FAI TECHNICAL COMMISSION ON AIRSPACE & NAVIGATION SYSTEMS (CANS)

GLOSSARY OF TERMS AND ABBREVIATIONS

This includes terms concerned with airspace, avionics, air traffic management, navigation and distance measurement systems such as those based on radar and satellite navigation. It also includes some more general FAI terms and references

Updated 13 April 2009

FAI Sporting Code Sections
See also the table in para 1.4 of the General Section of the Sporting Code (the GS)

The General Section (GS) of the Sporting Code
Section 1 of the Sporting Code - Aerostats
Section 2 of the Sporting Code - General Aviation
Section 3 of the Sporting Code - Gliding
Section 4 of the Sporting Code - Aeromodelling
Section 5 of the Sporting Code - Parachuting
Section 6 of the Sporting Code - Aerobatics
Section 7 of the Sporting Code - Hang Gliding
Section 8 of the Sporting Code - Astronautics
Section 9 of the Sporting Code - Rotorcraft
Section 10 of the Sporting Code - Microlights
Section 11 of the Sporting Code - Human Powered Aircraft
Section 12 of the Sporting Code - Unmanned Aerial Vehicles
Section 13 of the Sporting Code - Solar Powered Aircraft

Other FAI Documents Available
In addition to the sections of the Sporting Code (table, FAI GS para 1.4), other Documents are available from FAI on request:

FAI Distance Calculations (Ex GS Annex B)
FAI Anti-Doping Control Regulations for Air Sports (3.11.2.6 refers)
Rules for FAI WAG (3.1.7 refers)
International Jury Members Handbook (4.3.2.5 refers)

Technical Specification for IGC-approved GNSS Flight Recorders (http://www.fai.org/gliding/gnss/tech_spec_gnss.asp). *Although this document is maintained by IGC, other airsports may wish to use it, or parts of it such as the common data file standard which enables analysis programmes developed for it to be used.*

GLOSSARY

Numerical

978 – The frequency in MHz used by the Universal Access Transceiver (UAT), see under UAT

1030 – The frequency in MHz used by radar transponders for receiving TCAS signals.

1090 – The frequency in MHz used by radar transponders for transmitting.

1090ES – 1090 Extended Squitter. Squitter messages are down-link transmissions at a constant rate ("squirting" the data, hence "squitter") from a Mode S radar transponder system. This allows passive acquisition of the data by other aircraft (that is, without the need for interrogation), for Traffic Alert (TA) and other purposes.

2D Position - A navigational position in terms of plan (horizontal) position (ie lat/long). In GNSS systems, at least three position lines (ie correct data from three satellites) are needed for a 2D fix. With multi-channel GNSS receivers capable of receiving signals from 12 satellites at one time (if they are above the horizon at the time), this is normally academic. However, where signal strength to the receiver is poor due to a defect such as an antenna fault, or flying in a deep valley, 2D fixes may be produced.

3D Position - A navigational position in terms of plan (horizontal) position and altitude. In GNSS systems, at least four position lines (ie correct data from four satellites) are needed for a 3D fix. With multi-channel GNSS receivers capable of receiving signals from 12 satellites at one time (if they are above the horizon at the time), this is normally academic. However, where signal strength to the receiver is poor due to a defect or flying in a deep valley, 3D fixes using data from only 4 satellites may be produced.

> GNSS Altitude. Due to the geometry of the lines-of-position between the satellites and the surface of the earth, errors in recorded GPS altitude will be not less than between 1.8 and 2.2 times those in latitude and longitude. In addition, GNSS altitude figures from low-cost receivers are more subject to short-term variations compared to lat/long figures.

4D Position - A navigational position in terms of plan (horizontal) position, altitude, and time. Since highly accurate time is an integral part of the principle of operation of a GNSS system, it is automatically available with every GNSS fix.

Alphabetical

A (FAI Class) - Balloons

AC – Advisory Circular, terminology used by the US FAA. For a listing of current ACs, see http://rgl.faa.gov , and for proposed new ACs, see http://www.faa.gov/aircraft/draft_docs

ACAS - Airborne Collision Avoidance System. An aircraft system based on secondary surveillance radar (SSR) transponder signals which operates independently of ground-based equipment, and is designed to provide advice to the pilot on potential conflicting aircraft that are also equipped with an SSR transponder. Implementation is by systems such as TCAS, for the detail, see under TCAS.

ADS-B - Automatic Dependent Surveillance - Broadcast. The ADS-B system uses Global Navigation Satellite System (GNSS) position data and a relatively simple broadcast communications link. It has been said that the ADS-B system is the future for worldwide Air Traffic Management (ATM) and for proximity warning between aircraft. Programmes implementing ADS-B include CASCADE and SESAR in Europe and NextGen in the USA (see elsewhere in this Glossary). The initials ADS-B originate from the following: it is Automatic, in that it is always live and requires no operator action. Dependent, in that it depends on a GNSS system such as GPS for position data. Surveillance, in that it provides this 3D position data to ground controllers and other aircraft. Broadcast, in that it broadcasts data on pre-set radio frequencies to any aircraft or ground station equipped with ADS-B that is listening. Unlike radar, ADS-B accuracy does not diminish with range, atmospheric conditions or target altitude and has the same accuracy as GNSS. ADS-B aircraft equipment takes GNSS position data and combines that data with other aircraft information, such as pressure altitude, airspeed and flight/aircraft identification. This information is then broadcast to other ADS-B-equipped aircraft for proximity warning (anti-collision) purposes. It is broadcast also to ADS-B ground stations for identification, surveillance and Air Traffic Control purposes. It will also work on the ground, for instance in monitoring airfield movements and the choice of the correct runway for takeoff in conditions of poor visibility. ADS-B with an appropriate network of ground stations also works

in remote areas or in mountainous terrain where there is either no radar coverage, or where radar coverage is restricted by obstacles in the line-of-sight. An ADS-B ground station consists of antennas and other equipment to receive and request aircraft data and either land-lines or microwave links to communicate with Air Traffic Control Centres. An ADS-B ground station is much simpler and less expensive than a surveillance radar station. As ADS-B becomes operational, the large surveillance radars presently used for civil air traffic control, can be phased out in favour of a network of ADS-B ground stations.

ADS-B in North America. In the USA, the FAA awarded a contract on 30 August 2007 to a consortium led by ITT Corporation to provide ADS-B surveillance uplink (ground-to-air) and downlink (air-to-ground) services, Automatic Dependent Surveillance Re-broadcast (ADS-R), Traffic Information Services - Broadcast (TIS-B) and Flight Information Services - Broadcast (FIS-B). Ground stations in Florida were completed in September 2008 and other areas in North America follow including Canada and the Gulf of Mexico. Under FAA NPRM 7-15 dated 1 October 2007, infrastructure for ADS-B Out, including broadcast services and 548 ground stations, is to be available by the end of Fiscal Year 2013. The FAA compliance date for aircraft to be fitted with ADS-B is 2020, and some aircraft (such as those of the freight carrier UPS) are fitted now. ADS-B Out will use the 1090 MHz Extended Squitter (1090ES) or the 978 MHz Universal Access Transceiver (UAT) broadcast links. UAT will also be used to uplink Flight Information Service (FIS) information to aircraft.

ADS-B In – An ADS-B system configured to receive signals

ADS-B Out – An ADS-B system configured to transmit signals

ADS-R - Automatic Dependent Surveillance – Re-broadcast. See under ADS-B

Aerodyne - See GS Chapter 2 for definitions, page 2 – 1

Aeronautics - For FAI purposes, aerial activity, including all air sports, equal to or less than 100 kilometres of the earth's surface (Source: Statutes, Preamble, Terms). See also under Space

Aerostat - See GS Chapter 2 for definitions, page 2 – 1

AFAIK - As Far As I Know.

AIGD - ADS-B Implementation and operational Guidance Document

Aircraft - See GS Chapter 2 for definitions, page 2 - 1

AIRE - Atlantic Interoperability Initiative to Reduce Emissions

Airspace Classes – A summary of current ICAO Airspace Classes is as follows, but it should be noted that individual nations often vary the definitions and the way that airspace classes are used:

Class A: All flights must be under Instrument Flight Rules (IFR) or Special visual flight rules (SVFR) and are subject to ATC clearance. All flights are separated from each other by ATC.

Class B: As Class A but with the addition of flights under Visual flight rules (VFR).

Class C: As Class B except that VFR flights are given traffic information on (rather than ATC separation from) other VFR flights.

Class D: As Class C except that IFR and SVFR flights are given traffic information on (rather than ATC separation from) VFR flights, and VFR flights are given traffic information on all other flights.

Class E: As Class D except that VFR flights are not subject to ATC clearance. As far as is practical, traffic information on VFR flights is given to all flights.

Controlled Airspace (CAS) - Classes A-E are referred to as controlled airspace. Classes F and G are uncontrolled airspace.

Class F: As Class E except that ATC separation will be provided, so far as practical (compared to being a requirement as in the higher Classes), to IFR aircraft. Traffic information may be given on other flights as far as is practical.

Class G: As Class F except that ATC separation is not provided, but traffic information may be given on other flights as far as is practical.

Air Sport Commission - The FAI Commissions responsible for individual FAI Air Sports, plus the Air Sport General Commission (see below)

Air Sport General Commission - The FAI Commission responsible for the General Section (GS) of the Sporting Code and other common Sporting procedures across all FAI Air Sports. Frequently the French title Commission d'Aéronautique Sportive Internationale (abbreviated CASI) is used. Terms of Reference are in FAI ByLaw 5.2.

AIS – Airborne Identification System. A system for identifying an individual aircraft in flight

AL - Amendment List

ALPA – Airline Pilots Association

Altitude - The vertical distance from mean sea level (MSL) or other defined datum such as the WGS84 ellipsoid for GPS altitude. See also `QNH', and `Height'.

ALTP – Air Line Transport Pilot's Licence

AME – Aviation Medical Examiner

AMSL - Above Mean Sea Level

ANB – Air Navigation Bureau. For instance of ICAO

ANDS (committee) - Air traffic, Navigation and Display Systems, a committee of the FAI International Gliding Commission (IGC), previously called the GNSS Committee.

ANS - Air Navigation System/Service

ANSP - Air Navigation System Provider (or Procedures)

ANT - Air Navigation Team

AOPA - Aircraft Owners and Pilots Association. There are National AOPAs, regional AOPAs, and IAOPA (International Council of Aircraft Owner and Pilot Associations). IAOPA is a federation of 66 national general aviation organisations, see www.iaopa.org).

APDSG - Air Traffic Management Procedures Development Sub-Group (Eurocontrol body)

API - Application Programming Interface. A set of functions that an application can call to tell the Operating System (OS) to perform a task.

ARC – Aviation Rulemaking Committee, for instance of the US FAA

ARINC - Aeronautical Radio Incorporated, the company which the US FAA uses to develop and publish numbered standards, eg ARINC 510 for avionic interfaces with simulators. Many avionic standards use ARINC protocols.

ASA - Aircraft Surveillance Applications

ASC - Air Sport Commission (List, GS page 1-2), responsible for a specific Sporting Code section.

ASDE – Airport Surface Detection Equipment

ASIAS - Aviation Safety and Information Analysis and Sharing

ASP – Aeronautical Surveillance Panel, of ICAO

ASPIRE - Asia and South Pacific Initiative to Reduce Emissions

Asterix – A format standard for data sharing between Air Traffic Control automation systems, maintained by Eurocontrol. Asterix Cat 21 for ADS-B is a worldwide system that is accepted by ATM manufacturers.

ATC, ATCC – Air Traffic Control, Air Traffic Control Centre

ATCO – Air Traffic Controller

ATM – Air Traffic Management (System, personnel, equipment etc)

ATO - Air Traffic Organization

AUW - All Up Weight / Mass of an aircraft at a defined time

AWRP - Aviation Weather Research Program

B (FAI Class) - Airships/Dirigibles

Battery - a source of electrical power independent of mains power or that produced by mechanical electrical generators. Batteries that are safe to operate in the air are required in sport aircraft that have no electrical generation capability such as balloons, hang gliders, gliders, some microlights and motor gliders, para gliders and powered hang-gliders and para-gliders. Other sport aircraft have limited electrical generating capacity such as some microlights and motor gliders, particularly Self Launching Motor Gliders (SLMG) with pylon-mounted engines. See also under Gel Cell, Lithium Ion, NiCad, NiMH.

Beidou/Compass - A Satellite Navigation System being developed by the Peoples Republic of China (PRC). In 2007, five satellites are in orbit and the full Beidou-2 system is planned to have 35 satellites. The existing satellites are geostationary and provide an area enhancement similar to EGNOS in Europe and WAAS in North America.

BOC – Binary Offset Carrier. A signal modulation technique applied in GNSS systems such as GPS and Galileo. In June 2004, the European Union agreed with the USA that Galileo would use the BOC 1.1 system, enabling the coexistence of GPS and Galileo on future receivers. BOC variants include Composite BOC (CBOC), Cosine- and Sine-BOC modulation, Double BOC (DBOC), Multiplexed BOC (MBOC) Time-MBOC (TMBOC).

BPIM - Bureau International des Poids et Mesures. The organisation has its headquarters in Sèvres, near Paris, and provides a single system of worldwide measurements, based on the International System of Units (the SI system). It works through a diplomatic treaty between fifty-two nations, and operates through a series of Consultative Committees, whose members are the national metrology laboratories of the Member States of the Convention. See www.bipm.org

BSR - Basic Surveillance Requirements

C (FAI Class) - Aeroplanes
C (Temperature) - Celsius

CAA- Civil Aviation Authority. A title used in several nations for the civil aviation Regulatory authority.

CANS - Commission on Airspace and Navigation Systems, a Technical Commission of FAI

CANSO - Civil Air Navigation Services Organisation (www.canso.org) represents the interests of worldwide Air Navigation Service Providers (ANSP). CANSO HQ is near Schiphol, The Netherlands, with offices in Brussels and Montreal.

CAPT – Coverage Analysis and Planning Tool. A Eurocontrol project using simulation techniques to analyse the future use of ADS-B and TIS-B. Simulation allows potential anomalies and failure cases to be analysed without any safety impact to aircraft in the air.

CAS – Controlled Airspace, or Calibrated Air Speed. Controlled Airspace is subject to special rules and control, within which the regular patterns of Commercial Air Traffic (CAT) can flow smoothly. Calibrated Airspeed is Indicated Air Speed corrected for Instrument and Pressure Errors.

CASCADE - a European programme for the co-ordination of the implementation of ADS-B. Under the CASCADE programme, ADS-B-Out is expected to reach Initial Operational Capability (IOC) in 2009, ADS-B-In for air traffic situational awareness in 2011. A CASCADE project called CRISTAL GA for general aviation is to define a certification path for ADS-B configurations. The equivalent programme in the USA is NextGen, see below.

CASI - Commission d'Aéronautique Sportive Internationale (the Air Sport General Commission of FAI). Responsible, amongst other things, for the General Section (GS) of the FAI Sporting Code. Terms of Reference are in FAI ByLaw 5.2

CAT - Commercial Air Traffic, sometimes Commercial Air Transport

CCG - Central European Air Traffic Services (CEATS) Coordination Group, a Eurocontrol body

CDA - Continuous Descent Approach

CEATS - Central European Air Traffic Services

CEP - Circular Error Probable, or Circular Error of Probability, normally to a 50% level of probability unless stated otherwise.

Certification - The signature on and preparation of certificates and other documents concerned with a particular process such as airworthiness. Also, flight verification with a view to validation of an FAI Flight Performance

CGSIC – Civil GPS Service Interface Committee (US Body)

CIA - Commission Internationale d'Aérostation, the International Ballooning Commission. In the USA, the Central Intelligence Agency.

CIACA - Commission Internationale des Amateurs Constructeurs d'Aéronefs, the FAI Amateur-built and Experimental Aircraft Commission. A technical commission of FAI. (AL7)

CIAM - Commission Internationale d'Aéromodélisme, the International Aeromodelling Commission

CIEA - Commission Internationale d'Education Aéronautique et Spatiale, the education commission. A technical commission of FAI. (AL1)

CIG - Commission Internationale de Giraviation, the International Rotorcraft Commission

CIMA - Commission Internationale de Micro-Aviation, the International Microlight Commission

CIMP - Commission Internationale Médico-Physiolgique, the medical commission. A technical commission of FAI

CIVA - Commission Internationale de Voltige Aerienne, the International Aerobatics Commission

CIVL - Commission Internationale de Vol Libre, the International Hang Gliding and Paragliding Commission

CLEEN - Continuous Low Emissions, Energy and Noise consortium

Clutter – Interference with a radar system

CND – Co-operative Network Design

CNS – Communications, Navigation and Surveillance systems.

C of A - Certificate of Airworthiness

Commission - FAI Commissions consist of Air Sport Commissions (ASC) and Technical Commissions. The ASC are listed on page 1-2 of the Sporting Code General Section (the GS) and each one is responsible for a specific section of the Sporting Code. Technical commissions consist of CANS, CIACA, CIEA, CIMP, and EnvC, see under these initials in this glossary.

CP - Control Point

CPL – Commercial Pilot's Licence

Constellation - When used in the context of satellite navigation, the group of satellites used in a GNSS fix. The individual identities (IDs) of satellites used in a fix (if recorded) may be used to verify the validity of the recorded flight data because the satellites on-line above the horizon can be checked later. In the IGC flight data format, IDs appear in the F Record.

CRLF - `Carriage Return' followed by a `Line Feed'. These two characters, represented by the hex numbers 0D and 0A, are usually used to denote the end of a record (category of data) in the IGC file.

CS – Community Specification. A Specification of the European Union (EU). CS are published in the Official Journal of the EU (OJEU)

CTA – Control Area

CTAF – Common Traffic Advisory Frequency

CTZ – Control Zone

CWP – Controller Working Position

D (FAI Class) - Gliders

DA - Design Approval. In aviation, DA applies to specified materials, parts, processes, and appliances used on aircraft.

Datum, Geodetic - The Geodetic Datum (qv) or earth model used by a mapping co-ordinate system such as lat/long, before the projection process is applied to convert earth model (curved) data into flat maps.

DFS – Deutsche FlugSicherung GmbH - is a. government-owned company responsible for.air traffic control in Germany and with headquarters at Langen, near Frankfurt-am-Main.

Digital Signature (DS) - see under Security.

DLL - Dynamic-Link Library. In Microsoft Windows, a DLL is a small program containing functions that other programs or resources can call or use. Outside MS Windows, DLLs are used in areas such as Distributed Interactive Simulation (DIS) links and other processing.

DM (FAI Class) - Motor Gliders

DME - Distance Measuring Equipment. In its specialised aviation meaning, this is transponder-based radio navigation technology that measures distance by timing the propagation delay of VHF or UHF radio signals. The system was a post-war development of IFF (identification friend or foe) systems of the 1939-45 war. DME is identical to the distance measuring component of TACAN (qv)

DO – Document. For instance the DO series of documents published by the US RTCA (qv). Examples include RTCA DO-260A MOPS for 1090ES ADS-B and TIS-B, dated April 2003 (for the initials, see elsewhere in this Glossary). For a list of the RTCA DO series of documents, see:
www.rtca.org/downloads/DEC%202004%20-%2005-01-06.htm#_Toc92863916

DOP - Dilution of Precision - The reduction of precision in a GNSS fix due to the geometry of the constellation of satellites used for the fix. Computed by a GNSS receiver for each fix, see also EPE. DOP can be estimated in various ways, including, HDOP (Horizontal position), GDOP (Geometric), PDOP (Position, overall), TDOP (Time) and VDOP (Vertical position). EPE also varies with constellation position. Some definitions from RTCA sources are given below.

> GDOP - Geometric Dilution of Position - The ratio of position error of a multilateration system (see definition of Multilateration). More precisely, it is the ratio of the standard deviation of the position error to the standard deviation of the measurement errors, assuming all measurement errors are statistically independent and have a zero mean and the same standard distribution. GDOP is the measure of the quality (sometimes, "goodness") of the geometry of the multilateration sources as seen by the observer; a low GDOP is desirable, a high GDOP undesirable. (See also PDOP, HDOP and VDOP.)
>
> HDOP - Horizontal Dilution of Position - The ratio of user-referenced horizontal position error to the measurement error of a multilateration system. (See GDOP for a more detailed description.)
>
> PDOP - Position Dilution of Position - The ratio of user-referenced three-dimensional position error to the measurement error of a multilateration system. PDOP is the root-sum-square of HDOP and VDOP.
>
> VDOP - Vertical Dilution of Position - The ratio of user-referenced vertical position error to the measurement error of a multilateration system (see GDOP for a more detailed description).

Download - Normal usage in avionics is that download refers to data being transferred from an aircraft module such as a flight recorder, to a computer for analysis and processing. The reverse is the "uploading" of data into the module such as settings, navigation waypoints, programs etc.

DSA - Digital Signature Algorithm. In its specialist meaning, DSA is an asymmetric system of Public/Private Key Cryptography (PKC) used in the US National Institute of Standards and Technology Digital Signature Standard (DSS). It is comparable in performance and strength to an RSA (qv) signature with the same key length, and uses a protocol called SHA-1 as the message digest algorithm. Signing a message takes about 1/2 the computation of RSA thus reducing data transfer times from Flight Recorder to PC, and some computation can be done "on the fly" while the recorder is operating normally. However, DSA takes more computation than RSA to verify a signature, the IGC VALI process taking longer than RSA (but the VALI process is not time-critical, whereas data transfer from Flight Recorder to PC is). More detail on the implementation of DSA can be found via http://csrc.nist.gov/publications/fips/fips186-2/fips186-2.pdf.

E (FAI Class) - Rotorcraft (Helicopters and Autogyros)

EAS – Europe Airsports. A European organisation that co-ordinates matters on behalf of individual Air Sports and represents them with other European bodies such as EASA (see below)

EASA – European Aviation Safety Agency, the EU regulatory agency for aviation, headquartered in Cologne

EB – Executive Board, for instance of FAI

EC – European Commission

ECAC – European Civil Aviation Conference. A group of 42 nations (both inside and outside of the European Union) with common interests in Civil Aviation matters.

EGNOS - European Geostationary Navigation Overlay Service. EGNOS is a GPS area enhancement system for the European area that makes the same kind of corrections as the North American WAAS (see below). It has been shown to reduce position errors to about one quarter those of un-enhanced GPS systems. EGNOS has a series of Ranging and Integrity Monitoring Stations (RIMS) which receive GPS signals. Master Control Centres (MCC) then process RIMS data and calculate corrections based on the known accurate position of the RIMS stations. The correction data is then sent to three special EGNOS satellites that are geostationary over the equator. GPS users on the ground in the area of EGNOS cover can receive data from the EGNOS satellites so that the corrections for the European area can be applied to raw GPS positions. EGNOS is part of a European GPS initiative and became operational in July 2005.

EGOA - Enhanced General Aviation Operation by ADS-B. See also under ADS-B and VDL-4.

EGU – European Gliding Union. The gliding branch of ESA and the IGC

Ellipsoid - A three-dimensional ellipse, the same as an oblate (flattened) spheroid. The term ellipsoid is preferred compared to spheroid or Geoid (qv) because it is mathematically unambiguous. An ellipsoid is the best simple mathematical model of the overall shape of the Earth and the currently accepted best simple overall earth model, WGS 84, is ellipsoid based, as are other geodetic datums (qv).

ELT – Emergency Location Transmitter

EMI - ElectroMagnetic Interference. This refers to interference with the working of equipment (hardware, software or firmware) due to ElectroMagnetic radiation external to the equipment. May be due to Radio Frequency (RF) radiation from radios in the aircraft itself, or from powerful RF sources outside the aircraft such as from radar and other equipment transmitting in the RF bands.

Enhancement systems, for GNSS - This term is generally used for Satellite-Based Augmentation Systems (SBAS) that apply corrections to GPS receivers over a specified area. These systems increase accuracy by monitoring errors over their area and making corrections available to compatible receivers. More detail is under SBAS below.

ENL – Engine Noise Level. ENL is a three-letter code for an FAI/IGC system where ambient noise at a GNSS recorder is also recorded together with the GNSS data. This is so that the running of an engine in FAI aircraft such as motor gliders can be automatically documented so that flight without engine can be differentiated from flight with the engine producing forward thrust.

ENRPM – European Notice of Proposed Rulemaking

EnvC - The official abbreviation for the FAI Environmental Commission. A technical commission of FAI

EPE - Estimated Position Error - An estimate by a GNSS receiver of the probability of position error in each fix, taking into account the geometry factors of DOP (qv below) with the addition of factors such as received signal strength. The probability used in the calculation should be stated so that the significance of the size of the resulting shape (frequently a circular error) is known. Probabilities are frequently calculated to a 2-sigma (95.45%) level, implying that there is about a 95% (19 out of 20) chance that the true position is inside the shape concerned. This probability figure applies to a single fix in isolation and is increased by taking into account adjacent fixes and with knowledge of how the types of aircraft is flown. The EPE value appears in the IGC file as a three number group in metres through the FXA code.

ERAM - En Route Automation Modernization, Part of the US NextGen programme (qv). The FAA computer system for high altitude en route centres processes flight radar data, provides communications and generates display data to air traffic controllers. The current system, called the Host, is being replaced by ERAM. En route controllers will be able to track 1,900 aircraft at a time, instead of the current 1,100. Coverage will also extend beyond facility boundaries, enabling controllers to handle additional traffic.

ES – Extended Squitter. See under 1090ES and Squitter

ESSARs - European Safety Regulatory Requirements. These are ATM safety-related regulatory requirements such as Safety Oversight in ATM (ESSAR 1). ESARRs are approved by the Eurocontrol Permanent Commission for implementation by Nations, National safety regulatory authorities and Air Navigation Service Providers (ANSP). The European Safety Regulation Commission (SRC) may also establishes procedures for the uniform application of ESARRs within Nations.

ETRF - European Terrain Reference Frame, a Geodetic Datum system similar to WGS84 and designed for the European area.

EUROCAE - European Organisation for Civil Aviation Equipment (www.eurocae.eu). The organisaton for certifying aviation equipment in Europe. It is a non-profit organisation formed from manufacturers of aircraft, airborne equipment, Air Traffic Management (ATM) systems and ground equipment, Service Providers, National and International Aviation Authorities and Users (Airlines, Airports, operators) from Europe and elsewhere. EUROCAE develops performance specifications and other documents that are referenced as a means of compliance to European Technical Standard Orders (ETSOs) and other regulatory documents. EUROCAE works with US standardisation bodies, including RTCA (see later) and SAE, to produce harmonised specifications where possible. EUROCAE documents also take into account ICAO standards and ARINC specifications.

Eurocontrol - the organisation for the harmonisation of air navigation services across Europe (www.eurocontrol.int). It is a civil and military inter-governmental organisation, currently with representation from 38 Member States. Its mission is to harmonise and integrate air navigation services through a uniform Air Traffic Management (ATM) system for civil and military users. Implementation will include a system known as the Single European Sky (SES). Eurocontrol is based in Brussels, Belgium, and has offices in six other European countries.

F (FAI Class) - Model Aircraft

FAA - Federal Aviation Administration, the aviation regulatory body of the USA

FAB – Functional Airspace Block. A volume of airspace that is optimised for best ATM functionality, compared to previous airspace blocks that were based mainly on individual national boundaries. For instance, in Europe it has been proposed that the airspace be divided into nine FABs. These are, in alphabetical order: 1. Baltic (based on Lithuania and Poland), 2. Blue Mediterranean (based on Cyprus, Egypt, Greece, Italy, Malta and Tunisia), 3. Central Europe (based on Austria, Bosnia-Herzgegovina, Croatia, Czech Republic, Hungary, Slovakia, Slovenia), 4. Danube (based on Bulgaria and Romania), 5. Europe Central (Based on Belgium, France, Germany, Luxembourg, Netherlands, Switzerland), 6. NUAC (based on Denmark and Sweden), 7. Northern Europe (Based on Estonia, Finland, Iceland and Norway), 8. Spain/Portugal, 9. UK/Ireland.

FAI – Fédération Aéronautique Internationale, the international air sports federation, founded in 1905.

FAI Member, Active Member - A national organisation that represents the greatest number of aeronautic and astronautic disciplines in its Country and has been elected to represent that Country in the FAI (from the definitions in FAI Statutes).

FAI Sphere - This is an approximate earth model with a radius of 6371km exactly, and has a similar volume to that of the WGS 84 ellipsoid. Where this is used for distance calculation, the distance for FAI purposes should be the length of the arc of the great circle joining given points defined by their geographical coordinates, using the same Geodetic Datum for each set of co-ordinates. A short paper titled "FAI Distance Calculations" giving the appropriate formulas and methodology, is available from the FAI Secretariat. Also, a small Java-based distance calculation program is available from the FAI office

FCL – Flight Crew License/ Licensing

FI – Flight Instructor

FIR – Flight Information Region

FIS - Flight Information Service

FIS-B - Flight Information Service – Broadcast. Part of the ADS-B system, see above under ADS-B. FIS-B is a ground-based uplink of flight information services and weather data. Other flight information provided by the FIS-B service includes Notices to Airmen (NOTAMs) and Temporary Flight Restrictions.

Fix - For IGC flight analysis, a fix is a sample of simultaneous data from GNSS satellites that successfully records the parameters required for assessment. A sample is where the Flight Recorder is set to record UTC, latitude, longitude, both GNSS and pressure altitude, fix accuracy (EPE/FXA), and any other variable required with each sample and specified by IGC. See 2D, 3D, 4D and the definitions below. A flight log consists of a series of fixes in time order. Fixes are recorded as individual lines in the B record in the IGC file, separated by CRLF.

Fix, Spurious - A GNSS fix with a significant error in time or two-dimensional position (Lat/long). Determined by analysing the fix concerned and adjacent fixes; the spurious fix will generally show an anomalous position (a side-step in 2-D position or in altitude, or both) and involve an unlikely groundspeed between it and adjacent correct fixes. It may or may not have a high EPE or DOP (see above). For flight analysis purposes such as proving presence in an FAI Observation Zone, spurious fixes must be rejected. See Sporting Code Section 3 (Gliding) Annex C (Pilot and Observer Guide) for examples and diagrams. With modern multi-channel GNSS receivers, the incidence of spurious fixes in Lat/Long, is greatly reduced compared to earlier receivers.

Fix, Valid. For flight analysis purposes, a valid fix is a one that successfully records the minimum parameters required for the analysis concerned, and is not assessed as Spurious (see above). For the purpose of assessing presence in an Observation Zone, geographical position should be the centre of the co-ordinates of the fix, ignoring any error circles.

FL – Flight Level. Pressure altitude to a 1013.25 millibar sea level datum, rounded off to the nearest hundred of feet. For instance, FL 55 is 5500ft and FL250 is 25,000ft, both to a pressure setting of 1013.25 hPa (or millibars).

FLARM - A proprietary GPS-based short-range proximity-warning system for light aircraft, gliders and other aircraft, developed by the Flarm company of Zurich, Switzerland, using frequencies in the 800 MHz band. The name is taken from the words FLight AlaRM. It transmits the GPS position and pressure altitude of the own aircraft (the "ownship") to other Flarm-equipped aircraft and displays proximity information on a cockpit indicator and also through cockpit audio. It was originally developed for flights over the Alps but has worldwide applications. It uses the Swiss uBlox TIM-LP 16-channel GPS receiver board. The operating range of the original version is about 5km. A longer-range ADS-B-compatible version may be developed. OzFlarm is a variant used in Australia that uses a different frequency to the European (Swiss) version. See www.flarm.com

Flight Level – Pressure Altitude using the ICAO International Standard Atmosphere (ISA) scale, in thousands of feet but dropping the last two characters. For instance, FL55 is 5,500ft and FL360 is 36,000 ft, each to the ICAO ISA.

Flight Recorder Serial Number (S/N) - In the IGC recorder system, a unique set of three alphanumeric characters allocated by the manufacturer to a individual Flight Recorder. It appears in the beginning of the IGC file as part of the "A Record". For complete identification, the S/N is prefixed by the manufacturer's name and the Flight Recorder model number.

FOC – Full Operational Capability. See also IOC

FR - Flight Recorder. In IGC terms, a device recording data for the purpose of flight validation to IGC/FAI criteria, such as a GNSS Flight Recorder. A GNSS Flight Recorder is a device capable of producing an IGC flight data file, and includes a GNSS receiver, pressure altitude sensor (IGC requirement), and a memory storage device. It may also include other

facilities such as those for detecting operation of the Means of Propulsion (MoP) in a Motor Glider, the input of Way Points and flight declarations, etc.

Fruit – A type of interference in radar systems

FTM – False Target Mitigation. A system designed to reduce the incidence of false radar targets

g - Acceleration due to average gravity at the surface of the Earth (9.81 m/sec^2)

G - Multiple of average surface gravity force on an aircraft under acceleration. Under 2G a person weighting 100kg would appear to weigh 200kg.

G (FAI Class) - Parachuting

GA - General Aviation. Aviation other than Commercial Air Traffic (CAT) and Military aviation. It is generally taken to exclude expensive business jets and similar aircraft. The term "light GA" is sometimes met when dealing with aircraft with which the General Sporting Commission of FAI is primarily concerned.

GAC - General Aviation Commission (of FAI)

GAGAN – GPS Aided Geostationary Augmentation System, a Satellite-Based Augmentation System (SBAS) for the Indian region

Galileo – The future European GNSS system. In March 2002, the European Union (EU) and European Space Agency (ESA) agreed to produce the system, and the Galileo project was formally launched in May 2002 under EU Council Regulation EC 876/2002, creating the Galileo Joint Undertaking (GJU). In September 2003, China joined the Galileo project, Israel in July 2004, Ukraine in June 2005, India in September 2005, Morocco and Saudi Arabia in September 2005 and South Korea in January 2006. In June 2004, the European Union agreed with the USA that Galileo would use the BOC 1.1 signal modulation system, enabling the coexistence of GPS and Galileo on future receivers. In November 2007, the 27 EU transportation ministers agreed that Galileo should be operational by 2013, at a reported cost of about 3.4 billion Euros. There are intended to be 30 satellites at an altitude of about 22,200 km and in three groups at an orbital plane of 56 degrees. Galileo will under civil control and is intended to be interoperable with the Russian GLONASS and US GPS systems. See http://ec.europa.eu/transport/galileo

GAT – General Air Traffic

GBT – Ground Based Transceiver.

GD - Geodetic Datum, see below

Gel Cell - A type of electrical battery in which the electrolyte is in gel (jelly), rather than liquid form, to prevent spillage. Generally Gel Cells use the lead-acid principle and come as 12 volt units. They are extensively used in sport aircraft that have no electrical generating power, or limited generating power. See above under "battery".

General Commission (of FAI) - The Air Sport General Commission of FAI (CASI, qv). Terms of Reference are in FAI ByLaw 5.2. The Air Sport General Commission is responsible for the General Section (GS) of the FAI Sporting Code.

General Section – of the FAI Sporting Code (the GS). The Air Sport General Commission of FAI (CASI, qv) is responsible for the FAI GS.

GEO, Geostationary – A satellite that maintains a relatively constant position over a point on the earth's surface. Due to orbital dynamics, this can only be achieved over the equator. Because the earth is not a pure ellipsoid but has bumps and depressions, small variations of gravity on a geostationary satellite cause it to slowly start a "figure of eight" path of increasing magnitude. This is normally corrected every now and again by firing small thrusters to retain its geostationary position. Geostationary satellites are used for a number of purposes, one being the relaying of accuracy enhancement information in Satellite Based Enhancement Systems (SBAS), which see below.

Geodesic - A Geodesic is the shortest distance between two points on the surface of an ellipsoidal world model. It is the ellipsoid equivalent to a Great Circle on a sphere. Once accurate lat/longs are available based on the same geodetic datum, the ellipsoid /geodesic distance between them can be calculated using one of a number of freeware computer programs that are commonly available. For FAI distance calculation purposes, the WGS84 ellipsoid is used (GS 7.3.1.1). A small Java-based distance calculation program for the WGS84 ellipsoid is available on the FAI web pages

Geodetic Datum - In Geodesy (large-scale Earth Measurement), when a mathematical model of the earth's shape is fixed at a particular orientation and position with respect to the Earth, it constitutes a so-called `Geodetic Datum', over which a grid of latitude and longitude (or other geographic reference system) can be constructed. Most Geodetic Datums are based on the shape of an ellipsoid; WGS 84 is an example. Having fixed a geodetic datum, map projection methods are then used to represent the three-dimensional earth model on a two-dimensional map into a flat map sheet (including topographical features and the reference grid). Over 200 Geodetic Datums (GD) are in current use and generally were chosen for the `best fit' of their particular mathematical model to the shape of the earth over the map area concerned. Lat/long figures, to be unambiguous, should quote the GD used which is normally given in the data at the edge of each map. The WGS 84 Datum is generally accepted as the best simple mathematical model for the overall shape of the earth. It is an ellipsoid with an equatorial radius of 6378.1370 km and a polar radius of 6356.7523 km, and is centred on the earth's centre and orientated to the spin axis. PC-based transformation programmes are available which convert latitudes and longitudes from those relevant to one Geodetic Datum, to WGS 84 or other Datums. For the same position on the earth's surface, differences in lat/long figures between the different Geodetic Datums vary from a few metres to a few kilometres. These differences are not errors, each lat/long figure is perfectly correct, it is only the different GD (world mathematical model) which changes the lat/long figures for a given point on the earth's surface. Therefore, for distance calculations to be accurate, the lat/longs of points at the beginning and end of the leg concerned must be with respect to the same Geodetic Datum (see GS para 7.3.1.1). The WGS 84 Datum can be used in deriving lat/longs for long distance calculations and is used by ICAO and national aviation agencies in defining highly accurate standardised runway datums for the use of GNSS as a runway approach aid.

Geoid - Sometimes used to mean a generalised earth model. In the WGS84 system it has a more precise meaning, the shape of a theoretical equi-potential surface due to the gravity effect of the earth's mass and terrain, but without external gravity (ie no spin, no tides). In this more precise meaning, the WGS84 geoid is a smooth but irregular surface over the whole earth, close to Mean Sea Level (MSL). The maximum differences between the WGS84 Geoid and the WGS84 Ellipsoid are +65m at 60N 030W (S of Iceland, geoid above the ellipsoid) and -102m on the equator at 080E (S of India, geoid below the ellipsoid). The variation depends on the gravity effects of mountains, ocean trenches, crustal thickness and density. It is used in the form of an electronic `look-up table' in many GNSS receiver systems to indicate an approximate Sea Level datum for GPS altitude readings, but will not correspond exactly with Above Sea Level (ASL) altitudes given on local maps. It was used in the past in the selection of the ellipsoid (qv) that was the `best fit' for the region concerned. See also Ellipsoid and Spheroid.

GFAC - The GNSS Flight Recorder Approval Committee of IGC. Its Terms of Reference are in Chapter 1 of Annex B to the Sporting Code Section 3 (Gliding).

GLONASS - The Russian GNSS system, the initials standing for GLObal'naya NAvigatsionnaya Sputnikovaya Sistema (GLObal NAvigation Satellite System). Unlike the US GPS system, GLONASS alters its system time on the date and time of every leap-second and is inoperative while doing so (see under GNSS, GPS, and UTC). Its system time is based on Moscow time rather than UTC.

GNSS - Global Navigation Satellite System. A system that includes a constellation of satellites in earth orbit and equipment that receives signals from them in order to calculate the position of the receiver. It includes the European Galileo, Russian GLONASS and US GPS systems. The Peoples Republic of China (PRC) is developing the Beidou system. The principle of operation is that receivers calculate the small time delays between the receipt of signals from different satellites, whose exact position is known from predictions of their orbits. The exact time is known to an accuracy of better than a nanosecond, through atomic clocks carried in the satellites and maintained in accurate calibration by the GNSS system ground control centre. When accurate time and signals from the satellites is combined with a mathematical model of the earth's shape (see Ellipsoid and Geodetic Datum), the receivers are able to calculate 3D position anywhere on the earth's surface to an average accuracy of 10 metres or better.

GNSS Altitude - This is altitude calculated solely from GNSS position lines. In the IGC format file, GNSS altitude must be referenced to the WGS84 ellipsoid (that is, not a Geoid). Where GNSS altitude is not available from GNSS position-lines (2D fix, altitude drop-out), it is recorded in the IGC format file as zero so that the situation can be clearly identified during post-flight analysis. Note that in other GNSS systems, GNSS altitude may be set to show approximate altitudes above local sea level by calculating distance above a Geoid. This is normally through an electronic look-up table giving geoid heights above and below the selected ellipsoid rather than distance above the ellipsoid appropriate to the selected Geodetic Datum.

GNSS equipment for flight verification - includes the GNSS receiver and associated Flight Recorder (FR) system, including the antenna and all associated hardware such as the processing, data storage, cockpit display and keyboard modules, pressure-altitude sensor (IGC requirement), and the engine sensor for Motor Gliders. It also includes the associated software and firmware (Such as ROM) both in the aircraft GNSS equipment and also where used for

transferring data into and from the aircraft equipment from PCs. Software processing using PCs includes the analysis and presentation of flight data. It may also include the preparation of data about gliding sites, turn points, time zones, geodetic datums, pilot information, and so forth; for transfer into the aircraft GNSS equipment, in accordance with the procedures in the appropriate Sporting Code.

GP – General Practitioner, a medical doctor

GPS - Global Positioning System, the US GNS System administered jointly by the Department of Defense (DoD) and the Department of Transportation (DoT). Signals are normally available from 24 out of 27 satellites in six circular orbital planes at 55 degrees to the equator at an altitude of 20,200km and an orbital period of 12 hours. The control segment of GPS consists of five monitor stations, three ground antennas and a master control station. Receiver-processors (GPS units) provide 3-D position and precise timing to the user.

GPS system time - is the continuous and highly accurate time kept by the GPS satellites. In the US GPS system, it began as UTC for 6 Jan 1980 when the system first became operational, and continues to maintain that time frame. It does not change with the 'leap seconds' additions that are made to UTC to allow for the slowing down of the Earth's rotation (see under UTC). In year 2007, UTC was 13 seconds later than GPS System Time. However, the GPS system keeps track of leap seconds corrections, and these are sent as part of the satellite's message to users. Most receivers use the GPS satellite message automatically to compensate and output UTC rather than GPS time. In some GPS receivers, stored track records do not take leap seconds into account and output in GPS system time, whereas NMEA data outputs generally include leap seconds and times are corrected to UTC.

Grandfather rights. This term is used for a situation where the approval of a type of equipment is continued unaltered although the Specification conditions have changed with time (generally, increased). Detail on its application to IGC-approved GNSS Flight Recorders is in para 1.1.3.3.5 of Annex B to the Sporting Code Section 3 (Gliders).

GS - The General Section of the FAI Sporting Code, for which the Air Sport General Commission of FAI (CASI) is responsible. See also under CASI, General Section.

H (FAI Class) - Vertical Take-off and Landing Aircraft

Hard/Soft Data/Storage - Hard data or storage is that which is not lost when the unit concerned is switched off or its battery fails or is removed. Soft data is otherwise.

Height - The vertical distance from a given height datum such as the take-off place. See also `QFE', and `Altitude'.

HF – High Frequency, Human Factors

HMI – Human-Machine Interface

Homologation - The validation of a Flight Performance by an NAC or FAI for record purposes

hPa - Hecto Pascal (Pressure unit, equal to a millibar)

Horizontal fix accuracy - the best prediction for the horizontal 2-sigma (95%) value of the overall position error. Included in the IGC data file in the B (fix) record through the FXA three-letter code.

HX – A descriptor for a time-dependant system (H = hours) such as the application of airspace restrictions on a time-basis such as day-only, weekday-only, weekend-only, etc.

I (FAI Class) - Human Powered Aircraft

IAG - International Association of Geodesy

IAIN - International Association of Institutes of Navigation

IAOPA - International Council of Aircraft Owner and Pilot Associations, a federation of 66 national general aviation organisations, see www.iaopa.org).

IAS - Indicated Airspeed. The speed indicated on a pilot's Airspeed Indicator in the cockpit. This is essentially a measure of the pressure of air in a forward-facing pitot tube, calibrated in units of speed rather than pressure. If perfectly calibrated,

this should indicate the same as True Airspeed (IAS) at Sea Level (SL), but due to decreasing air density with altitude, TAS will increase such that at 40,000 ft TAS is about twice IAS.

IATA – International Air Transport Association

IATCC – Integrated Air Traffic Control Centre

ICAO - International Civil Aviation Organisation with its HQ in Montreal, Canada. Nations are represented at Ambassador level. See www.icao.int

ICAO ISA – ICAO International Standard Atmosphere. See under ISA

ICARE - International Commission for Astronautics Records, an FAI Commission

ICAS - The International Cooperation on Airport Surveillance (ICAS) (www.icas-group.org) is a group of Airports, Air Navigation Service Providers (ANSPs) and Eurocontrol. Some 40 ANSPs are represented and airport authorities come from 26 nations.

ICB - Industry Consultation Body

ICD – Interface Control Document

ICG – International Committee on GNSS, an Industry Consultation Group sponsored by the United Nations Office for Outer Space Affairs (UNOOSA) in Vienna (www.oosa.unvienna.org/oosa/en/SAP/gnss/icg/activities.html)

IFR - Instrument Flight Rules. These are regulations and procedures where navigation and obstacle clearance is maintained with reference to aircraft instruments only and separation from other aircraft is provided by Air Traffic Control. The main purpose of IFR is the safe operation of aircraft in Instrument Meteorological Conditions (IMC), that is, when the weather does not meet the minimum requirements for Visual Meteorological Conditions (VMC). IFR should not always be equated with IMC. In good weather, flight under IFR is carried out in VMC.

IGC - International Gliding Commission

> IGC Approval - GNSS Flight Recorders (FRs) are subject to a special approval process before they can be used in the verification of flight performances to IGC/FAI criteria. The IGC GNSS Flight Recorder Approval (GFA) Committee (GFAC) tests and evaluates GNSS FRs and issue approval documents on behalf of IGC.

IGS - International GNSS Service

IMC - Instrument Meteorological Conditions. Meteorological conditions poorer than VMC (qv) and in which flight by Instrument Flight Rules (IFR) applies (see above for IFR). VMC requirements for visibility and separation from cloud vary by country and class of airspace. Typical visibility requirements vary from 1,500m to 8km (1-5 miles). Typical cloud clearance requirements vary from simply remaining clear of cloud to remaining at least 1,500m (1mile) from cloud horizontally and one thousand feet vertically.

IN/INS – Inertial Navigation (System)

IOC – Initial Operational Capability. See also FOC. Also International Olympic Committee, headquartered in Lausanne.

ION – Institute of Navigation

IP - Instructor Pilot

IPC - International Parachuting Commission

IR – Infra-Red, Interoperability Regulation

IRNSS - Indian Regional Navigational Satellite System. A regional satellite navigation system being developed by the Indian Space Research Organisation. The Indian government approved the project in May 2006, with the intention of the system to be completed and implemented by about 2012. By this date it is intended that 7 satellites will be in Geostationary orbit (GEO) (India is close to the Equator) and a lower number of other satellites will also be used. It is intended to provide 20 m accuracy over India and 2,000 km around it.

ISA - International Standard Atmosphere. The ICAO ISA is used by FAI and the rest of world aviation for the calibration of pressure altimeters and barographs. Detail is given on the Web and in ICAO Document 7488 tables 3 and 4, a copy of which is held at FAI HQ. It assumes sea level conditions of 15° Celsius and an atmospheric pressure of 760 mm of mercury (1013.25 mb/hPa). Above sea level, it assumes a constant temperature lapse rate of 6.5°C per 1000 m (1.98°C or /3.56°F per 1000 ft) rise in height, up to an altitude of 11,000 m (-56.5°C). 11,000m is assumed to be the Tropopause, above which the ICAO ISA assumes constant temperature (-56.5°C) is assumed. Pressure figures from this ISA are used in calibration of barographs and altimeters. Although the real atmosphere varies from day to day, for calibration purposes a set of internationally agreed figures is needed so that all altimeter readings and calibrations are to the same datum, whether or not such figures correspond to `true' height on a given day.

ISD – In Service Date / Decision

ISO - International Standards Organisation, HQ in Geneva, Switzerland

ITRF - International Terrain Reference Frame, a Geodetic Datum system similar to WGS84

JAA, JAR – Joint (European) Airworthiness Authorities, JAA Airworthiness Requirement. The JAA functions have been absorbed by the European Aviation Safety Agency (EASA).

JHUAPL - Johns Hopkins University Applied Physics Laboratory. A US not-for-profit R&D organization with HQ at Baltimore, Maryland, USA. The University is named after Richard Johns and Gerard Hopkins

JPDO - Joint Planning and Development Office

JU – Joint Undertaking. As in SESAR JU, see under SESAR

K (FAI Class) - Spacecraft

LAPL – Light Aircraft Pilot Licence

Latitude - North/South angle on the Earth's surface from the equator. In the IGC flight data format, this is a seven character numeric group expressed as two figures for the degrees, two figures for the minutes and three figures representing tenths, hundredths and thousandths of minutes followed by the N or S character.

Leap Second - see under UTC

Lithium Ion – a type of electrical battery, see above under "battery".

Longitude - East/West angle on the Earth's surface from the Greenwich meridian. In a the IGC flight data format, this is an eight character numeric group expressed as three figures for the degrees, two figures for the minutes and three figures representing tenths, hundredths and thousandths of minutes followed by the E or W character.

LORAN – Long Range Aid to Navigation (system). LORAN-C operates from 90 to 110 kHz and derives position data of the receiver from the time difference between signals from a pair of radio transmitters. A constant time difference between the signals from two stations can be represented by a hyperbolic line of position (LOP) and such systems are sometimes referred to a Hyperbolic Navigation Systems. LORAN-C users include the United States, Japan, and several European countries. Russia has a similar system in the same frequency range called CHAYKA. LORAN was an American development of the British GEE system that was used during the 1939-45 World War.

M (FAI Class) - Tilt-Wing Aircraft

Madtran – Mapping Datum Transformation. Madtran programs are available that transform co-ordinates for one Geodetic Datum to another.

MASPS - Minimum Avionic System Performance Standards. For instance, US FAA MASPS are published in RTCA document DO-242

MDA – Minimum Decision Altitude

MEO – Medium Earth Orbit

MG - Motor Glider (FAI Class)

min - Minute, unit of time (UT), compared to 'arcmin' which is 1 minute of angle

Mitigation – Procedures and methods aimed at reducing the adverse effects of one system on another

MLAT – Multi-lateration

Mode A, C, S – Types of radar transponder equipment. Mode A re-transmits (transponds) with one of 4096 codes set on the equipment. Mode C adds altitude. Mode S stands for "Selective" where the interrogating round station can selectively turn on or off the response from that transponder.

Monopulse radar - an adaptation of conical scanning radar that sends additional information in the radar signal in order to avoid problems caused by changes in signal strength. The system also makes jamming more difficult. Most radars designed since the 1960s are monopulse systems.

MoP - Means of Propulsion, for Motor Gliders. A MoP Recorder is a recorder used in motor gliders which is capable of producing an after-flight record of operation of the Means of Propulsion (MoP) against a timebase for the flight. The timebase may be that of a barograph or of a GNSS Flight Recorder. It must be shown that the sensor and its method of operation is such that a record will always be made when the MoP is operated so as to provide a forward thrust force, irrespective of pilot actions in the cockpit.

> MoP Inoperative - The MoP is not in a position to generate propulsion, such as when a pylon-mounted engine or propeller is stowed in the fuselage and physically cannot generate propulsion in this position, or a propeller can be shown to be feathered. In the case of the Stemme (patent) retractable propeller, that the nose-cone into which the propeller retracts, is closed.
>
> MoP Operative - The MoP is in a position to generate propulsion, but is not necessarily generating forward thrust. In most aircraft this indicates that the MoP pylon is extended, or that the engine doors are opened, or that the prop is unfeathered, or, in the case of the Stemme (patent) retractable propeller, that the nose-cone into which the propeller retracts, is opened.
>
> MoP On - The MoP starts to or is generating forward thrust. Generally by showing in some way that the propeller has started rotating, or that a jet engine has begun giving thrust.
>
> MoP Stop - The MoP stops generating forward thrust. Generally by showing in some way that the propeller has stopped rotating, or that a jet engine has ceased giving thrust.

MOPS - Minimum Operational Performance Standards

m/s - Metres per Second

MSAS - Multi-Functional Transport Satellite (MTSAT) Space-Based Augmentation System (Japan)

MSL - Mean Sea Level

MSPSR, MS-PSR – Multi-Static Primary Surveillance Radar

MSR – Multi-Static Surveillance Radar

MSSR – Monopulse Secondary Surveillance Radar

MTOM – Maximum Take Off Mass

MTSAT - Multi-Functional Transport Satellite

Multilateration, MLAT - literally, having many sides, the shape of such a geometric figure. Therefore, in navigation systems, the obtaining of a fix from multiple lines of position which, if plotted out, would form a multi-sided figure (sometimes called a "cocked hat" by navigators because that is what it sometimes looks like when plotted on a chart). Modern aviation MLAT systems use an array of ground stations that receive signals from an aircraft and calculate its

position using time-difference principles. The data on aircraft in the area can then be used for Air Traffic Management purposes.

NAA – National Aeronautical Association

NAC – National Airsport Control., or Navigation Accuracy Category. In FAI, the National Airsport Control (NAC) body is part of the organisation of each FAI Member, The NAC is responsible for making sure that National officials and others are aware of current FAI Rules and Procedures. These include those in the General Section of the Sporting Code and the Specialist Sporting Codes for individual Air Sports. Such individuals include Officials including Members of appropriate Committees, Championship Directors, Judges, Official Observers and others requiring copies of appropriate Sporting Codes.

NACp - Navigation Accuracy Category for Position

NAS - National Airspace System

NATS - National Air Traffic Service/Services. Self-explanatory for organisations in a number of countries.

NDB – Non-Directional Beacon. A radio beacon for aircraft and marine navigation. For aviation, ICAO Annex 10 specifies that NDBs be operated on a frequency between 190 kHz and 1750 kHz

NDGPS - Nationwide Differential GPS System. This is a ground-based GPS augmentation system operated by the U.S. Coast Guard, Federal Railroad Administration, and Federal Highway Administration. Modernisation efforts include the High Accuracy NDGPS (HA-NDGPS) system, to enhance performance and provide 10-15 centimetre accuracy throughout the coverage area. See www.tfhrc.gov/its/ndgps

NEASCOG - NATO/EUROCONTROL ATM Security Coordinating Group

NERL – NATS En-Route Limited. A UK company providing Air Traffic Services.

NextGen - short for "Next Generation", the future Air Traffic Management (ATM) system of the U.S. Federal Aviation Administration (FAA). NextGen is designed to transform ATM from a system based on ground radars to a system based on satellite-based aircraft navigation equipment. This is to be achieved through the US Next Generation Air Transportation System Integrated National Plan. Implementation of NextGen is through a Joint Planning and Development Office (JPDO). The JPDO is made up of representatives from the Departments of Transportation, Defense, Homeland Security, Commerce, the FAA, NASA and the White House Office of Science and Technology Policy. It is also supported by a wide range of private sector aviation experts. Equivalent European programmes include CASCADE and SESAR, see elsewhere in this Glossary. See www.faa.gov/about/initiatives/nextgen

NIC - Navigation Integrity Category

NiCad – Nickel Cadmium, a type of electrical battery. See above under "battery".

NiMH – Nickel Metal Hydride, a type of electrical battery, see above under "battery".

NMEA - National Marine Electronics Association. NMEA is an international body with its HQ in Maryland, USA and publishes data standards for interfacing marine electronic devices. As GNSS was developed for the marine as well as the aviation market, most GNSS manufacturers use NMEA standards to interface GNSS to peripheral devices. NMEA data is divided into groups called "sentences" identified by three-letter codes, the details being given in documents such as NMEA 0813. For instance the sentence GGA gives GPS fix data, GNS gives fix data for all GNSS systems (US GPS, Russian GLONASS, European Galileo and any other systems), GSA gives the satellites in view at any one time. Some GNSS receiver boards output NMEA data directly and others use manufacturer's binary or other output formats. See www.nmea.org

NNEW – NextGen Network-Enabled Weather information. See under NextGen

NOTAM - NOtices To AirMen. Published notification of matters that pilots should be aware of, such as temporary airspace restrictions, unusual air activity and so forth. Such matters include air displays, military exercises, air races and competitions.

NPA – Notice of Proposed Amendment (for instance to air Regulations)

NPRM - Notice of Proposed Rulemaking (for instance to air Regulations)

NRA – National Regulatory Authority, Non-Rulemaking Action

NSA – National Supervisory Authority. Under the Single European Sky (SES) program, each EU member state has established a NSA with the object of effective regulation and avoidance of conflicts of interests. Since 20 June 2007, Air Navigation System Providers (ANSPs) are certificated by the NSAs under EU Regulation 2096/2005.

NTSB - National Transportation Safety Board. A body in the USA concerned with safety issues in transport systems on land, sea on air.

NVS - National Airspace System (NAS) Voice Switch

O (FAI Class) - Hang Gliders and Paragliders

O&R - Out and Return

OS – Operating System. When applied to computing, the underlying system through which other system operates, such as the MicroSoft Windows™ series

Obligations - Obligations of NACs to FAI are listed in FAI Statute 2.4.2.2. They include conforming to the FAI Sporting Code (General Section and Specialist Sections) and fulfilling financial obligations to FAI. When an FAI Member has fulfilled its obligations to FAI it is said to be "in good standing" with FAI.

OO - Official Observer

OSTIV – Organisation Scientifique et Technique de Vol a Voile, the specialist scientific and technical organisation of IGC

OZ - Observation Zone. A volume of airspace within which a valid fix is required to validate an FAI event such as start, reaching a turn point, and the finish of a flight performance. Fixing may be from a series of GNSS fixes, by photography or by direct observation by Observers. The various Sporting Codes define the shape of such OZ for each FAI Air Sport. For GNSS fixes, a turn point OZ is often defined as a 90 degree area, the bisector of which is opposite the bisector of the two legs making up a turn point, or opposite to the first course leg for a start, and the last course leg for a finish. A Circular OZ for turn points can also be used. For starts and finishes, lines of finite length are also used.

P (FAI Class) - Aerospacecraft

PGP - Pretty Good Privacy. A commercial system for electronic security that uses RSA asymmetric keys, first publicised by Philip R Zimmerman in June 1991 through a public Internet bulletin board. The US authorities initially tried to prosecute Zimmerman for a security breach, but after 3 years gave up the attempt. See http://www.pgp.com . The rights of Zimmerman's company PGP, Inc., were later sold to Network Associates, http://www.nai.com . It has been estimated that over 500 million copies of PGP are in use worldwide, and the `padlock' symbol on a PC screen normally indicates that the PGP system is available.

Pilot Event (PEV Code) - In GNSS recording systems, the pilot records an event in time and space, generally by pressing an `event button' that takes an additional GNSS fix and marks the time as a Pilot-recorded Event (PEV) on the flight data that is downloaded after flight. It has no significance in the flight verification process for FAI flight performances but may be required in competitions (such as to identify a start), and be useful to the pilot as a reminder of what happened at that time. A Pilot Event is also used to start a sequence of GNSS fixes at short time intervals (fast-fix facility).

PKC - Public/private Key Cryptography. A system where the recipient of a message has an encryption system that is not secret (the Public Key) and is used by people sending messages to him. However, the mathematical factors that make up the Public Key are only held by the recipient (the Private Key), and are needed before the message can be de-coded. The PKC principle was discovered in 1973 by James Ellis and Clifford Cocks of the classified Government Communications HQ organisation in the UK, but this discovery was not publicised until later. It was then discovered in May 1975 by Whitfield Diffie, Martin Helman and Ralph Merkle (DHM) of the Electrical Engineering Department of Stanford University, USA, who published a paper on the subject. The first commonly available practical application of PKC was the RSA system (qv).

PPL – Private Pilot's Licence.

Pressure Altitude - In the IGC flight data file format, this is a five number group giving the pressure altitude in metres with respect the International Standard Atmosphere (ISA) used in aviation, to a sea level datum of 1013.25 HPa. The pressure recorded in the IGC file may either be "cockpit static" (vented within the Flight Recorder box), or use a tube connection to the aircraft instrument system static tubing. If the pressure altitude signal within the Flight Recorder is used for other purposes such as cockpit instrument readings that can be set to other datums such as QNH or QFE, a one-way transmission system must be used so that the IGC file always records the required ISA to the 1013 sea level datum irrespective of other settings used for flight instruments. The use of instrument-static is intended for a GNSS Flight Recorder mounted in the instrument panel. With such an installation, the pre-flight inspection of the Flight Recorder installation must check the tubing and the pressure connection to the Flight Recorder to ensure that they will be out-of-reach of the aircrew in flight. This is to prevent alteration to the IGC-file pressure altitude record.

PRM – Precision Runway Monitor. A radar system designed to allow aircraft to make near-simultaneous approaches to different parallel runways.

P-RNAV – Precision Area Navigation. See also R-NAV

Projection – In mapping, a process whereby a flat map can be produced from a curved earth model. In theory, an infinitely small light course is placed at the centre of the earth model and a flat surface placed over the outside of the earth model. The lat/long grid on the earth model is then "projected" on to the flat surface and becomes the reference grid on the map, to which topographical and other features are then added. Mercator projections are cylindrical, where a cylinder of paper (normally orientated N/S) is placed over the earth model. Conical projections such as Lambert's use a cone which touches the earth model at two radii, also known as a "conical projection with two standard parallels".

Proof Drive or Flight - A method of checking that a Flight Recorder produces a correct IGC flight data file. Under the control of an OO or other official, the Flight Recorder is taken on a drive in a vehicle or on a flight in an aircraft, over a course with known co-ordinates. A proof drive in hilly terrain can be used to check altitude data, and a proof flight can check not only altitude data but other records such as a motor glider engine. A proof drive including an identifiable turn or a marked fix at a surveyed point can be used to check GNSS fix accuracy and is used by the IGC GFA Committee for this purpose with each Flight Recorder tested

PSR – Primary Surveillance Radar

Pseudo-range - a measure of the apparent propagation time from the satellite to the receiver antenna, expressed as a distance. The distance from the user to a ranging source (for instance a satellite) plus an unknown user clock offset distance. With four ranging source signals it is possible to compute position and offset distance. If the user clock offset is known, three ranging source signals would suffice to compute a position.

QFE - An altimeter Pressure Setting which indicates zero altitude when at airfield height

QFI - Qualified Flying Instructor

QNH - An altimeter Pressure Setting which indicates height above Mean Sea Level (MSL)

qv – Quod Vide (Latin), literally, "which see". Used where it is suggested at the reader should look elsewhere, for instance for a definition or other reference such as a paper or presentation.

QZSS - Quasi-Zenith Satellite System. A three-satellite regional enhancement for GPS, receivable within Japan. The first satellite is scheduled to be launched in 2009.

R (FAI Class) - Microlights, Powered Hang Gliders and Powered Paragliders

RAIM - Receiver Autonomous Integrity Monitoring. A system inside a GPS receiver that automatically compares the position-line obtained from each satellite with other position-lines being received at any one time. Any anomalous ("rogue") position lines are then discarded for the purpose of calculating the fix for the time concerned. A numeric code is used which indicates 0 if RAIM is satisfied and 5 when not. In theory, RAIM calculations can be based on a minimum of four position lines (three good ones and the "rogue") but in practice, six satellite position-lines are needed for the system to operate properly. With a 12- or 16-Channel receiver and the antenna in a good position, this is not normally a problem. See also SBAS.

RAS – Radar Advisory Service

RAT – Remote Alert Type.

RCS – Radar Cross Section. The size of a radar return, normally expressed as a figure in Square Metres

RIM – Runway Incursion Monitoring (system)

RIS – Radar Information Service

RMCDS - Radar Message Conversion and Distribution System

R-NAV - Regional (or Area) Navigation. Specifically, the use of aircraft GNSS systems to allow more versatile use of airspace. Also P-RNAV for Precision R-NAV.

RNP – Required Navigation Performance. A high level of navigational systems accuracy and reliability appropriate, for instance, to flight in Controlled Airspace (CAS).

RPR – Rulemaking Project Record (FAA term)

RPT – Regular Passenger Transport

RSA - A system of Public/Private Key Cryptography (PKC), developed by Ronald Rivest, Adi Shamir and Leonard Adelman of MIT, employing an asymmetric system for key exchange. First published in an article in Scientific American in August 1977. The company RSA Security Inc was formed to apply it commercially. More detail on the implementation of RSA can be found in the book "Applied Cryptography" by Bruce Schneier, 2nd edition, ISBN 0-471-11709-9. An overview of various cryptographic algorithms can be found in http://www.ssh.fi/tech/crypto/algorithms.html. High Speed RSA Implementation (PDF file) is in: ftp://ftp.rsasecurity.com/pub/pdfs/tr201.pdf. Details of the FIPS 180 Secure Hash Standard are in http://www.itl.nist.gov/fipspubs/fip180-1.htm. Cryptographic libraries with source code in C and C++ are in: http://www.cs.auckland.ac.nz/~pgut001/cryptlib and http://www.eskimo.com/~weidai/cryptlib.html. The IGC GFAC will give advice as necessary.

R/T – Radio Telephony. Normally applies to voice communications by radio

RTCA Inc - a US not-for-profit corporation concerned with aviation and aviation electronic systems. It functions as a US Federal Advisory Committee and develops recommendations on aviation issues based normally on consensus. Nearly 300 organizations are members, about one-quarter being non-US, one of which is FAI. The initials RTCA originally stood for Radio Technical Commission for Aeronautics, a previous government body that was discontinued. The initials RTCA no longer have a longer official form, but the bottom of its letter pages has the words: Requirements, Technology and Concepts for Aviation. See www.rtca.org

RTT - Research Transition Team

RU – Radar Unit, Remote Unit, Recorder Unit

RVSM – Reduced Vertical Separation Minima. Due to improvements in pressure altitude sensors, the 1000 ft vertical separation that has been used in the lower levels has been extended to FL 410 (41,000ft)

S (FAI Class) - Space Models

SA – Situational Awareness. Also Selective Availability, a deliberate error that was applied to non-military receivers for the the U.S. GPS system. SA was removed on 1 May 2000 through a protocol signed by President Clinton, and the positional accuracy of civil GPS systems increased by a factor of about five.

SAAAR - Special Aircraft and Aircrew Authorization Required

Safeguarding – a process where elements critical to a particular operation are identified and monitored so that the operation is not compromised by unexpected changes. An example is airfield operations where, for instance, applications to build large vertical features close to circuit and approach patterns, would be resisted.

SAMM – Surface Area Movement Management. An ADS-B GNSS-based system for tracking aircraft and other vehicles in an airport ground environment.

SARPS – Standards and Recommended Practices. For instance, ICAO SARPS

SASP – Separation and Airspace Safety Panel, of ICAO

SASS-C - Surveillance Analysis Support System for ATC Centre. Eurocontrol software for performance assessment.

SAT – Service Acceptance Test

SBAS - Satellite-Based Augmentation System. A system that increases GNSS accuracy by monitoring errors at ground stations in the area concerned and making corrections and other data available to compatible receivers. For GPS, systems in service include WAAS (North America) and EGNOS (Europe). Other future SBAS systems include GAGAN (India) and MSAS (Japan). A Ground-Based Augmentation System (GBAS) is being developed in Australia.

SBS - Surveillance and Broadcast Services

SCG – Standards Co-ordination Group, also Stakeholder Consultation Group

SCRSP - Surveillance and Conflict Resolution Systems Panel. An ICAO panel

SDCM - System of Differential Correction and Monitoring. Russia is developing its own System for Differential Corrections and Monitoring (SDCM) and has proposed to consolidate it with the European EGNOS enhancement system. A joint ESA and Roscosmos working group has developed a number of pilot projects over the European part of Russia for demonstration of a combined EGNOS and SDCM system.

Security - Digital Signature (DS) - A Digital Signature (DS) is a set of encrypted data generated by an Flight Recorder and transferred form the Flight Recorder with the flight data. Mathematically, the DS corresponds with (matches) the flight data in such a way that any subsequent alteration of any part of the flight data destroys the correspondence (the data match) and so the alteration is detectable. See Chapter 2 para 2.8.3 of the Specification for IGC GNSS Recorders.

SES - Single European Sky. An EU programme started in 2004 under four EU Regulations with a view to obtaining a logical European-wide airspace and ATM structure with less regard to the boundaries of individual nations. A Single Sky Commission advises the EU Commission and works with civil and military authorities, some non-EU nations and ICAO. Technical support comes from Eurocontrol and an Industry Consultation Body exists to take commercial factors into account. Under SES, each member state has established a National Supervisory Authority (NSA, qv). Other SES functions include transparency of charging for Air Navigation services, harmonisation of licensing of Controllers, equipment interoperability, future research under SESAR (see below) and formulation of an ATM Masterplan.

SESAR - Single European Sky Air Traffic Management (ATM) Research Programme. This is a European-wide ATM improvement programme that started in 2004 It involves civil and military, legislators, industry, aircraft operators, ground and airborne users. It also supports Single European Sky (SES) legislation. SESAR objectives include transforming the European ATM system, eliminating the previous fragmented approach to ATM across European Nations, synchronising plans of the different partners and pooling of resources. SESAR is being run in three major phases: 2005-2008, Definition Phase; 2008-2015, Development Phase; 2014-2020, Deployment Phase. The equivalent programme in the USA is called NextGen, see above.

Shall - See under `Wording'

Should - See under `Wording'

SIL - System Integrity Level

Single European Sky (SES) - an initiative launched by the European Commission to restructure European airspace as a function of air traffic flows (rather than according to national borders); to create additional capacity; and to increase the overall efficiency of the air traffic management (ATM) system. Implementation will be through the Eurocontrol organisation, see under Eurocontrol.

SL – Sea Level

Sliding Window Radar - a method of correlating a number of individual radar returns in order to produce a good probability of detecting a target and its track.

SMGCS – Surface Movement Guidance and Control System

SMR – Surface Movement Radar. Generally, for use in airport control towers to track aircraft movements on the ground

Soaring - The utilisation of the vertical component of movements of air in the atmosphere for the purpose of sustaining flight, without the use of thrust from a means of propulsion. Upcurrents are generally found in "thermals" under and in cumulus-type cloud, in atmospheric waves in the lee of high ground, and in ridge lift where air rises over an up-slope. Flight paths in thermals are generally circular, linear in the case of lee wave or ridge lift

Soft/Hard Data - See under Hard Data.

Space - For FAI purposes, Space activities are those above 100 kilometres from the earth's surface. See also under Aeronautics.

Sphere - See FAI Sphere

Spheroid - A three-dimensional oblate (flattened) sphere in the form of a three dimensional ellipse (an ellipsoid). The term ellipsoid is preferred to spheroid because it is mathematically unambiguous, whereas `flattening' of a sphere could imply shapes other than an ellipse.

Spurious Fix - see under Fix

Squitter – Derived from "squirt", to emit in a jet or stream. See above under 1090 ES (Extended Squitter.)

SRC - Safety Regulation Commission, for instance for the European Union. See above under ESSARs

SSR - Secondary Surveillance Radar. "Secondary" because the system does not rely on a radar echo from the aircraft structure itself. SSR works through aircraft having a radar transponder which replies to interrogation signals by transmitting its own response containing encoded data. A transponder is a radio receiver and transmitter which normally receives on one frequency (typically 1030 MHz) and transmits on another (typically 1090 MHz). The system is based on military Identification Friend or Foe (IFF) technology originally developed during the 1939-45 war.

Start - The beginning of a task, ie the point from which measurement of the flight performance commences. Usually crossing a start line or exiting a Start Point Observation Zone.

STOL - Short TakeOff and Landing

SWIM – System-Wide Information Management. Part of the US NextGen ATM system, to enable information to be managed at a system-wide level rather than point-to-point

TACAN - TACtical Air Navigation. This is a military air navigation system that gives distance and bearing from a ground station. It is a more accurate version of the VHF OmniRange / Distance Measuring Equipment (VOR/DME) system that provides range and bearing information for civil aviation. At facilities known as VORTAC, the DME portion of the TACAN system is made available for civil use.

TAS - True Air Speed. The speed of an aircraft with respect to the surrounding air.

TCAS - Traffic alert and Collision Avoidance System. A transponder-based system designed to reduce the risk of mid-air collisions between Commercial Air Transport (CAT) aircraft. Independent of air traffic control, each TCAS-equipped aircraft interrogates (at 1030 MHz) other aircraft, and other aircraft in range reply to interrogations (at 1090 MHz). This interrogation-and-response cycle may occur several times per second, allowing a TCAS system to build a 3D dimensional plot of nearby aircraft with their bearing, altitude and range. Using this data to calculate flight paths, the TCAS computer determines if a potential collision threat exists and indicates avoiding action to be taken by the pilot. In aircraft with electronic instruments (glass cockpits), the TCAS display may be integrated in the navigation displays; in other aircraft, the TCAS display may be part of the Vertical Speed Indicator (VSI) presentation. TCAS is an implementation of the Airborne Collision Avoidance System (ACAS) that is recommended by ICAO to be fitted to all aircraft with a maximum take-off mass (MTOM) of over 5700 kg or certificated to carry more than 19 passengers. The official definition from the ICAO Air Navigation Commission (ANC) Procedures of Air Navigation Services - Air Traffic Management (PANS-ATM) is that ACAS / TCAS is an aircraft system based on secondary surveillance radar (SSR) transponder signals which operates independently of ground-based equipment to provide advice to the pilot on potential conflicting aircraft that are equipped with SSR transponders.

TCO – Total Cost of Ownership

TDOA – Time Difference of Arrival.

Technical Commission (of FAI) - See under Commission

TIS-B - Traffic Information Services – Broadcast. Part of the ADS-B system, see above under ADS-B

TLAT - Technical Link Assessment Team

TMA – Terminal Area

TMZ - Transponder Mandatory Zone. A volume of airspace in which the use of transponders is required.

Total Energy Altitude (TEAlt) - The combination of the potential and kinetic energy of an aircraft expressed as a hypothetical `zero-energy' altitude, expressed in metres. eg TAS 300 kph (162 knots) gives a height increment of 354 m (1160 ft) for the purpose of calculating TEAlt, 250 kph (155 knots) gives an altitude increment of 245.5 m (805 ft); 200 kph (124 knots) an increment of 157.6 m (517 ft); 150 kph (81 knots) an increment of 88.4 m (290 ft), and 100 kph (62 knots) an increment of 39.32 m (129 ft).

TP - Turn Point

Track - The true track (continuous sequence of actual 2D positions) on the ground over which the aircraft has flown. Frequently expressed as an angle with reference to either True or Magnetic North.

Transponder. An electronic device that re-transmits data in response to interrogation (requests) from an external electronic source. A transponder is a radio receiver and transmitter which receives on one frequency (typically 1030 MHz) and transmits on another (typically 1090 MHz). The received signal is processed and displayed the interrogator's equipment, radar in the case of ground control, flight instruments in the case of other aircraft using the TCAS traffic alert function. Modes of operation under ICAO procedures include Modes A, C and S. Mode A is based on a 4-digit code using numbers between 0 and 7 assigned by ATC and set by the pilot, re-transmitting (transponding) with one of 4096 codes set on the equipment. Mode C transmits pressure altitude, read automatically from the aircraft altimeter. Mode S stands for "Selective" where an interrogating ground station can selectively turn on or off the response from that transponder. Response is triggered by a specific Mode-S interrogation and can provide particular information that is requested by the interrogation signal. For modes A and C, all aircraft receiving the interrogation signal will reply, whereas mode S allows aircraft to be addressed individually. In modern ATC systems the data appear with alphanumeric characters in a tag or label linked to the flight position symbol on the radar screen. However, GPS-based units capable of responding to external data requests such as ADS-B and Flarm (qv), also use the general principle of interrogate-and-response although they are not transponders in the generally accepted sense. See also under SSR.

TSO - Technical Standard Order. This is a minimum performance standard issued by the US FAA for specified materials, parts, processes, and appliances used on civil aircraft. Current TSOs are the approved FAA performance standard that a new applicant must use to receive a TSO authorisation. A TSO Index of Articles is published, listing authorised manufacturers and articles under a TSO authorisation or Design Approval (DA). Such articles are eligible for use on US Type-Certificated Products. The TSO authorisation or DA does not include installation approval, which is inspected and obtained separately. For a listing of current TSOs, see http://rgl.faa.gov , and for proposed new TSOs, see http://www.faa.gov/aircraft/draft_docs

Turn or Way Point Confirmation- The indication that the aircraft has reached the TP/WP to the criteria laid down in the appropriate sporting code, for instance by demonstrating presence in the Observation Zone by the use of photography, a GNSS Flight Recorder or by direct Observation. In some Sporting Codes this is known as "reaching" the turn point and in these cases there is no obligation to actually fly round the point itself such as is done in pylon racing.

TWR – Tower. The visual element of an airfield Air Traffic Control site

U (FAI Class) – Unmanned Aerial Vehicle

UAT - Universal Access Transceiver, a U.S. development of the ADS-B system (qv) using a frequency of 978 MHz. The "time-sharing" principle is used so that the same frequency can be used for both in and out messages.

UAV – Unmanned (sometimes Uninhabited) Air Vehicle

UNOOSA - United Nations Office for Outer Space Affairs, see www.oosa.unvienna.org/oosa. Amongst other things, the OOSA sponsors the International Committee on GNSS, an Industry Consultation Group, see above under ICG.

Upload – The process of transferring data from a source to specified equipment such as aircraft avionics or ground-based electronic equipment. See also Download.

UT - UTC to the local hour convention

UTC - Universal Time Co-ordinated. Used to be called Greenwich Mean Time (GMT), the time at the Greenwich meridian (zero degrees longitude) on the east side of London, England. UTC is virtually the same as GMT other than for astronomical purposes. A so-called `leap second' is added at midnight on agreed dates such as 30 Jun or 31 Dec and is used to change UTC by a whole second at a time, to allow for the slowing down of the Earth's rotation. The period between the addition of the next leap second varies between one and two years, and is agreed internationally. Between 1980 and 2006, 13 leap-seconds were added. The IGC data file requirement (Appendix 1) requires times in data files to be in UTC. See also GLONASS, GNSS and GPS.

Validation, VALI check. An act of ratification or official approval. In FAI terms, the act of approving a Flight Performance to FAI standards of evidence, or an element of one such as reaching a Turn Point. For IGC GNSS Flight Recorder data, Validation is the process of checking and then showing that electronic flight data has the integrity to be used in the overall flight validation process. Electronic flight data is checked by using the appropriate Validation program, through the Windows-based IGC Shell program and the Recorder manufacturer's DLL file that is designed to work with IGC Shell. This program checks the Digital Signature that is part of the IGC-format file that was transferred from the Flight Recorder, indicates that data has originated correctly from the Flight Recorder, and that the data in the IGC file is the same as that initially transferred from the Flight Recorder. The IGC Shell program and manufacturers' DLLs for all IGC-approved recorders are available free from the IGC/GNSS web pages.

VDL-4. VHF Data Link Mode 4. VDL-4 is a VHF data link technology designed for Air Traffic Management communication, including safety-critical broadcast links and point-to-point communications. It can be used as the broadcast link in the ADS-B system (qv), particularly for General Aviation (GA), part of the concept for Enhanced General Aviation Operation by ADS-B (EGOA). The "time-sharing" principle is used so that the same frequency can be used for both in and out messages. VDL-4 is in use in Sweden and in some areas of Russia. See: www.eurocontrol.int/vdl4

Verification - The process of checking and assembling evidence with a view to validating a Flight Performance

Vertical fix accuracy - the best prediction for the vertical 2-sigma component of the overall position error. When included in the IGC data file, through the VXA three-letter code.

VFR - Visual Flight Rules. A set of aviation regulations under which a pilot may operate an aircraft in meteorological conditions better than VFR Weather Minimums, generally VMC, see below. These are conditions that allow the pilot to fly safely by visual reference to the outside world and basic flight instruments. A VFR flight is a "flight conducted in accordance with the visual flight rules" and separation from other aircraft is based on the "see and avoid" principle.

VMC - Visual Meteorological Conditions. Conditions in which flight is permitted under visual flight rules (VFR), where a pilot can maintain separation from terrain and other aircraft by visual means. VMC is the opposite of Instrument Meteorological Conditions (IMC). VMC minima are the boundary between IMC and VMC. VMC requirements for visibility and separation from cloud vary by country and class of airspace. Typical visibility requirements vary from 1,500m to 8km. Typical cloud clearance requirements vary from simply remaining clear of cloud to remaining at least 1,500m from cloud horizontally and one thousand feet vertically. ATC may also issue a "Special VFR" clearance, to allow departure from a control zone in defined conditions that are less than full VMC.

VOR – VHF Omni-directional Radio Range, often shortened to VHF Omni-Range. A type of radio navigation system for aircraft, operating in the VHF band. VOR stations broadcast a composite signal that includes the station Morse code identifier and data that allows aircraft equipment to obtain a magnetic bearing from the station to the aircraft.

Vs - Stalling Speed

VSM – Vertical Separation Minimum

VTOL - Vertical TakeOff and Landing

WAAS - Wide-Area Augmentation System. A Satellite-Based Augmentation System (SBAS) that corrects GPS positions based on the actual position of monitoring stations in North America. It consists of an integrity and reference monitoring network, processing and control facilities, and special WAAS geostationary satellites above the equator. Reference stations receive data from the GPS and WAAS satellites and measure differential corrections, ionospheric delay information,

GPS/WAAS accuracy, WAAS network time, GPS system time and UTC time. These measurements are sent to Data Processing sites for calculation of corrections for the area of WAAS cover. In addition, residual errors can be calculated for data from each satellite. The Data Processing sites also generate navigation messages. This information is broadcast to users from the WAAS geostationary satellites and the resulting GPS/WAAS fixes are more accurate than those using GPS alone. See also EGNOS and RAIM.

WADA - World Anti Doping Agency. FAI operates under WADA rules and procedures, specially adapted for aviation (such as allowing for the use of oxygen at altitude). The FAI Medical Commission (CIMP) is the interface with WADA on matters of detail. See http://www.wada-ama.org

WAG - World Air Games. An international sporting event involving several FAI air sports at the same time, see GS3.1.7

WAM – Wide Area Multilateration. See above under Multilateration

Waypoint, way point (WP). Either (a) A precisely specified point or point feature on the surface of the earth using a word description and/or a set of coordinates, or (b) a set of coordinates not represented by any specific earth feature. A waypoint may be a start point, a turn point, or a finish point and has an associated observation zone (Sporting Code Section 3, definitions, para 1.1.2). It may also be used as a reference point for defining an area that is to be reached as part of a task. The area concerned is within the clockwise angle between two radials originating from the point and a minimum and maximum distance from the WP. (Based on Sporting Code Section 3 Annex A Part 7, description of Assigned Areas).

WGS 84 - World Geodetic System 1984. This is a co-ordinate system based on a mathematical model of the earth and including many variables such as gravity constants and coefficients, formulas for the Earth's angular velocity, a WGS84 ellipsoid and a WGS84 geoid, (equipotential surface approximating to local sea levels) with associated constants, conversion factors and co-ordinate systems. The WGS84 ellipsoid is generally accepted as the best simple mathematical model for the overall shape of the earth. It is used by the US GPS system and as the Geodetic Datum in many aeronautical maps. See also under "Geodesic" and "Geodetic Datum". Fix positions and distance calculations between fixes can be transformed to their equivalents on any of over 200 other ellipsoids (local Geodetic Datums). Some systems very similar to WGS84 include the International Terrain Reference Frame (ITRF) and the European Terrain Reference Frame (ETRF), but lat/long differences between these systems are generally less than 1m with respect to WGS84. For distance calculations using the WGS84 ellipsoid, a small PC-based program is available on the FAI web site.

WGS84 Ellipsoid. The ellipsoid radii for WGS 84 are as follows:
Major Axis (the Equator), radius = 6378.1370 km
Minor axis (Polar), radius = 6356.7523 km (flattening 21.3847 km)
Orientation. The minor axis is between the Earth's centre of mass and the Terrestrial Pole as defined by the Bureau Internationale de l'Heure (BIH). In approximate terms, this is the Earth's spin axis.

WGS84 Geoid. The maximum differences between the WGS84 Geoid and the WGS84 Ellipsoid are +65m at 60N 030W (S of Iceland, geoid above the ellipsoid) and -102m on the equator at 080E (S of India, geoid below the ellipsoid). A table of WGS84 Geoid heights with respect to the WGS84 Ellipsoid is available in MS Excel format from the IGC GFAC Chairman). See also under Geoid in this Glossary.

Wind Farm – A group of large wind turbines for the purpose of generating electricity that feeds into the local electricity grid. They can be on land and also offshore, and individual wind turbines can be up to 100m high with very large rotating blades. Wind Turbines produce a number of anomalous effects on radar systems such as clutter, Doppler, reflections, shadowing and even variable positions of the Turbine mast

Wording - The use of "shall" and "must" implies that the aspect concerned is mandatory; the use of "should" implies a non-mandatory recommendation. The word "may" indicates what is permitted and "will" indicates what is going to happen. Words of masculine gender should be taken as including the feminine gender unless the context indicates otherwise. *Italics are used for explanatory notes.*

W/T – Wireless Telegraphy

WTIC - Weather Technology in the Cockpit

WTTF – Wind Turbine Task Force. A Eurocontrol body tasked with analysing the effects of Wind Turbines on ATM systems and proposing mitigations.

WX - Weather