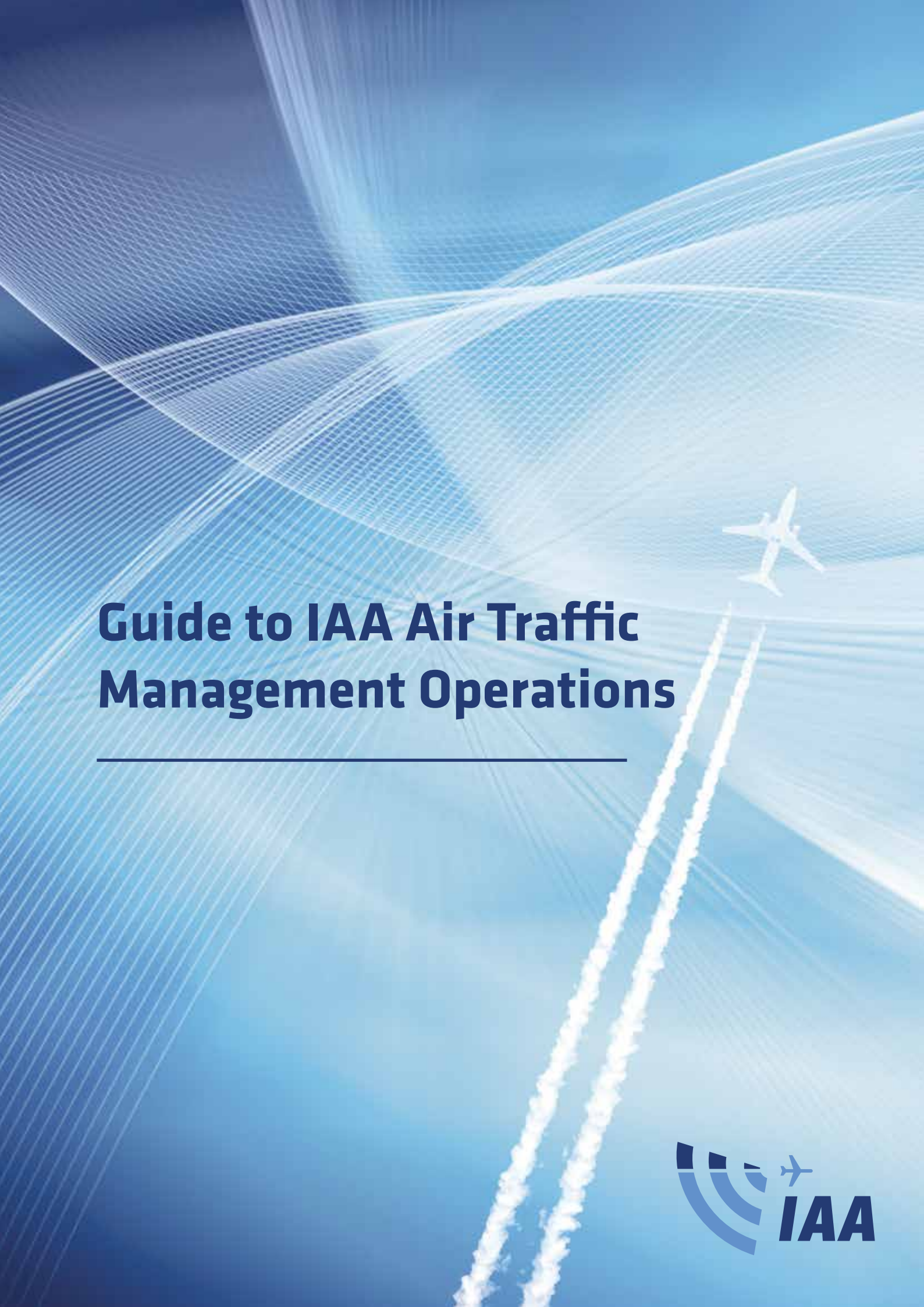

Guide to IAA Air Traffic Management Operations

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1 Introduction

The Irish Aviation Authority (IAA) is responsible for the management of Irish controlled airspace and the safety and security regulation of Irish civil aviation. Air traffic management includes the provision of operational services namely Air Traffic Control (ATC), engineering and communications in airspace controlled by Ireland and the provision of the related air traffic technological infrastructure. The safety and security oversight functions of the IAA reside in the Safety Regulation Division. The IAA ensures that Irish civil aviation operates to safety standards set internationally. Safety is our business and underlines everything we do.

Even to the most seasoned traveller, the world of Air Traffic Control remains largely a mystery. This guide has been produced to assist our stakeholders and the broader public to understand how Air Traffic Control works and to provide insights into everyday occurrences at airports.

OUR GOVERNANCE

The Irish Aviation Authority (IAA) is a commercial semi state company employing approximately 700 people at six locations around Ireland. It was established in 1994 taking over the functions previously provided by the Department of Transport. **The IAA receives no State funding.** Its revenues are generated through charges and fees raised from its airline customers and regulatory clients in respect of its operational and regulatory activities.

OUR MISSION

Collectively management and staff ensure the Authority is true to its mission statement below:

The Board and staff of the Irish Aviation Authority are committed to providing efficient and cost-effective safety regulation of the Irish aviation industry and to providing, on a sound commercial basis, safe, efficient and cost-effective air navigation services, which meet the needs of our customers. The Authority aims to be a world leader in its field.

CONTACTING US

You can find more information on our activities at **www.iaa.ie.**

2 Responsibilities for Aviation in Ireland

IRISH AVIATION AUTHORITY (IAA)

The IAA is responsible for Air Traffic Management (ATM). The ATM Operations & Strategy Directorate of the Irish Aviation Authority provides Air Traffic management services in airspace controlled by Ireland.

Air traffic management services include:

- Air traffic control
- Air Traffic Control flight information
- Search & Rescue service alerting
- Aeronautical information
- North Atlantic Communications

The IAA Safety Regulation Division ensures that Irish civil aviation operates to safety standards set internationally. The regulatory functions include aircraft airworthiness certification and registration; the licensing of personnel and organisations involved in the maintenance of aircraft; the licensing of pilots, Air Traffic Controllers, radio officers and aerodromes; the approval and surveillance of airlines operating standards and of general aviation.

The IAA security oversight division carry out inspections and audits of airports, air carriers, cargo companies, airport suppliers and supplier of inflight services.

DEPARTMENT OF TRANSPORT, TOURISM AND SPORT (DTTAS)

The DTTAS is responsible for ensuring that aviation practices and procedures comply with best international standards; promoting the development of a vibrant, competitive and progressively regulated aviation sector and the provision of adequate airport infrastructure and competitive airport services. Implementation of some aspects of the policies has been entrusted to a range of State-Sponsored Bodies and Agencies for which the Department retains overall responsibility.

AIR ACCIDENT INVESTIGATION UNIT (AAIU)

The AAIU which is part of the Department of Transport, Tourism and Sport investigates aviation occurrences that occur within the state of Ireland and co-ordinate and co-operate with other safety investigation authorities overseas, in particular, with those authorities who conduct investigations into Irish registered/operated aircraft abroad.

IRISH COAST GUARD (IRCG)

The IRCG is responsible for Search and Rescue and forms one arm of the Maritime Safety Services, the other

being the Maritime Safety Directorate. Its purpose is to reduce the loss of life within the Irish Search and Rescue Region and to provide an effective emergency response service.

DEPARTMENT OF DEFENCE

The Department of Defence is one of the Government Departments primarily concerned with ensuring the secure and stable environment necessary for economic growth and development. Put simply, its job is to ensure that the Defence Forces are in a position to carry out the roles assigned to them by Government. Maintaining a defence capacity related to security needs is an important expression of national sovereignty. The role of the Air Corps under the Defence Act is to contribute to the security of the State by providing for the Military Air Defence of its airspace. The primary role of the Air Corps is to support the Army, this includes diverse operations such as Observation and Reconnaissance, Casualty Evacuation, National Security, maintaining and flying Garda Support Unit Aircraft and Cash Escorts.

MET ÉIREANN

Met Éireann, the National Meteorological Service, monitor, analyse and predict Ireland's weather and climate, and provide a range of high quality meteorological and related information. Met Éireann meet the State's obligations to provide meteorological services to the Aviation sector in Ireland. The operation and maintenance of meteorological services for Air Navigation in Ireland is subject to a number of International Civil Aviation Organisation (ICAO) and EC Regulations, Standards and Recommended practices.

3 Air Traffic Control

Air traffic control is used to manage the safe and orderly flow of aircraft into, out of, and across Irish airspace and at the three State airports, Cork, Dublin, Shannon. Our Air Traffic Controllers keep aircraft at safe distances from each other in the air and on the ground, while arranging them in an optimised order for landing or take-off along organised flight paths. We use systems and processes to remove the risk of collisions, while allowing the maximum number of aircraft to fly safely in our skies. As airspace gets busier, and at peak times, this becomes increasingly challenging.

TYPES OF AIR TRAFFIC CONTROL

Aerodrome Control (familiarly known as Tower control) is in many ways the most visible part of Air Traffic Control. The IAA is responsible for providing aerodrome control at the three State airports, Shannon, Dublin and Cork. From the Tower, the controller is responsible for all aircraft operating within the airport control zone and on the ground at the airports.

Before departure aircraft must file a flight plan which details important information such as the destination, route and preferred altitude. When ready for departure, the pilot will contact the control tower. Start up and taxi clearance will be issued by the surface movement's controller while it's the responsibility of the air movement's controller to issue take off clearance. Once airborne, the aircraft contacts the appropriate area radar controller.

Approach Radar Control: the approach radar controller is responsible for arriving aircraft within approximately 30 - 40 miles of the aerodrome. They sequence traffic for arrival and line them up with the runway. The standard separation is 5 nautical miles, however, under certain conditions, 3 nautical mile, separation is permitted. This reduction in separation under certain circumstances is in keeping with international standards at busy airports to increases the efficiency and capacity of these airports. This reduction in separation is permitted in the airspace in the vicinity of Dublin Airport. The controller uses techniques such as speed control and changes in altitude and direction (radar vectoring to ensure separation and the correct sequencing of arriving aircraft). Innovative procedures such as Point Merge are also used to good effect.

Area Radar Control: as in approach radar control, here too controllers work on radar, but on a bigger range. Airspace is like a giant jigsaw - as a puzzle consists of many individual pieces, the airspace is divided into different sectors which are assigned to individual radar positions. As an individual area becomes busier, more radar positions are opened to reduce the workload on individual controllers. Each sector also has a sector

capacity to ensure that individual controllers do not become over loaded. Area radar controllers in Dublin handle traffic up to 24,000 feet while in Shannon they operate up to 66,000 feet.

Irish controlled airspace acts as a gateway between Europe and North America. This is hugely significant for the IAA as its Air Traffic Controllers at Shannon safely handle more than 90% of all aircraft that operate between the two continents. This equates to in excess of 1,200 aircraft every 24 hours during the busy summer months.

These aircraft are charged for the services they receive as they transit Irish airspace, namely en-route Air Traffic Control and HF communications charges. This income amounts to approximately 75% of the IAA's total revenue.

Flight Information Service: A 'flight information service' (FIS) is available to any participating VFR (Visual Flight Rules) flight operating in Class G airspace. It provides information pertinent to the safe and efficient conduct of flight, and includes information on other potentially conflicting traffic, possibly derived from radar, but does not provide positive separation from that traffic.

Flight Information also includes:, meteorological information, information on aerodromes, information on possible hazards to flight and information on changes in the serviceability of navigation aids.

From the information received, pilots must decide the appropriate course of action to be taken to ensure the safety of the plane whilst taking off, landing or during the en-route portion of their flight.

SEPARATION STANDARDS

Air Traffic Controllers apply separation standards to keep aircraft operating in controlled airspace a minimum distance apart. Different separation standards apply depending on whether aircraft are operating under instrument flight rules (IFR – all large passenger aircraft) or visual flight rules (VFR - most light aircraft and helicopters and operates on the see and be seen principle).

HOW CLOSE CAN THEY GO – IFR AIRCRAFT - VERTICAL SEPARATION

In Ireland, aircraft flying in controlled airspace up to 66,000 should not come closer than 1000ft (305m) vertically to another aircraft unless they are appropriately separated horizontally.

HORIZONTAL SEPARATION

In controlled airspace, the horizontal separation standard between aircraft flying at the same altitude is 5nm (9260m) and 10nm when operating towards the limit of radar coverage. In the Dublin Control Area 3nm (5500m) radar Separation is permitted within its boundaries.

RADAR CONTROL POSITION, BALLYCASEY

In areas outside of radar coverage or other satellite-based navigation services, separation of aircraft is achieved by the application of various procedural rules, for example, based on time and their estimated position. This applies to aircraft crossing the Atlantic Ocean as they are outside of radar coverage.

HOW CLOSE CAN THEY GO – VFR AIRCRAFT

The minimum separation in visual flight conditions are less than that in an instrument flight. At or in the vicinity of an airport with a control tower, controllers may reduce the separation when both aircraft are in sight. Visual Flight Rules operate on a see and be seen principle and aircraft arrange their own separation.

HOW LOW CAN THEY GO?

Aircraft can fly no lower than 1500ft (305m) above the ground/terrain in built-up areas or 500ft (152m) in non-residential areas. Helicopters can fly no lower than 500ft above the ground/terrain in built-up areas.

SERVICE DISRUPTIONS

Equipment Failure

Air Traffic Control services, on very rare occasions, may be affected by the failure of radar or other facilities or equipment. This can result in a reduction in the normal level of service in a certain area of airspace but in all cases safety levels will be maintained.

In these cases, back-up equipment, processes and procedures and specific contingency plans, are always available and activated as required.

4 How Airspace Works

Airspace is classified into 'categories' which determine the level of service provided. Within IAA controlled airspace these range from Class A (NOTA,- an area to the north west of Donegal over the North Atlantic ocean and SOTA – an area to the south of Cork and also over the North Atlantic ocean), Class C (controlled airspace) and Class G (uncontrolled airspace predominantly used by light aircraft). See airspace architecture section page 10 for more information.

The service provided by Air Traffic Controllers varies depending on the class of airspace and the aircraft flight rules – IFR or VFR.

Separation service: Air Traffic Controllers keep aircraft a minimum distance apart to reduce the risk of collision and prevent accidents due to wake turbulence.

Flight information service: the provision of advice and information which may be valuable for the safe and efficient conduct of flight.

Traffic information service: information issued by controllers to alert the pilot of an aircraft that another may be close to his or her position or intended route.

CONTROLLED VERSUS UNCONTROLLED AIRSPACE

Airspace is designated as 'controlled' or 'uncontrolled'. Controlled airspace in Ireland is actively monitored by Air Traffic Controllers. To enter controlled airspace, an aircraft must first file a flight plan; gain a clearance from an Air Traffic Controller. In contrast, no clearance is required to operate in uncontrolled airspace. The large majority of light aircraft and helicopters operate outside or underneath controlled airspace. Different areas of controlled airspace are also managed by different Air Traffic Controllers.

RESTRICTED AIRSPACE

In restricted airspace, aircraft movements are restricted in accordance with certain specified permissions. Examples of restricted airspace include airspace around certain sensitive areas and high density flying operations at an air show or other large public event. Military airspace will also be restricted when it is active.

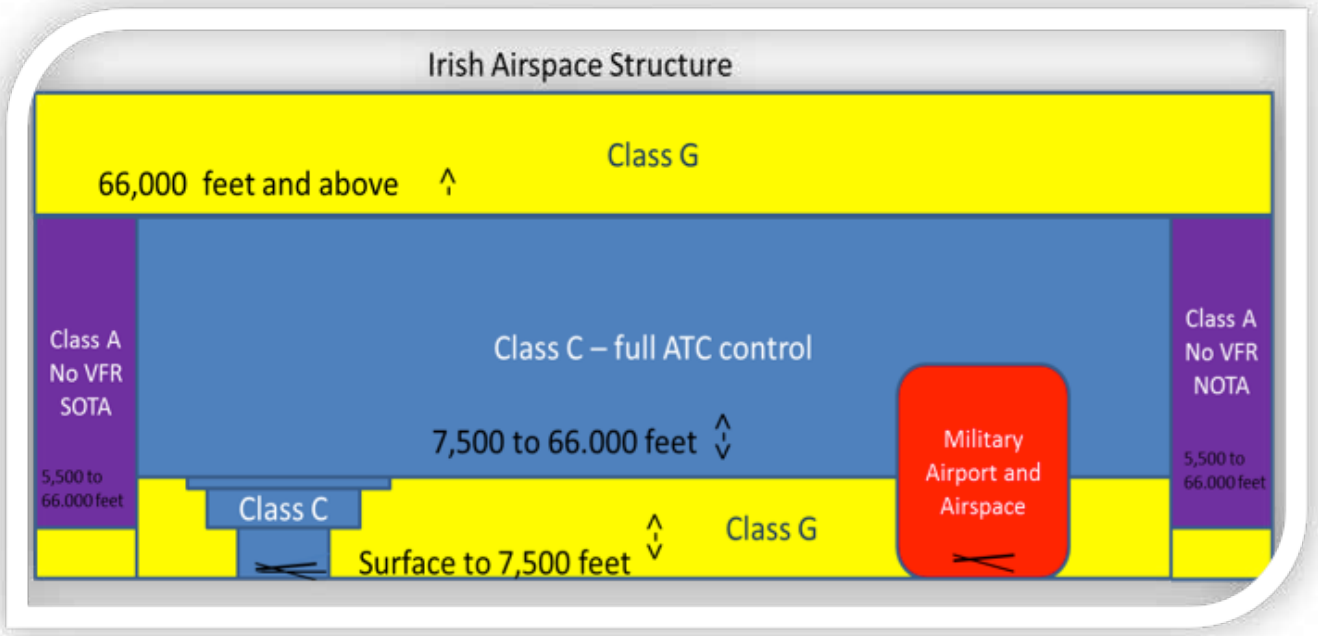
5 Irish Airspace Architecture

There are two types of airspace – controlled and uncontrolled. Airspace is also broken down into a number of different classes.

CLASS A Airspace: This high-level en route controlled airspace is used predominately by commercial and passenger jets. Only IFR flights are permitted and they require ATC clearance. Class A airspace exists in the Northern Oceanic Transition Area (NOTA) and the Southern Oceanic Transition Area (SOTA).

CLASS C Airspace: This is the controlled airspace above 7,500 feet and surrounding major airports. Both IFR and VFR flights are permitted and both require ATC clearance and separation service is to be provided by ATC..

CLASS G Airspace: This airspace is uncontrolled. Both IFR and VFR aircraft are permitted and neither requires an ATC clearance.



6 IAA Technology

Engineering systems used in Air Traffic Control are commonly categorized as Communications, Navigation Flight Data Processing Systems or Surveillance (CNS/ATM.) The provision of these systems is allocated to individual specialized domains which are as follows;

Communications: The Communications domain is responsible for all the VHF/HF communication systems required to maintain Air-Ground Communications between aircraft and the Air Traffic Controllers, and Ground-Ground Communications between adjacent Air Traffic Control Centres.

Navigation: The Navigation domain is responsible for the facilities used to provide en-route navigation (DVOR, DME) and approach and landing aids (DME and ILS).

Surveillance: The Surveillance domain is responsible for the provision of Primary and Secondary RADAR and the display of aircraft position information to the controllers.

Flight Data Processing Systems (FDPS) The Flight Data Processing Systems domain is responsible for the provision of FDPS and the automated coordination between adjacent centres. It also has responsibility for the IAA's data network.

The Technology & Training Division is responsible for the day-to-day management and certification of the IAA's complex network of electronics systems. Engineers are based at all airport sites including Ballygirreen, Co. Clare and provide a 24 hour restoration service, 365 days a year.

Systems maintained include Surface Movements Radar (SMR), Surveillance Radar Equipment (SRE) and Monopulse Secondary Surveillance Radar (MSSR) radars and Instrument Landing Systems (ILS) comprising GlideSlope, Localiser, IRVR, DVOR, DME, NDB, and Marker Beacons.

Engineers also maintain the Air Ground Communications (both VHF and HF) and the **COOPANS Air Traffic Management (ATM) system**. The COOPANS system is one of the most modern ATM systems in Europe, developed in partnership with Sweden, Denmark and the leading ATM system supplier Thales of France. Recently, Austria and Croatia have joined the partnership.

Engineers liaise with national providers of met data and telecom infrastructures and also with neighbouring Civil Aviation Authorities with regard to existing technological interfaces.

RADAR/SURVEILLANCE

The Surveillance Domain is responsible for the provision of Surveillance Sensors and Surveillance Data Processing Systems to deliver a current and accurate picture of the air traffic and airport surface traffic to IAA Air Traffic Controllers, enabling them to safely and efficiently maintain separation. The IAA has nine radar sites strategically placed throughout the country. At these sites we have all new Mode-S radars and three new Solid

State Primary Radars at the three state airports.

ADVANCED SURFACE MOVEMENT GUIDANCE AND CONTROL SYSTEM (ASMGCS)

The IAA have implemented an ASMGCS which facilitates the safe movement of aircraft and airport vehicles at Dublin Airport even during poor visibility conditions. The ASMGCS incorporates Surface Movement Radar, Multilateration and ADS-B.

LIGHT DETECTION AND RANGING (LIDAR)

The IAA installed LIDAR systems which deliver a picture of the atmosphere above the LIDAR enabling us to detect the presence of volcanic ash in Irish airspace.

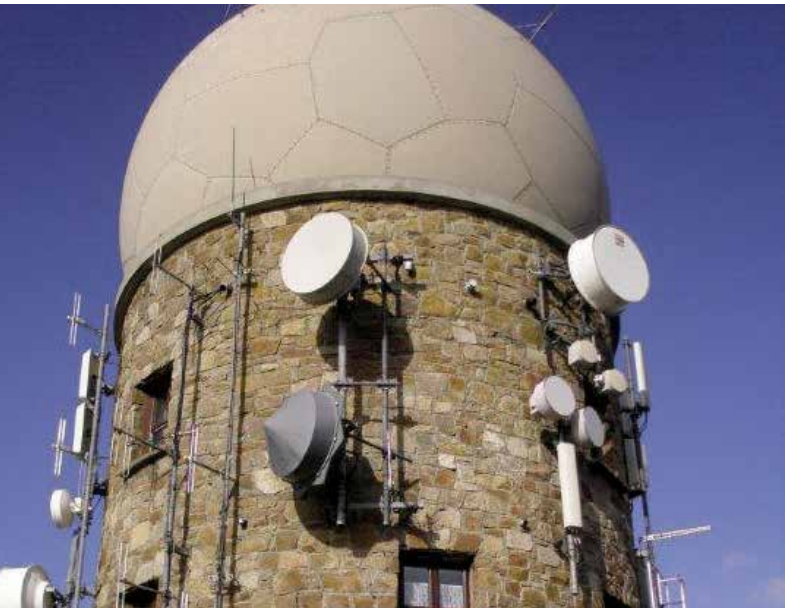
NAVIGATION INFRASTRUCTURE

The IAA's navigation infrastructure is designed to provide our airline customers with the following services:

- Precision and non-precision approaches to runways at the three state airports (Dublin, Shannon and Cork)
- A route structure to facilitate navigation through Irish airspace below 24,500 ft (FL245). Above this level, Irish airspace is route free with aircraft Operators deciding on where to fly.
- Standard Instrument Departures (SIDs) and Standard Arrival (STARs) routes to and from the three state airports
- Instrument Runway Visual Range (IRVR) information.

VHF AIR & GROUND - GROUND COMMUNICATIONS SYSTEMS

The IAA maintains a large VHF communications network which is distributed across the country. In addition there is an independent Radio Backup System that is maintained at alternative sites.



The IAA's North Atlantic Communications Service is provided from its communication station located at Ballygirreen, Newmarket-on-Fergus, Co. Clare and covers the Eastern half of the North Atlantic. It is known as Shannon Aeradio, or Shanwick Radio. Approximately 70 personnel are employed at the North Atlantic Communications Centre.

7 Weather

Weather can significantly affect aircraft operations. Low cloud, fog, rain, sleet and snow may disrupt visibility at or around an airport. Thunderstorms and lightning strikes will also affect operations and aircraft may be re-routed around a storm cell or occasionally divert to another airport. Ground operations at airports may also be stopped when thunderstorms are in the area. High winds may also disrupt aircraft operations.

MINIMISING DISRUPTIONS

Air Traffic Controllers will adjust the number of aircraft movements per hour to match the operating conditions at each airport.

AIRPORT CLOSURE

The IAA does not have the authority or ability to close an airport. This decision can only be made by an airport operator, but would only occur in extreme circumstances.

IMPACT ON RUNWAY SELECTION

Weather, in particular, wind speed and direction, is generally the main factor in determining which runways are in use at an airport, in which direction aircraft will take off and land and which flight paths are used.

Aircraft take off and land into the wind, or with minimal tail wind. As a result, the wind direction (both current and forecast) dictates the selection of runway(/s) in use at any time. This, in turn, determines which flight paths are used, and can change at short notice.

WINDSHEAR

Windshear is a sudden change in wind direction or speed and is usually associated with thunderstorm activity. Windshear can be either vertical or horizontal and can have a significant impact on the control of aircraft during take-off and landing.

CONDENSATION TRAILS

A condensation trail, or contrail, is a thin trail of condensed water vapour sometimes seen trailing behind aircraft flying at high altitudes.

VOLCANIC ASH

The UK Met office based in Exeter has the regional role of Volcanic Ash Advisory Centre (VAAC) with responsibility for Ireland, UK, Iceland, and the North Eastern part of the North Atlantic. .

The IAA does not close or restrict airspace as a result of volcanic ash but provides advice to airlines on the likelihood of encountering ash. Airlines will make individual decisions on whether or not to fly in or around ash-affected airspace or to suspend operations.

8 Accidents and Emergencies

ACCIDENT INVESTIGATION

Investigation into the cause of an aircraft accident is the responsibility of the Air Accident Investigation Unit (AAIU) for the State. The IAA cooperates with the AAIU during all investigations relating to our operations. Following an incident or accident, the IAA will assist the AAIU in the provision of data that is pertinent to the investigation. The IAA will conduct an internal investigation under its own investigations procedures and will furnish the AAIU with all relevant detail from that investigation.

SEARCH AND RESCUE

The Aviation Rescue Co-ordination Centre (ARCC) is responsible for search and rescue co-ordination. On receiving a distress signal or notification of an aircraft accident ARCC in Dublin or Shannon will co-ordinate search and rescue efforts, generally with the assistance of local emergency services.

9 Unusual Activity on the Ground and in the Air

The IAA regularly receives calls relating to what is perceived as 'irregular' aircraft activity or other activity at or in the vicinity of an airport. It can be difficult for passengers or those on the ground to have an accurate picture or understanding of an incident or activity. Examples of activity that the public may consider unusual, or cause concern, but are part of normal operations, are listed here.

GO-AROUNDS OR MISSED APPROACHES

A go-around, or missed approach (also sometimes referred to as an aborted landing), is a safe and well-practised manoeuvre that sees an aircraft discontinue its approach to the runway when landing. This standard manoeuvre does not constitute any sort of emergency or threat to safety, but may cause passengers or witnesses to become anxious.

During a go-around, the pilot will apply full take off power to the engine(s), adopt a nose-up take-off attitude, retract the landing gear and flaps and climb into the traffic pattern to circle around for another approach.

A go-around may be initiated by the pilot, or the pilot may be directed to go-around by an Air Traffic Controller.

The causes are usually adverse weather conditions including strong winds experienced by the aircraft on final approach. Other causes include debris on the runway, an aircraft that has been slow to take-off or an aircraft (or vehicle) that has not yet cleared the runway. In these circumstances, a go-around is the safest course of action.

ABORTED TAKE-OFF

Similar to a go-around or missed approach, an aborted take-off is a procedure which sees an aircraft discontinues the take-off. Usually, it will be a pilot's decision to abort a take-off. Causes include an engine or other technical malfunction or a bird strike.

LOW LEVEL FLIGHTS

Occasionally, aircraft and helicopters fly at low level for security, rescue and military operations as well as air show displays. Low level flying requires the aircraft operator and pilot to have a special endorsement and permission.

LASER ATTACKS

Shining a laser at an aircraft is a criminal offence. The IAA encourages anyone who witnesses the shining of a laser at an aircraft to contact An Gardaí Siochana immediately. The IAA does not investigate reports of laser attacks, but will pass on information provided by pilots to the Gardaí. Air Traffic Controllers will also broadcast a warning to other pilots in the area.

BIRD STRIKES

Striking a bird while an aircraft is travelling at speed can cause damage to the airframe or engines. Depending on the size of the bird and where on the aircraft it comes into contact, a pilot may declare an emergency or request a priority landing as a precaution.

CALIBRATION OF EQUIPMENT

The IAA is responsible for conducting regular flight calibration inspections on all our navigational aids nationwide. This can involve a specially-equipped aircraft conducting numerous 'approaches' to test and calibrate equipment.

10 Training Services

The Irish Aviation Authority National Training Centre is located in Ballycasey, just five minutes from Shannon Airport. We offer a variety of Air Traffic Management related training at our state-of-the-art facility. The Training Centre is licensed by the National Supervisory Authority (NSA) and training programs are presented to both ICAO and EUROCONTROL standards and in line with European Commission Directive EC/23/2006. All training programs are conducted through English by Irish instructors, the majority of whom maintain current licenses appropriate to the individual training delivery item.

New Air Traffic Controllers are recruited and trained through the Student Controller Programme (SCP). This is an intensive training programme with duration of approximately two years.

TRAINING PROGRAMMES:

- Abinitio/Student Air Traffic Controller Training
- Aerodrome Control Service (ADI/ADV)
- Approach Radar Control (APS)
- Area Radar Control (ACS
- Continuation Training
- Unusual Occurrence Training
- Supervisors Management Course
- Assessing Operational Competency
- Team Resource Management Course
- Human Factors
- Safety Management
- Refresher Training
- Staffing

The Irish Aviation Authority offers training in the critical area of Safety Management Systems (SMS) to ATM professionals. The IAA Training Centre provides 70,000 square feet of space comprising of 6 classrooms fitted with the very latest audio-visual equipment and a superb 90 seat auditorium.

11 The Environment

Environmental concern about climate change, gaseous emissions and noise is becoming an increasingly important political, economic and social issue for aviation. Tackling the environmental issue is the latest major challenge facing global aviation. Although aviation represents only 2% of global CO2 emissions, air transport generates 0.6 billion tonnes of CO2 a year.

The IAA seeks to minimise the impact on the environment caused by its safety regulation and air navigation service activities. The Authority is committed to working with international aviation bodies with the aim of protecting the environment through the implementation of an Environment Policy. This policy adopts international best practice to reduce climate-effecting emissions and the adverse impact of aircraft noise emissions and to implement initiatives to conserve energy at all IAA facilities. Air traffic control operations are continuously working to improve the service it provides to its airline customers. Significant improvements have been made to the airspace design in recent years which has resulted in a better service for airlines and their customers. The re-organisation of the airspace means aircraft are flying fewer track miles meaning less fuel burn, reduced CO2 emissions and time saved.

One significant project completed in Dublin is the Point Merge project. This is a new and innovative system for sequencing arrival traffic flows (a change from the traditional 'stacking' system), will give environmental benefits and result in savings in fuel, CO2 emissions, distance flown and time.

Appendix 1

How an aeroplane flies

There are four forces acting on an aeroplane in flight; lift, weight, thrust and drag. These four forces are continuously battling each other while an aeroplane is in flight. Weight opposes lift, thrust opposes drag

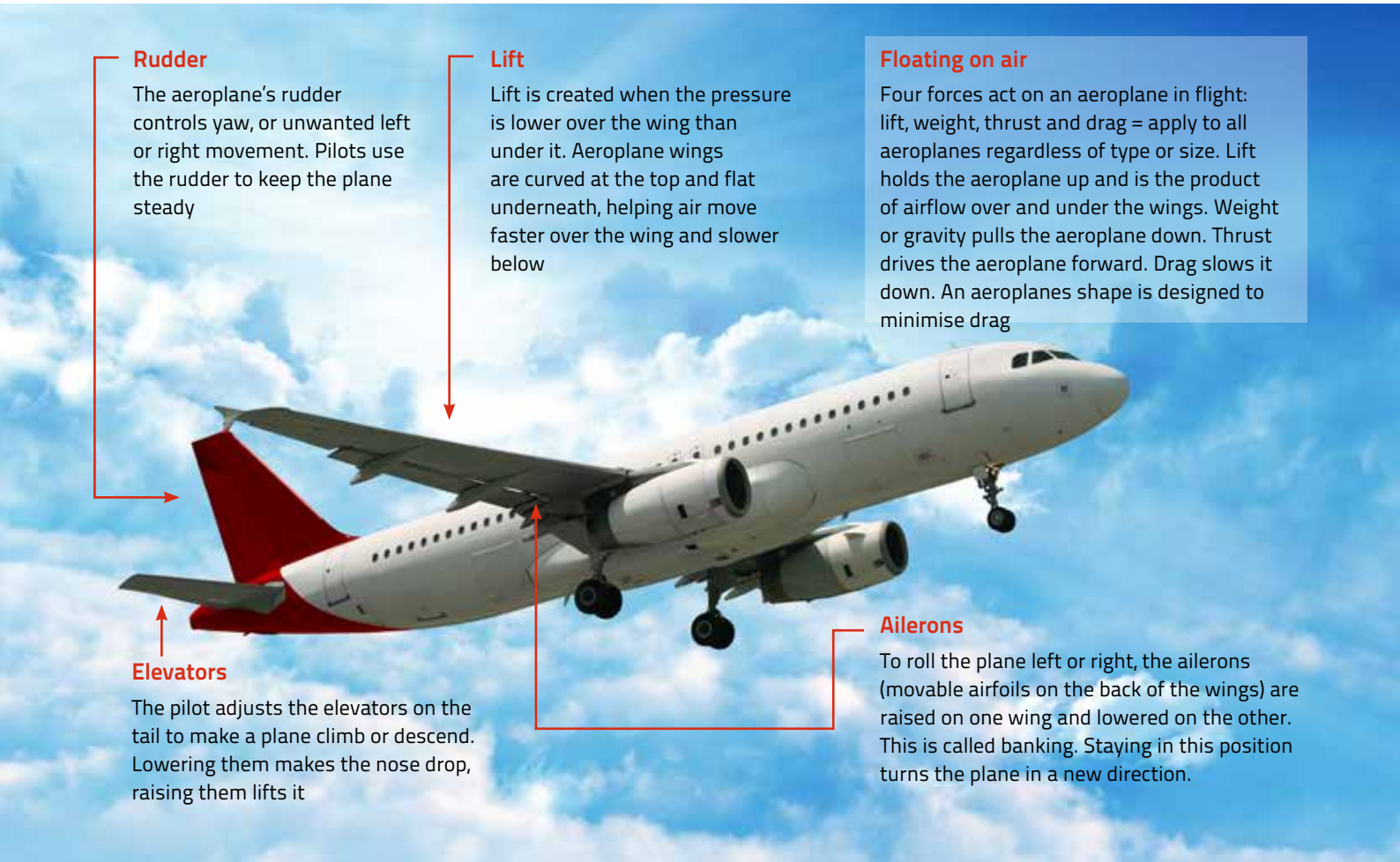
Lift pushes the aeroplane up. The way air moves around the wings gives the aeroplane lift. The shape of the wings creates a difference in air pressure above and below the wings. High pressure air from below the wing moves to an area of low pressure air above the wing and this generates the lift.

Weight is the force that acts with gravity to pull an aeroplane toward the ground. Aeroplanes are designed to be as light as is possible with the weight spread evenly throughout the airframe. This helps to keep the aeroplane balanced in flight.

Thrust is the force that moves the aeroplane forward. Engines give thrust to aeroplanes. Sometimes an engine turns a propeller. Sometimes it is a jet engine. It doesn't matter as long as air keeps going over the wings.

Drag slows the aeroplane. You can feel drag when you walk against a strong wind. Aeroplanes are designed to let air pass around them with the minimum drag.

An aeroplane flies when all four forces work together. But, most aeroplanes need one more thing: They need a pilot to fly them !



Appendix 2

Wake Turbulence

Wake turbulence is turbulence that forms behind an aircraft as it passes through the air. This turbulence includes various components, the most important of which are wingtip vortices and jet wash. Jet wash refers simply to the rapidly moving gases expelled from a jet engine; it is extremely turbulent, but of short duration. Wingtip vortices, on the other hand, are much more stable and can remain in the air for up to three minutes after the passage of an aircraft.

Wingtip vortices occur when a wing is generating lift. Air from below the wing is drawn around the wingtip into the region above the wing by the lower pressure above the wing, causing a vortex to trail from each wingtip. Wake turbulence exists in the vortex flow behind the wing. The strength of wingtip vortices is determined primarily by the weight and airspeed of the aircraft. Wingtip vortices make up the primary and most dangerous component of wake turbulence.

Lift is generated by high pressure below the wing and low pressure above the wing. As the high-pressure air moves around the wingtip to the low pressure, (high pressure always moved towards lower pressure areas) the air rotates, or creates a horizontal 'tornado" behind the wings. This tornado sinks lower and lower until it dissipates.

Wake turbulence is especially hazardous to aircraft in the take off or landing phases of flight. During take-off and landing, aircraft operate at high angle of attack. This flight attitude maximizes the formation of strong vortices. In the vicinity of an airport there can be multiple aircraft, all operating at low speed and low height, and this provides extra risk of wake turbulence with reduced height from which to recover from any upset.

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