ICAO RBIS TOD PROJECT

TERRAIN AND OBSTACLES DATA

TOD DATABASE MANAGEMENT AND EXCHANGE TOR

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0. DOCUMENT ADMINISTRATION

0.1. APPROVAL PAGE

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Reviewed by			
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0.2. LIST OF EFFECTIVE PAGES

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0.4. DOCUMENTS REFERENCES

- ICAO Annex15 ;
- ICAO Doc 10066;
- ICAO Annex 4
- ICAO Annex 14, vol1 ;
- ICAO DOC 9881;
- EUROCONTROL TOD Manuel
- ICAO DOC 9674 :
- ICAO DOC 8168, vol2 ;
- ICAO Doc 9750 ;
- ISO de la serie 19100 (19109-19110-19113-19115-19117-19123-19131).

0.5. CONTENTS

1. CONTEXT

The volume of data shared across public and private geographic agencies providers mandated as TOD users in TOD database increase rapidly, making difficult the management of exchanged data, especially in case of absence of well-tailored database management system.

One possible solution for terrain and obstacles data management is Database Management Software or plateform which allows TOD manager unit to improve data accessibility and simplifies the management process to provide quality data to AIS provider for publication purpose, flight procedure design and aeronautical charts design.

This TOR is developed to tailor well adapted solution of database in relation with feeder stakeholder and timely responding publication needs.

The database offered in this TOR, based on physical and Web material, will only be used for the management of obstacles and terrain data.

2. PURPOSE

This TOR aims to provide national AIS/AIM services with a database platform for evaluating, recording and then effectively exploiting information relating to natural (terrain) and artificial obstacles, in order to assess their impact on air navigation, in accordance with ICAO Annex 15.

According ICAO Annex 15 two database must be developed. Obstacles are not included in a terrain database.

3. TERRAIN DATABASE

3.1. SPECIFICATIONS DATABASE

Terrain database should maintain the following specifications:

Post Spacing

Terrain database post spacing numerical requirements shall be presented in both angular and linear units to provide general guidance about the required density of measurement points.

Horizontal Reference System

The horizontal reference system is the datum must be expressed in the WGS-84 reference system. If the horizontal reference system is not WGS-84, the reference system and transformation parameters to WGS-84 must be specified.

Horizontal Resolution

Horizontal resolution must be state. Use of more decimal places can provide for higher resolution.

Horizontal Accuracy

Horizontal accuracy must be stated in the same units as used for the elevation.

Horizontal Confidence Level

The confidence level of the position must be stated, e.g. as a percentage.

Horizontal Position Data

Horizontal position data shall defined by geodetic latitude and longitude. Terrain databases must use projection-based coordinates (e.g. Universal Transverse Mercator (UTM) Eastings and Northings).

Elevation

Elevation must be expressed in linear units that are consistent with the accuracy and resolution specifications.

Database Units

For every attribute that requires it, the units used must be stated and the units must be consistent within the database.

Elevation Reference

The elevation reference must be explicitly defined.

Vertical Reference System

Mean Sea Level (MSL) is the required vertical reference system. The Earth Gravitational Model (EGM-96) must be used as the global gravity model. If a geoid model other than the EGM-96 model is used, a description of the model used, including the parameters required for height transformation between the model and EGM-96 must be provided.

Vertical Resolution

Vertical resolution must be stated. Use of more decimal places can provide for higher resolution.

Vertical Accuracy

Vertical accuracy must be stated in the same units as used for the elevation. The statistical derivation of the vertical accuracy must be stated.

Vertical Confidence Level

The confidence level of the elevation must be stated, e.g. as a percentage.

Surface Type

Surface type is a classification of the recorded surface, e.g., marshland, water, permanent ice, etc.

Recorded Surface

Recorded surface identifies the surface that the elevation data represent. Some examples of surfaces that may be recorded by available technologies are:

- The ***bare earth*** recorded by land survey or by remote sensing techniques when vegetation,
- The ***reflective surface*** recorded by either an active or a passive remote sensing sensor.

Penetration level

The estimated penetration will be expressed as a unit of measurement e.g. meters or feet.

Integrity

The integrity of the data set must be expressed, indicating the probability of any single data element having been changed inadvertently since the creation of the data set.

Date and Time Stamps

Time stamps must refer to Universal Coordinated Time (UTC) and date stamps must refer to the Gregorian calendar.

3.2. TERRAIN DATA FORMAT

Terrain data must be made available in one of the following formats:

- (City) GML,
- Shapefiles,
- GeoTIFF.

3.3. TERRAIN DATA BASE MANAGEMENT

A terrain database file shall be kept in geodatabase. In case of use of GeoTIFF, a conversion should be performed to meet following criteria.

Each feature of terrain database shall contain at least 7 minimum files, all of which must retain the same NAME and be stored in the same file directory, in order to help the manager to be able to work with them.

1. .shp: the file that contains the geometry for all terrain features.
2. .shx: the file that indexes the geometry of terrain.
3. .dbf: the file that stores terrain feature attributes in a tabular format.
4. These files need to have the same name and to be stored in the same directory (folder) to open properly in a GIS or Python tool.
5. .prj: the file that contains information on projection format including the coordinate system and projection information. It is a plain text file describing the projection using well-known text (WKT) format.
6. .sbn and .sbx: the files that are a spatial index of the features.
7. .shp.xml: the file that is the geospatial metadata in XML format, (e.g. ISO 19115 or XML format).

All the key associated file types shall be kept all of the together.

To share the terrain database it is necessary:

- to zip up all of these files into one package before to share it .
- To export extracted information into AIXM 5.1 (compatible attributes) or better into AIXM5.2

Indeed, within AIXM 5.1 provisions: XML/GML is used as data encoding format, the XML schema is automatically derived from the UML, therefore covering all classes, attributes and associations of the information model and AIXM provides an extension mechanism.

3.4. EXCHANGE MODEL FOR TERRAIN DATA.

Model exchange terrain data formats shall be GeoTIFF, Shapefile, ESRI ASCII GRID, (City) GML.

3.5. QUALITY ELEMENTS OF TERRAIN DATABASE

The quality of terrain data will not only depend on the precision of the data. The following elements must also be considered into the database management criteria:

- Precision:
  - thematic precision,
  - temporal accuracy.
- Data resolution
- Traceability:
  - Ident of the user
- Integrity:
  - Excess
  - omission
- Logical consistency:
  - format consistency,
  - conceptual consistency
  - domain consistency
  - topological consistency.

3.6. DATA MAINTENANCE

Terrain data sets are increasingly being used in dynamic environments: shared, interchanged, and used for purposes that require both accuracy and temporal relevance. Continuous maintenance and timely updates of terrain databases are vital to the process of end-user applications.

4. OBSTACLES DATABASE

4.1. SPECIFICATIONS OF OBSTACLES DATABASE

The obstacles database should maintain the following specifications:

Area of Coverage

Area of coverage is a description used to identify the boundary of obstacle data. This should be used to help the user identify in general terms the area under consideration.

Data Originator Identifier

Data originator identifier uniquely identifies the obstacle data originator. Sufficient information must be provided to distinguish between multiple data originators. A permanent record of the originator must be kept to establish an audit trail.

Horizontal Position

Horizontal position must be expressed as a point, or a line or a polygon. Horizontal position must be expressed in geographic coordinates by latitude and longitude.

Horizontal Reference System

The horizontal reference system is the datum to which the positions of the data points are referenced.

Coordinates used for air navigation must be expressed in the WGS-84 reference system. If the horizontal reference system is not WGS-84, the reference system and transformation parameters to WGS-84 must be specified.

Horizontal Resolution

Horizontal resolution must be stated. Use of more decimal places provides for higher resolution.

Horizontal Extent

Horizontal extend must be expressed in linear units that are consistent with the elevation specifications.

Horizontal Accuracy

Horizontal accuracy must be stated in the same units as used for the elevation.

Horizontal Confidence Level

The confidence level of the position must be stated as a percentage.

Elevation

Elevation must be expressed in a unit that is consistent within the data set.

Height

Height must be expressed in a unit that is consistent within the data set.

Unit of measurement used

For every obstacle attribute that requires it, the unit used must be stated and the unit must be consistent within the data set.

Vertical Reference System

Mean Sea Level (MSL) is the required vertical reference system. The Earth Gravitational Model (EGM-96) must be used as the global gravity model. If a geoid model other than the EGM-96 is used, a description of the model used, including the parameters required for height transformation between the model and EGM-96 must be provided.

Vertical Resolution

Vertical resolution must be expressed use of more decimal places provides for higher resolution.

Vertical Accuracy

Vertical accuracy must be stated in the same unit as used for the elevation. The statistical derivation of the vertical accuracy must also be stated.

Vertical Confidence Level

The confidence level of the elevation must be stated as a percentage.

Obstacle Type

Obstacle type is a description of the recorded obstacle, e.g., tower, building, tree, power lines, windmill farms, or cable car. Obstacles may be temporary. The description of the obstacle type must be stated.

Integrity

The integrity of the data set must be expressed, indicating the probability of any single data element having been changed inadvertently since the creation of the data set.

Date and Time Stamps

stamps must refer to Universal Coordinated Time (UTC) while date stamps must refer to the Gregorian calendar.

Effectivity

Effectivity is a description of the date/time period for which an obstacle exists. For all temporary obstacles, effectivity must be provided. Effectivity must include:

- The time and date of building/setting up the obstacle (referenced to UTC and the Gregorian calendar)
- The time and date of dismantling/removing the obstacle (referenced to UTC and the Gregorian calendar)

Obstacle Status

When an obstacle is still being built, an indication “under construction” must be provided.

Obstacle Lighting

When an obstacle has lighting this information must be provided.

Obstacle Marking

When an obstacle has markings this information must be provided.

Geometry Type

Obstacles must be described either as points, lines, or polygons.

4.2. OBSTACLES DATA FORMAT

Data models for obstacles must correctly reflect the position, shape and temporality of an obstacle, as well as providing sufficient information about the obstacle, such as its type, markings and lighting.

4.3. EXCHANGE MODEL FOR OBSTACLES.

Data exchange model for obstacle data must be AIXM5.1/5.2.

Alternative formats used are CSV files or proprietary but documented GIS formats such as ESRI® Shapefile.

4.4. DATABASE QUALITY

Data files must be protected by CRC to ensure that data is not corrupted during the interchange process.

4.5. DATA MAINTENANCE

Continuous maintenance and timely updates of obstacle databases is vital to the process of end-user applications.

5. AIXM DATABASE RELATION TO TOD DATABASE

AIXM 5.1 and AIXM 5.2 are the formats to power from obstacle database and by which aeronautical information shall be exchanged as, they:

(a). use Unified Modelling Language (UML, GML) to describe the aeronautical information features and their properties, associations and data types;

(b). include data value constraints and data verification rules;

(c). include provisions for metadata as specified in 4.2.1 and 5.3.2; and

(d). include a temporality model to enable capturing the evolution of the properties of an aeronautical information feature during its life cycle."

6. DATABASE MANAGEMENT TOOLS DELIVERABLES

- Terrain Database;
- Obstacles database;
- A central TOD database, allowing traceability of geographical input data, export of aeronautical terrain data, user and workflow data;
- A workflow specifically dedicated to the management of terrain data and obstacle data;
- A physic and cloudd (Visual Machine) server hosting server licenses, the PostgreSQL / PostGIS database server and the central database;
- procedures to populate suppress and update database.

7. MINIMUM CHARACTERISTICS OF SERVER LICENSES AND DATABASE SERVERS

The minimum characteristics for the VMs Servers are as follows:

- 1 license server;
- 1 Database management software;
- Database" VM + server license;
  - vCPU : 12,
  - RAM (GB) :48,
  - DD (GB) : 256,
  - OS : linux preferably.
- TOD data population software and visualisation software.

8. TOD DATABASE MANAGEMENT ACTIVITIES

The databases developed must allow:

- Develop data collection online form and offline Excel Sheet (or other convenient format);
- Collecting data from accredited surveyors working in the field offices;
- Examine the current database structure and in line with that develop the assessment;
- Tracking module using the same platform;
- Review the authorization and access control system of The current database, and modify if necessary;
- add all accredited surveyors as users into appropriate user groups and assign access- to relevant modules. These names of users will be checked by the database before inserting data;
- Check and deny TOD data duplication in a database, even if multiple users are simultaneously connected- to populate database;
- Prevent accidental damage to the TOD database by authorized users;
- Run automatic regular backup to protect TOD database against data loss.

9. AERONAUTICAL DATASET TOD EXCHANGE

- Export and import obstacles data dataset in AIXM 4.5, AIXM 5.1 and AIXM 5.2;
- Export and import terrain data dataset in shape file, GEOTIF, ESRI ASCII GRID;
- Plan export extension of TOD to geographical format used as input data to flight procedures data, if different;

- Plan export extension of Export TOD to geographical format used specifically by Cartography, if different;
- Check of conflicting overlap values of name and geometry area when importing terrain data;
- Check of conflicting overlap values when importing obstacles data;
- Keep historical instances recorded in database, even in case of suppressing data;
- The aeronautical data exchange model should use and apply a commonly used data encoding format;
- The commonly used data encoding format is to ensure interoperability of aeronautical data exchange between agencies and organizations involved in the data processing chain;
- Examples of commonly used data encoding formats include Extensible Markup Language (XML), Geography Markup Language (GML) and JavaScript Object Notation (JSON).

10. MAINTENANCE AGREEMENT WITH DATABASE SUPPLIER

- The maintenance contract must include, in favor of the unit responsible for managing the TOD database;
- a hardware maintenance service including remote diagnosis, repair or replacement of any component of hardware under warranty;
- a software maintenance service including remote diagnosis, updating of software, middleware, and delivery of patches for updating database management extensions;
- a service for updating database management procedures in conjunction with the version of PostgreSQL / PostGIS and other related plateforms;
- a service to fix software and hardware troubles.