Institute of Air & Space Law

Air Navigation

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TURKISH AVIATION ACADEMY

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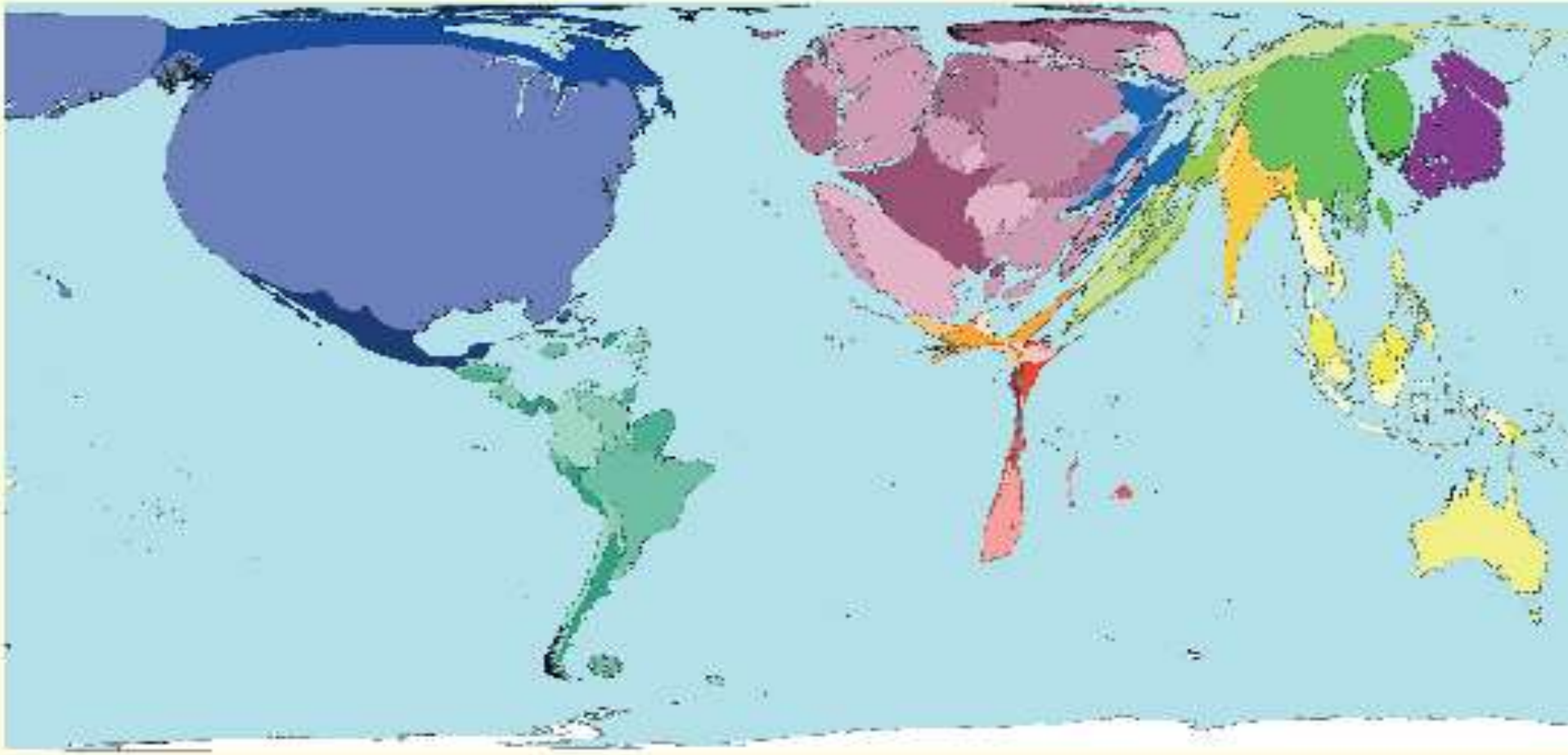
The Importance of Air Navigation

Air navigation services are manifestly important to the safety and efficiency of air transportation. . . . They also impact airline economics both in terms of the charges they impose upon users of the system, and the delay and circuity they can impose on aircraft operations. “Among the traditional functions of government, air traffic control is provided for the purpose of preventing collisions between aircraft in the air and between aircraft and obstructions on the ground, as well as expediting and maintaining an orderly flow of air traffic. In addition to ATC, the effective management of air traffic requires associated services such as meterology, search and rescue, and telecommunications, as well as the provision of aeronautical information such as charts.”

Aircraft Departures



Land area

Technical notes

- Data source: World Bank, World Development Indicators, 2006. Data are from 2003.

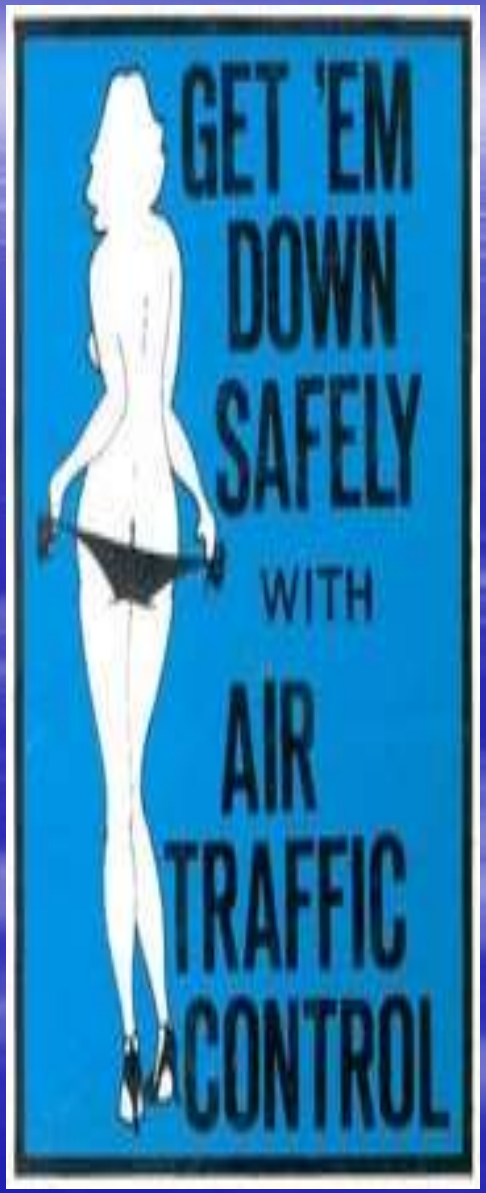
MOST AND FEWEST AIRCRAFT DEPARTURES

Rank	Territory	Value
1	Antigua & Barbuda	672
2	Monaco	412
3	Seychelles	186
4	Luxembourg	102
5	Bahamas	82
6	Marshall Islands	75
7	New Zealand	65

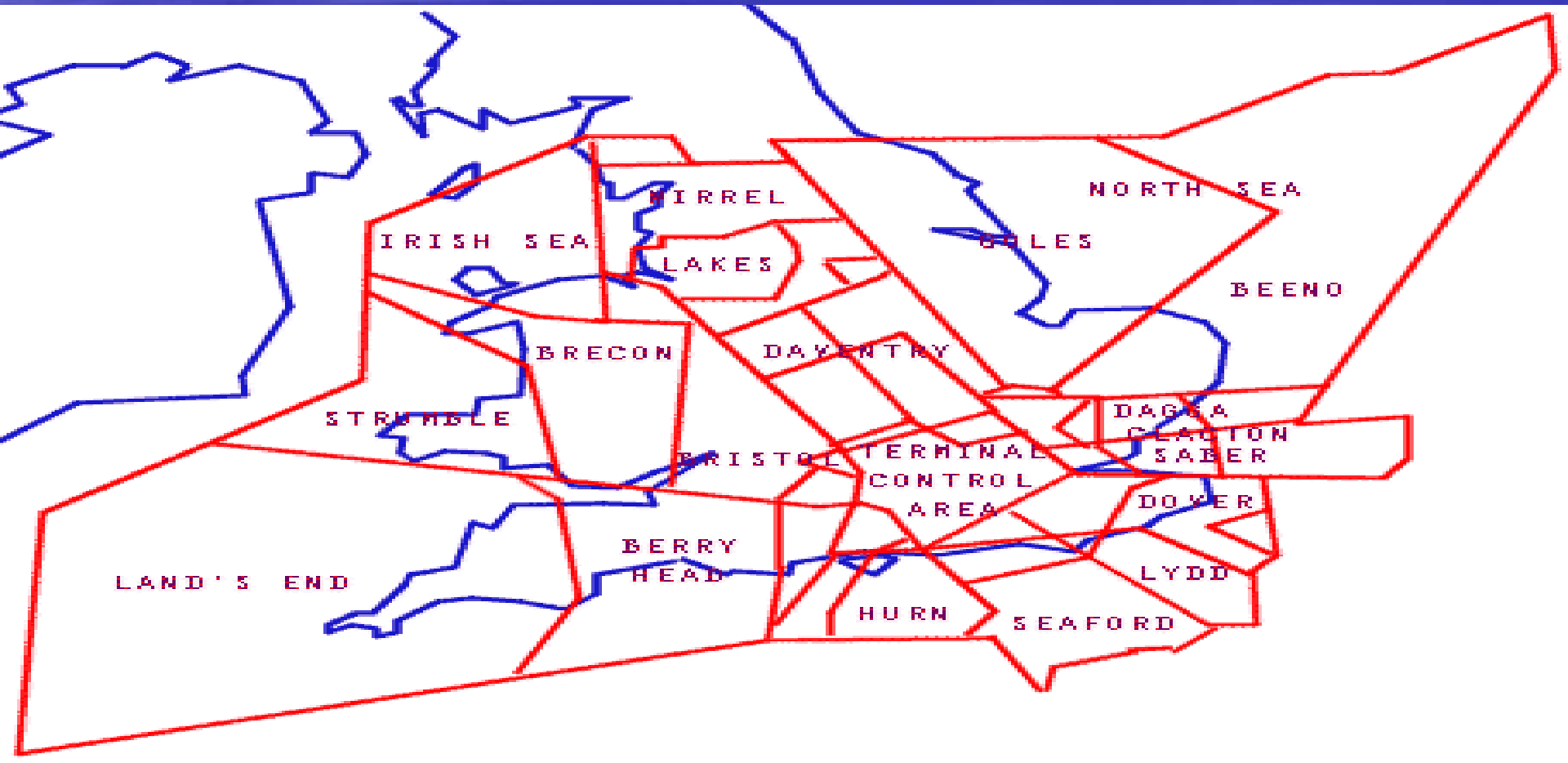
Rank	Territory
191	Nigeria
192	Guinea
193	DPR Korea
194	Niger
195	Mali
196	Bangladesh
197	Dominican Republic

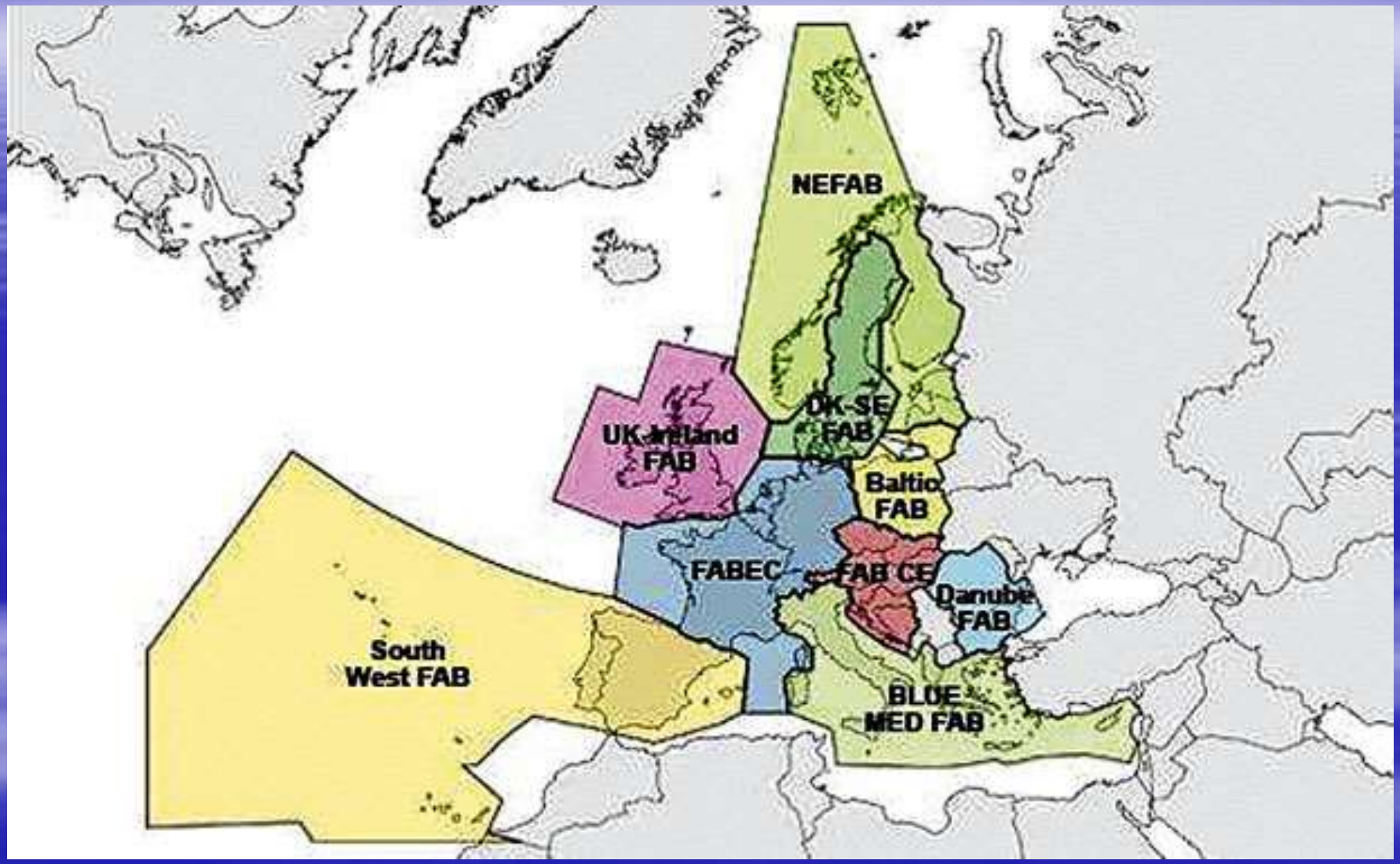

B757-200
TU154M

- The purpose air traffic services is to move aircraft from A to B efficiently, while preventing collisions between aircraft, or damage to persons or property on the ground.
- Annex 11 requires States to provide flight information centers and air traffic control units. They provide clearances and information to achieve longitudinal, vertical or lateral separation between aircraft.
- The world's airspace is divided into contiguous flight information regions [FIRs] within which air traffic services are provided. An aircraft in flight follows en route air traffic control instructions as it flies through successive FIRs. Upon approaching an airport at which a landing is to be made, the aircraft passes into the terminal control area [TCA].



EXAMPLE: UK Airspace is divided into 2 main Flight Information Regions, or FIRs --the Scottish FIR, and the London FIR. The responsibility for these lies with three centres. The London Area and Terminal Control Centre (LATCC) situated at West Drayton, The Scottish Oceanic and Area Control Centre at Prestwick, and the Manchester Area Control Centre (MACC), at Manchester Airport.




NEFAB
UK-Ireland FAB
DK-SE FAB
Baltic FAB
FABEC
FAB CE
Danube FAB
South West FAB
BLUE MED FAB

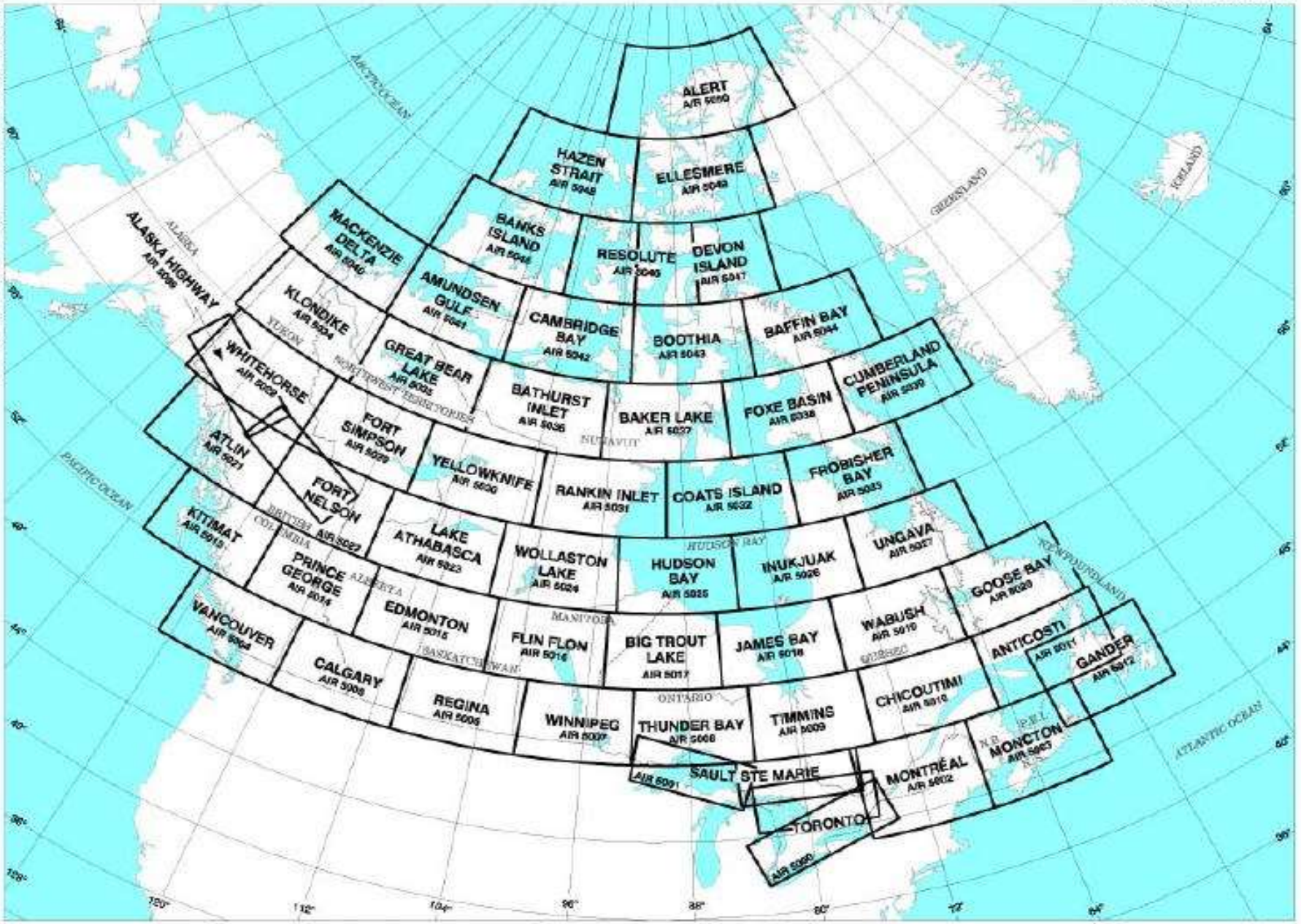
VFR NAVIGATION CHARTS (VNC)

CARTES AÉRONAUTIQUES DE NAVIGATION VFR (VNC)

SCALE/ÉCHELLE 1:500,000

Published by Geomatics Canada
Department of Natural Resources

Publié par Géomatique Canada
Ministère des Ressources naturelles



The Chicago Convention of 1944

- Article 1 – Each State has complete and exclusive sovereignty over its airspace;
- Article 5 – States may prescribe specific routes for non-scheduled flights;
- Article 6 – Scheduled flights may not be conducted over the territory of another State without its authorization;
- Article 8 – No pilotless aircraft may be flown over the territory of another State without special permission;

Designated Routes

Article 68 – Each State may designate international air routes and international airports in its territory;

PROHIBITED ZONES

Article 9:

- States may establish “prohibited areas” for military or public safety reasons;
- such prohibited areas must be of reasonable extent and location as not to unnecessarily interfere with air navigation;
- in exceptional circumstances, or during periods of emergency or in the interest of public safety, States may immediately and temporarily restrict or prohibit flying over the whole or part of its territory, without discrimination as to aircraft nationality;
- States may require that aircraft finding themselves in “no-fly” zones to promptly land at a designated airport.

Annexes 2, 4 and 15

- **Prohibited area** – an air space of defined dimensions above the land area or territorial waters of a State, within which the flight of aircraft is prohibited;
- **Restricted area** – an air space of defined dimensions above the land areas or territorial waters, within which the flight of aircraft is restricted in accordance with certain specified conditions; and
- **Danger area** – a specified area within which activities dangerous to flight exist at specified times.

Eurocontrol — SAAM

Military Areas

Chicago Convention Art. 3:

The Convention applies to civil aircraft, and not state aircraft.

However, when issuing regulations for state aircraft, States shall have due regard for the safety of navigation of civil aircraft.


SEPTEMBER 12, 1983
$1.25
TIME
MIDEAST TURMOIL
Beirut Claims Two Marines, Begin's Era Ends
SHOOTING TO KILL
The Soviets Destroy an Airliner
KOREAN

KAL 007 Resulted in Art. 3 bis

Article 3 *bis*

- States may require aircraft flying through its air space without permission to land promptly at a designated airport.
- However, States must refrain from using weapons against civil aircraft in flight or endangering the lives of persons on board or the safety of aircraft;
- States retain their right of self-defense under Article 51 of the UN Charter.


HOW CLOSE TO THE CONFLICT ZONE
The flight path of MH-17 on the day it crashed
The flight path of Air India's AIC-111 on July 16
The flight path of Jet Airways' 9W-230 on July 15
Centres of pro-Russian insurgency
Lublin
Lviv
Kiev
Poltava
Cherkasy
Kramatorsk
Luhansk
UKRAINE
Horlivka
Donetsk
Shakhty
Map not to scale
RUSSIA
Area of Pro-Russia rebel activity
Donetsk


DNEPROPETROVSK
SIMFEROPOL
AFGHANISTAN
SYRIA
IRAQ
IRAN
SINAI PENINSULA
LIBYA
MALI
NORTHERN ETHIOPIA
YEMEN
NORTH KOREA
KENYA
SOMALIA
DEMOCRATIC REPUBLIC OF THE CONGO
KEY
FAA prohibits planes from flying in this airspace (specified altitude limits may apply).
FAA warns planes that this airspace is a high-risk area.

Annex 2

- Interception is to be undertaken only as a last resort;
- If undertaken, interception shall be limited to determining the identity of the aircraft, unless it is necessary to return it to its planned track, direct it beyond the boundaries of national air space, guide it away from prohibited, restricted or danger areas, or instruct it to land at a designated airport.

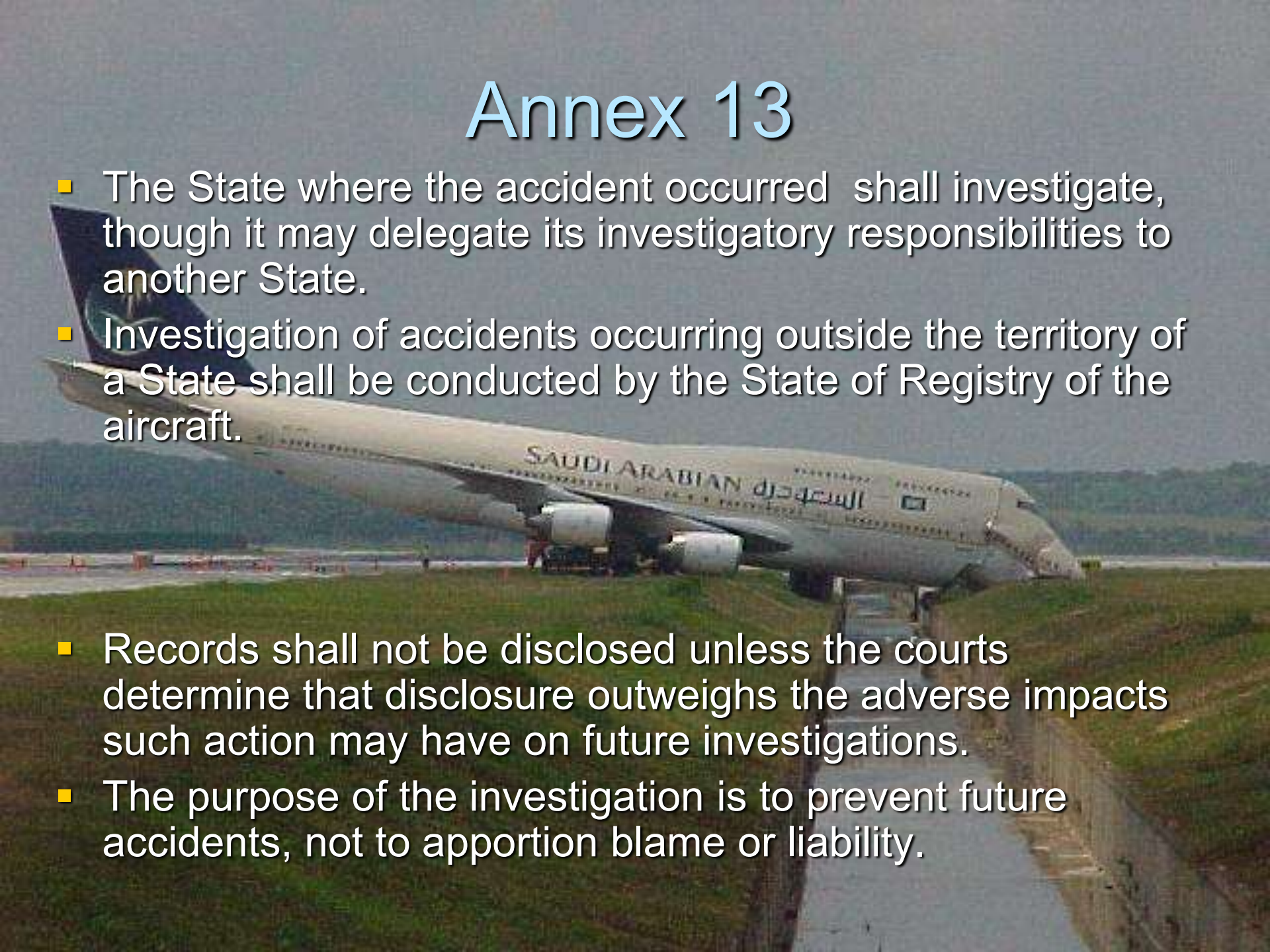

Air Defense Identification Zones (ADIZ) over the East China Sea region
Seoul
SOUTH
Sea of Japan
CHINAWATCH
CHINA DAILY
DIAOYU ISLANDS BELONG TO CHINA
Diaoyu Islands, which include Diaoyu Island and its affiliated islands, have been an inherent territory of China since ancient times, and China has indisputable sovereignty over the islands.
Diaoyu Islands had long been under China's jurisdiction in the Ming (1368-1644) and Qing (1644-1911) dynasties.
Chinese and foreign maps show that Diaoyu Islands belong to China.
Japan grabbed Diaoyu Island from China.
Diaoyu Island was returned to China after the Second World War.
China has opposed the backroom deals between the United States and Japan concerning Diaoyu Island.
Japan's so-called "nationalization" of Diaoyu Island severely infringes upon China's sovereignty and rejects and challenges the outcomes of the victory of the World Anti-Fascist War.
China's will to defend national sovereignty and territorial integrity is firm and its resolve to uphold the outcomes of the World Anti-Fascist War will not be shaken by any force.
© Reuters
Diaoyu Islands
Source: Chinese, South Korean and Japanese governments
VOA

Aircraft in Distress and Accident Investigations

Article 25 – States must provide assistance to aircraft in distress;
Article 26 – the State in which an aviation accident involves death or serious injury shall investigate its causes; the State of aircraft inj

Annex 13

- The State where the accident occurred shall investigate, though it may delegate its investigatory responsibilities to another State.
- Investigation of accidents occurring outside the territory of a State shall be conducted by the State of Registry of the aircraft.



- Records shall not be disclosed unless the courts determine that disclosure outweighs the adverse impacts such action may have on future investigations.
- The purpose of the investigation is to prevent future accidents, not to apportion blame or liability.

Facilitation of Air Navigation

Article 22 – States must adopt all practicable measures to facilitate and expedite navigation by aircraft and prevent unnecessary delays;
Article 28 – States in their territories must provide airports, radio and meteorological services, and other navigational facilities;
States must implement SARPs addressing communications, codes, marking, signals, and operating procedures, and aeronautical maps and charts.

Uniform Conditions and Nondiscriminatory Charges

Article 11 – air navigation rules must be nondiscriminatory;
Article 15 – air navigation charges must be nondiscriminatory;

Article 15

- uniform conditions shall apply to the use of air navigation facilities by aircraft of every contracting State;
- air navigation charges shall not be higher for scheduled foreign aircraft than national aircraft engaged in similar international operations;
- no charge may be imposed solely for the right of transit over, entry into, or exit from its territory;
- charges imposed shall be published and communicated to the ICAO Council; and
- if a contracting State so requests, the ICAO Council may review such charges and report and make recommendations thereon to the concerned State(s).

Airport and ATC Charges

Charges are fees paid by airlines for services and facilities provided by airports and ANSPs such as:

- Use of the runway (landing charges)
- Use of the airport infrastructure (parking and boarding bridge charges)
- Use of the terminal building (passenger charges)
- Airport security (security charges)
- Protection of the environment (noise charges)
- Air traffic control (en route navigation and terminal charges)
- Other air navigation services (Meteorological and Aeronautical Information Services) Source: IATA

IATA's Concerns

- Worldwide, airlines and their passengers pay at least US$43.5 billion a year to airports and ANSPs or 11% of airline revenues.
- These infrastructure charges form the 2nd largest external cost to airlines after fuel.
- Over the past 5 years airport aeronautical revenues per passenger increased 27%.
- The unit cost of air navigation increased 9.4% during the same period.
- At the same time airlines reduced unit costs (excluding fuel) by 16%. Source: IATA

Article 12 – States must assure that aircraft in its territory or carrying its nationality shall “comply with the rules and regulations relating to the flight and maneuver there in force”; such domestic regulations shall be uniform, to the greatest possible extent, with SARPs; rules over the high seas shall be those established by ICAO.

Duties of States

Article 37 – States must “collaborate in securing the highest practicable degree of uniformity in its regulations, standards, procedures, and organization” so as to “facilitate and improve air navigation.” ICAO shall adopt SARPs addressing communications systems, characteristics of airports and landing areas, collection and exchange of meteorological information, aeronautical maps and charts, aircraft in distress and accident investigation, “and such other matters concerned with the safety, regularity, and efficiency of air navigation as may from time to time appear appropriate”;

Article 38 - States that find it “impracticable to comply” with SARPs shall notify ICAO immediately; ICAO shall immediately notify all other States of the differences between the SARPs and the national practice of that State.

FORCE MAJEURE

- Article 89 – in case of war or national emergency, the Convention shall not affect the freedom of action of any State;


Pursuant to Articles 9 and 89 of the Chicago Convention, the U.S. Federal Aviation Administration grounded all commercial aircraft over U.S. airspace for three days following the September 11, 2001 attack.

The Role of ICAO

Article 44 – ICAO shall “develop the principles and techniques of international air navigation”; it shall promote safety of flight, and encourage the development of air navigation facilities;
Article 69 – if the ICAO Council concludes a State’s air navigation facilities are deficient, it may consult with said State;
Articles 70, 71 & 74 – the ICAO Council may finance, or provide, air navigation services, or provide technical assistance if deficiencies exist, and the State agrees.

ICAO's Navigation-Related SARPS

- Annex 2 – Rules of the Air
- Annex 3 – Meteorology
- Annex 4 – Aeronautical Charts
- Annex 5 – Units of Measurement to Be Used in Air-Ground Communications
- Annex 6 – Operation of Aircraft, International Commercial Air Transport
- Annex 10 – Aeronautical Communications
- Annex 11 – Air Traffic Services
- Annex 15 – Aeronautical Information Services

ANNEX 2 - Rules of the Air

- Annex 2 consists of general rules, visual flight rules and instrument flight rules. The pilot-in-command of an aircraft is responsible for compliance with the rules of the air.
- An aircraft must be flown in accordance with the general rules and either the visual flight rules (VFR) or the instrument flight rules (IFR). Flight in accordance with visual flight rules is permitted if a flight crew is able to remain clear of clouds by a distance of at least 1 500 m horizontally and at least 300 m (1 000 ft) vertically and to maintain a forward visibility of at least 8 km. For flights in some portions of the airspace and at low altitudes, and for helicopters, the requirements are less stringent. An aircraft cannot be flown under VFR at night or above 6 100 m (20 000 ft) except by special permission.
- Most airliners fly under IFR at all times. When operating under air traffic control the aircraft must maintain precisely the route and altitude that have been assigned to it and keep air traffic control informed about its position.
- A flight plan must be filed with air traffic services units for all flights that will cross international borders, and for most other flights that are engaged in commercial operations. The flight plan provides information on the aircraft's identity and equipment, the point and time of departure, the route and altitude to be flown, the destination and estimated time of arrival, and the alternate airport to be used should landing at destination be impossible. The flight plan must also specify whether the flight will be carried out under visual or instrument flight rules.
- Regardless of the type of flight plan, the pilots are responsible for avoiding collisions when in visual flight conditions, in accordance with the principle of see-and-avoid. However, flights operating under IFR are either kept separated by air traffic control units or provided with collision hazard information. Source: ICAO

ANNEX 3 - Meteorological Service for International Air Navigation

- Annex 3 requires the provision of necessary meteorological information to operators, flight crew members, air traffic services units, search and rescue units, airport management and others concerned with aviation.
- At international aerodromes the meteorological information is normally supplied to aeronautical users by a meteorological office. Aerodrome reports include surface wind, visibility, runway visual range, present weather, cloud, air and dew-point temperature and atmospheric pressure, and are issued either half-hourly or hourly. These reports are complemented by special reports whenever any parameter changes beyond pre-fixed limits of operational significance. Aerodrome forecasts include surface wind, visibility, weather, cloud and temperature, and are issued every three or six hours for a validity period of 9 to 24 hours.
- Landing forecasts contain expected conditions over the runway complex in regard to surface wind, visibility, weather and cloud.
- To assist pilots with their flight planning, most States provide meteorological briefings which are increasingly carried out using automated systems. Briefings comprise details of en-route weather, upper winds and upper-air temperatures, often given in the form of meteorological charts, warnings related to hazardous phenomena en-route, and reports and forecasts for the destination aerodrome and its alternates.
- To provide aircraft in flight with information about significant changes in weather, meteorological watch offices are maintained. They prepare warnings of hazardous weather conditions. Furthermore, aircraft in flight are required to report severe weather phenomena encountered en route. These reports are disseminated by the air traffic services units to all aircraft concerned.
- ICAO has implemented the World Area Forecast System (WAFS) to provide States and aviation users with standardized and high-quality forecasts on upper-air temperature, humidity and winds and on significant weather. Source: ICAO

ANNEX 4 - Aeronautical Charts

- Annex 4 defines the obligations of States to make available certain ICAO aeronautical chart types, and specify chart coverage, format, identification and content including standardized symbology and colour use. The goal is to satisfy the need for uniformity and consistency in the provision of aeronautical charts that contain appropriate information of a defined quality. The ICAO series of aeronautical charts now consists of twenty-one types, each intended to serve specialized purposes. They range from detailed charts for individual aerodromes/heliports, to small-scale charts for flight planning purposes, and include electronic aeronautical charts for cockpit display.
- There are three series of charts available for planning and visual navigation, each with a different scale. The *Aeronautical Navigation Chart — ICAO Small Scale* charts cover the largest area for a given amount of paper; they provide a general purpose chart series suitable for long-range flight planning. The *World Aeronautical Chart — ICAO 1 : 1 000 000* charts provide complete world coverage with uniform presentation of data at a constant scale, and are used in the production of other charts. The *Aeronautical Chart — ICAO 1:500 000* series supplies more detail and provides a suitable medium for pilot and navigation training. This series is most suitable for use by low-speed, short- or medium-range aircraft operating at low and intermediate altitudes.
- The vast majority of scheduled flights take place along routes defined by radio and electronic navigation systems that make visual reference to the ground unnecessary. This type of navigation is conducted under instrument flight rules.

Source: ICAO

ANNEX *5* - Units of Measurement to be Used in Air and Ground Operations

- At the International Civil Aviation Conference held at Chicago in 1944, the importance of a common system of measurements was realized and a resolution was adopted calling on States to make use of the metric system as the primary international standard.
- Adopted in 1979, Amendment 13 of Annex 5 extended ICAO's role in standardizing units of measurements to cover all aspects of air and ground operations, and not just air-ground communications. It also introduced the International System of Units, known as SI from the "Système International d'Unités", as the basic standardized system to be used in civil aviation.
- In addition to the SI units, the amendment recognized a number of non-SI units which may be used permanently in conjunction with SI units in aviation, including the litre, the degree Celsius, and the degree for measuring plane angle. There are some non-SI units which will have to be retained, at least temporarily, including the nautical mile and the knot, as well as the foot when it is used in the measurement of altitude, elevation or height only.
- Amendments 14 and 15 to Annex 5 introduced a new definition of the metre, and references to temporary non-SI units were deleted. Source: ICAO

ANNEX 6 - Operation of Aircraft

- Annex 6 covers such areas as aircraft operations, performance, communications and navigation equipment, maintenance, flight documents, responsibilities of flight personnel and the security of the aircraft.
- SARPs exist in respect of operating minima based on the aircraft and the environmental factors found at each aerodrome. Subject to the State of the Operator's approval, the aircraft operator has to take into account the type of aeroplane or helicopter, the degree of sophistication of equipment carried on the aircraft, the characteristics of the approach and runway aids and the operating skill of the crew in carrying out procedures involved in operations in all weather conditions.
- Annex 6 spells out the responsibilities of States in supervising their operators, particularly in respect of flight crew. It calls for the provision of an operations manual for each aircraft type, and places the onus on each operator to ensure that all operations personnel are properly instructed in their duties and responsibilities, and in the relationship of such duties to the airline operation as a whole.
- The pilot-in-command has the final responsibility to make sure that flight preparation is complete and conforms to all requirements, and is required to certify flight preparation forms when satisfied that the aircraft is airworthy, and that other criteria are met in respect to instruments, maintenance, mass and load distribution (and the securing of the loads), and operating limitations of the aircraft. Annex 6 also requires operators to establish rules limiting the flight time and flight duty periods for flight crew members.
- The Annex also sets out minimum performance operating limitations with respect to aircraft taking into account the mass of the aircraft, elevation, temperature, weather conditions and runway conditions, and include take-off and landing speeds under conditions which involve the failure of one or more power-units.
- Part II of Annex 6 deals with aeroplanes in international general aviation. International commercial in transport operations and general aviation operations in helicopters is covered in Part III. Source: ICAO

ANNEX 10 - Aeronautical Telecommunications

- Annex 10 is divided into five volumes:
- *Volume I — Radio Navigation Aids* is a technical document which defines for international aircraft operations the systems necessary to provide radio navigation aids used by aircraft in all phases of flight. The SARPs and guidance material of this volume list essential parameter specifications for radio navigation aids such as the global navigation satellite system (GNSS), instrument landing system (ILS), microwave landing system (MLS), very high frequency (VHF) omnidirectional radio range (VOR), non-directional radio beacon (NDB) and distance measuring equipment (DME).
- In *Volume II — Communications Procedures including those with PANS status*, general, administrative and operational procedures pertaining to aeronautical fixed and mobile communications are presented.
- *Volume III — Communication Systems* contains SARPs and guidance material for various air-ground and ground-ground voice and data communication systems, including aeronautical telecommunication network (ATN), aeronautical mobile-satellite service (AMSS), secondary surveillance radar (SSR) Mode S air-ground data link, very high frequency (VHF) air-ground digital link (VDL), aeronautical fixed telecommunication network (AFTN), aircraft addressing system, high frequency data link (HFDL), aeronautical mobile service, selective calling system (SELCAL), aeronautical speech circuits and emergency locator transmitter (ELT).
- *Volume IV — Surveillance Radar and Collision Avoidance Systems* contains SARPs and guidance material for secondary surveillance radar (SSR) and airborne collision avoidance systems (ACAS), including SARPs for SSR Mode A, Mode C and Mode S, and the technical characteristics of ACAS.
- In *Volume V — Aeronautical Radio Frequency Spectrum Utilization*, SARPs and guidance material on the utilization of aeronautical frequencies are defined. Volume V contains information on the assignment planning of individual aeronautical radio stations operating or planned to operate in different frequency bands. Source: ICAO

ANNEX 11 - Air Traffic Services

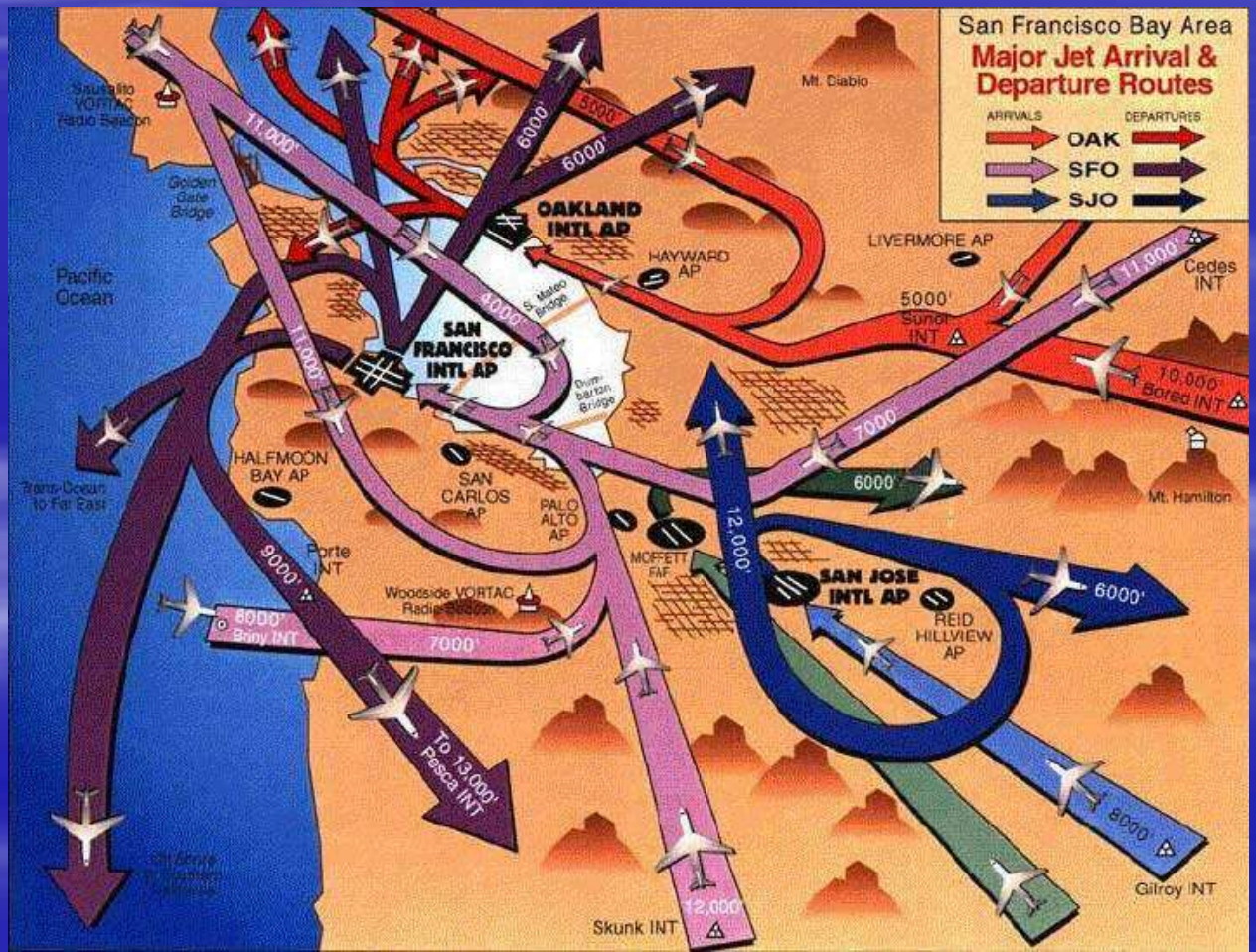
- Addresses ways of preventing collision between aircraft, expediting and maintaining an orderly flow of air traffic, providing advice and information for the safe and efficient conduct of flights, and alerting service for aircraft in distress. To meet these objectives, ICAO provisions cal l for the establishment of flight information centres and air traffic control units.
- The world's airspace is divided into a series of contiguous flight information regions (FIRs) within which air traffic services are provided.
- Air Traffic Control services consists of clearances and information issued by ATC units to achieve longitudinal, vertical or lateral separation of aircraft. All aircraft fly in accordance with either instrument flight rules (IFR) or visual flight rules (VFR).
- Requires States to implement air traffic services (ATS) safety management programmes to ensure that safety is maintained in the provision of ATS within airspaces and at aerodromes.
- Air traffic control service consists of clearances and information issued by air traffic control units to achieve longitudinal, vertical or lateral separation between aircraft.
- Provides for ATC units to specify restrictions to the traffic flow, when required, for the purpose of avoiding excessive delays to aircraft in flight.
- Specifies the requirements for coordination between the civil air traffic control units and military authorities.
- Alert the rescue coordination centres when an aircraft is believed or known to be in distress. Source: ICAO

ANNEX 15 - Aeronautical Information Services

- Annex 15 defines how an aeronautical information service (AIS) shall receive and/or originate, collate or assemble, edit, format, publish/store and distribute specified aeronautical information/data. The goal is to satisfy the need for uniformity and consistency in the provision of aeronautical information/data that is required for the operational use by international civil aviation.
- The philosophy underlying Annex 15, which stems from Article 28 of the Convention on International Civil Aviation, is that each State is responsible for making available to civil aviation interests any and all information which is pertinent to and required for the operation of aircraft engaged in international civil aviation within its territory, as well as in areas outside its territory in which the State has air traffic control or other responsibilities.
- Aeronautical information is handled differently depending on its urgency, operational significance, scope, volume and the length of time it will remain valid and relevant to users. Annex15 specifies that aeronautical information be published as an integrated aeronautical information package. It is composed of the following elements: the *Aeronautical Information Publication* (AIP), including amendment service, AIP supplements, international notices to airmen (NOTAM), pre-flight information bulletins (PIB), aeronautical information circulars (AIC), checklists and lists of valid NOTAM.
- The need, role and importance of aeronautical information/data have changed significantly with the evolution of the Communications, Navigation and Surveillance/Air Traffic Management (CNS/ATM) systems. The implementation of area navigation (RNAV), required navigation performance (RNP) and airborne computer-based navigation systems has brought about exacting requirements for the quality (accuracy, resolution and integrity) of aeronautical information/data and terrain data.
- States must establish a quality system and put in place quality management procedures at all stages (receiving and/or originating, collating or assembling, editing, formatting, publishing, storing and distributing) of the aeronautical information/data process. The quality system must be documented and demonstrable for each function stage, ensuring that the organizational structure, procedures, processes and resources are in place in order to detect and remedy any information/data anomalies during the phases of production, maintenance and operational use. Explicit in such a quality management regime is the ability to trace all information/data from any point, back through the proceeding processes, to its origin. Source: ICAO

Additionally, best practices for air navigation have been identified in various Procedures for Air Navigation Services [PANS].

PANS are operating practices too detailed for SARPs; they amplify the basic principles contained in the corresponding SARPs



Air Traffic Management

Air traffic management [ATM] is a system consisting of a ground part and an air part.

The airborne part of ATM consists of the functional capability which interacts with the ground part to attain the general objectives of ATM.

The ground part of ATM comprises the functions of Air Traffic Services [ATS], Airspace Management [ASM] and Air Traffic Flow Management [ATFM].

Air Traffic Services is a generic term meaning variously, flight information services, alerting service, air traffic advisory service, and Air Traffic Control service (area control service, approach control service or aerodrome control service). [1]

[1] Roderick van Damm, A European Legal Framework for Air Traffic Management (presentation before the McGill University Institute of Air & Space Law, Montreal, Canada, Jan. 11, 2006).

AIR TRAFFIC CONTROL

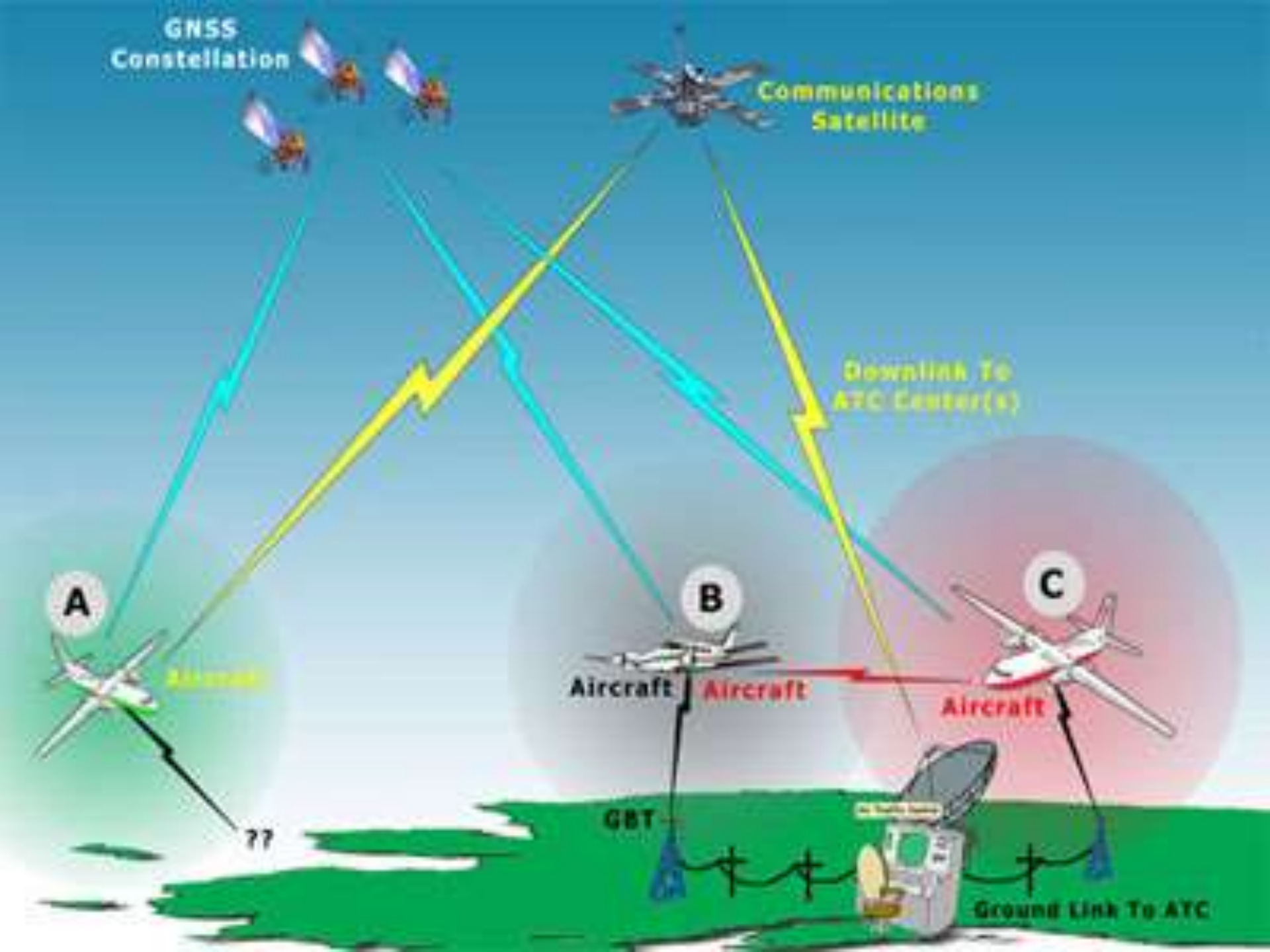
Air traffic control [ATC] is typically divided into three areas:

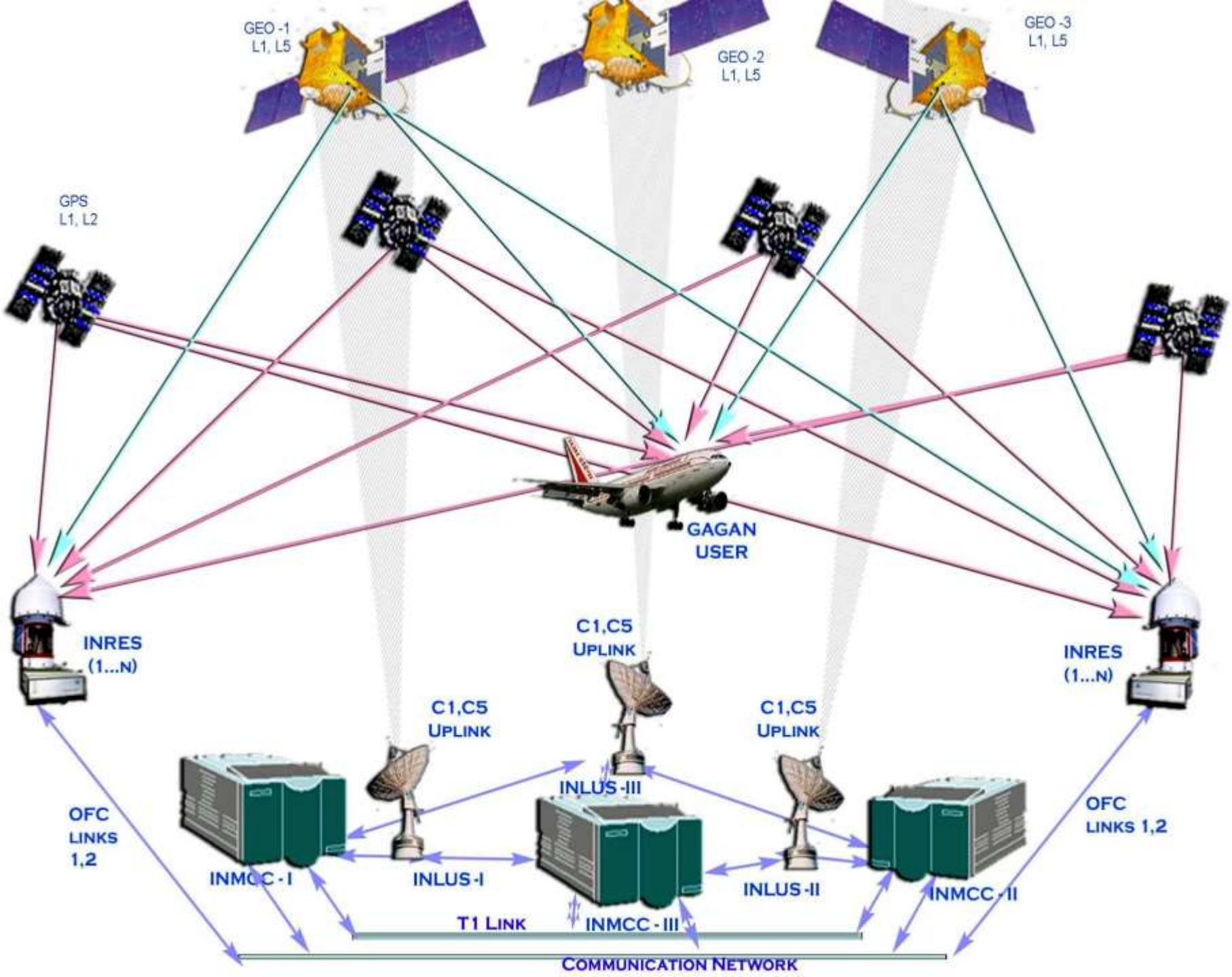
1. *Area control* is designed to ensure adequate separation of aircraft once an aircraft has left the airspace controlled by an airport and is en route to another airport.
2. *Approach control* (or terminal radar control) gives approaching and departing aircraft radio instructions within the approach control area (the airspace extending like a staircase from the airport. Airport surveillance radar monitors location and altitude of aircraft under terminal radar control.
3. *Aerodrome control* consists of clearance given to an aircraft landing at or taking off from an airport in a control zone. This is performed from the air traffic control tower located at the airport.

Radio Navigation Aids

- global navigation satellite system (GNSS),
- instrument landing system (ILS),
- microwave landing system (MLS),
- very high frequency (VHF) omnidirectional radio range (VOR),
- non-directional radio beacon (NDB) and
- distance measuring equipment (DME).

ICAO is attempting to assist States in GNSS satellite-based communications, navigation and surveillance/air traffic management (CNS/ATM) systems.


GNSS
Constellation
Communications
Satellite
Downlink To
ATC Center(s)
A
B
C
Aircraft
Aircraft
Aircraft
Aircraft
??
GBT
Ground Link To ATC


GEO -1
L1, L5
GEO -2
L1, L5
GEO -3
L1, L5
GPS
L1, L2
GAGAN
USER
INRES
(1...N)
INRES
(1...N)
C1,C5
UPLINK
C1,C5
UPLINK
C1,C5
UPLINK
INLUS -III
OFC
LINKS
1,2
OFC
LINKS 1,2
INMCC - I
INLUS -I
INLUS -II
INMCC - II
T1 LINK
INMCC - III
COMMUNICATION NETWORK


Western veer
Original flight path
Malaysia
Nakhon Si Thammarat
Phang-nga
Krabi
Phuket
Trang
Hat Yai
Perlis
Kota Bharu
Kedah
Penang
Kelantan
Terengganu
Dungun
Chukai
Kuantan
Ipoh
Malacca Strait
Aceh
Langsa
Lhokseumawe
Gunung Leuser National Park
Medan
Tebing Tinggi
Pematangsiantar
Kuala Lumpur
Malacca
Johor
Singapore
North Sumatra
Dumai
Sibolga
Ca Mau
Bac Lieu


Last military radar contact
Last civilian radar contact
Kuala Lumpur
Satellite
35,800km above
sea level
Possible last known position
based on satellite data
March 28 search area
319,000 sq. km
AUSTRALIA
Perth
Previous search areas
1,000km
Malaysian government, Australian Maritime Safety Authority
VOA

Air Navigation Service Providers

There are three forms of classical" ANS providers:

- Individual State
- Joint States (e.g. EUROCONTROL, MUAC, and EAD)
- Non-Governmental Entity on behalf of a State/States

ANSP Organizational Structures

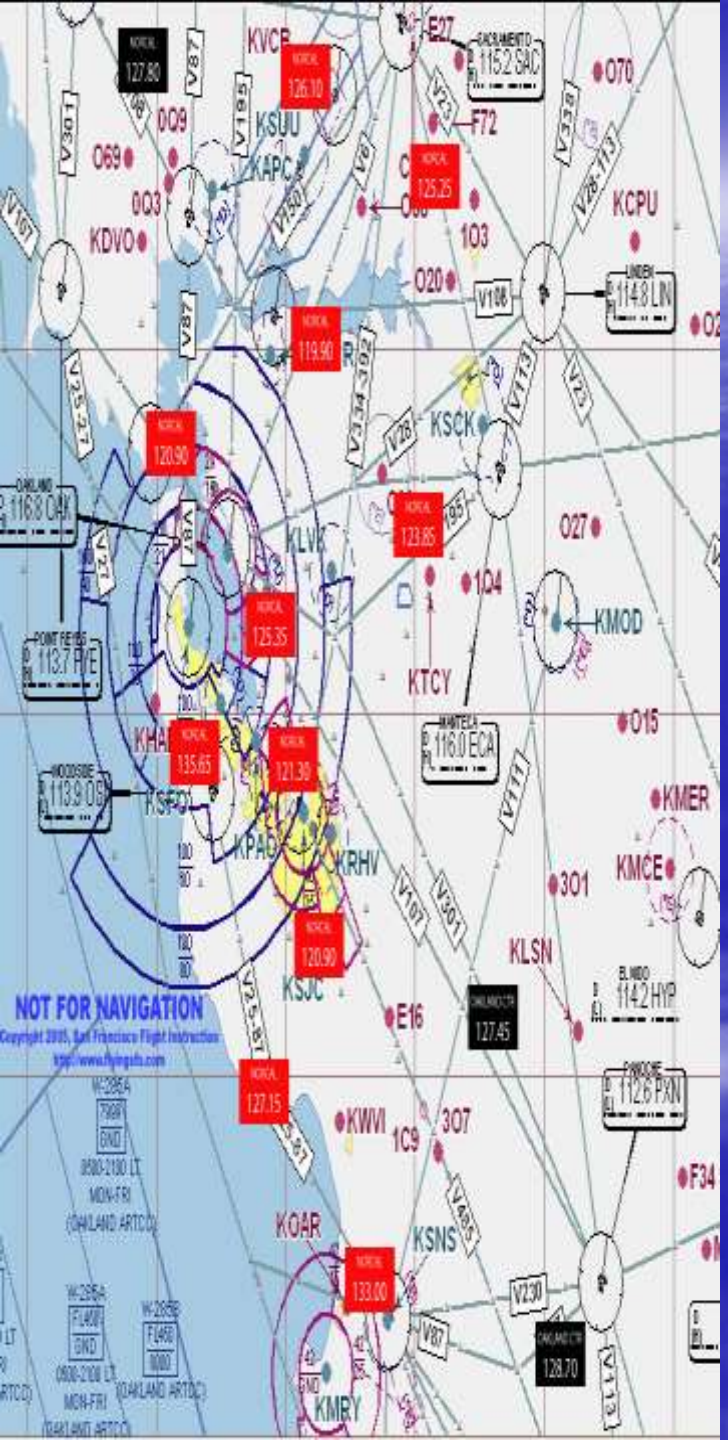
ANS Organizations

Degree of Commercialization

0%

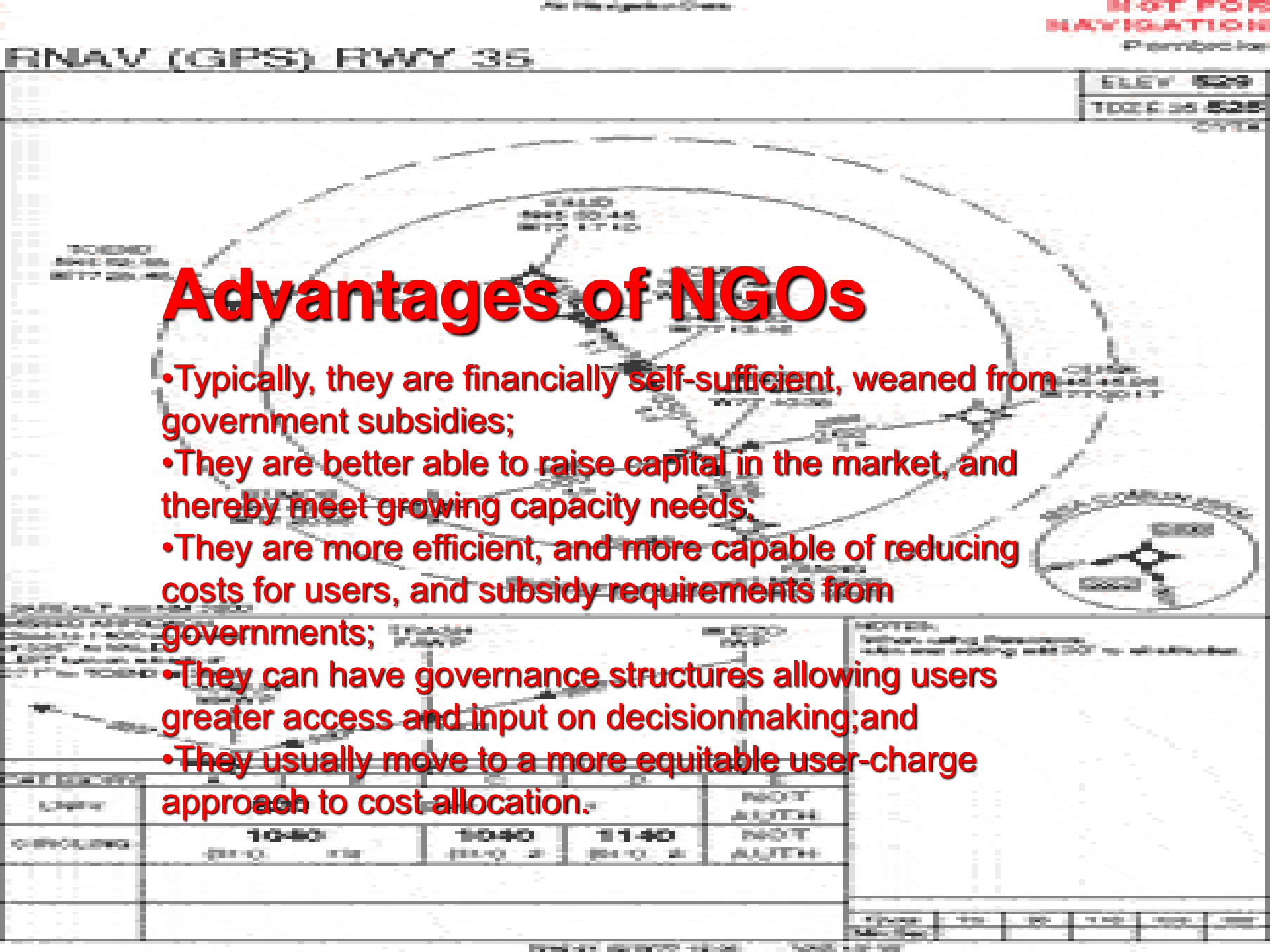
State Authority (CAA)
Autonomous State Entity
State-owned Corporation (Crown corporation)
Concession/Lease (all or part of the facilities)
Partial Privatization (e.g. non-aeronautical)
Not-for-profit (stakeholder owned) Corporation
Fully Privatized Company (publicly traded shares)

100%



Problems of Traditional Governmental Institutions

- They have had difficulty in keeping pace with the capital needs of ANS to accommodate rapidly growing traffic demands and maintain high levels of safety in aviation;
- They usually are restricted in their ability to borrow money in capital markets to finance infrastructure improvements.
- They are subject to governmental procurement and decisional policies and practices, imposing bureaucratic efficiency impediments; and
- They are subject to civil service labor costs and staffing levels undisciplined by market forces.



Advantages of NGOs

- Typically, they are financially self-sufficient, weaned from government subsidies;
- They are better able to raise capital in the market, and thereby meet growing capacity needs;
- They are more efficient, and more capable of reducing costs for users, and subsidy requirements from governments;
- They can have governance structures allowing users greater access and input on decisionmaking;and
- They usually move to a more equitable user-charge approach to cost allocation.

IATA's Concerns About Corporatization

ANS commercialization may have a negative side, in particular when the principal objective is to maximize profits. No matter what organizational form an airport or ANS entity assumes through the process of commercialization, it remains by its nature a monopoly on which the users are completely dependent. There are a growing number of cases of abuse of this monopolistic situation by newly created commercial organizations, often with the complicity of the governments concerned.

IATA's experience is that, in many cases, commercialization has resulted in significant increases in the airport and ANS cost base that are used to determine charges. In addition, the promised increases in efficiency and productivity have not always materialized.

IATA's Concerns

- Despite IATA calls for all air navigation service providers (ANSPs) in Eurocontrol to freeze or reduce rates in 2010, no fewer than 19 states have proposed increases over 2009 levels. Adjusting for the amount of traffic handled, the greatest impact of the price rises will come in Poland (+18%), Romania (+17%), Austria (+14%), France (+6%), the UK (+5%) and Italy (+4%). In all, it will add $360 million to the airline bill.

ICAO Recommendations

ICAO recommended several of the following requirements for the ANS provider:

(1)the organization should be subject to the State obligations under the Chicago Convention;

(2)its Charter should provide for appointment of a Board of Directors;

(3)it should be self-financing, obtain funds from commercial markets, and attempt to achieve a financial return on investment;

(4)it should apply commercial accounting standards and practices; and

(5)it should be subject to normal business taxes.

Duties of the Regulator

- prevent overcharging and other monopolistic practices;
- ensure transparency as well as the availability and presentation of all financial data required to determine the basis for charges;
- assess efficiency and efficacy in the operations of providers;
- review standards and quality of services providers; and
- monitor investments planned in relations to traffic forecast.

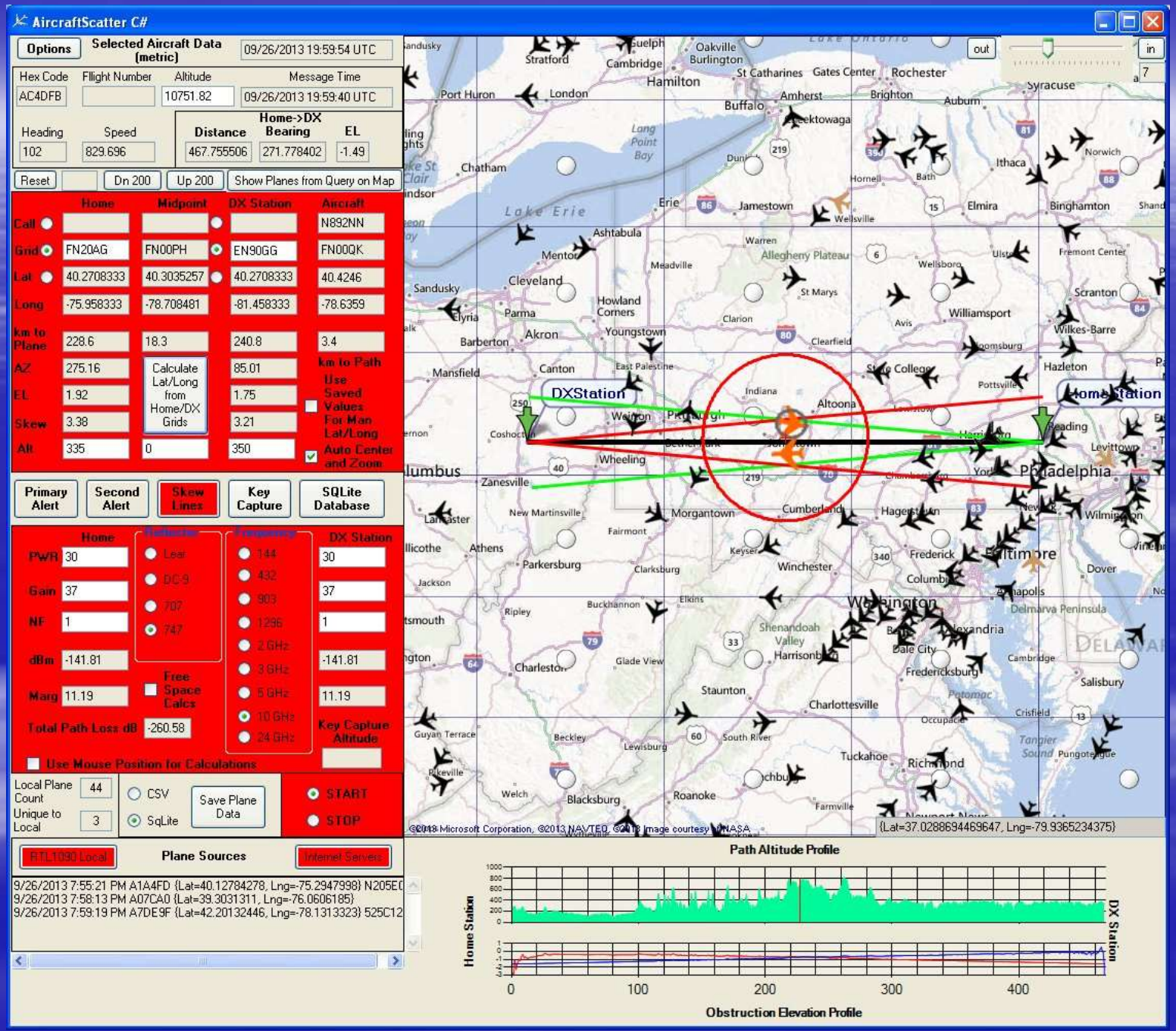
State Liability

- Article 28: State responsibility and related Liability
  - Because it is the ANS Provider
- And/or because it exercises regulatory/oversight functions (negligence in the exercise of supervisory responsibilities)
  - Ultimate liability towards third parties (subject to a right of recourse against actual entity liable)
  - Civil and Criminal liabilities Source: EUROCONTROL

Delegation, Outsourcing, Privatisation, Commercialisation, etc do NOT exonerate the State from its obligations under the Chicago Convention

Delegation of services and liability

- Agreement between the Service Providers
- Need for States' prior approval (for ATS: agreement for the delegation of ATS to be concluded between the States)
- Clear description of services subject of the Agreement
- Allocation of inter-parties liability (usually, the provider of service)
- Source: EUROCONTROL


AircraftScatter C#
Options
Selected Aircraft Data (metric)
09/26/2013 19:59:54 UTC
Hex Code
Flight Number
Altitude
Message Time
AC4DFB
10751.82
09/26/2013 19:59:40 UTC
Heading
Speed
Home->DX Distance
Home->DX Bearing
EL
102
829.696
467.755506
271.778402
-1.49
Reset
Dn 200
Up 200
Show Planes from Query on Map
Home
Midpoint
DX Station
Aircraft
Call
Grid
Lat
Long
km to Plane
AZ
EL
Skew
Alt
N892NN
FN20AG
FN00PH
EN90GG
FN00QK
40.2708333
40.3035257
40.2708333
40.4246
-75.958333
-78.708481
-81.458333
-78.6359
228.6
18.3
240.8
3.4
275.16
85.01
1.92
1.75
3.38
3.21
335
0
350
Calculate Lat/Long from Home/DX Grids
km to Path
Use Saved Values For Man Lat/Long
Auto Center and Zoom
Primary Alert
Second Alert
Skew Lines
Key Capture
SQLite Database
Home
Reflector
Frequency
DX Station
PWR
Gain
NF
dBm
Marg
30
37
1
-141.81
11.19
Lear
DC-9
707
747
144
432
903
1296
2 GHz
3 GHz
5 GHz
10 GHz
24 GHz
Free Space Calcs
Total Path Loss dB
-260.58
Key Capture Altitude
Use Mouse Position for Calculations
Local Plane Count
Unique to Local
44
3
CSV
SqLite
Save Plane Data
START
STOP
RTL1090 Local
Plane Sources
Internet Servers
9/26/2013 7:55:21 PM A1A4FD {Lat=40.12784278, Lng=-75.2947998} N205EC
9/26/2013 7:58:13 PM A07CA0 {Lat=39.3031311, Lng=-76.0606185}
9/26/2013 7:59:19 PM A7DE9F {Lat=42.20132446, Lng=-78.1313323} 525C12
DXStation
Home Station
©2013 Microsoft Corporation, ©2013 NAVTEQ, ©2013 Image courtesy of NASA
{Lat=37.0288694469647, Lng=-79.9365234375}
Path Altitude Profile
Home Station
DX Station
0
100
200
300
400
Obstruction Elevation Profile


No SIM
12:58
54%
WP
RTE
NAV KU09O DIST 11.3 nm
Route
Summary
go to y-stone (1-BZN)
LEGS 4 DIS 75.8 nm ETA 13:18
Legs
1
User WP
KU09O
DIST 11.3 nm
BRG 149° ETA 12:04
ETE 6:21
HAU
WP KU09O
BRG 149° DIS 11.3 nm ALT MSL 5607 ft ETE 6:21
TRK 150° GS 107 kts ALT GND 1430 ft ETA 12:04
067° 10.8 nm
140° 11.7 nm
155° 42.0 nm
9.2 nm
Max 5778 ft

Institute of Air & Space Law

Air Navigation

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