Data Origination, Management and WGS 84
Overview

Learning Objectives

• Understand the implication of publishing incorrect navigational data in the State’s AIP
• Identify why it is essential to use a common reference system
• Understand the impact of using different ellipsoids
• Recognise why late publication of data should not take place.
Content

- The Challenge
- The Data Chain
- Achieving data quality
- Reference systems
- Surveying
- Publishing the data
The Problem Identified

- ANSP (AIS) 
- DB Providers 
- Aircraft Operators

AIP 
ADB/DB

If unclear or ambiguous procedure description 
Lack of Integrity

Aircraft fly different tracks
Impact of AIP Errors

Conventional:

Automatic:
Coordinates required

RNAV:
Coordinates required
Coordinates required
Coordinates required
Sample Chart Error
Who is Involved?

- Aerodrome
- Air Traffic Service Provider
- Communications Service Provider
- Procedure & Airspace Designer
- Aeronautical Information Service
- AIP
- End Users
- Navigation Data Processor
- FMS Data Applications Provider
- Flight Planning Data Applications Provider
- Simulator Data Applications Provider
- Other Government Sources
- NOTAM

Navigation Data Tailoring Requirements
Every player must establish a Navigation Data Process in order to ensure the quality of data delivered to the users.
Data Chain Processes and Standards

- Origination
  - Preparation by Data Service Provider (Coding)
  - Application Integration (Packing)

- End Use
  - DO-200A/ED-76
  - DO-178B/ED-12B

- State’s Responsibility
  - Receive
  - Assemble
  - Translate
  - Select
  - Format
  - Distribute

- DO-201A/ED-77

- Load and Maintain current cycle
  - JARs/FARs

- Derive and Publish eg States’ AIPs
  - DO-201A/ED-77

- Link to target equipment in required format
  - DO-200A/ED-76
  - DO-178B/ED-12B
Data Exchange after Publication in AIC

Data Houses

CMC Canada
Garmin
Rockwell
Smiths
Honeywell

Data Packers

FMS Packed Data
Compiled Data

Lufthansa Systems - CH
Jeppesen - DE
EAG - UK

Jeppesen - US
What is Data Quality?

• Quality is ability to meet requirements
• Characterised by:
  – Accuracy
  – Resolution
  – Assurance Level
  – Traceability
  – Timeliness
  – Completeness
  – Format
Managing Data
What is Data Integrity?

- The assurance that a data item retrieved from a storage system has not been changed since the original data entry or latest authorised amendment.
Navigation Data Processing Model

INPUT
- RECEIVE
  - FAIL
  - PASS
- ASSEMBLE
  - FAIL
  - PASS
- TRANSLATE
  - FAIL
  - PASS

- SELECT
  - FAIL
  - PASS
- FORMAT
  - FAIL
  - PASS
- DISTRIBUTED
  - FAIL
  - PASS

CHECK
- C

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ICAO Requirements

User requirements in ICAO Annex 15

Critical \(10^{-8}\)
Essential \(10^{-5}\) Data
Routine \(10^{-3}\)
From the executive summary:

These documents are submitted to the aviation community as a collection of disciplines necessary to provide assurance that the production of aeronautical databases meets the high integrity required for safe flight.
Processing Requirements

Each supplier of data in the chain assures:

- The data meets quality requirements
- The source of any data can be traced
- All detected data discrepancies addressed
- All reported errors resolved in a timely manner
- Delivery of data is made at the agreed time
- Data is applicable to the intended period of use
- Any unresolved errors or anomalies known to remain are made available to the client
Issues to be Addressed

- Survey
  - Not meeting accuracy and integrity requirements
- No real data integrity
  - No guarantee that data not corrupted
- RNAV coding
  - Has the data house correctly interpreted the design
- No real Traceability
  - Cannot validate to confirm whether process working
• **Geoid**
  - The equipotential surface of the earth's gravity field which would coincide with the ocean surface, if the earth were undisturbed and without topography.
The Earth as an Ellipsoid

Normal

Solid Earth

Reference Ellipsoid

Zoom

Reference Ellipsoid
WGS 84

Global Geodetic System
accurate to 1-2 Metres

Realisation

• International Terrestrial Reference System (ITRS)
  – Precise geodetic system -1-3 cm over 5,000 km
  – Maintained by the International Earth Rotation Service
  – Plate Tectonic movements – therefore position changes
  – ITRF – globally distributed network with defined epoch (date), position and velocity
  – In Europe original surveys done to ETRF 89 network – New Standard move to ITRF 2000 – accepted realisation of WGS 84
  – Use transformations to update:
    ➢ ON CONDITION THAT DATA INTEGRITY SUFFICIENT
Deviation of the Vertical and Undulation

- Mean sea surface (geoid)
- Ocean
- Geoid
- Ellipsoid
- Geoid undulation
- Perpendicular to ellipsoid
- Perpendicular to geoid (plumbline)
- Deviation of the vertical

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WGS 84 vs. Geoid
Impact of Different Ellipsoids

Solid Earth

Ellipsoid

Ellipsoid

Equatorial Plane

Equatorial Plane

$p \neq L$

$L \neq L$
Effect of Geodetic Systems

Diekirch Nav-Aid (Luxembourg)

Northings (m)

Eastings (m)

B 50
Potsdam
ED 50
NTF
WGS 84
LUX
How to Survey

GPS Survey Consideration

- GPS Observation Techniques
- Connection to the geodetic reference frame
- Stations with defined ITRF coordinates
- Control Stations
  - Clear line of sight away from reflecting surfaces
  - Ensure no interference
  - Redundancy of data collection to allow validation
  - Hardware selection – NB take care if mixed receiver network
    - antenna phase centre differences
- Survey Execution and Marking
Surveys

What to Survey

Survey

Survey

Survey
Surveys

How to mark (Monumentation)

- Steel or Alloy tube
- Optional concrete collar
- Fine mark cross on ground surface

Length to be agreed according to ground conditions. The illustration is diagrammatic only and is not intended to refer to any particular proprietary type.

- Bevelled top with centre punch nail at top
- Concrete 500x500 mm on plan
- Compressible filler 25 mm thick minimum
- 20 mm diameter stainless steel rod 600 mm long
- Trial pit back filled with concrete
- 10 mm diameter stainless steel rod 100 mm long fitted through pre-drilled hole in 20 mm dia (vertical) rod.
6.1.1 Information ..., shall be disseminated under the regulated system (AIRAC), i.e. basing establishment, withdrawal or significant changes upon a series of common effective dates at intervals of 28 days, including 10 January 1991.
AIRAC Cycle: Timeliness

- Annex 15, Chapter 6, Paragraph 2:
  - Information published on paper and distributed 42 days in advance of the effective date
  - Recommendation – Major changes minimum 56 days

**AIRAC Cycle Timeline**

- Publication
- Reception
- Effective Date

- 14 days for postal delivery
- 28 days for system updating
- 56 days for major updates
- 14 days for system updating
Why 28 Days
To update a wide range of systems!

Commercial Data Providers
Airline operators
   Charts
   Flight Management Systems
Aircraft Performance DB
Flight Planning
Simulators
ATC Centres
   Flight planning
   Simulators
   ATC screens
OTHERS
   Simulators
   Flight Planning

Varying freeze dates!

Publication
Reception
14 days for postal delivery
28 days for system updating

AIRAC Effective date
PBN Consideration: Operational Implementation Date

- Experience has shown that an additional 3 to 10 days after publication effective date should be allocated before operational implementation ("turn-on") in the air traffic system.

- Additional period provides time to ensure ground and aircraft system data is correctly validated and loaded in data bases.
EUROCONTROL Guidance Material

Integrity of Aeronautical Information
- Aeronautical Data Origination
AFN/NAV/DAT/ORG/DOC001-150404
Survey and procedure Design Requirements

FAA Guidance Material

- FAA Specification 405 Standards for Aeronautical Surveys and Related Products
- FAA Order 8260.19 Flight Procedures and Airspace
Summary

- AIP Issues
- Data Chain
- Aeronautical Data Processes
- WGS 84
  - Geoid
  - Impact of different ellipsoids
- Surveying Issues
- Timeliness
Thank You