AUSTRALIAN (AVIATION) UPDATE

CGSIC

2010

FREE OFFERS!

- CASA Training DVDs
  - GNSS
  - ADS-B
    - More available from CASA
  - Safety Management System (SMS) Booklet
- Australian PBN Plan
- CASA Shop Items

AUSTRALIAN APPROVALS

- 1995 Primary Means Enroute
- 1998 GPS Approaches
  - 500+
- 2006 Primary Means GNSS
  - "Only" navigation aid required (Thanks Karen!!)
- 2007 RNP-AR
- 2007 RNP arrivals and departures
  - 100, 000+ operations
- 2008 GLS - Sydney
- 2010 APV approaches
  - Baro-VNAV
- 2008 ADS-B voluntary
- 2013 ADS-B mandate F290+

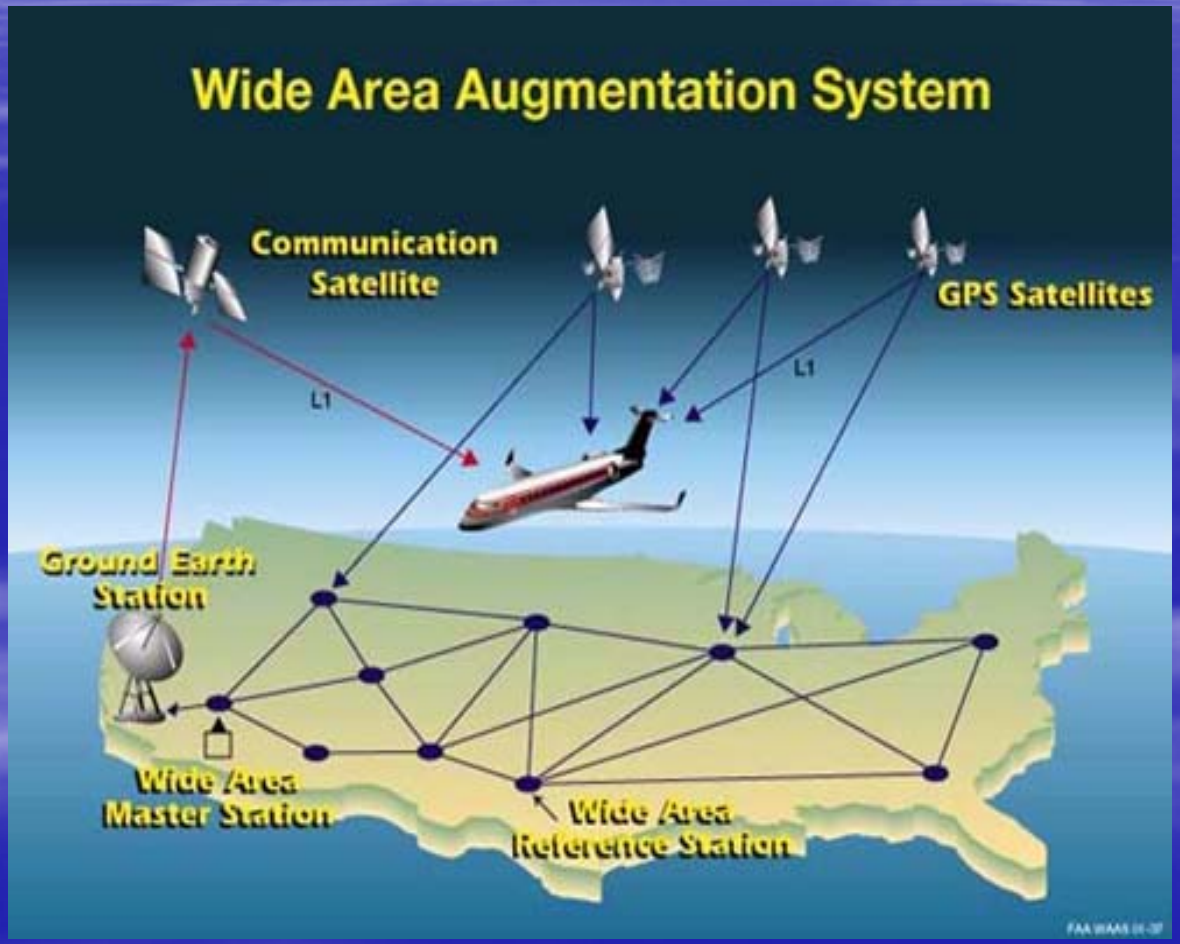
NEW GNSS SYSTEMS

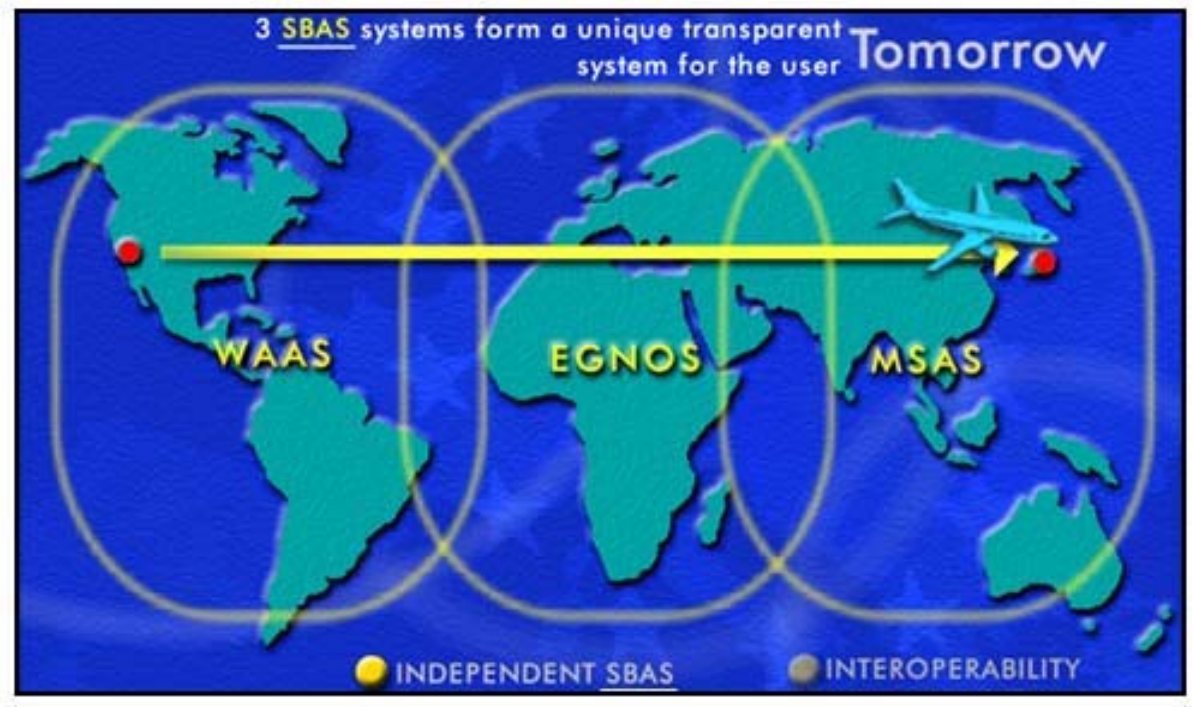
- GPS 3
  - Upgraded satellites
    - Dual frequency
- GLONASS
  - Being upgraded
- GALILEO
  - 2015
- Result = hybrid receivers

AUGMENTATIONS

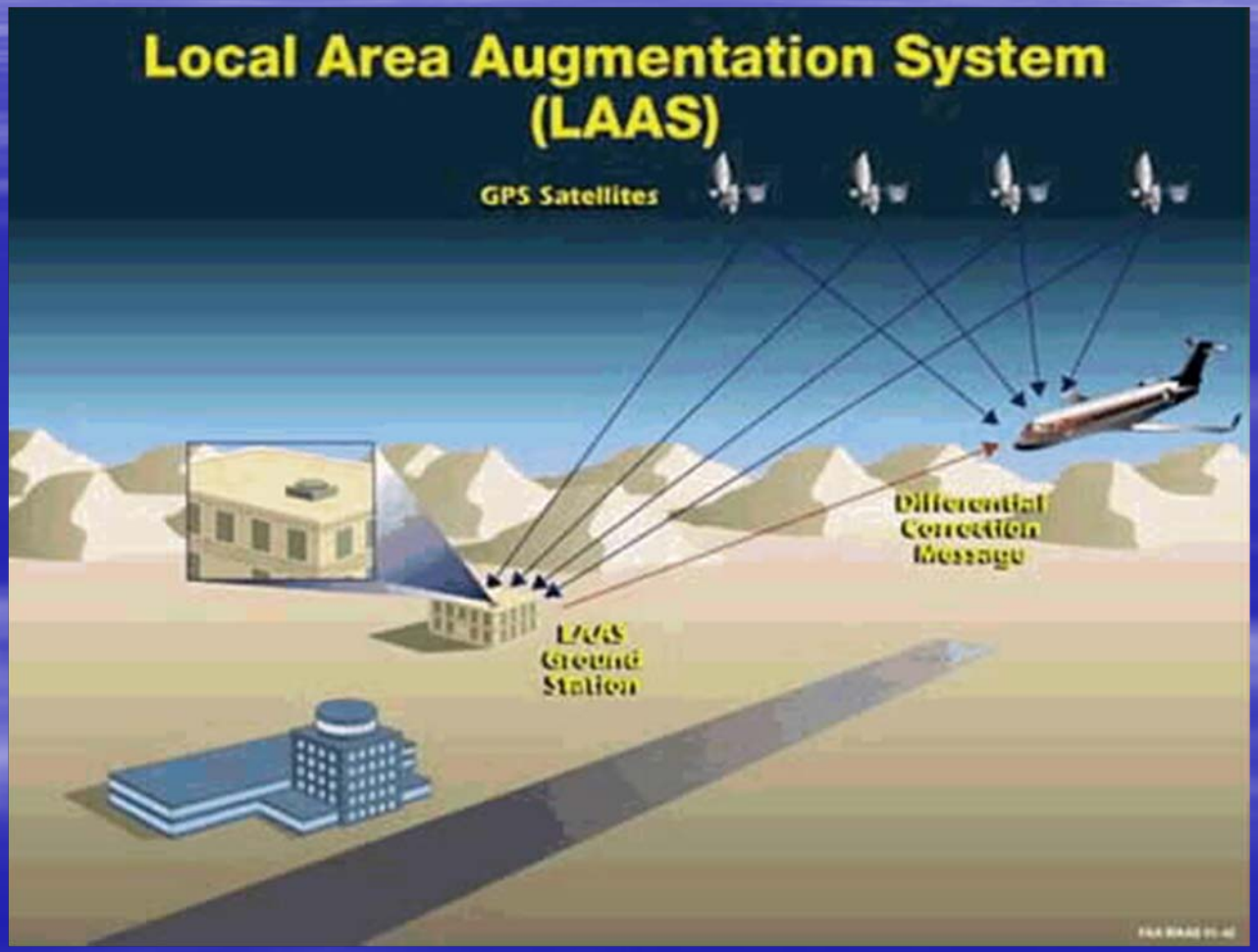
- **AIRCRAFT BASED - ABAS**
  - Existing Receivers
- **SATELLITE BASED - SBAS**
  - WAAS (June 2003) EGNOS MSAS GAGAN
  - GPS + GLONASS (or GALILEO)
- **GROUND BASED - GBAS**
  - Precision Approach – ILS,MLS
    - GLS – Sydney B737 and A380
      - **Certified 2011**

AUSSIE SBAS?


Wide Area Augmentation System
Communication Satellite
GPS Satellites
L1
L1
Ground Earth Station
Wide Area Master Station
Wide Area Reference Station


3 SBAS systems form a unique transparent system for the user
Tomorrow
WAAS
EGNOS
MSAS
INDEPENDENT SBAS
INTEROPERABILITY

Sydney GBAS


Local Area Augmentation System
(LAAS)
GPS Satellites
Differential
Correction
Message
LAAS
Ground
Station

IFR GPS RECEIVERS

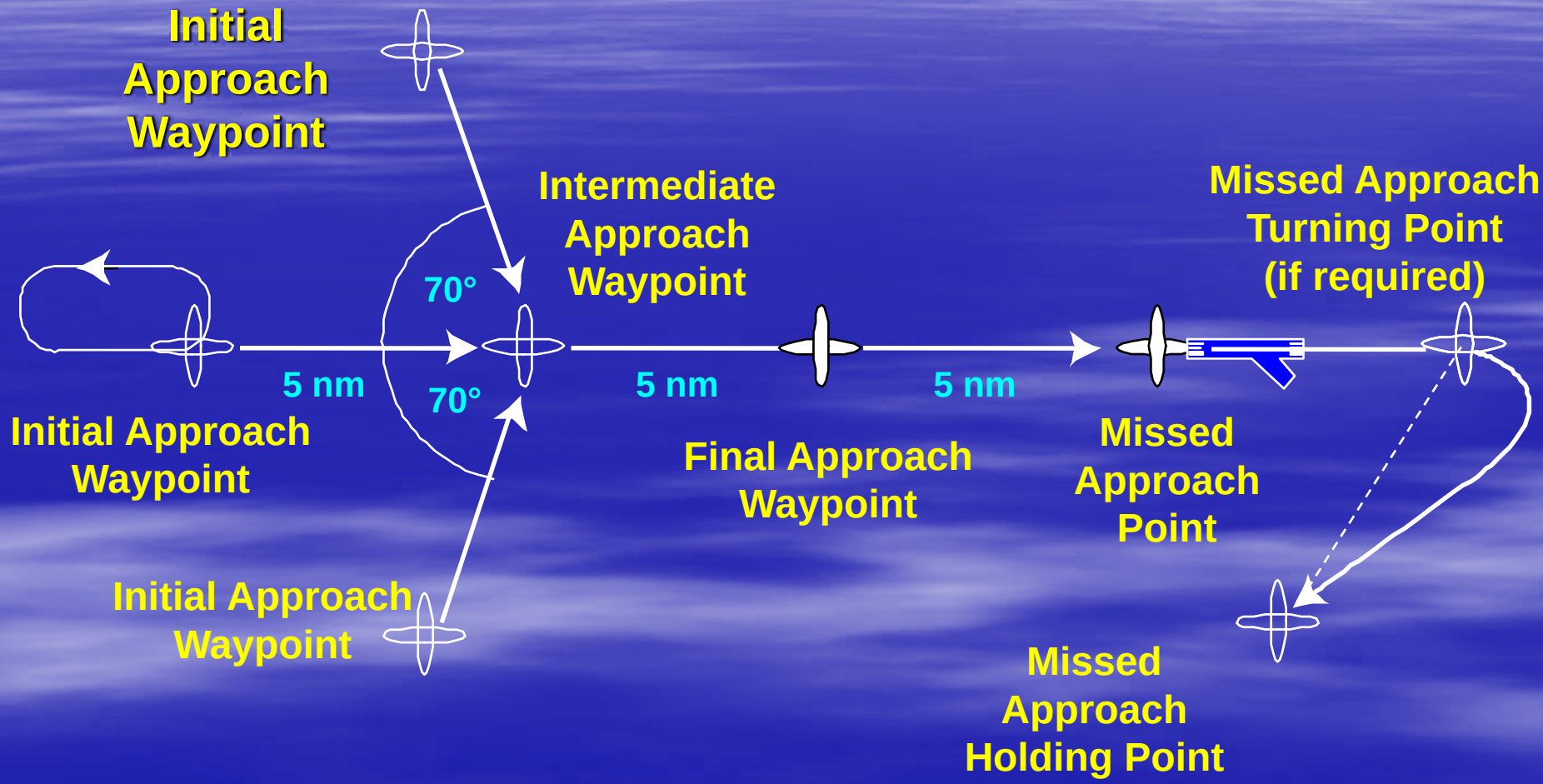
- TSO C129a
  - Limited approvals
    - Fault Detection Only (FD)
    - Poor RAIM performance, limited human factors
- TSO C145/6 “WAAS Receiver”!!!
  - SBAS ‘capable’ – but not required
  - Includes Fault Detection and Exclusion (FDE)
  - Approved for ‘sole means’ FAA SFAR 97
  - Far better GPS receiver!!
- New Hybrid Receiver Design?
  - When?

WAAS Satellite
APOLLO CNX80
ACT 124.500
SBY 118.700
ACT 116.70
16.7nm vor
SBY 109.50
UTC 22:09:44
VOR 145
N
16
134
22
23
11
25
26
1
14
30
24
23
134
20
16
1
24
11
30
22
14
25
WAAS: Standby
TIME: 22:09:44
EPU: 0.02 nm
HPL: 41 m VPL: ---
35°32.31'S 149°19.51'E
SYS
GPS
VERS
CNFG
COM
VOR
XPDR
CDI
SUSP
FN
MAP
NRST
INFO
CLR
MENU
ENTER

NEW AIRCRAFT

- TSO C146 Receivers
  - GPS
  - VOR
  - ILS
- **Not fitted with ADF**
  - **Includes airline aircraft**
- RNAV “primary means’ approval
  - GPS is only aid required

RNAV (GNSS) APPROACHES



GPS SAFETY ISSUES

- Lack of understanding of GPS by pilots
  - Accuracy versus integrity
- Cranfield Study into GPS approaches
  - 35% of crews continued approach
    - With integrity light on
  - Lack of understanding of missed approach
    - DR procedure
      - Leave GPS alone!!

ICAO Resolution A36-23, 36th Session, September 2007

- ICAO has recommended the implementation of
  - Performance-Based Navigation (PBN)
  - Approaches with Vertical Guidance (APV)
- State and Regional implementation plans are to be complete by 2009
- The Asia/Pacific (APAC) Regional PBN Implementation Plan has been produced in accordance with Resolution A36-23
- Australia has developed a State PBN implementation plan in accordance with the Regional plan

AIRSPACE CONCEPT

COM NAV SUR ATM

PBN Concept

- Safety
- Capacity
- Efficiency
- Environment

Nav Appl'n
- Routes, SEP
- SIDs / STARs
- Approaches

Nav Spec
- Function,
- System,
- Procedures

Nav Infr
- Navaids (terr / celest)
- (Surv)
- (Comms)

http://www.boeing.com/commercial/aeromagazine/articles/qtr_2_08/AERO_Q208_article3.pdf
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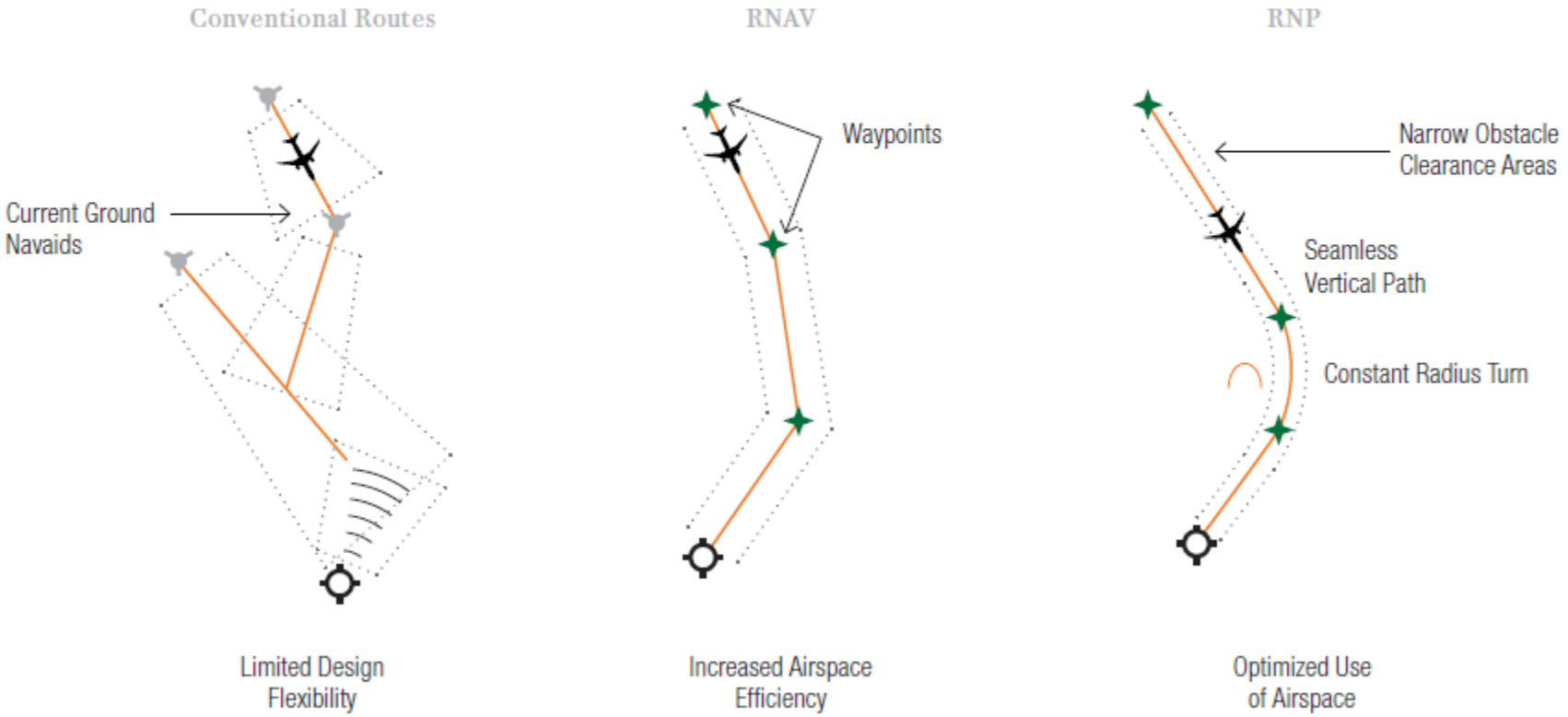

Unknown Zone

http://www.boeing.com/commercial/aeromagazine/articles/qtr_2_08/AERO_Q208_article3.pdf
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http://www.boeing.com/commercial/aeromagazine/ar...
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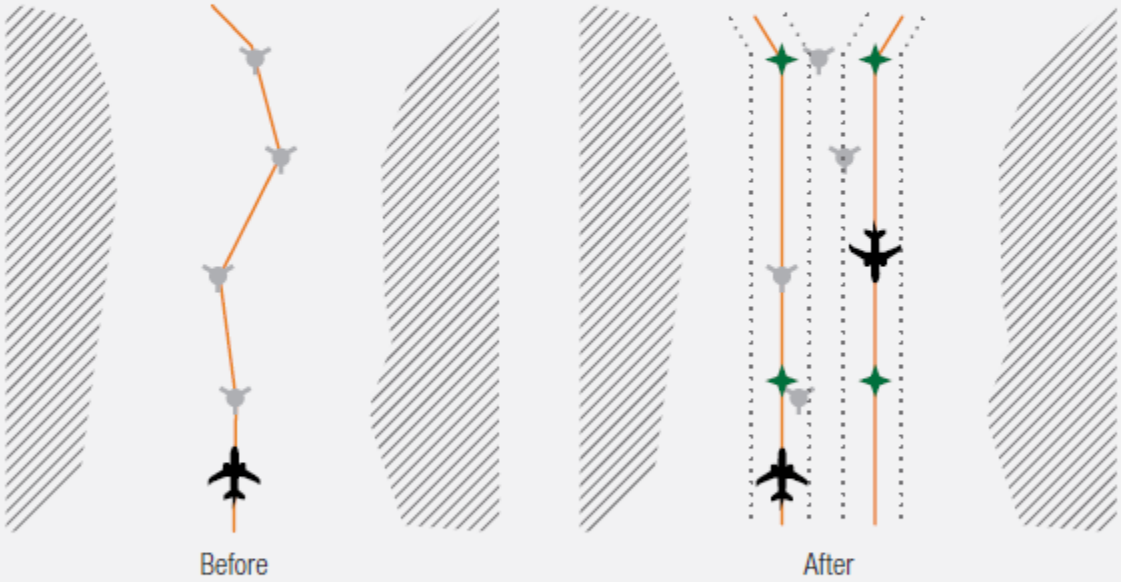


INCREASED CAPACITY

Figure 4

Conventional routes (left) have limited development and flexibility due to vertical separation requirements and implementation of routes based on ground navaids. RNAV and RNP routes (right) offer design flexibility and capacity from additional flight levels and parallel routes using latitude- and longitude-based fixes.

Unknown Zone

Australia's concept for implementation of PBN and APV is

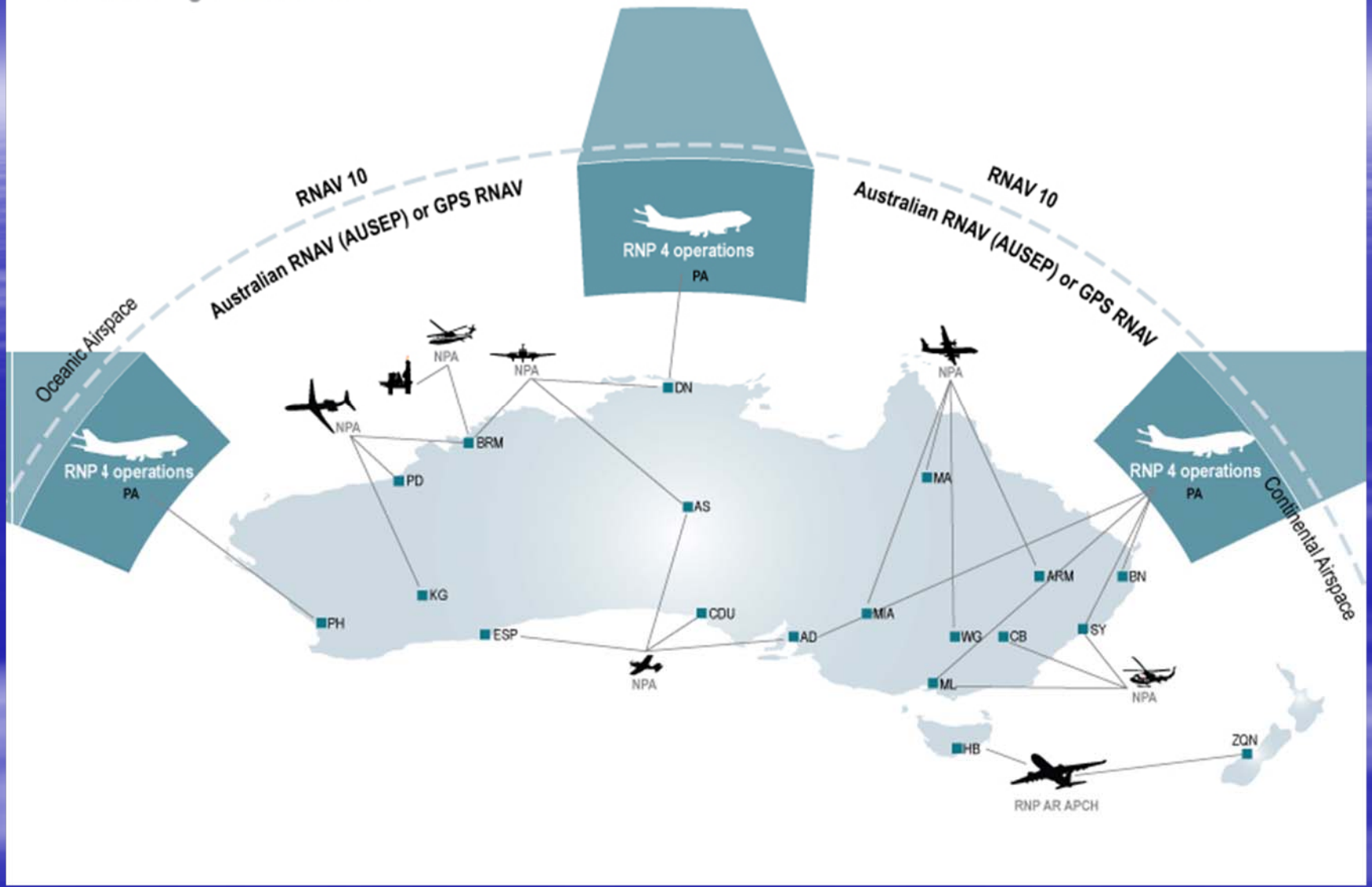
- Parallel availability of RNAV and RNP specifications
- APV enabled through barometric vertical navigation

Australia's methodology for implementation of PBN and APV is

- Maintenance of present RNAV capability
- Development of RNP capability
- Transition of Australian unique specifications to PBN specifications (RNAV and RNP)
- Introduction of limited APV capability through barometric vertical navigation
- Consideration of full APV capability through acquisition of an SBAS in the near term
- Full APV capability achieved circa 2022 through enhanced GNSS

PBN IMPLEMENTATION PLAN—AUSTRALIA

Current navigation construct

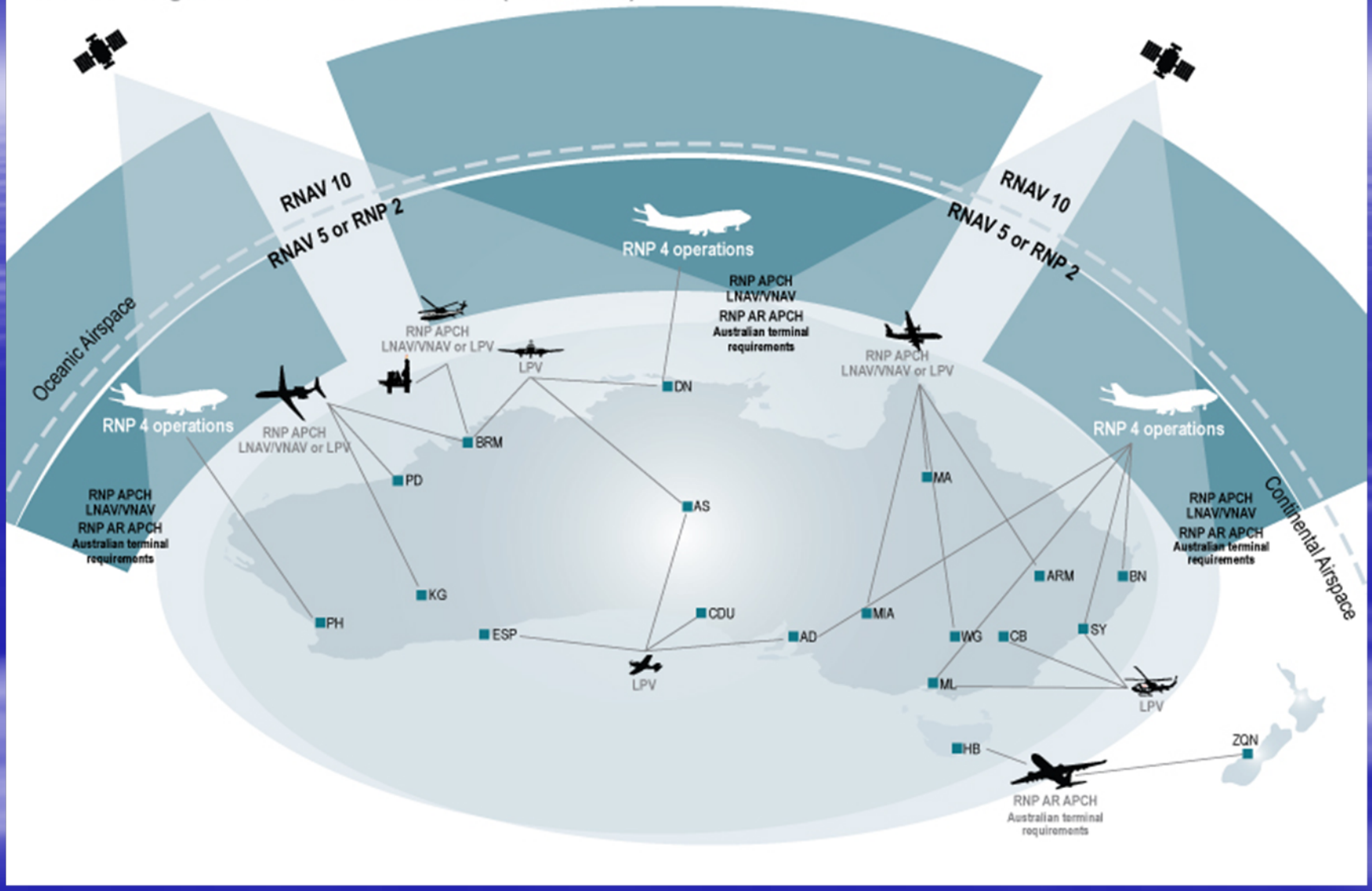


Further development considerations

- Australia cannot implement APV through GNSS augmentation without acquiring an SBAS
- Australia is considering the acquisition of an SBAS
- Australia's concept for PBN implementation will not be affected by any decision regarding SBAS acquisition
- Australia's methodology for APV implementation will be based upon Baro-VNAV irrespective of any decision regarding SBAS acquisition

PBN IMPLEMENTATION PLAN—AUSTRALIA

Future navigation construct—2013-2017 (with SBAS)



APV APPROACHES

- New ICAO Approach Classification
- "minimum level of approach design"
- ICAO – "All approaches APV by 2016"
- Achievable using different technologies
  - Baro-VNAV RNP
  - Augmented GNSS
    - US LPV
- Cannot be done in Australia without SBAS

STUDY OUTCOMES

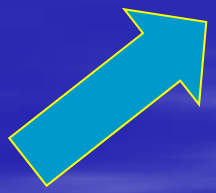
- Implement Baro-VNAV Approaches
  - Use existing aircraft
  - Redesign approaches to standard
    - Prioritise the process
    - Need input
    - What aircraft are capable of Baro-VNAV?
  - ASTRA APV WG set up
    - RAAA membership required
- Further study of SBAS options
  - ABAA input
  - Cannot meet ICAO APV mandate without SBAS

VERTICAL GUIDANCE ??

- Vertical Advisory
  - From FMS
  - May be pilot or data base generated
  - NO tolerances or integrity
    - Must monitor altitudes eg Cessna CJ3
    - >400’ error in B737-800s!!
    - RNAV (GNSS) from data base
  - Considerable Industry Confusion
    - Receivers/data bases/system capabilities
    - “No need for APV – I already have it!”
- Vertical Guidance
  - System generated – Augmented GPS, Baro-VNAV
  - Has design requirements for a/c and approach
  - Fly maximum of ½ scale vertical (FTE)

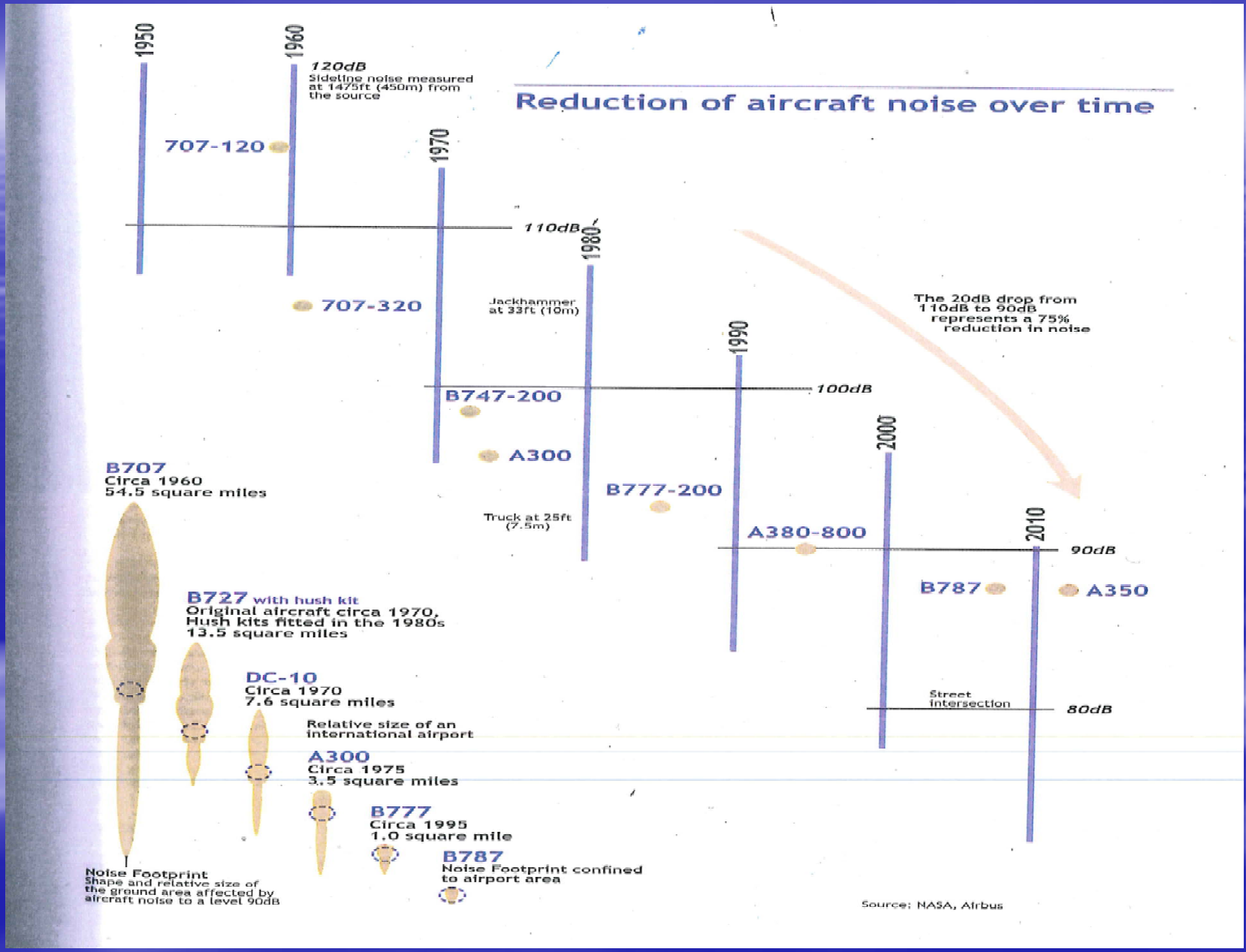
AVIATION IMPACT

- Noise
- Carbon
- Toxic chemicals
- Fuel use
- Visual impact
- Land use
- Economics



Increased Growth

Improved Efficiency


Reduction of aircraft noise over time
1950
1960
1970
1980
1990
2000
2010
120dB
Sideline noise measured at 1475ft (450m) from the source
707-120
707-320
110dB
Jackhammer at 33ft (10m)
B747-200
A300
B777-200
100dB
Truck at 25ft (7.5m)
A380-800
90dB
B787
A350
Street intersection
80dB
The 20dB drop from 110dB to 90dB represents a 75% reduction in noise
B707
Circa 1960
54.5 square miles
B727 with hush kit
Original aircraft circa 1970.
Hush kits fitted in the 1980s
13.5 square miles
DC-10
Circa 1970
7.6 square miles
Relative size of an international airport
A300
Circa 1975
3.5 square miles
B777
Circa 1995
1.0 square mile
B787
Noise Footprint confined to airport area
Noise Footprint
Shape and relative size of the ground area affected by aircraft noise to a level 90dB
Source: NASA, Airbus

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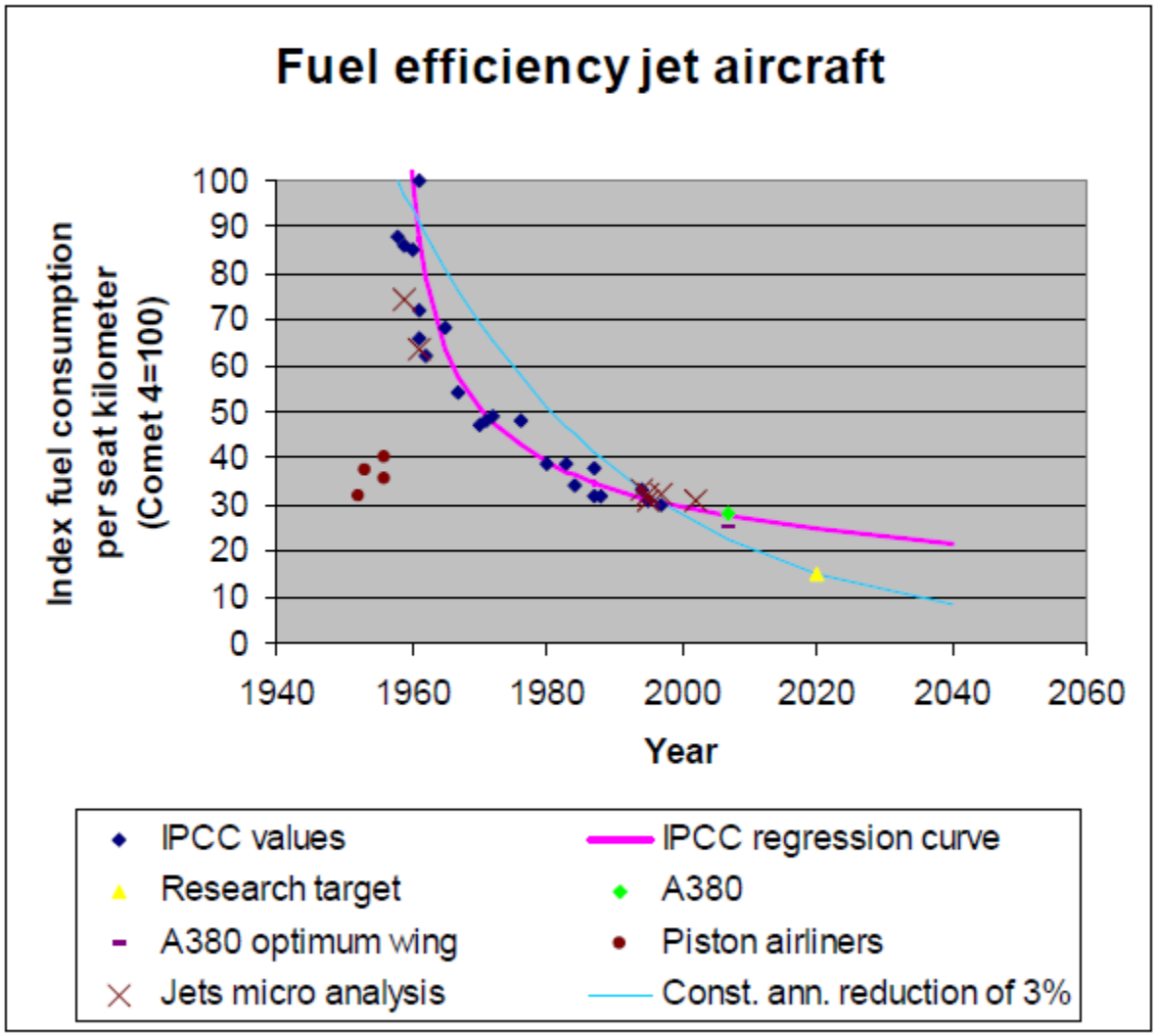
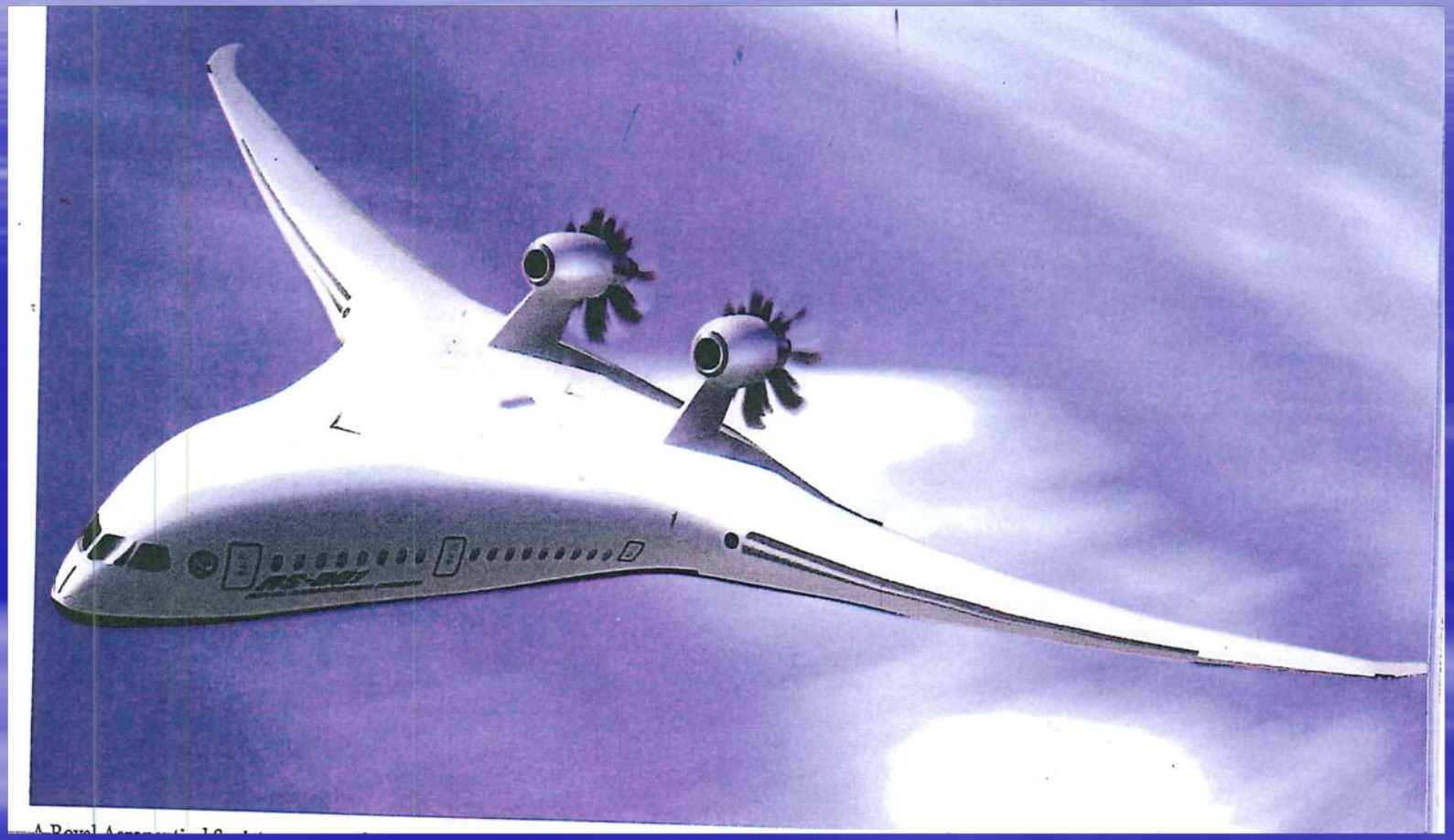


Figure 11: IPCC graph with additional data (see text for references).

NOISE vs CARBON

- **Noise greatest constraint**
  - Flight Paths
  - Curfews
  - Aircraft limitations
- Often result in reduced safety
  - Downwind landings
  - No reverse
- Also increased pollution through ++ fuel burn



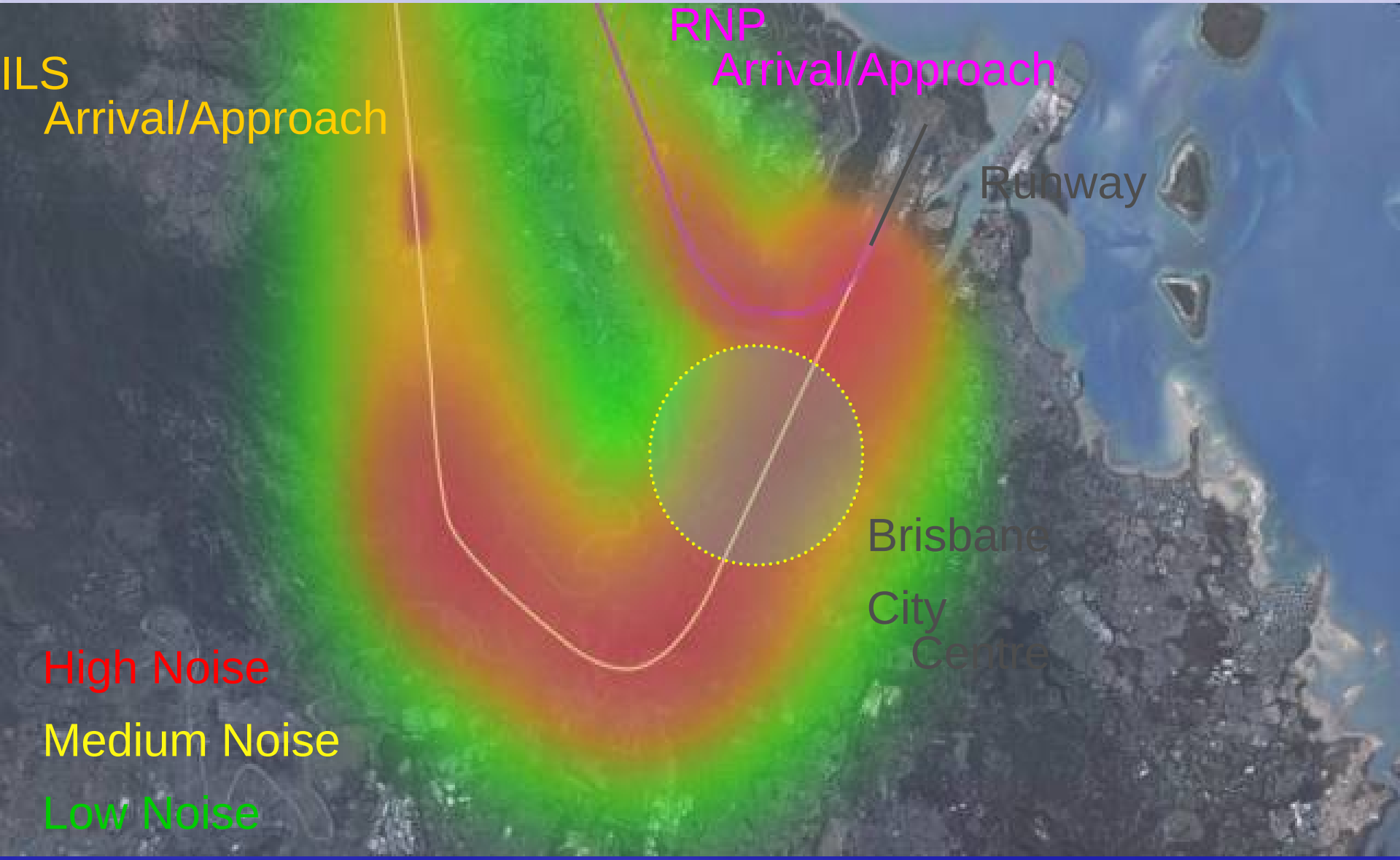
IMPACT ON INDUSTRY

- Focus on aviation impact
  - Noise
  - Fuel use – carbon emissions
    - Aviation only represents 2% of carbon emissions
    - But increasing 5% per annum
- High level emissions
  - Ice
  - hydrocarbons

SOLUTIONS

- Don’t fly!!
  - Increased Taxes on aviation
- Mass ground transit systems
- Improved aircraft efficiency
  - Engine, Wing design
- **PBN based airspace design**
- Reduced Noise footprint
- New fuels
  - Hydrogen?
- Education

PBN at Work


RNP
Arrival/Approach
ILS
Arrival/Approach
Runway
Brisbane
City
Centre
High Noise
Medium Noise
Low Noise

PBN SAVINGS

- 26 July 2007 through to 25 July 2009, controllers recorded 16,390 Qantas RNP-Special approach operations into Brisbane.
- 3,100 RNP approaches that resulted in track miles/minutes saved
- Approximately 55,946 Nautical miles saved
- Approximately 699,325 kg fuel saved
- Over 2,237,840 kg CO2 not emitted
- 100,000+ PBN ops

RNP-AR BENEFITS

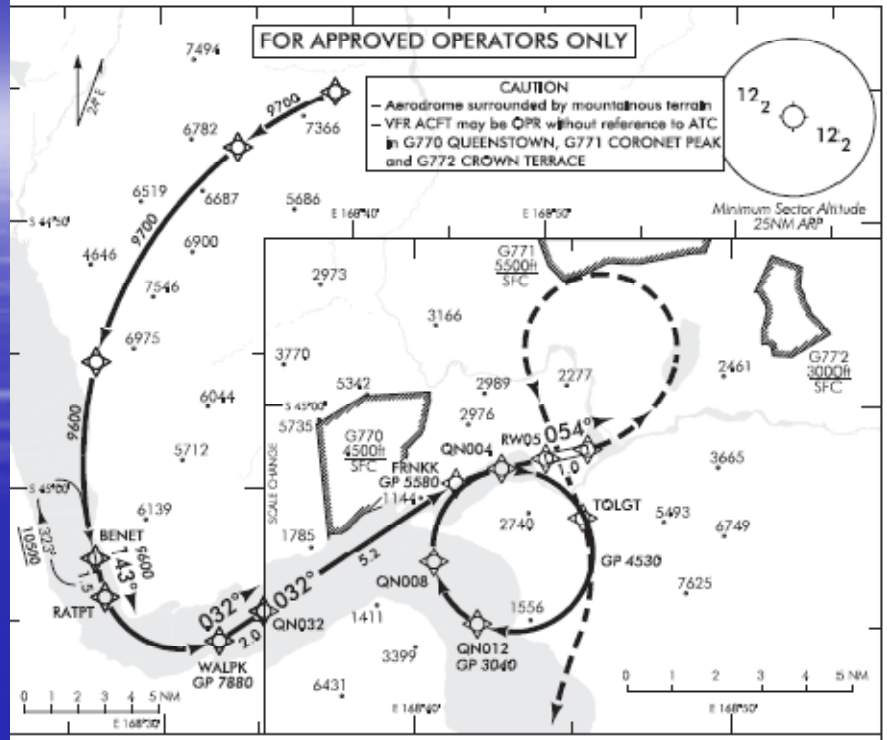
- Safety
  - Runway aligned DA – almost anywhere
  - Lateral & vertical guided approaches
  - CFIT risks reduced
  - Use of automatics
  - Engine INOP solutions
- Operations
  - Departure uplift
  - Low minima
  - Cost benefit

ELEV 1171 CAT C,D

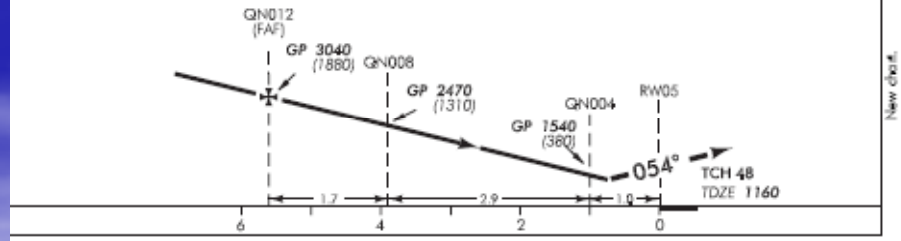
QUEENSTOWN

RNAV (RNP) RWY 05

TOWER: 118.1 128.0 UNATTENDED: 118.1 ATIS: 126.4



Use Queenstown QNH



New chart.

MISSED APCH: Climb to 9800 via the RNP RNAV missed approach track

Category	A	B	C	D
RNP0.10	NA		1434(274) – 2000	
RNP0.15			1488(328) – 2000	
RNP0.18			1501(341) – 2000	
RNP0.30			2361(1201) – 5	

Effective: 9 JUN 05

© Civil Aviation Authority

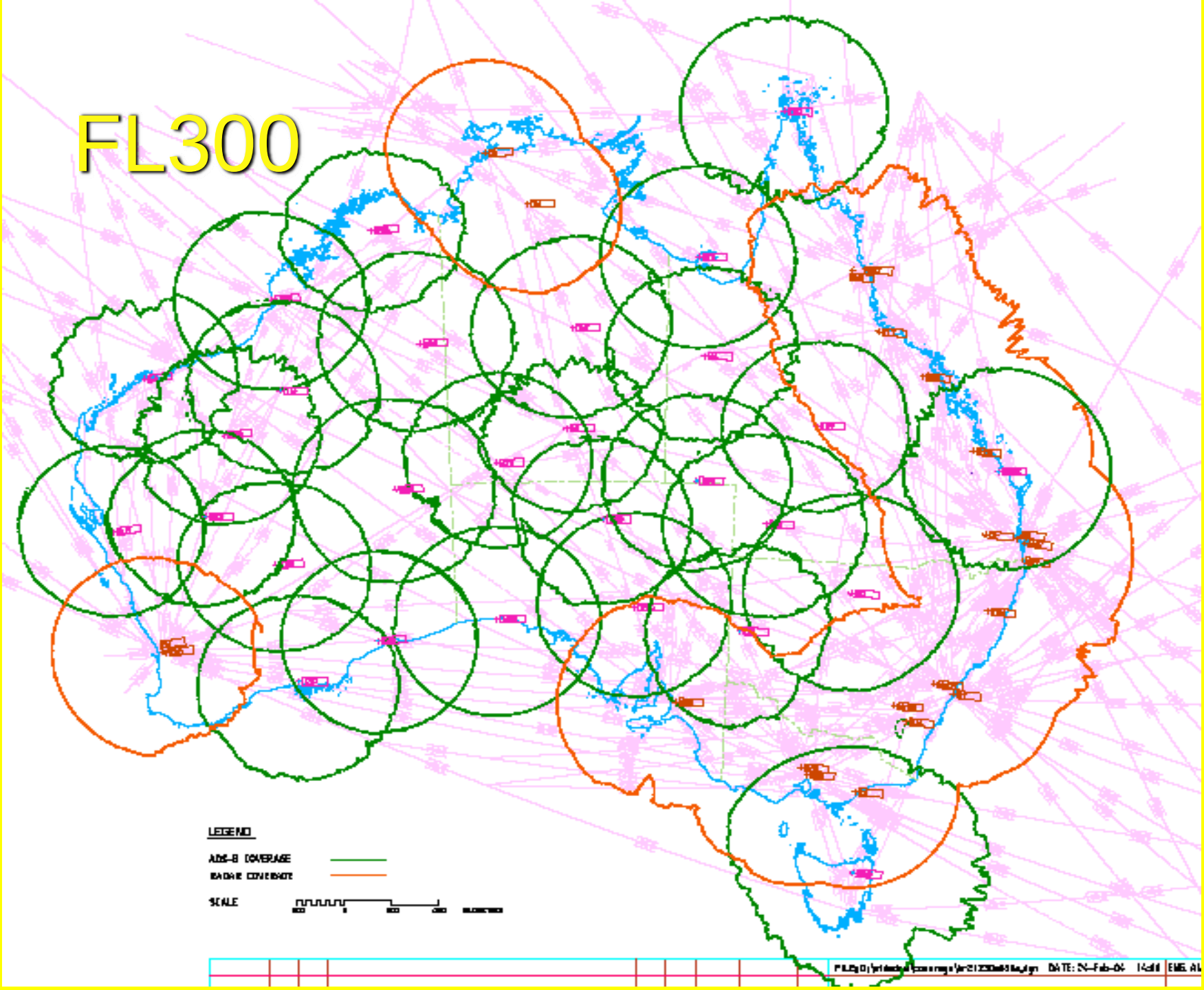
QUEENSTOWN
RNAV (RNP) RWY 05

MAN
AUTO
HUD BRT
FUEL PUMPS
OFF
L
R
ON CTR
AFT
FWD
FUEL PUMPS
FWD
AFT
APU GEN
APU
L WIPER
PARK
INT
LOW
RUNWAY TURNOFF
TAXI
STANDBY COMPASS
RADIO RECEIVERS ON
COURSE
234
A/T ARM
IAS/MACH
V NAV
HEADING
234
L NAV
ALTITUDE
10500
FIRE WARN
SPEED
LVL CHG
HDG SEL
VOR LOC
APP
ALT HLD
V/S
MAIN PANEL DU
LOWER DU
LIGHTS
YAW DAMPER
FUEL FLOW
AUTO BRAKE

SYDNEY GLS

MCP SPD
VOR/LOC
LNAV
G/S
131
G34B/335°
RW34R 4.0
GLS
CMD
180
160
100
2000
1600
1400
1200
1300
RADIO
100
070 H
MAG

FL300



ADS-B MANDATE

- ADS-B mandate above F290
  - 2103
  - CAO published
- Low Level Project cancelled (ATLAS)
  - Means Radars and Nav Aids to be replaced
  - Other aids to be refurbished/replaced $200m+
  - More costly adoption of APVs
- **Should we mandate GNSS navigation?**

SATCOM VOICE

- ICAO - “Not for ATC Purposes”
  - See AIC
- Issues
  - No message delivery standards
  - Human Factors of Voice
  - No time stamp
  - Aircraft integration including recorders
- Taken up with ICAO
  - Allowed for one HF substitution in Nat Tracks

The Australian Strategic ATM Group (ASTRA)

ASTRA

The Australian Strategic Air Traffic Management Group

ASTRA is Australia's whole of industry ATM planning body. ASTRA's membership includes airlines, airports, pilots, general aviation and government organisations, including CASA.

One of ASTRA's main roles is to produce the Australian ATM Strategic Plan through the collaborative efforts of its member organisations.

WORK IN PROGRESS

- Aviation White Paper initiatives
- Possible navigation (GNSS) mandate?
- Possible transponder mandate?
- Sat Com Voice
- APV implementation
- New Rules
  - CAO on PBN
    - Part 91U
    - Part 61

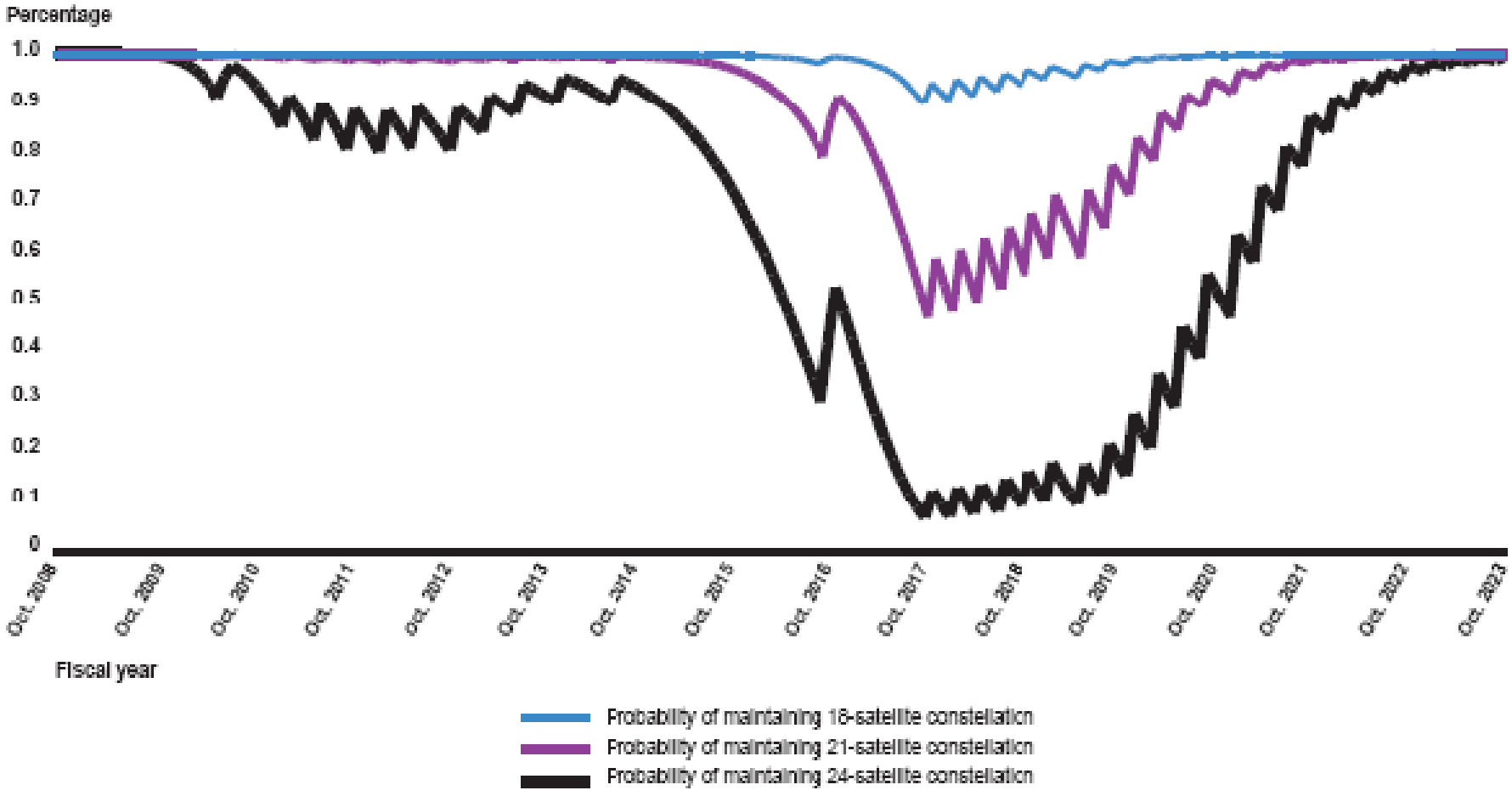
REGIONAL ISSUES

- GPS/GLO ‘military systems’
  - Lack of awareness of US and Russian letters to ICAO
- Lack of State rules for GNSS
- WGS-84 not completed
- Lack of GNSS straight in approaches
- Safety issue going straight to RNP-AR
- Lack of instrument approach designers

ISSUES

- GAO Report
  - Will we really only have SPS level of service?
- Solar Max
- Need for a backup system?
- Augmentation
  - SBAS for Australia and region?
- Next Generation of Aircraft receiver
  - Hybrid
  - Capabilities?
    - Need for Augmentation?

Figure 5: Probability of Maintaining a Constellation of at Least 18, 21, and 24 GPS Satellites Based on Reliability Data as of March 2009 and a 2-Year GPS III Launch Delay



Source: GAO analysis of DOD data.

Websites

- www.airservices.gov.au
  - NOTAMs, NPA RAIM predictions
- www.casa.gov.au - GPS approvals
- www.gps.faa.gov
- www.navcen.uscg.mil
  - GPS information - status messages
- www.icao.int/pbn
- www.garmin.com

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QUESTIONS
&
DISCUSSION

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