Draft by Ian Strachan dated 23 November 2006 - for the intended FAI Navigation database. Produced mainly by combining and editing the existing Glossaries from the General Section of the Sporting Code and the Technical Specification for IGC-approved GNSS Flight Recorders. It needs strengthening with Air Traffic Management terms such as those from ICAO and other sources. Check ?? before final

---

GLOSSARY
OF TERMS AND ABBREVIATIONS

This includes specialised terms concerned with navigation and distance measurement systems such as those based on satellite navigation. It also includes some FAI terms and references

FAI Sporting Code Sections
See also the table in para 1.4 of 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 (*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 some thirty analysis programmes developed for it to be used.*

GLOSSARY

Numerical

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.

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.

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, probably because of less-than-ideal installations in many sport aircraft, significant short-term additional inaccuracies in GPS altitudes have been recorded in IGC files. These include GPS altitude unlocks and short-term (occasionally major) variations compared to pressure altitude. Source: GFAC report to IGC in 2001, posted on the fai.org/gliding web site.

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

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 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 interrogating it. 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 on (electronic) request to other ADS-B-equipped aircraft for anti-collision purposes and to ADS-B ground stations for identification, surveillance and Air Traffic Control functions. 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. The 978 MHz Universal Access Transceiver ("UAT") variant can be used to uplink Flight Information Service (FIS) information to aircraft. ADS-B 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.

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

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

AL - Amendment List

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'.

AMSL - Above Mean Sea Level

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

API - Application Programming Interface. A set of functions that an application can call to tell the operating system to perform a task.

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.

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

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

B (FAI Class) - Airships/Dirigibles

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

CAS - Calibrated Airspeed (IAS corrected for Instrument and Pressure Errors)

CASI - Commission d'Aéronautique Sportive Internationale (the Air Sport General Commission of FAI)
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

CIA - Commission Internationale d'Aérostation, the International Ballooning Commission

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

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 GS and each one is responsible for a specific section of the Sporting Code. Technical commissions consist of CIACA, CIEA, CIMP and EnvC, see under these initials in this glossary.

CP - Control Point

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

Constellation - The group of satellites used in a GNSS fix. The 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. Satellite IDs are recorded in the IGC flight data file as 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.

D (FAI Class) - Gliders

Datum, Geodetic - The Geodetic Datum (qv) or earth model used by a mapping co-ordinate system such as lat/long.

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

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 PC. The reverse is the "uploading" of data into the module such as settings, 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.
The IGC GFA Committee will give advice as necessary.

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

EGNOS - European Geostationary Navigation Overlay Service. Designed for the European area, EGNOS is a GPS-enhancement system similar to WAAS (see below). It has been reported that it reduces position errors to about one quarter 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.

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).

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 systems that apply corrections to GPS receivers over a specified area. Local area enhancements such as WAAS (North America), EGNOS (Europe) and equivalent systems for India, Japan and Australia, are also well advanced. These increase accuracy by monitoring errors over their area and making corrections available to compatible receivers.

EnvC - The 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 gliders are flown. The EPE value appears in the IGC file as a three number group in metres through the FXA code.

EUROCAE - European Organization for Civil Aviation Equipment. The European counterpart of the US RTCA, see under RTCA. It has fewer members than RTCA but carries out joint projects. National aviation authorities often refer to RTCA/EUROCAE documents.

F (FAI Class) - Model Aircraft

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 shall 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 PC-based distance calculation program is available by email from the FAI office

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 Observation Zone, spurious fixes must be rejected. See Sporting Code Section 3 (Gliding) Annex C (Pilot and Observer Guide) for examples and diagrams.

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 shall be the centre of the co-ordinates of the fix, ignoring any error circles.

FLARM - A proprietary GPS-based short-range proximity-warning system for gliders, developed by the Flarm company of Zurich, Switzerland, and using frequencies in the 800 MHz band. The name is said to derive 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 in 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. An ADS-B-compatible version is understood to be being developed. See www.flarm.com

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.

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.

g - Acceleration due to gravity (9.81 m/sec^2)

G - Multiple of gravity force on an aircraft under acceleration

G (FAI Class) - Parachuting

GAC - General Aviation Commission

GD - Geodetic Datum, 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 PC-based distance calculation program for the WGS84 ellipsoid is available by email from the FAI office

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, and 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 future use of GPS 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, sea level. 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 system 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 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 navigational data. It includes the European Galileo, Russian GLONASS and the US GPS systems. Such equipment calculates time delays between signals from different satellites and, by knowing the exact position of the satellites and the exact time to great accuracy, together with a mathematical model of the earth's shape (see Ellipsoid and Geodetic Datum) is able to calculate position information on the earth's surface in four dimensions (4-D, see above) through software programs.

> 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 shall be 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 (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 MoP sensor for Motor Gliders. It also includes the associated software and firmware (Such as ROM) both in the aircraftr 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, and 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 this code.

GPS - Global Positioning System, the US GNSS 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 2006, 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.

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'.

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 error of the overall position error. Included in the IGC data file in the B (fix) record through the FXA three-letter code.

I (FAI Class) - Human Powered Aircraft

IAS - Indicated Airspeed

ICAO - International Civil Aviation Organisation with its HQ in Montreal, Canada

ICARE - International Commission for Astronautics Records

IGC - International Gliding Commission

IGC Approval - Certain equipment is subject to a special approval process before it can be used in the verification of flight performances to IGC/FAI criteria. GNSS Flight Recorders (FRs) are examples, and the IGC GNSS Flight Recorder Approval (GFA) Committee (GFAC) test and evaluate GNSS FRs and issue approvals on behalf of IGC.

IPC - International Parachuting Commission

International Standard Atmosphere (ISA) - 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^{o} Celsius and an atmospheric pressure of 760 mm of mercury (or 1013.25 mb/hPa). Above sea level, it assumes a constant temperature lapse rate of 6.5^{o}C per 1000 m (1.98^{o}C or /3.56^{o}F per 1000 ft) rise in height, up to an altitude of 11,000 m (-56.5^{o}C) . 11,000m is assumed to be the Tropopause, above which constant temperature (-56.5^{o}C) is assumed. Pressure figures from this ISA are used in calibration of barographs, because although the real atmosphere varies from day to day, for calibration purposes a set of internationally agreed figures are needed so that all calibrations are to the same datum, whether or not such figures correspond to `true' height on a given day. A similar principle is used in calibrating pressure altimeters for aircraft, so that all aviation activities have a common standard of pressure height indication in the cockpit.

ISA - International Standard Atmosphere, See above.

ISO - International Standards Organisation, HQ in Geneva, Switzerland

K (FAI Class) - Spacecraft

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

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.

M (FAI Class) - Tilt-Wing Aircraft

MG - Motor Glider (FAI Class)

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

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.

m/s - Metres per Second

MSL - Mean Sea Level

Multilateration - 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).

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. In the latter case, where NMEA data is mentioned in this document the Flight Recorder manufacturer must show that equivalent data that is acceptable to GFAC is recorded on the IGC data file. See www.nmea.org

O (FAI Class) - Hang Gliders and Paragliders

O&R - Out and Return

Obligations - (such as to FAI) Obligations of NACs to FAI are listed in the FAI Statutes, search for the word "obligations". The relevant Statute number is 2.4.2.2.

OO - Official Observer

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. Start and finish lines are also permitted as well as the 90 degree angle.

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 May 1975 by Whitfield Diffie, Martin Helman and Ralph Merkle (DHM) of the Electrical Engineering Department of Stanford University, USA, and previously in 1973 by James Ellis and Clifford Cocks of the classified Government Communications HQ organisation in the UK. The first commonly available practical application of PKC was the RSA system (qv).

Pressure Altitude - In the IGC flight data file, 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.

Proof Drive or Flight - A method of checking that a Flight Recorder produces a correct IGC flight data file. Under the strict control of an OO or other official, the GNSS/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 of the means-of-propulsion in a motor glider. 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 GFAC for this purpose with each Flight Recorder tested

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

QNH - An altimeter Pressure Setting which indicates height above sea level

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 GNSS satellite with other position-lines being received at any one time. Any anomalous position lines ("rogues") are then discarded for the purpose of calculating the 3-D 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 practical terms, six satellites are normally needed for the system to operate efficiently. See also WAAS.

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.

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 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 which 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.

S (FAI Class) - Space Models

SBAS - Satellite-Based Augmentation Systems. These increase accuracy by monitoring errors at ground stations in the area concerned and making corrections available to compatible receivers. For GPS, systems in service include WAAS (North America) and EGNOS (Europe). Future systems include GAGAN (India), MSAS (Japan) and systems for Russia and Australia.

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.

Shall - See under `Wording'

Should - See under `Wording'

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

Soft/Hard Data - See under Hard Data.

Space - For FAI purposes, activities 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

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

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).

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

Technical Commission (of FAI) - See under Commission

TP - Turn Point

Track - The true track (continuous sequence of actual 2D positions) on the ground over which the aircraft has flown.

Transponder. An electronic device that re-transmits data in response to interrogation (requests) from an external electronic source. The original transponders were radar-based and produced radar responses on the interrogator's equipment. However, GPS-based units capable of responding to external data requests such as ADS-B and Flarm (qv), also use the transponder principle.

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

U (FAI Class) – Unmanned Aerial Vehicle

UT - UTC to the local hour convention

Upload - Not used in this document because of possible ambiguity. `Transfer' used instead, see under Download.

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.

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.

Vs - Stalling Speed

VTOL - Vertical TakeOff and Landing

WAAS - Wide-Area Augmentation System. A system that corrects GPS positions based on the known accurate positions of a number of ground 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. Ground reference stations receive satellite data. They measure differential corrections, ionospheric delays, 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 and 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 because the systematic corrections for the area concerned are already applied and only residual errors remain. See also EGNOS and RAIM.

WADA - World Anti Doping Agency. 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

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.

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.*
