ADLS Implementation Options

Aircraft Detection Lighting Systems

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TABLE OF CONTENT

1 INTRODUCTION 3
1.1 Scope 3
1.2 Purpose of the document 3
1.3 Intended audience 3
1.4 Structure of the document 3
1.5 Conventions 4
1.6 Abbreviations 4
1.7 References 5
2 BASIC CONCEPT OF ADLS 6
2.1 Problem description 6
2.2 Definition of ADLS 6
2.3 Types of obstruction lighting 7
2.4 Regional or countrywide use of ADLS 8
2.5 ADLS light activation perimeter 8
2.6 ADLS recommended system capabilities 9
2.7 Conditions for the suppression of obstruction lights 9
2.8 Night-time operations 10
2.9 ADLS architectures 10
2.9.1 Centralised vs decentralised 11
2.10 ADLS aircraft detection capabilities 11
2.10.1 Surveillance based detection 11
2.10.2 Analysis of airframe movements (Detection via flight plans) 12
2.11 System Components 12
2.12 Regulatory Framework 13
3 DESCRIPTION OF PROCESSES 14
3.1 Stakeholder roles description 14
3.2 Process description 15
3.3 Assessment of needs 16
3.4 Stakeholder and environment identification 16
3.5 Initial architecture and system requirement definition 17
3.6 Regulatory framework, safety assessment and refinement of system requirements definition loop 17
3.6.1 Regulatory framework 17
3.6.2 Safety assessment 18
3.6.3 Refinement of architecture and system requirement definition 18
3.7 NO-ADLS zones identification 18
3.8 Implementation (Including Validation) 18
3.9 Communication and training 18
4 IMPLEMENTATION ARCHITECTURE DESCRIPTION 20
4.1 ADLS implementation options as “construction blocks” 20
4.1.1 Permanent activation of IR lights 20

4.1.2 Manual activation of obstruction lights 21
4.1.3 No low-level flights 22
4.1.4 Declaration of No-Fly Zones (NFZ) 22
4.1.5 Detection of aircraft with cooperative SUR 23
4.1.6 Detection of aircraft with non-cooperative SUR 24
4.1.7 Detection of aircraft with flight plan 24
A. ADLS CONCEPT IN AUSTRIA – FLIGHT PLAN ARCHITECTURE 26
A.1 Overview 26
A.2 Working Principle 26
A.2.1 General Aviation 26
A.2.2 Military Operation 26
A.2.3 HEMS Operations 26
B. - ADLS CONCEPT IN GERMANY – SURVEILLANCE ARCHITECTURE 27
B.1 Overview 27
B.2 Visual description of the ADLS requirements in Germany 29
C. ADLS CONCEPT IN SWITZERLAND - PROCEDURAL ARCHITECTURE 30
C.1 Overview 30
C.2 Prerequisites 30
C.3 First step in deactivation of night lighting 30
C.4 Second step in deactivation of night lighting 31
C.5 Summary 31

TABLE OF FIGURES

Figure 1 ADLS activation perimeter 9
Figure 2 ADLS implementation process 16
Figure 3 ADLS implementation options 20
Figure 4 ADLS requirements in Germany 29

1 INTRODUCTION

1.1 Scope

This document provides guidance on the implementation of Aircraft Detection Lighting Systems (ADLS) as a measure to reduce the environmental and social impact of continuous obstruction lighting while ensuring aviation safety. It describes concepts, processes, system capabilities, regulatory considerations, and technical options for the deployment of ADLS, focusing particularly on wind farms and similar tall obstacles. It is not a document to verify operational acceptability of ADLS systems, and it does not include a generic safety assessment.

1.2 Purpose of the document

The purpose of this document is to assist stakeholders in understanding and applying best practices for the deployment of ADLS. The document is intended to support national and regional authorities, service providers, and infrastructure operators in defining ADLS implementation strategies in accordance with local airspace, regulatory, and operational environments. It aims to harmonize approaches where possible, clarify stakeholder roles, and present viable implementation architectures. The document is structured to facilitate safe, efficient, and environmentally responsible integration of ADLS into obstruction lighting strategies across different regions.

1.3 Intended audience

This document is intended for a range of stakeholders involved in airspace safety and obstacle lighting, including but not limited to:

- Regulatory authorities responsible for aviation safety and infrastructure.
- Bodies assessing and approving ADLS systems.
- Solution providers developing and deploying ADLS technologies.
- Wind farm and other obstacle operators/owners implementing lighting solutions.
- Air Navigation Service Providers (ANSPs) managing surveillance and airspace operations.
- Airspace users (e.g., general aviation, military, emergency services) who operate in environments affected by ADLS.

1.4 Structure of the document

The document is structured into the following main sections:

- Section 1 – Introduction: Describes the scope, purpose, and intended audience, and explains the document's structure.
- Section 2 – Basic Concept of ADLS: Describes the need for ADLS, its principles, and its regulatory and technical context.
- Section 3 – Description of Processes: Details stakeholder roles and the step-by-step implementation process.
- Section 4 – Implementation Architecture Description: Describes the various system architecture options and safety considerations.
- Annexes – Provides examples of different national approach to implement ADLS.

1.5 Conventions

ADLS

ADLS (Aircraft Detection Lighting System) is a well-known term used for a system that deactivates obstruction lighting automatically when no aircraft is nearby. Although the term refers to ‘aircraft detection’, this document also covers systems without a specific ‘aircraft detection’ function. In other words, this document also includes systems using other means to manage the risk of aircraft not being able to detect the obstruction, such as flight plans and/or operational constraints.

Obstacle

In this document, the term obstacle refers to any fixed structure equipped with obstruction lights. While the primary focus is on wind turbines, this definition is intended to generalize the applicability of the guidelines to all relevant obstacles, including communication towers, tall buildings, chimneys, and similar structures that could be a hazard for air navigation.

Obstruction light

The term obstruction light (or obstacle obstruction light) is used throughout this document to refer to any lighting system installed on obstacles for the purpose of making them visible to aircraft, particularly during night-time or low-visibility conditions. These lights include, but are not limited to, low-, medium-, and high-intensity red or white lights.

Suppression of obstruction lights

By default, obstruction lights are assumed to be continuously active during hours of darkness or low-visibility conditions to ensure obstacle visibility to aircraft. Suppression of obstruction lights refers to the automatic deactivation of these lights specific conditions are satisfied. An ADLS controls this suppression.

It is important to note that when referring to the suppression of obstruction lights in this document, infrared (IR) lights are explicitly excluded.

Relevant aircraft

In this document, relevant aircraft refers to any aircraft that must be detected by the ADLS for the purpose of obstruction light activation. These are aircraft that may operate within the defined ADLS activation perimeter when the lights are deactivated and that are not equipped with other means to detect the obstacle (e.g. IR sensors or night vision goggles). The classification as "relevant aircraft" depends on the local airspace structure, regulatory context, and the likelihood of aircraft operating near obstacles and can be defined differently in different countries.

1.6 Abbreviations

ADLS	Aircraft Detection Lighting System
ADS-B	Automatic Dependent Surveillance–Broadcast
AGL	Above Ground Level
AIP	Aeronautical Information Publication
ANSP	Air Navigation Service Provider

ATM	Air Traffic Management
EASA	European Union Aviation Safety Agency
GA	General Aviation
GNSS	Global Navigation Satellite System
HEMS	Helicopter Emergency Medical Services
ICAO	International Civil Aviation Organization
IFR	Instrument Flight Rules
IR	Infrared
MLAT	Multilateration
NFZ	No-Fly Zone
NOTAM	Notice to Airmen
NVFR	Night Visual Flight Rules
NVG	Night Vision Goggles
RVR	Runway Visual Range
SAR	Search and Rescue
SERA	Standardised European Rules of the Air
SUR	Surveillance
TMA	Terminal Control Area
VFR	Visual Flight Rules

Table 1 Table of abbreviations

1.7 References

[RD 1] European Commission Implementing Regulation (EU) 2023/1770 of 12 September 2023, laying down provisions on aircraft equipment required for the use of the Single European Sky airspace.

[RD 2] European Commission Implementing Regulation (EU) No 923/2012 of 26 September 2012, laying down the common rules of the air and operational provisions regarding services and procedures in air navigation

[RD 3] EUROCAE ED-129C, Technical Specification for A 1 090 MHz Extended Squitter ADS-B Surveillance System, August 2023.

[RD 4] EUROCAE ED-142, Technical Specification for Wide Area Multilateration (WAM) Systems, September 2010.

[RD 5] EUROCAE ED-288, Technical Standard (TS) for an Independent Non-Cooperative Surveillance (INCS) System, June 2025.

[RD 6] EUROCONTROL-SPEC-189, EUROCONTROL Specification for European Mode S Station (EMS), Edition 4.0, 17 September 2021

[RD 7] International Civil Aviation Organization (ICAO), Annex 14: Aerodromes, Volume I — Aerodrome Design and Operations, 9th Edition, July 2022, Chapter 6.

2 BASIC CONCEPT OF ADLS

2.1 Problem description

In Europe, the constant illumination of obstruction lights on wind turbines and other obstacles at night is a safety requirement to alert aircraft of the obstacles' presence. This is especially important for general aviation and special operation aircraft. However, these lights, which are often red and/or flashing, can cause several problems, including:

1. **Light Pollution**: Constant or flashing lights can contribute to light pollution, affecting nearby communities, wildlife, and stargazing activities.
2. **Nuisance to Residents**: People living near wind farms often find the lights annoying, especially when they flash repeatedly throughout the night.
3. **Impact on Wildlife**: Certain species, such as birds and bats, may be disoriented by the lights, which could lead to harmful behavioural changes or increased risk of collision.

To address this, Aircraft Detection Lighting Systems (ADLS) can be implemented. These systems suppress the obstruction lights and use different mechanisms (e.g. radar, multilateration, flight plan…) to detect when an aircraft is nearby. The obstruction lights on the relevant obstacles are activated when an aircraft is detected and could potentially be at risk of collision (Note: the activation is per requirements expressed as deactivating the light suppression). Once the aircraft is not detected within the activation perimeter, the ADLS automatically suppresses the obstruction lights again. As such, this system reduces light pollution and the disturbance to residents and wildlife, while still maintaining safety for aircraft operations and can thereby increase the acceptance of wind turbines.

Note: ADLS also reduces the operating time of obstruction lights, leading to energy savings.

2.2 Definition of ADLS

An Aircraft Detection Lighting System is an advanced lighting control system designed for structures such as wind turbines, communication towers, and other tall infrastructure (in the following generally named obstacle) to mitigate the impact of obstruction lights on the environment and local communities.

The key features of an ADLS include:

1. **Aircraft Detection**: ADLS need to ensure the detection of aircraft within the activation parameter. This detection can be achieved by Surveillance systems such as radar, multilateration or ADS-B, which relies on aircraft's onboard transponders to determine their position. Alternatively, detection can be based on flight plan data, allowing the system to anticipate an aircraft's presence even before it enters the monitored area.
2. **Lighting Management**: Under normal conditions, the ADLS suppresses the activation of the obstruction lights. When an aircraft is detected in the activation perimeter around the structure, the suppression of lights is automatically lifted, illuminating the obstacles to warn the pilot of the potential hazard while minimising light pollution.

2.3 Types of obstruction lighting

The regulatory baseline for the lighting of obstacles, including wind turbines, is provided in ICAO Annex 14, Volume I, Chapter 6 (also including marking, which is however out of scope of this document). With the exception of the specifications of the actual lights, most of the relevant specification in that document is classified as recommendation. This leaves ample room for national regulation and guidelines. Over time however a typical use of the lighting types regulated by ICAO has emerged. Briefly summarised the following three types are in widespread use today:

1. White “daylight” lighting: The most intense of lighting types assures obstacle visibility even in bright sunlight when applying the high intensity lights. Often national regulation however allows/mandates deactivating the lights when ambient lighting is above a certain threshold and activating it below said threshold. In addition, the white lighting is turned off when the ambient light is below the red “night” lighting threshold, in which case the seamless transition from white to red lighting. In practice this often leads to the white lighting being used during twilight conditions such as dusk, dawn or when meteorological conditions deteriorate sufficiently (i.e. during thunderstorms or heavy cloud cover). White lighting is generally excluded from any deactivation of lighting from ADLS systems.
2. Red “night” lighting: This type of lighting is often composed of medium intensity lights (according to ICAO’s definition/national regulation) on the nacelle and low intensity lights at the tower. The activation of the red lighting is coupled to the deactivation of the white lighting, meaning there is a gapless transition between the two lighting types as the ambient light goes darker/brighter. As this type of lighting is the one that is best visible due to dark night conditions and also the many hours it typically stays on, it is by far the one with the most nuisance to the population and other stakeholders. In consequence this is also the type of lighting where the ADLS applies.
3. Infrared lighting: The requirements for infrared lighting were introduced in the wake of LED technology replacing traditional light bulbs. This since LED lighting is much less visible in night vision goggles (NVG), due to lower emission in the infrared spectrum. Most national regulators therefore mandated the use of dedicated infrared lights on the nacelle and tower in parallel to their respective regulation on red lighting. Infrared light may be required to be on during all times or can possibly (in some states) be de-activated based on ambient brightness. ADLS does usually not control the infrared lights.

While this summarization above fits most applications of lighting on wind turbines, their implementation details vary greatly between national regulations. One such example would be the intensity of the daylight lighting and the definition of its (de-)activation thresholds. While technically being a small difference, the consequences on the engineering of the lights and the general perception of lighting are significant. Such variances can lead to a perceived large difference in the application of the lighting regulation even though they are still well within the boundaries defined by ICAO.

Depending on the height of wind turbines, ICAO recommends to in addition to the nacelle lighting also light the towers with one or multiple red (and in parallel usually infra-red) lighting rings. With today’s wind turbine heights, this applies to almost all wind turbines, provided national regulation foresees it. The regulations have generally adopted this recommendation, and it has subsequently evolved from a recommendation into a de facto standard. However, there is a significant difference in

the implementation details. For the application of ADLS however, these separately regulated red-light applications (nacelle/tower) are treated as one, i.e. they are jointly active or inactive.

Lighting is, in spite of all the variants in implementation, mandatory. As such, wind turbine operators are mandated by national regulation to assure and monitor the correct functionality of wind turbine lighting. The unavailability of obstacle lighting is propagated via NOTAMs.

Note: ICAO lighting types are classified differently from the types outlined above. The ICAO classification focus on intensity levels and beam distribution of the lighting as the main characterization criteria. The summary of lighting types above is intended to give an overview from a perceptual viewpoint of wind turbine lighting and less from a technical, specification driven classification such as ICAO's definition of lighting for all sorts of obstructions.

Note: The deactivation of the red lights by ADLS is not related to the dimming of the red lights based on visibility distance permitted by some national regulators. The latter installs visibility measurement equipment on the wind turbine similar to the RVRs at airports. Depending on the deduced visibility distance the red lighting may then be reduced in intensity as a further measure to limit the nuisance to the population. Both ADLS deactivation and dimming may run in parallel, with ADLS obviously superseding dimming.

2.4 Regional or countrywide use of ADLS

At the time of editing this document, there is not any applicable regulation at European level that defines where and how ADLS are required to operate. The implementation of ADLS at regional level is considered optional for special obstacles such as wind farms. The implementation of ADLS is driven by the need to balance aviation safety with environmental concerns, such as reducing light pollution and minimizing the impact on local communities and wildlife.

Note: Usually, ADLS is defined for a larger area or a whole country. It is not considered useful to define small ADLS regions, which could lead to confusion and risks of misinterpretation by pilots. It is to be noted that in some areas, such as TMAs, the suppression of obstruction lights is not recommended.

2.5 ADLS light activation perimeter

The ADLS light activation perimeter refers to a specific airspace volume surrounding an obstacle. If no relevant aircraft is detected inside the light activation perimeter, the obstruction lights can be suppressed (i.e. turned off).

The ADLS light activation perimeter is typically a cylinder defined by a radius around the centre of an obstacle and a height measured from its highest point. The size of the ADLS light activation perimeter needs to allow pilots to see the obstruction lights and safely react to the new situation and avoid the obstacle. For defining the ADLS light activation perimeter, the characteristic of the relevant aircraft as well as the accuracy of the detection mechanism need to be considered.

Note: Typically, a distance of 4 or 5 kilometres and a height of 2000 ft allows pilots enough time to react to the illumination of a wind farm. However, these parameters should be established after a local assessment. In case of high-speed flights, larger distances or permanent lighting should be considered.

Note: For easier implementation a group of obstacles (e.g. wind farms) can be combined to one perimeter, by merging the single obstacles perimeter.

Note: When an aircraft's detected position has a high degree of uncertainty, a larger activation area can be defined to ensure safe operations. In some instances (e.g. when detection is based

solely on flight plan) these areas may extend across regions of a country or even cover the entire country.

A graphical example of an ADLS activation perimeter is given in the following figure

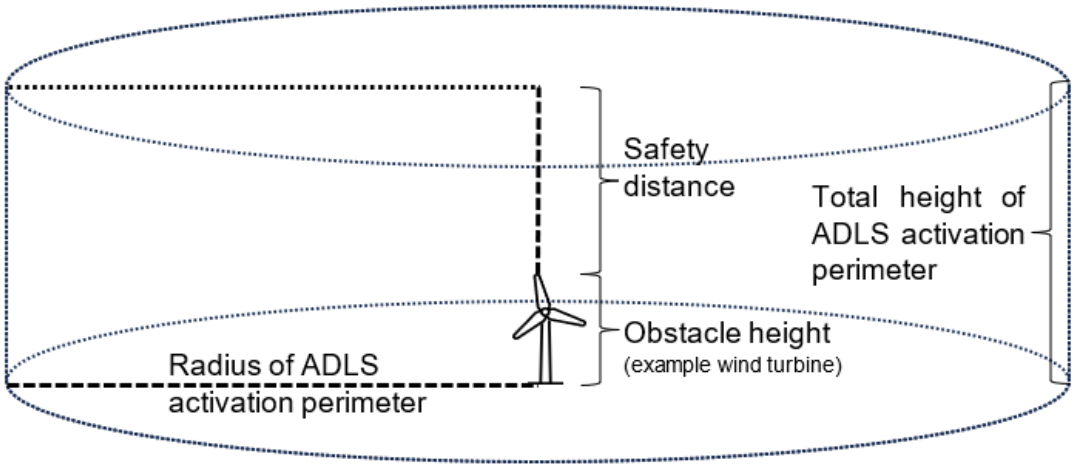

Figure 1 ADLS activation perimeter

2.6 ADLS recommended system capabilities

There are some general system capabilities that each ADLS system should have:

- Capability to detect relevant aircraft inside the ADLS activation perimeter or different means to ensure a separation of airspace users and suppressed obstruction lights. (See Chapter 2.10)
- Remote control and monitoring of all system components including the lighting system.
- Automatic monitoring of system warnings and errors and ability to turn on the lighting automatically in case of malfunction or if specific requirements are not met.
- Obstacles subject to ADLS should be equipped with infrared lighting and have these infrared lighting permanently active.
- Given that ADLS is not expected to be used in locations where operations are regularly occurring close to the related obstacles, the design requirements (design assurance, integrity, availability) may be lower compared to traditional ATC systems.

Note: Subject to local regulations IR lights could be deactivated together with white lighting during bright sunlight conditions.

2.7 Conditions for the suppression of obstruction lights

The aviation obstruction lights can be suppressed if at least the following circumstances are met:

- No relevant aircraft is within the activation perimeter
- The ADLS is fully functional, and system integrity is ensured
- No external activation (e.g. manual activation) of the lighting

Note: Depending on implementation constraints at local level, different conditions may be needed for the suppression of the obstruction lights activation.

Note: Detection is meant in the way it is described in this document, considering alternative means to Surveillance as well.

If one of the above conditions is not met, the lighting of obstacles cannot be suppressed.

All relevant aircraft need to be considered in the definition of the ADLS.

In case not all aircraft can be detected (e.g. military or special users) additional measures such as provision of equipment (e.g. ability to see IR lights) and instructions to pilots should be in place to allow the suppression of obstruction lights.

2.8 Night-time operations

Various types of airspace users may be present during night-time operations, including:

- NVFR (Night Visual Flight Rules) Traffic – Typically, general aviation aircraft flying under visual conditions but requiring obstacle lighting for avoidance of collision.
- Military Aircraft – Operating under various conditions, including low-level training missions and tactical operations.
- Special Users – Emergency and public service flights, including police, rescue, medical, and firefighting aircraft, which may need to operate at low altitudes and in unpredictable patterns.
- IFR (Instrument Flight Rules) Traffic – Commercial, cargo, and general aviation flights navigating primarily using instruments and subject to ATC. Typically, IFR traffic is not present in the areas where ADLS are implemented. Also, IFR procedures are designed with obstacles clearance criteria, keeping the aircraft away from obstacles during normal operations.

To mitigate the risks associated with supressing obstacle lighting and select the best implementation based on the options described in section 4.1, it is essential to characterize relevant airspace users by assessing the number of operations, level of equipage, and specific operational needs.

2.9 ADLS architectures

The ADLS can be implemented using various architectures, each suited to different operational needs. The decision of using one architecture must be tailored to fit in the operational environment of the country. The following ADLS mechanisms are identified in this document:

- Surveillance-based architecture relies on real-time detection through technologies like radar, multilateration or ADS-B to activate obstruction lights when an aircraft is within the light activation perimeter.
- Flight plan-based architecture relies on the detection of aircraft movements based on filed flight plans. This architecture has low certainty about the aircraft's exact position, leading to larger ADLS light activation perimeters.
- Regulation-based architecture relies on regulatory requirements preventing flights from operating in the vicinity of the obstacles during specific hours. This approach may allow for turning off obstruction lights during specific hours, independent of external influence.
- A hybrid architecture combines two or more of the above-mentioned approaches, offering a more tailored system.

2.9.1 Centralised vs decentralised

Another architectural consideration is whether the system should follow a centralised or decentralised architecture. Both approaches offer advantages and limitations, and the choice depends on the local environment, including regulations, airspace complexity and operational requirements.

In a **centralised architecture**, the detection and control functions of the ADLS are managed by a central authority or system (typically the ANSP). The central system collects data from the systems used for ATM (e.g., flight plans, Surveillance sensors) and determines whether obstruction lights should be activated or not.

This model is appropriate for countries where the flight plan-based or surveillance-based (using ATM surveillance systems) architecture has been chosen.

In a **decentralised architecture**, each obstacle or group of obstacles operates its own detection and decision-making system. The system is typically installed and managed by the wind farm operator or the ADLS solution provider. The obstruction lights are activated based on local surveillance inputs, such as radar [RD 5], multilateration [RD 4], Mode S [RD 6], ADS-B [RD 3] and/or other surveillance receivers deployed in proximity of the site.

This approach may be preferable when obstacles are located in remote areas or when surveillance data is not available or easily accessible at low-level, or where rapid deployment is needed.

The use of a decentralised architecture does not prevent that the obstacle obstruction lights can be activated in a centralised way (4.1.2)

2.10 ADLS aircraft detection capabilities

This section is applicable for ADLS systems based on detecting aircraft to activate obstruction lights.

2.10.1 Surveillance based detection

2.10.1.1 Cooperative Surveillance

The ADLS can detect aircraft based on spontaneous signals emitted by the aircraft such as Mode S, ADS-B or other technologies

- Techniques based on transponders or transmitters rely on cooperative surveillance, meaning that they are dependent on specific equipment which must be operational in the aircraft. As such to be an efficient means, there must be a match between the cooperative surveillance used by the ADLS and the equipage used onboard the aircraft in the applicable area.
- ADLS should rely on passive signals. While active interrogations are prohibited in some states to minimise transponder load, where such interrogations are permitted, they shall comply with the relevant regulatory provisions applicable to Surveillance Ground Equipment.

Note: If dependent cooperative surveillance such as ADS-B or conspicuity devices is used, the related accuracy and integrity must be considered (e.g. increase the ADLS light activation perimeter for aircraft with low quality indicators).

2.10.1.2 Primary Surveillance

Aircraft can be detected with active or passive primary radar solutions. The definition of detection capabilities is typically related to a minimum detectable cross-sectional area.

Active radar detection

Active radar solutions detect aircraft by measuring reflections signals transmitted by the radar:

- By using primary radar for detection, no minimum transponder equipment requirement is needed for the relevant aircraft user
- The only definition is the minimum cross-sectional area a primary radar for ADLS should detect.
- A typical minimum could be 1 m² of cross-sectional area that a primary radar solution should detect inside the ADLS activation perimeter.

Passive radar detection

Passive radar solutions detect aircraft by measuring reflections of existing signals (e.g. from radio or TV transmitters) at known locations.

- Like with active primary radar, passive radars are capable of detecting non-cooperative targets and therefore no specific airborne equipage is required.
- There are various techniques for passive radar, and the detection characteristics usually differs from active radar, as such radar cross-section may not be an equally appropriate metric for these types of systems.

2.10.2 Analysis of airframe movements (Detection via flight plans)

The ADLS can detect aircraft based on the analysis of airframe movements, such as flight plans.

- Detection using flight plans relies on information provided by the airspace users before the flight, aircraft do not need to have transponders or other equipment for detection.
- Flight plan-based detection allows the ADLS to anticipate the presence of aircraft even before they enter the monitored area, improving the system's predictive capability.
- In cases where the flight plan data is used, the ADLS must be capable of correlating the aircraft's planned flight path with the defined activation perimeter to ensure accurate activation of obstruction lights.
- This allows to influence obstruction lighting independently of sensor infrastructure or terrain impact on coverage.
- This solution requires that all relevant aircraft must submit a flight plan.

Note: When an aircraft's position has a high degree of uncertainty, a larger activation area can be defined to ensure safe operations. In some instances (e.g. when detection is based solely on flight plan) these areas may extend across regions of a country or even cover the entire country.

2.11 System Components

- Air traffic information source
  - Decentralised or centralised surveillance system

  - Flight plan database
  - Deployed and operated by solution provider or ANSP
- Data processing system (DPS)
  - Centralised (e.g. cloud) or distributed (e.g. in each wind farm or turbine)
  - Performs geofencing based on air traffic information
  - Built-in self-testing
  - Deployed and operated by solution provider or ANSP
- Obstacle light controller
  - Supresses light activation based on signals from DPS
  - Deployed by solution provider
- Lighting system
  - Provides interfaces for ADLS to control (suppress) obstruction lights
  - Activates lights if no active suppression signal received
  - Deployed by lighting system solution provider

2.12 Regulatory Framework

At present, there is no binding regulation at the European level that mandates the implementation or defines technical requirements for ADLS. However, the deployment of ADLS must comply with general aviation safety regulations, national airspace rules, and infrastructure-related laws.

In the absence of centralised regulation, ADLS implementation is governed at national level. This allows individual states to define their own frameworks, tailored to their specific operational environments, air traffic structures, and environmental policies. National regulators may issue guidance, enforce mandates, or introduce technical certification schemes for ADLS systems, often involving cooperation with ANSPs and certification bodies.

Despite the absence of centralised regulation, ADLS implementations must comply with the broader European and ICAO aviation regulatory framework, in particular those governing obstacle lighting, airspace usage, airborne surveillance equipage, and aerodrome/airspace operations.

Key regulatory elements typically considered include:

- **Airspace Usage Rules**:
  - SERA provisions, including SERA 5005[1], concerning minimum altitudes, night VFR (NVFR) operations, and equipment requirements.

[1] EASA SERA 5005 states:

(c) When so prescribed by the competent authority, VFR flights at night may be permitted under the following conditions: [...]

(5) except when necessary for take-off or landing, or except when specifically authorised by the competent authority, a VFR flight at night shall be flown at a level which is not below the minimum flight altitude established by the State whose territory is overflown, or, where no such minimum flight altitude has been established:

(i) over high terrain or in mountainous areas, at a level which is at least 600 m (2 000 ft) above the highest obstacle located within 8 km of the estimated position of the aircraft;

(ii) elsewhere than as specified in i), at a level which is at least 300 m (1 000 ft) above the highest obstacle located within 8 km of the estimated position of the aircraft.

  - National rules on NVFR operations, which may restrict night VFR flight activity, impose minimum altitudes, or require additional onboard equipment (e.g. transponders or IR-vision capabilities).

- **Surveillance equipment regulations**:
  - EU regulations mandating airborne Surveillance equipage such as EU 2023/1770. However, many aircraft relevant for ADLS are not subject to this regulation.
  - Local regulations requiring certain aircraft to have operational cooperative surveillance equipment when flying during night.

- **Flight plan requirements**: Some States may require mandatory flight plans for night VFR operations.

- **Obstacle Lighting Rules**:
  - National regulations (adopting ICAO Annex 14 principles) may allow the suppression of obstruction lights when certain safety conditions are met.
  - Regulations may also mandate permanent infrared lighting, define minimum technical specifications, or impose geographic or altitude-based restrictions (e.g. exclusion zones around airports and military areas).
- **Certification Processes**: National frameworks may require type approval of ADLS systems and site-specific acceptance criteria before operation.
- **Allocation of responsibilities**: The regulatory framework typically specifies the responsibilities of the stakeholders involved in the ADLS. **Requirements for spectrum use and interrogation**: Active ADLS systems need to comply with spectrum use and interrogation requirements (national, ICAO, ITU, ETSI etc.).

3 DESCRIPTION OF PROCESSES

3.1 Stakeholder roles description

This section describes the potential roles and responsibilities of each stakeholder involved in the ADLS implementation process. The specific allocation of responsibilities may vary depending on the ADLS system design and the requirements of the local implementation.

Regulator (not necessarily only aviation regulator)

- Defines the regulations concerning ADLS, typically with input from ANSPs and subject matter experts.
- Defines the process for implementing ADLS
- Determines responsibility and required expertise for system certification.
- Assigns responsibility for site-specific acceptance (e.g., by local/regional authorities, ANSPs, or the regulator itself).
- Specifies the minimum technical and operational requirements for ADLS systems.
- Defines which obstacles are eligible or possibly mandatory for ADLS deployment.

ANSP

- Provides Surveillance capability where coverage and legal conditions permit
- Provides expertise in any stage of the process to ensure airspace safety is not negatively impacted

Certification Body

- Needs to demonstrate technical expertise and present type approval process which needs to be approved by regulator or ANSP
- Provides independent type certification for ADLS to solution providers based on auditing system documentation, process descriptions and system tests.
- Supports site acceptance with independent assessment or local situation and deployment

Solution provider

- Provides technical solution that is compliant with requirements
- Provides required documentation and demonstrates compliance to certification body
- Takes care of deployment and approval by local authorities (optional or mandatory support from certification body in the approval process)
- Takes care of ADLS monitoring, maintenance and operations according to process approved by certification body
- Integrates surveillance input to ADLS

Obstacle owner/operator

- Needs to equip obstacles with lighting systems that conform with regulation
- Needs to satisfy community demands with respect to light pollution
- Needs to trigger NOTAM publication when unable to comply with regulation (i.e. failure of lighting)

Airspace users (GA, military, Rescue…)

- Should check NOTAMs and obstacle database before night flights
- Should ensure compliance to surveillance capability requirement (e.g. Mode S transponder).
- If required for the operation, should use night vision goggles when flying in low airspace
- Should report any observed issues regarding ADLS (e.g. failed activation)

To address all relevant airspace users, all airspace users that can operate during night in close proximity to obstacles should be identified. If new regulations about ADLS are established in a country, appropriate information about changes should be shared to all relevant stakeholders through typical communication channels.

3.2 Process description

This section provides an overview of the steps involved to deploy an ADLS, ranging from the initial assessment of the needs to the implementation of the ADLS and the communication to the relevant community.

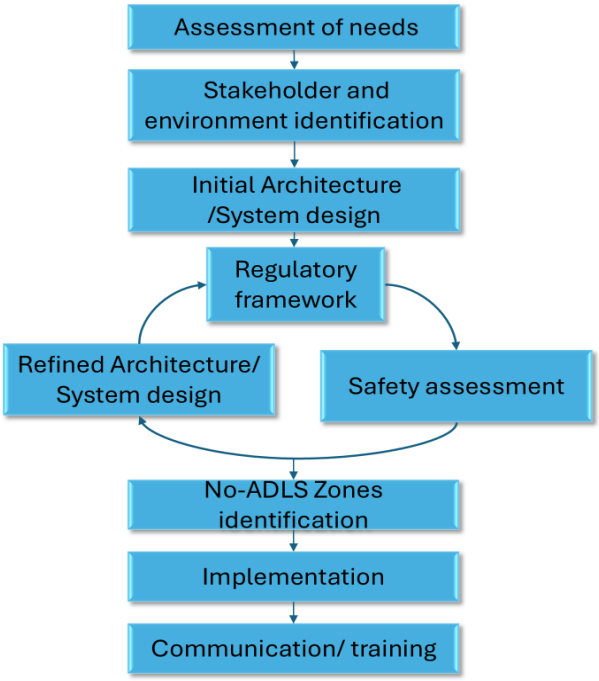

Figure 2 ADLS implementation process

3.3 Assessment of needs

The first step when defining an ADLS is to conduct a comprehensive needs assessment. This involves evaluating the operational, and environmental requirements to determine the necessity of obstruction lighting and the implementation of ADLS.

The need to implement an ADLS might be raised by multiple factors including public concerns regarding night light pollution or the need to comply with regulatory requirements.

An assessment of needs helps justify the investment by analysing whether an ADLS is necessary based on the volume of air traffic, presence of obstacles, and stakeholder concerns.

Once the need for an ADLS is established, it is recommended to define ADLS zones nationwide to avoid confusion and risks of misinterpretation by pilots.

In this step the key stakeholders are Regulators, General public and Political representatives.

3.4 Stakeholder and environment identification

In this phase, it is essential to identify the relevant stakeholders, as outlined in section 3.1. Engaging with these groups ensures that the system meets aviation safety requirements, aligns with existing regulations, and addresses the perspectives and needs of all stakeholders. Their input is essential for defining the operational and technical requirements of the ADLS

The environmental assessment serves as an input in the next steps of the process by evaluating factors such as terrain, airspace usage, regulatory framework identification, and ecological impact. The identification of the specificities of the environment will

support further decision-making process such as the architecture of the ADLS or the geographical areas where the ADLS will be active.

In this assessment, several key factors must be considered to ensure its effectiveness and compliance with requirements. These factors include traffic density, type of traffic, level of equipage and existing regulations.

A view on neighbouring countries and their solutions can be helpful at this stage to identify synergies and risks arising differences across country borders. Should very different solutions emerge, it may warrant the need for increased awareness among relevant pilots.

3.5 Initial architecture and system requirement definition

The Initial Architecture/System Design phase focuses on defining the fundamental structure and operational concept of the ADLS. This step establishes basic architecture including the detection methods, and integration requirements necessary to ensure compliance with aviation safety regulations while addressing stakeholder needs.

The design process considers various architectural options, such as surveillance-based, flight plan-based, procedure-based, and hybrid architectures as described in section 2.9. The inputs from the environment identification are key for the selection of the most appropriate architecture.

The stakeholders involved in the Initial Architecture/System requirement definition phase include Regulators, ANSPs and industry/solution providers.

3.6 Regulatory framework, safety assessment and refinement of system requirements definition loop

The next three steps in the process (refining the system design, assessing safety of operations and aligning it with the regulatory framework) operate in a loop. Each cycle involves refining the system design to enhance its functionality followed by reviewing and adjusting the regulatory framework to ensure that it aligns with the system's capabilities while ensuring safety of operations.

3.6.1 Regulatory framework

After the initial system design, the identification of necessary changes to the regulatory framework is done. This step involves assessing whether existing regulations need to be adapted to accommodate the system's design, such as the need for regulations allowing the suppression of obstruction lights under certain conditions. Regulatory adaptations could include:

- Rules for air traffic during night (IFR/VFR/MIL), including equipment/procedures during night operations (e.g. mandatory flight plans, minimum transponder equipage)
- Rules outside specific aeronautical regulations (e.g. Rules for Wind farm operators by Energy regulation)

It is essential to establish precise definitions of key terms, such as "aircraft detection" or "obstruction light activation," to ensure full alignment between the system's operational capabilities and the regulatory requirements. Additionally, the definition and identification of responsibilities of each stakeholder should be clearly stablished.

The stakeholders involved in the regulatory framework adaptation are the Regulator, ANSP, Certification Body and Solution Providers.

3.6.2 Safety assessment

This step ensures that the system architecture and applicable regulatory requirements work together to minimize safety risks associated with the automatic suppression of obstruction lights. The safety assessment includes an analysis of the barriers in place to guarantee that the obstacle remains visible to all airspace users when required.

The stakeholders involved in the regulatory framework adaptation are the Regulator, ANSPs, solution providers and certification bodies.

3.6.3 Refinement of architecture and system requirement definition

During this step, any gaps or issues identified in the previous phases are addressed, and adjustments are made to ensure the system meets both regulatory and operational requirements.

This phase often involves revisiting the system's components, detection methods, and integration strategies to improve the system and to ensure compliance with the regulatory framework.

The stakeholders involved in the refinement Architecture/System requirement definition phase include Regulators, ANSPs, WF/obstacle operators and industry/solution providers.

This collaborative effort ensures that the system design is not only technically feasible but also aligned with the business requirements of the obstacles, the regulatory framework, and the operational needs of the ANSPs.

3.7 NO-ADLS zones identification

The next step in the process is the identification of NO-ADLS zones. Even though it is recommended that ADLS are implemented nationwide there are specific areas where the system should not be implemented. These excluded areas may include, but are not limited to, proximity to airport and military bases.

The stakeholders involved in the identification of NO-ADLS zones are Regulators and ANSPs.

3.8 Implementation (Including Validation)

The Implementation phase focuses on deploying the ADLS architecture. If the new ADLS Regulation contains a mandatory validation and certification for each system type, the first step of the implementation phase is that any new system type needs to be validated and certificated by the responsible authority appointed in the regulation. It may also be possible, when defined in the regulation, for equipment already approved in other countries to be implemented directly with the other country's certificate. In this case, the implementation of the ADLS concept in both countries must be similar. Once the ADLS architecture has been refined and validated, the systems are produced, installed and integrated with relevant aviation and obstacle lighting networks. Coordination with ANSPs, regulators, certification bodies, wind farm operators, and solution providers is essential during this step to ensure proper alignment with airspace management and obstacle lighting regulations. Before a new ADLS system is going operational it should typically be tested in appropriate scenarios.

3.9 Communication and training

The Communication and Training phase ensures that all relevant stakeholders understand the ADLS functionality and operational procedures. Effective

communication and training are essential for the successful adoption and integration of the system into aviation operations. Each country should define their appropriate channels to address all relevant users.

4 IMPLEMENTATION ARCHITECTURE DESCRIPTION

4.1 ADLS implementation options as “construction blocks”

This section outlines various implementation options for ADLS, allowing flexibility to accommodate different local environments and operational needs. These options are designed to ensure that the system mitigates the risks specific to each location.

Each implementation block is not mutually exclusive, meaning that multiple options can be combined to achieve optimal safety and efficiency. The selection of specific blocks should be based on an assessment of the local environment, including air traffic characteristics, regulatory requirements, available infrastructure, and stakeholder needs. The implementation options support the decision-making process in the definition and refining of the architecture and system design.

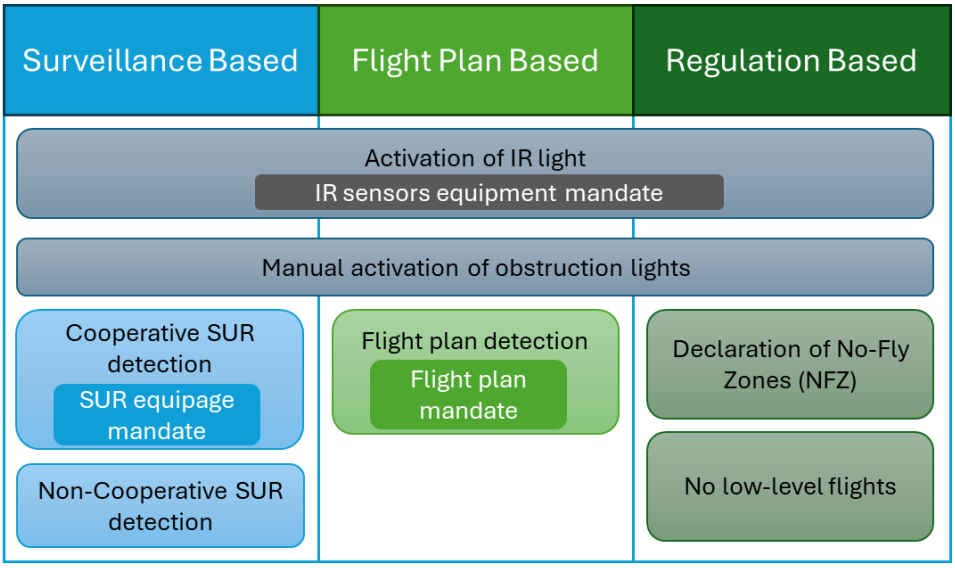

Figure 3 ADLS implementation options

4.1.1 Permanent activation of IR lights

This implementation option involves the permanent activation of infrared (IR) obstruction lights on obstacles during night hours. IR lights are invisible to the naked eye but detectable by aircraft equipped with suitable infrared sensors or night vision equipment (e.g. night vision goggles). Unlike visible obstruction lights, IR lights do not contribute to light pollution or disturb local communities and wildlife.

It is strongly recommended that this implementation option is selected regardless of the other implementation options chosen for the automatic suppression of obstruction lights.

The responsibility for maintaining and operating the IR lighting system lies with the obstacle operator (e.g. wind farm operator). Since IR lights are continuously active, no detection or control system is required to manage their operation.

Safety risks mitigated

Permanent activation of IR lights provides a constant visual reference for aircraft equipped with IR detection systems, typically military and special users.

Limitations

The effectiveness of IR lighting depends on aircraft being equipped with compatible infrared sensors, which is not yet universal. Aircraft without such equipment will not benefit from the IR lights, requiring complementary visible lighting or other detection methods to ensure safety.

Complementary options

Permanent IR lighting is considered as a baseline option used to complement the rest of the options, regardless of the architecture used for the ADLS.

4.1.1.1 IR sensors equipment mandate

This implementation is a complementary option to enhance the effectiveness of permanent infrared (IR) lighting by mandating the equipage of IR sensors on aircraft operating during the night. The mandate ensures that aircraft are capable of detecting IR obstruction lights, improving obstacle visibility without increasing light pollution.

This complementary option may be applied exclusively to military and special operations or extended to all night flights if the environmental analysis step (3.4) identifies a very low volume of night flight activity.

Safety risks mitigated

This option reduces collision risks by ensuring aircraft can perceive IR lighting, especially in environments where visible lighting is limited or suppressed.

Limitations

A mandate to equip IR sensors may not be feasible for all aircraft types and compliance may vary. Therefore, this approach may not provide full coverage of all airspace users and should be complemented by additional detection or lighting methods.

4.1.2 Manual activation of obstruction lights

This implementation option involves the deployment of a mechanism for manual activation of obstruction lights on wind turbines, typically controlled by the wind farm operator or ANSP for extraordinary circumstances. Unlike automatic systems, manual activation relies on human intervention based on known flight schedules, notifications, or real-time observations.

It is recognised that the implementation of a manual activation of the obstruction lights can be challenging in distributed architectures, where the suppression of the lights is responsibility of wind farm operators based on local surveillance data. The variety of systems available to be implemented make very difficult the implementation of a centralised activation of the obstruction lights.

Safety risks mitigated

Manual activation ensures the deactivation of the lighting suppression in cases not covered by the automatic barriers.

Limitations

This method depends on accurate and timely information about aircraft movements and human vigilance.

Complementary options

Manual activation is a complementary option used in combination with other options described in this section.

4.1.3 No low-level flights

This implementation option focuses on reducing the risk of aircraft collisions with obstacles by ensuring that no low-level flights occur during the suppression of obstruction lights.

This option can be implemented by limiting the take-off and landing of NVFR traffic during the deactivation time of the obstruction light (e.g. by limiting the opening hours of the local aerodromes). Cross border NVFR flights typically fly above a minimum flight level as stablished by SERA 5005.

This option serves for the regulatory-based architecture.

Safety risks mitigated

This option primarily limits the collision risks of local NVFR traffic.

IFR flights typically operate at higher altitudes.

Limitations

Military operations or special users (e.g. HEMS) could require low-level access to airspace during the deactivation time.

Complementary options

Depending on the needs of the local environment, additional implementation options are necessary to mitigate the risk of collision for some users.

In order to mitigate the risk of collision for military and special users this implementation option can be complemented with means to detect IR lights (4.1.1) and the manual activation of obstruction lights (4.1.2).

4.1.4 Declaration of No-Fly Zones (NFZ)

This implementation option establishes designated No-Fly Zones (NFZs) during the deactivation time of the obstruction lights to prevent aircraft from entering areas defined as ADLS zones.

This implementation option serves for the regulatory-based architecture.

This option should be enforced through airspace restrictions published in Aeronautical Information Publications (AIP), NOTAMs, and/or national regulations.

Safety risks mitigated

This option limits the collision risks of local NVFR traffic, military and special users.

IFR flights typically operate at higher altitudes.

Limitations

While NFZs provide strong protection, they may not apply to all airspace users. Military aircraft, emergency services, and other special operations might require exemptions.

Complementary options

Depending on the needs of the local environment, additional implementation options are necessary to mitigate the risk of collision for some users.

In order to mitigate the risk of collision for military and special users this implementation option can be complemented with means to detect IR lights (4.1.1) and the manual activation of obstruction lights (4.1.2).

4.1.5 Detection of aircraft with cooperative SUR

This implementation option relies on cooperative surveillance technologies to detect aircraft and deactivate obstruction lighting suppression only when an aircraft is inside the activation perimeter. Cooperative surveillance requires aircraft to be equipped with Surveillance transponders such as Mode S or ADS-B.

The responsibility of the detection can be done in a centralised way by an ANSP or locally by the windfarm operators. In the first instance, the ANSP is the responsible to deactivate the suppression of the obstruction lights, while in the second instance, the responsible is the wind farm operator.

To ensure no additional load to the surveillance spectrum, active interrogations on 1030MHz are not recommended to be used solely for ADLS. Some states do not allow the use of interrogations by ADLS. Transmission on 1030MHz is only allowed by approved systems and operators.

Note: For non-ADS-B-equipped aircraft, detection based on the Mode S transponder may rely on opportunistic Mode S replies generated in response to existing Surveillance system interrogations, or on Mode S acquisition squitter. This allows detection without requiring additional ADLS-specific interrogations.

Safety risks mitigated

This option limits the collision risks of all types of traffic that can be present during the night equipped with cooperative Surveillance.

Limitations

The effectiveness of this approach depends on the level of equipage among airspace users. NVFR, military, and special operations aircraft may not always be equipped or may operate with transponders switched off, which could limit detection capabilities.

Complementary options

This implementation option can increase its effectiveness by introducing an equipage mandate for night flights (4.1.5.1). By requiring aircraft to be equipped with cooperative surveillance systems the reliability and coverage of the ADLS can be enhanced.

For special operations where equipage may not be mandated or is not feasible (such as certain military), other implementation options should be used in combination with this approach such as means to detect IR lights (4.1.1) and the manual activation of obstruction lights (4.1.2).

The detection using cooperative Surveillance might be used to complement the detection of aircraft with flight plans to refine the areas where the suppression of lights is active.

4.1.5.1 SUR equipage mandate

This implementation is a complementary implementation option that is to be chosen only if the ADLS uses detection based on cooperative Surveillance. The mandate to equip a cooperative Surveillance transponder to all flight operating during the night mitigates the lack of equipment for some of the aircraft.

Safety risks mitigated

This option limits the collision risks of the traffic that would have not been equipped if the mandate was not in place.

Limitations

A mandate for SUR equipage applying to military aircraft is not always feasible and therefore such operations could not be covered using solely a cooperative Surveillance detection in combination with a Surveillance equipage mandate.

4.1.6 Detection of aircraft with non-cooperative SUR

This implementation option relies on non-cooperative surveillance technologies to detect aircraft and deactivate obstruction lighting suppression only when an aircraft is inside the activation perimeter. If flights without cooperative surveillance equipage are allowed during night, non-cooperative Surveillance may be used to provide detection of relevant aircraft.

The use of non-cooperative systems is not recommended for single obstacles or in unsuitable terrain due to the associated high cost and high complexity. However, in combination with a large coverage area and multiple obstacles to cover, this solution can be beneficial.

Safety risks mitigated

This option limits the collision risks of all types of traffic that can be present during the night.

Limitations

Non-cooperative Surveillance systems detect all flying aircraft in the coverage volume regardless of the type of aircraft. Technical limitations might include the size of the aircraft.

4.1.7 Detection of aircraft with flight plan

This implementation option relies on the detection of presence of aircraft based on the information from their flight plan. The position of the aircraft based solely on the flight plan information is highly inaccurate.

The selection of this implementation option is linked to the control of the suppression of obstruction lights in a centralised way by an ANSP.

Safety risks mitigated

This option limits the collision risks primarily to NVFR flights filing a flight plan. Collision risk of military and special users filing a flight plan is also mitigated by this implementation option.

Limitations

Military and special airspace users, such as HEMS and SAR, may operate without filing a flight plan, especially during time-critical or tactical missions.

Another limitation of this implementation option is the uncertainty of the position of aircraft due to the possible deviations with respect to the flight plan due to operational constraints. This limitation implies that the ADLS activation areas should be entire regions or even the whole country.

Complementary options

This implementation option can increase its effectiveness by introducing a mandate to file a flight plan for night flights (4.1.7.1). By requiring operator to file a flight plan the risk of having NVFR flights without a flight plan is mitigated.

For special operations where filing a flight plan may not be mandated or is not feasible (such as certain military or special users), other implementation options should be used in combination with this approach such as a mandate to detect IR lights (4.1.1) and the manual activation of obstruction lights (4.1.2).

The detection using cooperative Surveillance might be used to complement the detection of aircraft with flight plans to refine the areas where the suppression of lights is active.

The detection using flight plan information can be complemented with the detection of aircraft using cooperative Surveillance systems to reduce the ADLS activation area when the aircraft is detected an its position is known with low uncertainty.

4.1.7.1 Mandatory flight plan during nighttime

This implementation is a complementary implementation option that is to be chosen only if the ADLS relies on flight plan information for aircraft detection. The mandate to file a flight plan for all flights operating during the night improves situational awareness and supports timely activation of obstruction lights.

Safety risks mitigated

This option reduces the risk of undetected aircraft operations by ensuring air traffic services have updated flight intentions, allowing the ADLS to respond appropriately.

Limitations

A mandate to file flight plans may not always be feasible for military and special operations, such as HEMS or SAR missions, which may operate without filing. Therefore, relying solely on flight plan data in combination with a filing mandate may not cover all aircraft, potentially leaving some flights undetected.

A. ADLS CONCEPT IN AUSTRIA – FLIGHT PLAN ARCHITECTURE

A.1 Overview

Austria's Aircraft Detection Lighting System (ADLS) is centrally managed by Austro Control, the country's Air Navigation Service Provider (ANSP). The system is designed to optimize the activation of obstruction lighting for aviation safety while minimizing unnecessary light pollution.

The information on whether it is allowed to supress the activation of the obstruction lights is distributed to the obstacle operators by a web-interface.

A.2 Working Principle

A.2.1 General Aviation

- The system operates based on VFR flight plans and surveillance data to optimize light activation.
- If there is an **open VFR flight plan at night,** i.e. between evening defined as End of Civil Twilight (**ECT/ECDT**) and morning defined as Beginning of Civil Twilight (**BCMT**), obstruction lights are **activated Austria-wide**.
- Surveillance detection further **optimizes** the activation:
    - If an **aircraft is detected and** there is an **open VFR flight plan**, the **full-country activation is reduced**.
    - Instead, only **the area in the aircraft's vicinity** remains active.

A.2.2 Military Operation

Military flights may operate without:

- A filed flight plan,
- NVGs, or
- An active transponder.

However, since military operations are centrally planned and coordinated, military units will have the capability to remotely activate obstruction lights as needed.

A.2.3 HEMS Operations

HEMS operators have flexibility in their operations and can choose to:

- Fly with NVGs,
- File a flight plan, or
- Remotely activate obstruction lights if required.

The decision to activate obstruction lights Austria-wide remotely is at the discretion of the Operations Control Centre upon the pilot's request.

B. - ADLS CONCEPT IN GERMANY – SURVEILLANCE ARCHITECTURE

B.1 Overview

The German ADLS regulations are structured in several national laws. This includes Renewable Energy Law, General Administrative Regulations for aviation obstacles and in particular for ADLS and the NVFR definition in the Air Traffic Act and in the Regulation for Aircraft Equipment. This is a complex structure, however, the rules can be described in a relatively simple manner.

ADLS systems are mandatory for all kinds of wind farms in Germany, but regional limitations to the rules can be set by the regional aviation authority for example in major airport areas or special military low flying zones. The normal state of the obstruction lights is to be active. As such, the behavior of ADLS systems in Germany is based on suppression of the obstruction lights, if all conditions are valid to do so. Additionally, each obstacle that is part of an ADLS needs to be equipped with a permanent infrared marking next to the obstruction lights.

Before an ADLS system can be installed by any manufacturer in Germany it has to have a type approval issued by the authority. As part of the type approval process the system must show that its behavior fits to the requirements stated in the General Administrative Regulation for ADLS. Each approved system can then be installed by wind farm operators on their wind farms. However, the use of ADLS at a specific site is also subject to the regional aviation authorities, who has the final decision and defines possible limitations for each ADLS installation.

An ADLS system must ensure to detect aircraft within a defined perimeter and verify specific system functions (e.g. logging and storage of status, activation information, etc. for at least 30 days). The deactivation of obstruction lights is only allowed if no aircraft is inside the perimeter around the obstacle. The dimensions are defined by a radius of 4000 meters around the middle of the concerned obstacle and a height from ground up to 600 meters above the highest point of the obstacle, so if the highest point of a wing of a wind turbine is at 250 meters the desired perimeter of detection is 850 meters from the ground.

For the detection of aircraft, the ADLS system has the choice to use primary radar, secondary radar or a combination of both. The requirements for a primary radar are that the system must be capable of detecting an object with a radar reflecting area of 1 m² and to detect slow moving or hovering obstacles. ADLS systems based on secondary radar transponder technology must process Mode S DF11 messages and Mode A/C messages for detection purposes.

It is allowed to use other message types such as DF17 (ADS-B) and other technologies (like FLARM) but only in addition to primary radar or secondary radar and for the purpose of enhancing the system. These other messages and technologies are not accepted as the only means of detection.

Per the regulations, ADLS system are not allowed to interrogate on surveillance frequencies and are therefore only allowed to receive secondary radar data.

There are also requirements on ADLS system concerning system integrity, system controllability and logging capability. The ADSL system is required to store the received data and system conditions as well as information on lighting activation and deactivation conditions, for at least 30 days in case of any investigations.

In Germany, NVFR operations are required to have operational Mode S equipment and to provide a flight plan. Additionally, all NVFR flights have to follow SERA.5005(c), which includes altitude restrictions around obstacles, when operating in German airspace.

The actual German ADLS regulation is presented in a diagram in section B.2, independently in which law they are written down. The diagram is read starting from the top and split into three layers. As described above, the rules and regulations are split into several laws and acts and it is easier to describe the whole ADLS regulation in different layers.

The first layer contains all safety requirements and is split into the blocks ADLS requirements, Operational requirements and Deactivation criteria. The ADLS requirements block focus on the implemented system, a solution that needs to be validated and certificated by an announced authority. If all requirements are met, the solution receives a type approval and can be used in Germany for any ADLS implementation. The Operational requirements have preconditions on the aeronautical user and what is mandatory to operate during the night, when ADLS is used. Last, the deactivation criteria focus on the base conditions under which the system is allowed to suppress or to lift the suppression of the obstruction lights. Considering these three columns, all requirements and conditions must be met, to allow the safe operation of an ADLS solution.

The second layer of the diagram details the requirements for each of the groups of the first layer. This serves a summary to the German solution description provided above.

The third layer provides another breakdown, focusing on the detection requirement as part of the ADLS solution. These are the requirements defined by the regulator on how the specific solution should behave and detect any relevant aircraft inside the activation perimeter. In the German regulation there are different detection means and also additional data sources allowed, resulting in the requirement combination of “or” and “optional”.

B.2 Visual description of the ADLS requirements in Germany

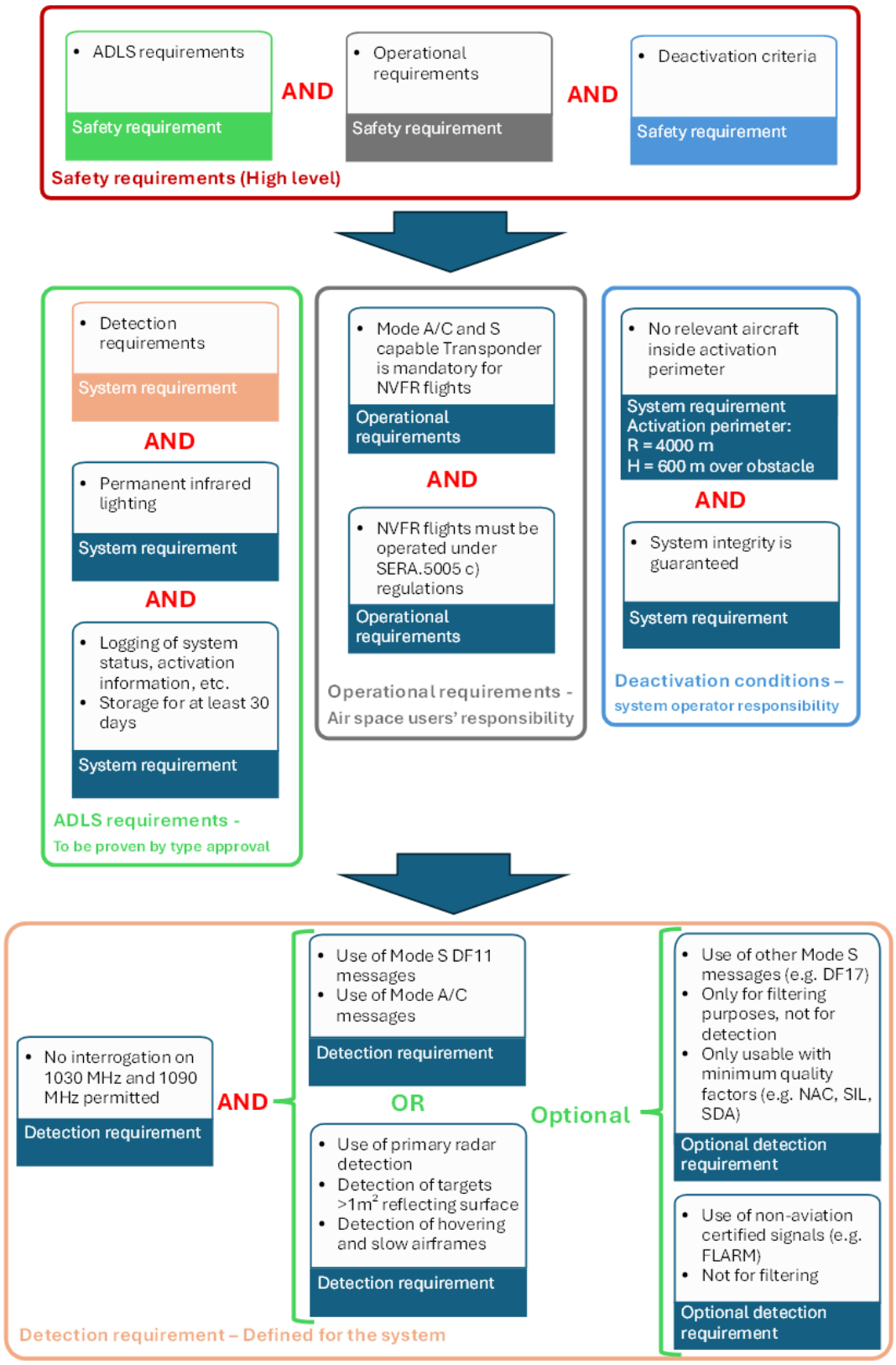

Figure 4 ADLS requirements in Germany

C. ADLS CONCEPT IN SWITZERLAND - PROCEDURAL ARCHITECTURE

C.1 Overview

Switzerland refrains from coming up with sensor-based ADLS, at least for the foreseeable future. This is in part to minimize overall cost and in part thanks to some specific prerequisites being available. The intention to achieve this is by addressing it in two steps.

C.2 Prerequisites

Before putting any legislation into place to regulate any deactivation of obstacle lighting, a number of supporting factors or even prerequisites were already in place:

- The latest closing time for any airfield supporting NVFR operation of general aviation aircraft is 2200LT. This time limit does not apply to state aircraft or HEMS (Helicopter Emergency Medical Service) flights.
- Air crews of state aircraft or HEMS flights flying NVFR are equipped with night vision goggles (NVG).
- All new obstacles constructed in Switzerland since the 2010s have been equipped with infrared lighting (IR) along with day/dusk/dawn (white) and night (red) lighting as far as stipulated in the applicable directive by the Federal Office of Civil Aviation (OFAC, see OFAC Obstacle information). This applies to all tall obstacles (i.e. Wind turbines, Telecom towers, buildings).
- Referencing SERA 5005 (5) with respect to minimum night VFR operational altitudes (see chapter 2.12) and taking any obstacle[2] higher than 60m into account. For approximately two thirds of the country NVFR aircraft have to maintain at least 300m or 600m (in mountainous terrain) above the highest obstacle within 8km of the aircraft's position.
- Optionally, obstacles requiring a medium intensity night (red) light on top may reduce their lower limit of emission up to -1°, compared to omni lighting (down to -90°), without any reduction. This effectively reduces the strongest disturbance by the night light in the vicinity of the obstacle already before the changes described below apply.

C.3 First step in deactivation of night lighting

Based on the prerequisites above, the OFAC announced to update its directive on obstacle lighting with new options in the course of 2025. As with the existing directive regarding the -1° rule, all deviation from "default" lighting is optional and needs to be applied for with the OFAC. Specifically, the following option is made available to operators / owners of obstacles taller than 60m:

- The low intensity lighting on the tower may be turned off at 2230LT until the first general aviation airfields reopen in the morning (after 0600/0700LT).
- The medium intensity lighting on top is not affected by this change and will stay on throughout the night. The -1° rule is unchanged and combines with the change above to reduce the night lighting visible to the population, if so, applied for by the operator / owner of the obstacle.
- Daylight/dusk/dawn lighting on top of the obstacle is not affected with this change and will activate during twilight conditions (dusk / dawn / dark cloudy day / etc.).

[2] As of early 2025

- IR lighting is unaffected and will stay on throughout the night.

Notably, this opens two cases in which NVFR without NVGs might encounter such “darkened” obstacles:

- NVFR flights flying through Swiss airspace during the night, departing / landing abroad. These flights are expected to fly considerably higher than any obstacles. Additionally, these cases occur very rarely and furthermore have to adhere to SERA 5005 minimum altitudes.
- NVFR helicopter flights (non-HEMS/state) within Switzerland, landing / taking off outside of airfields. They may depart their base before it closes and return back to an airfield / helicopter base only after its reopening in the morning, essentially staying out / camping in the country overnight. While legally possibly this is considered a very rare case.

C.4 Second step in deactivation of night lighting

After the first step has been introduced, a second step is conceivable. Currently there is no time frame defined and any such undertaking is under the auspices of the Swiss FOCA. Specifically, the following option would be made available to operators / owners of obstacles taller than 60m:

- The remaining medium intensity night lighting (on the top of the obstacle) may be turned off based on the same criteria as the low intensity night lights (i.e. after 2230LT). This would fully turn off the night obstacle lighting.
- In low visibility conditions, this full darkening of obstacles is however undesirable, as aircraft may find themselves surprisingly close to (then unlighted) obstacles. So, this second step would mandate the installation of visibility measuring devices on the specific obstacle / for a whole windfarm, turning back on the night lighting when visibility drops below a certain threshold.

C.5 Summary

In combination, the existing regulation plus the two steps would reduce the biggest part of the night lighting of tall obstacles, provided operators / owner opt to do so. The return to full lighting if visibility is hampered would change little to that situation, as the same limited visibility would help to reduce the propagation of the night lighting into the distance.

At the same time, the operators / owners of the obstacle can achieve this with comparatively little capital investment or operating costs compared to any surveillance-based solution. This is because even without these changes, the monitoring of lighting and – in case it fails – the publication of NOTAMs is already mandated today. So the change only involves the time based (de-)activation and in the long term possibly the installation of the visibility distance measuring equipment. Comparing those to ADLS brings out quite a cost benefit at the disadvantage of not reducing lighting during the hours between sunset and the end of NVFR flying.

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