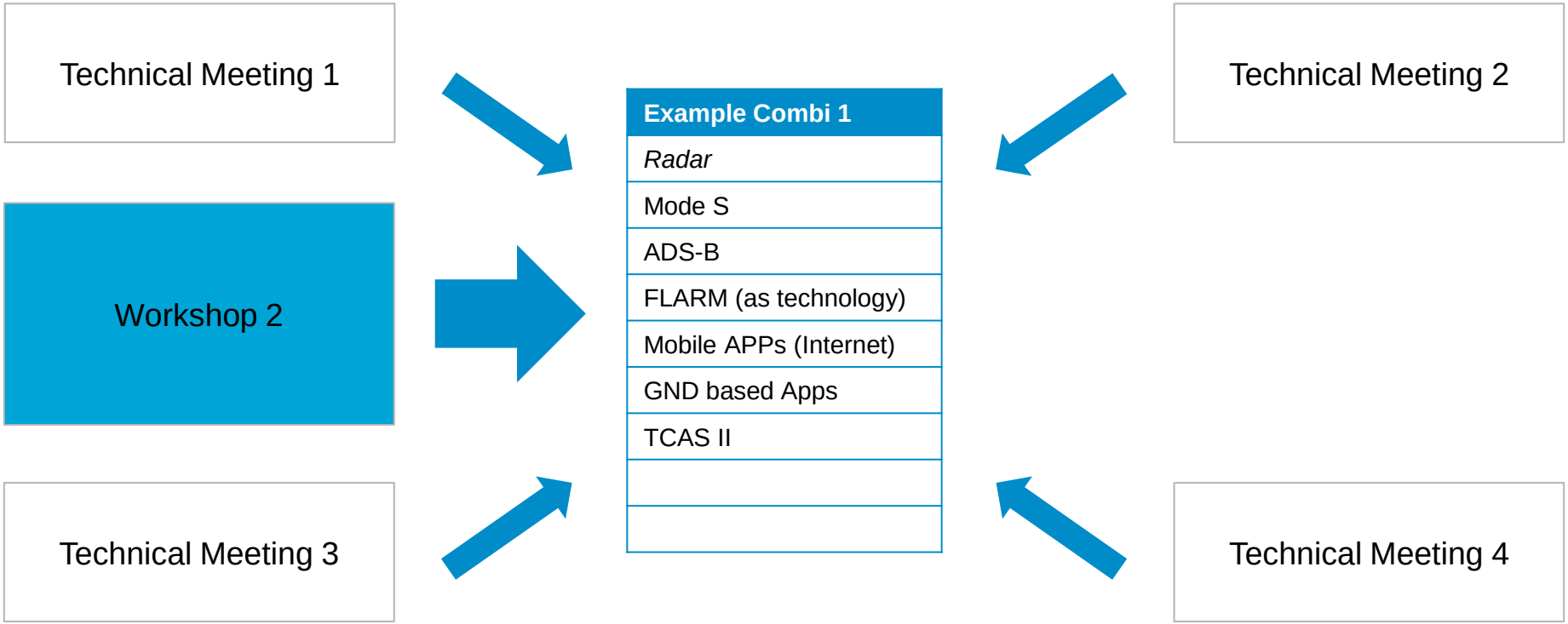
Potential System Combinations (for discussion)

System Combi S1
RADAR
Mode S
ADS-B
ADS-L 4 SRD-860
ADS-L 4 Mobile
FLARM (as technology)
Mobile APPs (Internet)
GND based Apps
TCAS II

System Combi S2
RADAR
ADS-B
UAT
FLARM (as technology)
Mobile APPs (Internet)
GND based Apps
ACAS X

Original planned approach: Re-check system combinations & evaluation

Slide shown in workshop



Actual performed approach during workshop

1. With the aligned approach one target system combination was built during the workshop
2. As this target system combination was extensively discussed, the agenda points showstopper and recheck were skipped
3. Two technical meetings following the first workshop were agreed upon in a follow up discussion

Actual performed approach:
Results – Criteria for target system

Scalability	Privacy	Alerts in different ways
Pan-European Applicability (legal)	Reliability	User acceptance
Affordability	Usability	Simplicity
Portability	Low latency	Cyber security
Infrastructure	Open protocol	Future ability

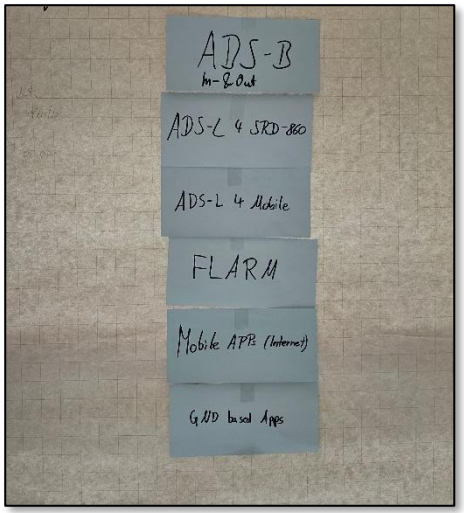
Actual performed approach: Results – System Combination

Target System Combination
ADS-B
ADS-L 4 SRD 860
ADS-L 4 Mobile
FLARM
Mobile APPs
GND based Apps

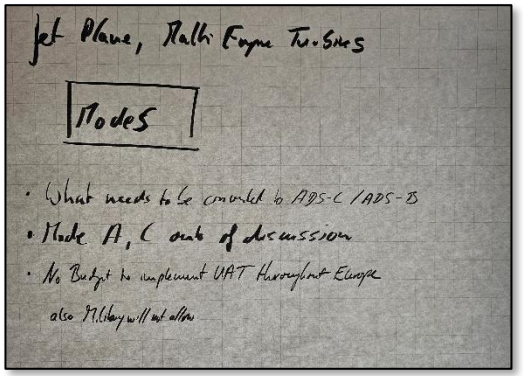
Systems still under investigation, but not in focus/scope
RADAR
Mode S
UAT
TCAS II
ACAS

Actual performed approach: Documentation of results

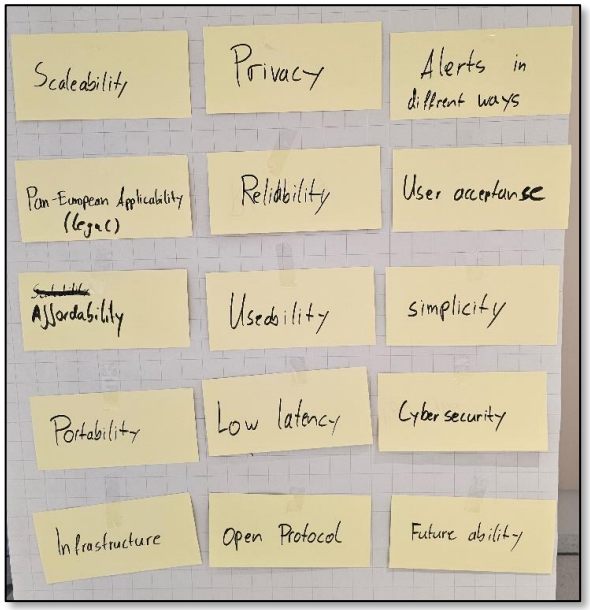
Target System Combination



Systems still under investigation, but not in focus/scope



Evaluation Criteria



Agenda

Needs and constraints for interoperability

- Enabling of Air-Air Connection and network between different systems
- Enabling of network capabilities (via ground systems; ground infrastructure, network and antennas…)
- Frequency usage and congestion
- Certified and non-certified components in regard to interchange data (e.g. SIL)
- Solution for position discrepancy (GPS and Radar, MLAT…)
- Interface for different (incompatible) transmission protocols
- Usage and legality of using mobile services in the air, service status in different altitudes
- Enabling security and anonymization of transmissions
- Enabling of cross-border flying and usage of the ec-systems in Non-EU countries

Agenda

Original planned approach: Technical Meetings for interoperability needs

Slide shown with 4 TMs in workshop

- **TM 1:** Mobile Services, legality, network ability, service status, technical limits
- **TM 2:** Connection air-air systems, harmonizing protocols, security and anonymization
- **TM3:** Frequency usage, congestions
- **TM4:** Position synchronization (GPS, MLAT, RADAR), Integrity Level (certified / non-certified equipment)

Based on discussion after workshop the technical meetings were merged into two meetings

Major results of follow up meeting between EASA, Droniq and Horváth on July 19th

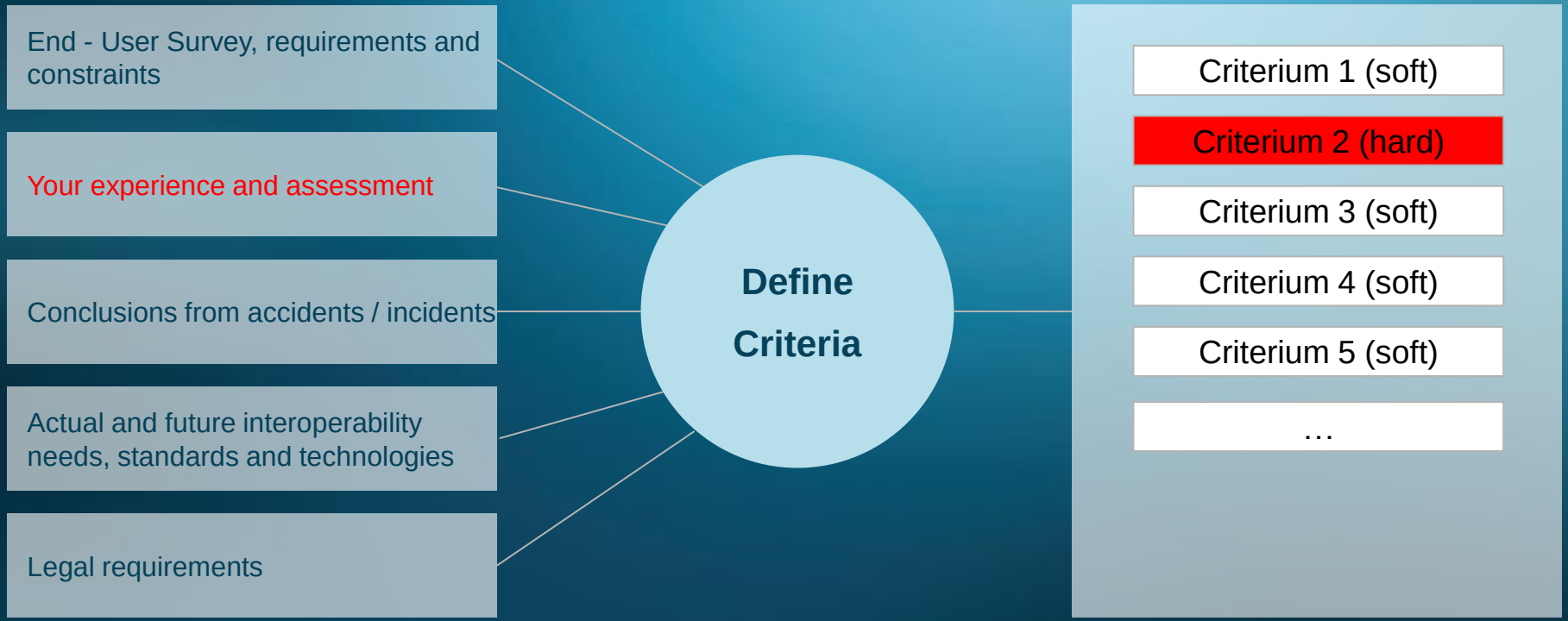
- Scope is changed to uncontrolled traffic (also in controlled airspace), focus is collision avoidance
- Focus is civil air traffic, but systems for UAS and model aircraft are taken into account
- UAT, Mode S still in view
- Considerations will be based on rules of way and tailored around air traffic, not airspace
- Focus is on traffic information interchange. Payload data as NOTAMs, weather, etc. is not part of the project.

Next Steps

Nº	Description	Responsibility
1	Set up Technical Meetings 1+2	Horváth
2	Set up Workshop 2	Horváth
3	Process and publish the survey results	Horváth / EASA


HORVÁTH

Procedure for Criteria finding (Originally planned Approach)



Procedure for System Combination (Originally planned Approach)

Procedure for Evaluation (Originally planned Approach)

Aim:

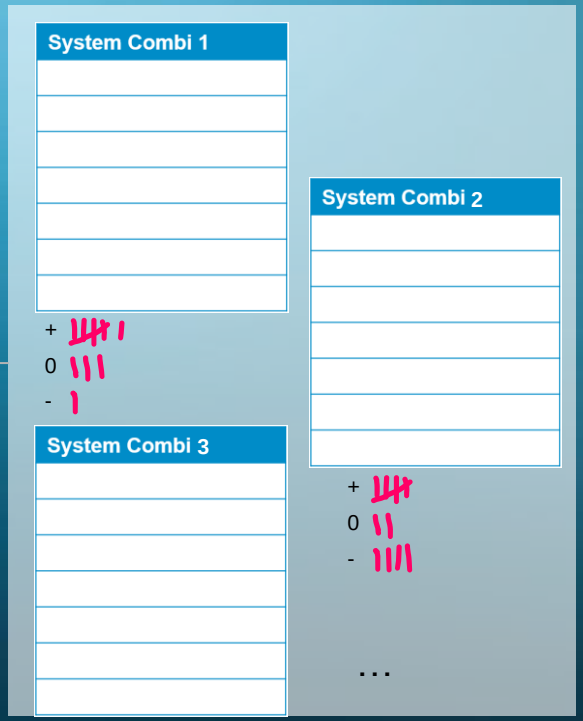
Two favourite system combinations

- Criterium 1 (soft)
- Criterium 2 (hard)
- Criterium 3 (soft)
- Criterium 4 (soft)
- Criterium 5 (soft)
- …

Positive (+)

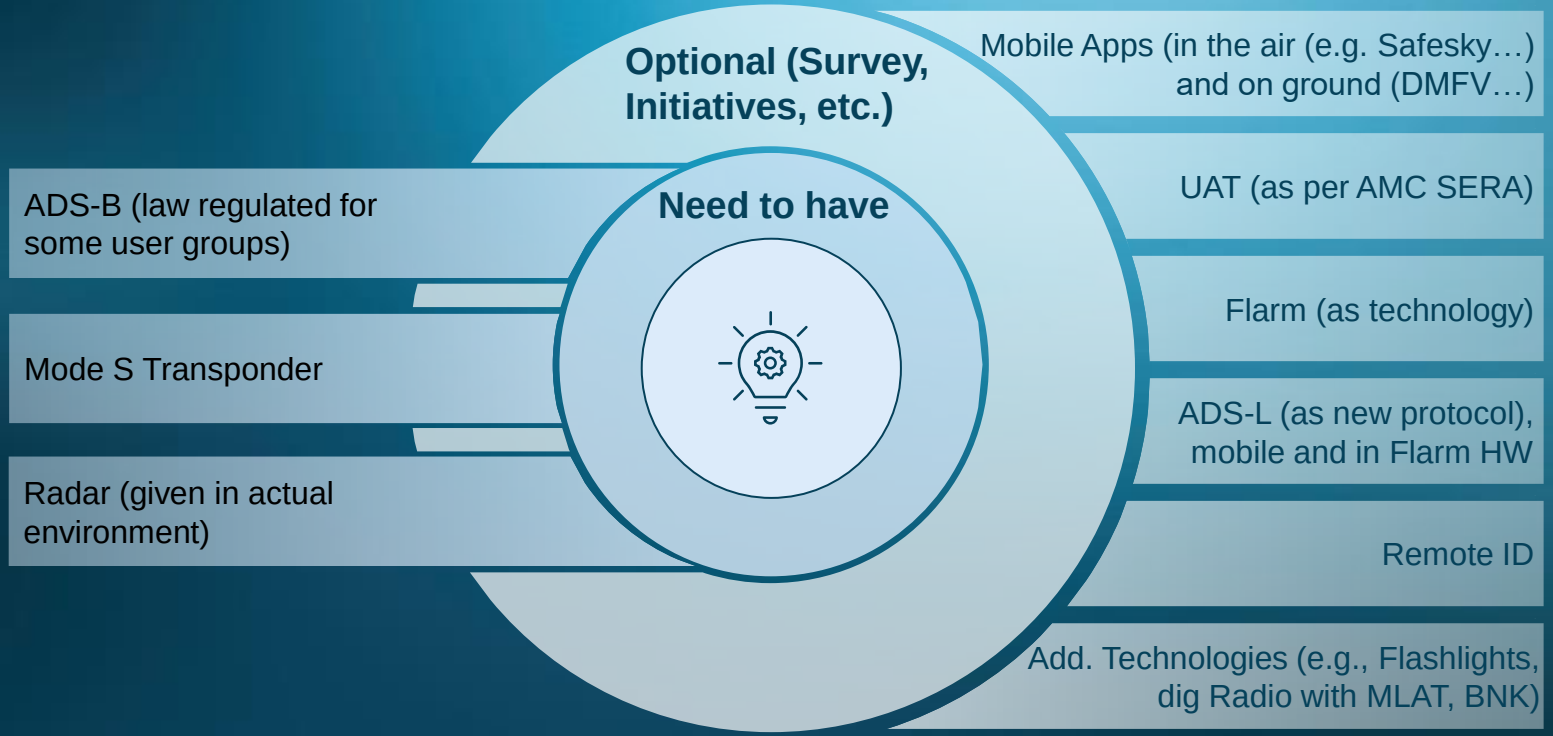
Neutral (o)

Negative (-)



Suggested Criteria (Originally planned Approach)

E-conspicuity techniques to be considered (Originally planned Approach)



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RADAR
ADS-B
UAT
FLARM (as technology)
Mobile APPs (Internet)
GND based Apps
ACAS X

Showstopper

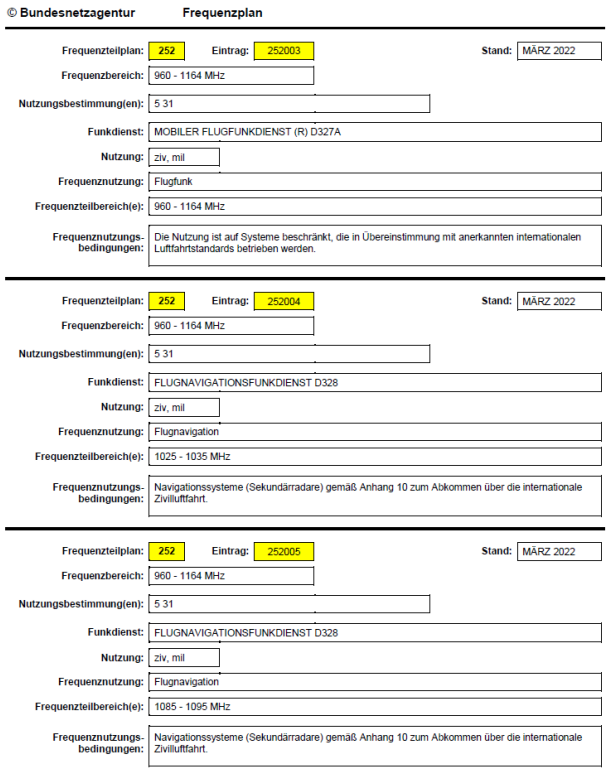
Frequency availability

Costs not acceptable for every user group

Legal problems (EU ?)

…

Frequencies



© Bundesnetzagentur Frequenzplan

Frequenzteilplan:	252
Eintrag:	252003
Stand:	MÄRZ 2022
Frequenzbereich:	960 - 1164 MHz
Nutzungsbestimmung(en):	5.31
Funkdienst:	MOBILER FLUGFUNKDIENST (R) D327A
Nutzung:	ziv, mil
Frequenznutzung:	Flugfunk
Frequenzteilbereich(e):	960 - 1164 MHz
Frequenznutzungs-bedingungen:	Die Nutzung ist auf Systeme beschränkt, die in Übereinstimmung mit anerkannten internationalen Luftfahrtstandards betrieben werden.

Frequenzteilplan:	252
Eintrag:	252004
Stand:	MÄRZ 2022
Frequenzbereich:	960 - 1164 MHz
Nutzungsbestimmung(en):	5.31
Funkdienst:	FLUGNAVIGATIONSFUNKDIENST D328
Nutzung:	ziv, mil
Frequenznutzung:	Flugnavigation
Frequenzteilbereich(e):	1025 - 1035 MHz
Frequenznutzungs-bedingungen:	Navigationssysteme (Sekundärradare) gemäß Anhang 10 zum Abkommen über die internationale Zivilluftfahrt.

Frequenzteilplan:	252
Eintrag:	252005
Stand:	MÄRZ 2022
Frequenzbereich:	960 - 1164 MHz
Nutzungsbestimmung(en):	5.31
Funkdienst:	FLUGNAVIGATIONSFUNKDIENST D328
Nutzung:	ziv, mil
Frequenznutzung:	Flugnavigation
Frequenzteilbereich(e):	1085 - 1095 MHz
Frequenznutzungs-bedingungen:	Navigationssysteme (Sekundärradare) gemäß Anhang 10 zum Abkommen über die internationale Zivilluftfahrt.

Comment

- Overload ADS-B ?
- UAT Usage in EU still not possible ?

U-Space Compatibility

MEANS OF TRANSMISSION OF INFORMATION AND INFORMATION TO BE TRANSMITTED

(a) Manned aircraft should transmit information through one or more of the following means to continuously make themselves electronically conspicuous to U-space service providers:

(1) A certified ADS-B OUT system compliant with ICAO Annex 10 Volume IV Chapter 5 (Mode-S Extended Squitter).

(2) A certified ADS-B OUT system compliant with ICAO Annex 10 Volume III Chapter 12 (Universal Access Transceiver) 12 months after its implementation and deployment for that purpose in all Member States.

(3) A system that transmits the information specified in Appendix 1 to this AMC using:

(i) a short-range device (SRD) 860 frequency band, and the information is transmitted in compliance with the format as documented in technical specification ADS-L 4 SRD-860;

(ii) standardised mobile telecommunication network services coordinated for aerial use in the relevant decisions of the Electronic Communication Committee (ECC) of the European Conference of Postal and Telecommunications Administrations (CEPT), and the information is transmitted in compliance with the format as documented in technical specification ADS-L 4 MOBILE. The aircraft operator using application-based service should ensure that all other applications or functions that might run in the background are switched off or made inactive to limit in-flight transmissions to only those necessary to minimise interference through unpredictable data upload.
This option becomes applicable 6 months after the publication of the technical specification ADS-L 4 MOBILE.

The systems used for transmission in accordance with points (3)(i) and (ii) should bear an appropriate CE marking, and be either installed on the aircraft with the installation approved by the competent authority or carried on board the aircraft as non-installed equipment.

(b) The information specified in Appendix 1 to this AMC, and which is transmitted through a system referred to in points (3)(i) and (ii), shall be transmitted in a machine-readable format accessible to U-space service providers without any restrictions.

Compatibility of ec systems

Conspicuity beacons	Which traffic receivers can see them?					
	ADS-B-in devices (certified)	ADS-B in Rx	Airborne Collision Awareness Systems (ACAS)	Pilot Aware Rosetta (PAW)	Power FLARM	Sky Echo 2 (SIL-1 Device) CAA CAP 1391 approved
ADS-B Out transponder certified GPS	Yes	Yes	Yes	Yes	Yes	Yes
ADS-B out transponder uncertified GPS (Surveillance Integrity Level (SIL) 0)	No*2	Variable*4	Yes	Yes	Yes	Yes
Power FLARM	No	No	No	Yes*1	Yes	Yes*3
Pilot Aware Rosetta (PAW)	No	No	No	Yes	No	No
Sky Echo 2 (SIL-1 Device) CAA CAP 1391 approved	Yes	Variable*4	No	Yes	Yes	Yes

*1) Dependent on proximity to ground infrastructure

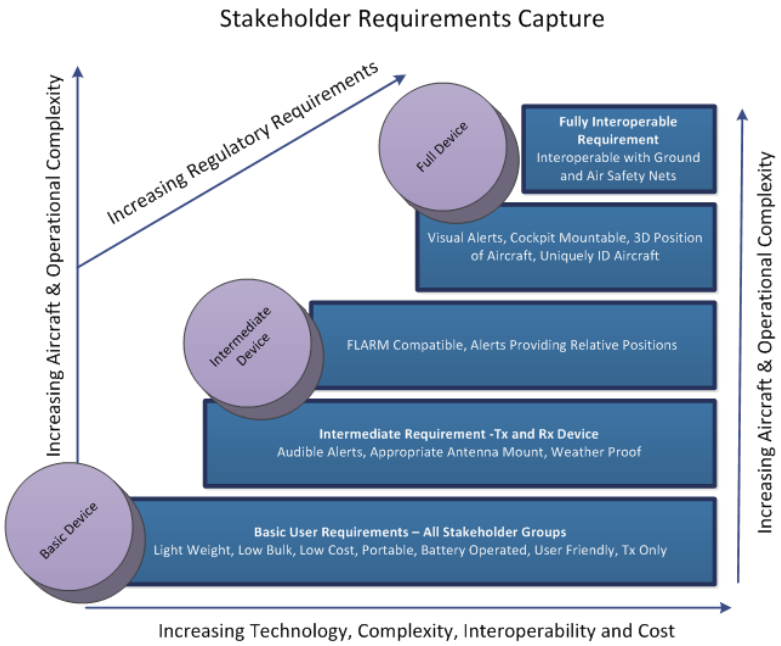
*2) Certified Traffic receivers normally exclude reports from transponders & beacons set to SIL 0

*3) New development requires a FLARM decode licence and a suitable display

*4) Transponders or beacons with a non-certified GPS may not be detected by a certified ADS-B in device. Systems with a quality indicator of System Design Assurance (SDA) ≥ 1 can be "seen' '. In the above table, the term certified means a device that has been tested for meeting EUROCAE/RTCA standards and operates in the aviation spectrum.

In the above table, the term certified means a device that has been tested for meeting ICAO standards and operates in the aviation spectrum.

Complexity and Costs (quote from CAA)



To encourage voluntary uptake from the widest cross-section of GA stakeholders, the design brief resulting from the ECWG's work is:

- **Portable**: there should be no barrier, either physical or regulatory, to moving the EC device from one aircraft to another instantly.
- **Light weight**: stakeholders identified a weight of approximately 200g including batteries could be acceptable.
- **Low bulk**: a device would ideally be no larger than approximately 140mm x 80mm x 25mm including batteries.
- **User friendly**: any EC device would be easy to operate, with minimal or no inputs required during flight. The device should not reduce 'look out' capabilities or have a negative impact upon safety.
- **Appropriate antenna fit**: the required antenna fit must be easily achievable and appropriate to the device.
- **Voluntary equipage**: the ECWG supports voluntary equipage of an EC device. There is no appetite for mandating carriage.
- **Minimal regulatory requirements**: stakeholders identified a requirement to have as few regulatory hurdles as possible. This will provide further positive encouragement for voluntary carriage.
- **Interoperable**: any system should be interoperable with as many players as possible.

NATS (ADS-B / GPS Trial Results 2015)

6 Conclusions

Based on the results of this trial, it can be seen that the quality of non-certified GPS is sufficient for use in enhancing visual acquisition / electronic conspicuity between participating general aviation aircraft outside controlled airspace.

There was no identified impact on the current or planned UK ATC use of 1090MHz, or regulated uses of surveillance on 1090MHz. However it would be prudent to undertake periodic monitoring of installations to ensure transmission and data content remain of suitable quality. This on-going monitoring role should be periodically reported to the certifying airworthiness authority for that a/c type.

It was interesting to note how closely the non-certified data matched the performance of the certified 'white-list' fleet.

All of these tests were performed in a GPS fault free environment. NATS safety analysis identified the risk and consequence of a faulty GPS for the enhancement of visual acquisition as minor and tolerable.

The use of this data in ground applications, whilst outside the scope of this study, should be examined for potential impact under GPS/GNSS faulted conditions.

Therefore, General Aviation should be encouraged to enable ADS-B from capable transponders to create an ADS-B based Electronic Conspicuity environment to support the introduction of dedicated ADS-B IN Electronic Conspicuity devices, such as NATS LPAT.

Mobile Services

MOBILE TELECOMMUNICATION SERVICES FOR AERIAL USE

(f) National and international roaming agreements rely on standardised roamed services (SMS, voice streaming, etc.), which cannot be automatically presumed for aerial services. Only the mobile telecommunication services concluded by the standardisation bodies for aerial use could be used by manned aircraft to make themselves electronically conspicuous to U-space service providers.

(g) There are country-specific restrictions for the aerial use of certain mobile telecommunication frequencies. Therefore, the frequencies used by aerial mobile telecommunication services should be consistent with the relevant decisions of the Electronic Communication Committee (ECC) of the European Conference of Postal and Telecommunications Administrations (CEPT) as implemented by national telecommunication authorities.

Security / Anonymization

- Legal framework for anonymization (DSGVO)
- Fake signals can cause accidents, influence safe traffic (higher value than data protection)
- Technical possibilities with transmission protocols ?