AUSTRALIAN CNS UPDATE

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1928 – NDB
1948 – VOR
1956 - ILS
1953 - VAR
1960 – Omega
1960s - INS
1995 – GPS
2011+ - ??????
FIRST IFR GPS RECEIVER
TSO C145/6 RECEIVERS

• Approved for primary means IFR
No ADF/DME – GPS may be only aid
GNSS APPROVALS

- 1995 Primary means enroute
  - 15 NM separation standard
- 1998 GPS non precision approaches 500+
- 2004 RNP 10 /RNP 4
- 2006 RNP-AR approaches
- **2006** Primary means GNSS
- 2007 GLS Sydney
- 2011 Baro-VNAV approaches
australia
272 Aerodromes
500+ RNAV (GNSS) Approaches
SYDNEY GLS – SLS 4000
Performance Based Navigation (PBN) and Approach with Vertical Guidance (APV)
Australia’s approach to PBN implementation

- PBN
  - RNAV
    - RNAV 10
    - RNAV 5
    - RNAV 2
    - RNAV 1
  - RNP
    - RNP 4
    - RNP 2
    - RNP 1
    - RNP 0.3
    - RNP APCH
    - RNP AR APCH

GNSS required
Airservices RNP AR Operations National Network

- Nationally linked RNP network by 2012
- 28 major and regional aerodromes
- RNP AR APCH, DEP and EOSID
- ICAO and Proprietary procedures
- Australian unique RNP AR op approval for proprietary procedures
PBN at Work

Noise vs Carbon?
The area under the fog is Lake Wakatipu, which after the fog cleared looks like this.
8 Years of RNP-AR Operation
RNP APPROACH BENEFITS

- **Safety**
  - Runway aligned DA – almost anywhere
  - Lateral & vertical guided approaches
  - CFIT risks reduced
  - Use of automatics
  - Engine INOP solutions

- **Operations**
  - Departure uplift
  - Low minima
  - Cost benefit
High reliance on self-contained area navigation systems

- TSO 129 stand alone navigators
- TSO 146 stand alone navigators
  - Mode S ES transponder to enable ADS-B
- IRS/GNSS/Multi sensor FMS
  - TSO 129 FMS
  - SA aware
  - FDE
  - Mode S ES transponder to enable ADS-C
AUSTRALIAN PBN EXPERIENCE

- Basic RNP/GNSS Navigation Regulations in place
- Very high level of industry acceptance
- Significant safety and financial benefits
- Transition to GNSS expected by industry
- Technology before the Regulations!
  - eg B737 – 800 RNP
- Next Generation?
  - Systems
  - Rules
NAVIGATION INFRASTRUCTURE

- GNSS – Primary Means
  - TSO C129 is OK provided ground aid alternate is available
- Reduction in ground based aids
  - Especially ADF
- “Back up” ground aids
  - Decided by Industry and Airservices
APANPIRG – recommended GNSS enabled RNP navigation specifications for APAC

- All RNP specifications

- Seamless interoperable regional ATM

RNAV 10
RNAV 5
RNAV 2
RNAV 1
Benefits of PBN revolve around safety, efficiency and environmental impact

- **Safety**
  - Approaches with Vertical Guidance (APV)
    - APV is CFIT mitigator (eg: Lockhart River, Kokoda)
    - Only 10% of Australian aerodromes have APV

- **Efficiency**
  - Reduced regulatory overheads (fewer specifications)
  - International interoperability (no duplication)
  - Fewer track miles flown (less time in air/fuel burn) per flight

- **Environmental**
  - Reduced track miles and lower power settings = reduced fuel burn = CO2 emissions
  - Reduced noise footprint, particularly on approach (late configuration, thrust at idle) and departure (reduced takeoff thrust)
ADS-B in Australia
SAT COM VOICE

- ICAO decision not to use in 1990s
- Europe now allow as a substitute for
  - One HF
  - “Third party” coms
    - No suitable for RNP 4 separation and below
- SAT Com Voice Task Force
  - To set rules for global use
    - As a substitute for one HF
    - Possible LRCS in long term
  - Airservices advice – ATS not set up to use SCV
    - Need new consoles etc
AUSTRALIAN CNS MANDATES

- ADS- B 2013+
- GNSS 2014-16
- TCAS 2014+

See Discussion Paper and NPRMs
ISSUES

- New GNSS Systems
  - Avionics?
  - Augmentation – needed?

- Interference
  - Jammers
  - Frequency protection
  - Solar High in 2013

- Policy on PNT
  - APNT
    - US Policy “Need Backup” – FAA has yet to decide
    - Australian/Regional/ICAO position???
## PLANNED GNSS

- **Global Constellations**
  - GPS (30+)
  - GLONASS (30)
  - Galileo (27+3)
  - **Compass** (27+3 IGSO + 5 GEO)
- **Regional Constellations**
  - QZSS (3)
  - IRNSS (7)

- **Satellite-Based Augmentations**
  - WAAS (3)
  - MSAS (2)
  - EGNOS (3)
  - GAGAN (2)
  - SDCM (2)
GNSS IN 2020?

- 50+ satellites in view
- Great car navigation - for urban canyons
- Receiver design
  - Aviation
    - Boeing Study – 441 possible combinations!!!
- Able to do APV without augmentation?
- Still need a back up?
- Australian Navigation Policy??
BACKUP???

- NDBs
  - Use against ICAO APV Resolution
  - Not fitted to new aircraft
    - A330 to new GA
    - Being phased out in USA and UK

- DME
  - Too expensive / technically ‘impossible’

- Any other choice???
- Multiple constellation GNSS?
Locata 101

Locata Technology Overview 12.15 Wednesday
The technology, the development and the business…
Nunzio Gambale – Locata Corp

Copyright Locata Corporation: V1.9 Aug 2011
“GPS is like Swiss cheese...
...it’s full of holes”

Customer Quote - a GPS fleet boss, trying to meet spec for bus location at LAX
A REGIONAL SBAS?

- APAC cannot meet ICAO APV resolution
  - Limited number of Baro-VNAV aircraft
  - Need 100% LPV = Need SBAS
    - (or wait for enhanced constellations/equipment)
- How to progress a Regional SBAS
  - PBN Task Force
  - APEC GNSS Implementation Team (GIT)
    - Successful SBAS trial
JAMMING AND INTERFERENCE

- **GPS jammers**
  - Illegal in Australia
  - Available on the Net - $40
  - “Personal Privacy Devices
  - Car/Truck monitoring

- **Stuff up GLS systems**
  - Memphis

- **TSO GPS – stop working (maybe)**

- **Report any GPS interference**
SOLAR MAX

Solar Max in 2012+
(along with end of world!)

No GPS issues with last one

Worst storm in Solar Low!
DECISIONS NEEDED

- **ICAO**
  - Is a back up required for GNSS?
  - Global Air Navigation Industry Symposium
    - GANIS
  - ASBUs!!!! – pick yours!!

- **Industry**
  - What is the next generation aviation receiver design
The joys of new technology??!!
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QUESTIONS DISCUSSION