

Update on Australian ADS-B Activities

APRIL 2005



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Airservices Australia

Australian ADS-B Activities

- Australian environment
- Bundaberg
- Upper Airspace Project
- Lower Airspace Project

The Australian FIRs

Approximately 11% of the world's airspace

IC Sectors (incl. terminal)

Brisbane = 40 (6 oceanic)

Melbourne = 51 (2 oceanic)

Flights Processed (typically)

Brisbane FIR = 2200/day

Melbourne FIR = 2700/day

Adelaide Airport Traffic

800/day [1000 @ Olympics]

30% Heavy

60% Medium

10% Light



Australian ATC

- Air Traffic Control by a government owned business
- One ATC system for
 - Oceanic / Domestic radar (terminal/approach 3nm & enroute 5nm)/ Domestic non radar
- WITHOUT paper strips in any of these domains
- Using Multiradar tracking in all domains with 5 second asynchronous update
- Radars are ALL monopulse SSR – no Mode S - no enroute primary radars – all rotate at 16.4 rpm – BUT limited coverage – much single radar coverage
- ADS/ CPDLC operational in whole system



The Australian ATC Environment



Outside radar coverage

Procedural ATC with VHF

Remote VHF outlets

- buildings, (solar) power, maintenance,

- Satellite links to ATC

Duplicated radar coverage in Terminal areas

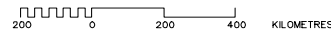
Single radar coverage elsewhere

MAJOR AIRLINE EQUIPAGE PROGRAMS UNDERWAY
MANY NEW AIRCRAFT A320, B737-800...

LEGEND

ADS-B COVERAGE
RADAR COVERAGE

SCALE



Airservices Australia ADS-B Activities

**BUNDABERG
TRIAL**

**ADS-B
UAP**

**ADS-B
LAP**

**ADS-B
R&D Supporting LAP**

International

ASTRA ABIT

**KE
ERATIONAL

ARN
SSONS**

**Benefits Major
Airlines

New service
Above FL300**

**Equip GA Fleet

Avoid radar
replacement

Air-Air benefit
For regional
airlines

Mandatory fit in
Some airspace**

**Low cost squitter
avionics

Low cost CDTI**

**ADS-B APANPIRG
TASK Force

ADS-B Sep
Standards @ ICAO
SASP

OPS @
ICAO OPLINK

WORKING WITH
OTHER SERVICE
PROVIDERS
FAA/ RFG/ SITA**



Australian Aviation Industry Strategic Planning (ASTRA)

- Group formed to address overall ATM strategic planning
 - Airlines, RAAA, military, government, ATC provider, airports, regulator
- Published strategic plan has emphasis on
 - All airspace users known to the system
 - ADS-B a key enabler
- Has formed a number of Implementation teams
 - ADS-B Implementation team formed December 03 to ensure commissioning, fitment etc
 - For Upper Airspace project & Lower Airspace Project

ASTRA Stakeholders



Department of
Defence



Guild of Air Pilot &
Air Navigators



RAPAC



Australian ADS-B Activities

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Bundaberg trial

- Deployed and operationally commissioned ADS-B
 - In a limited geographic area
 - Equipped 9 aircraft
 - Dh8, Shorts, B200, Jabiru
- Objective : Learn operational lessons
- One ground station (Sensis Corporation)



Antenna
Receiver

Antenna
Receiver



ADS-B commissioned :

Available on every BN enroute ATC Console



ADS-B Benefits

ADS-B will enhance safety and increase operational flexibility for suitably equipped aircraft.



ATC automation supports radar, ADS-B & non surveillance aircraft

ATC safety alerting will be provided

- route and altitude monitoring
- short term conflict detection

Radar-like separation standards will apply



Automatic Dependent Surveillance Broadcast (ADS-B)

ADS-B tracking of aircraft landing at Bundaberg Airport



VHTNX

Bombardier Dash 8



JAB875

Labiru Ultralight



Project Included

- ATC system updates
 - Safety net processing
 - Update of FDP
- ATC training simulator updates
- Controllers trained
- Procedures published
- Pilots trained
 - <http://www.airservicesaustralia.com/pilotcentre/projects/adsb/burnettbasin.asp>
- Safety Case approved

5Nm Separation Standard approved

- For trial aircraft only
 - Dash8, B200, Helicopters, Shorts, Jabiru (ultralight)
- Controlled airspace is radar covered
 - 5Nm use if radar fails
- ADS-B used for traffic advisory outside controlled airspace
- New ATC Eurocat Software due in weeks to enable use

Some lessons learned

- Don't involve pilots & controllers in 24 bit codes
- Use Flight ID for coupling to flight plan
- Keep the ground system simple
- Maximise Remote monitoring & control
- Pay attention to site monitoring
- Better RAIM prediction required
- Don't completely discard data when low NUC

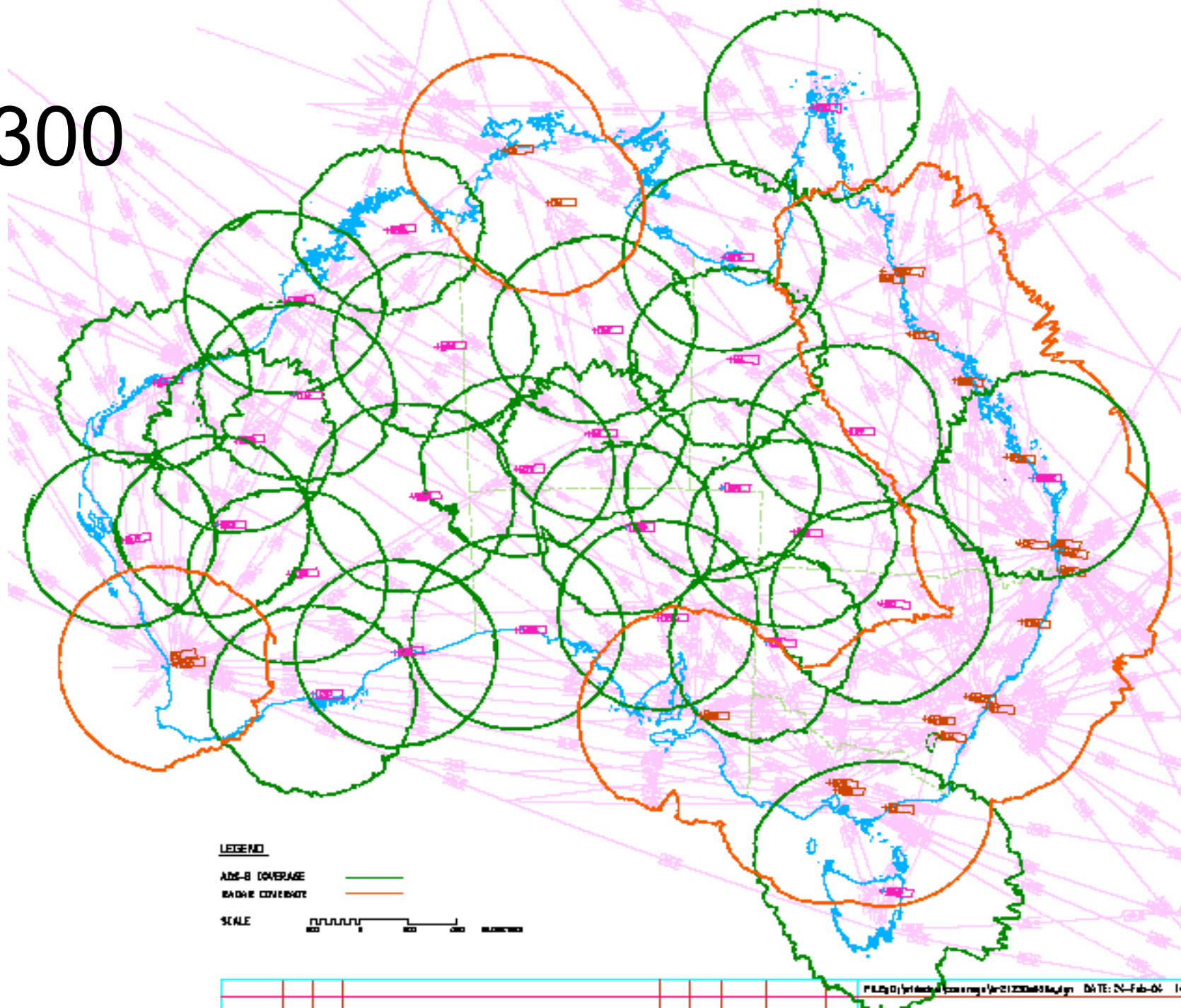
Australian ADS-B Activities

- Australian environment
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UAP focus

- ATC coverage of continent
 - 28 Duplicated Ground stations (Thales ATM)
 - Originally planned 20 – but less expensive than expected
- Voluntary equipage
- Safety benefit
- Efficiency benefit only when 2 nearby aircraft equipped
- Traffic above FL300
- In low density NRA airspace

FL300



FL200

LEGEND

AMS-B COVERAGE

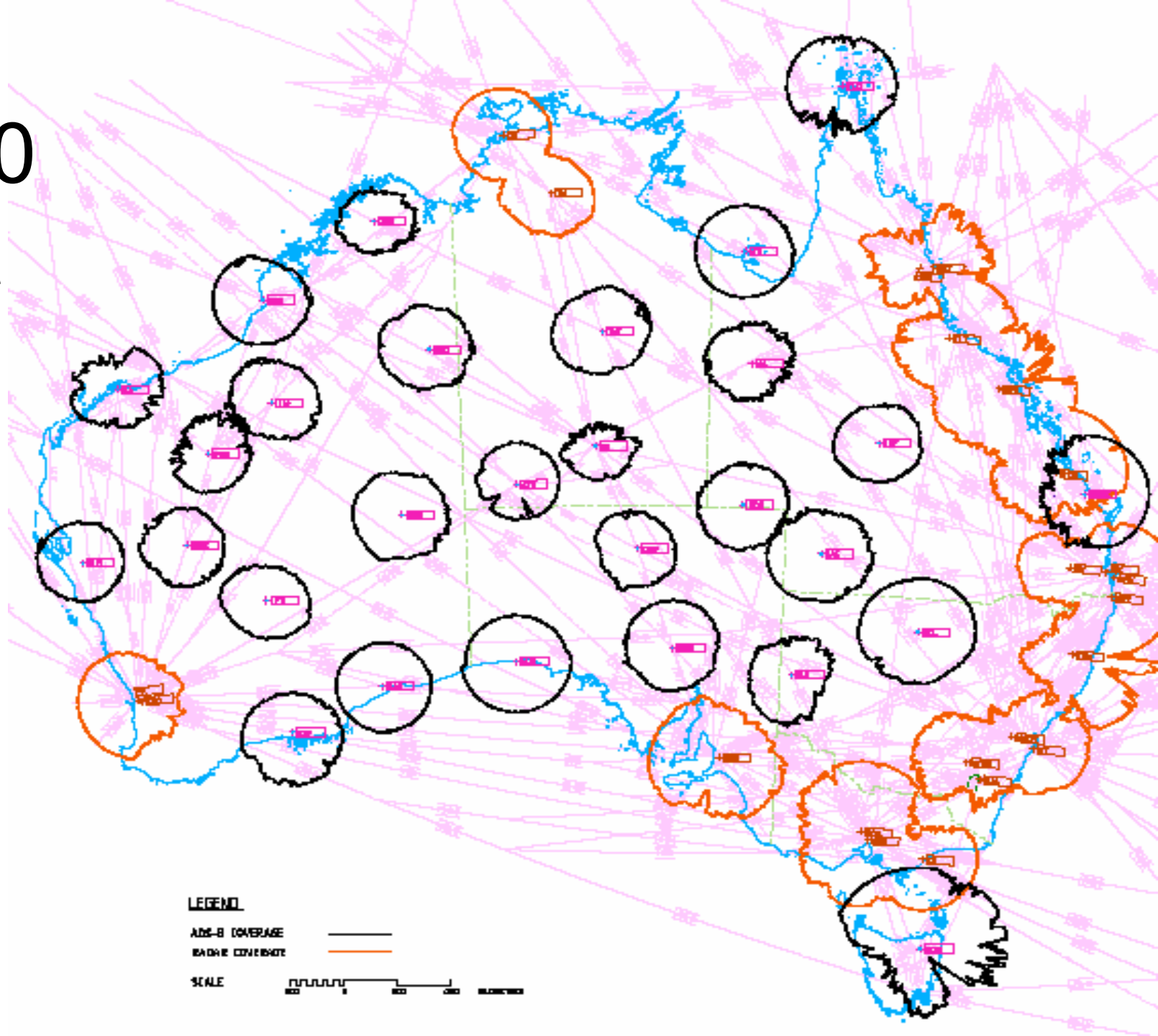
RADAR COVERAGE

SCALE

0 100 200 300 400 500 600 700 800 900 1000 1100 1200 1300 1400 1500 1600 1700 1800 1900 2000 2100 2200 2300 2400 2500 2600 2700 2800 2900 3000 3100 3200 3300 3400 3500 3600 3700 3800 3900 4000 4100 4200 4300 4400 4500 4600 4700 4800 4900 5000 5100 5200 5300 5400 5500 5600 5700 5800 5900 6000 6100 6200 6300 6400 6500 6600 6700 6800 6900 7000 7100 7200 7300 7400 7500 7600 7700 7800 7900 8000 8100 8200 8300 8400 8500 8600 8700 8800 8900 9000 9100 9200 9300 9400 9500 9600 9700 9800 9900 10000

ADD-81 COVERPAGE _____
READ DATE CONFERENCE _____

5,000
feet



Broome



Put ADS-B on a separate pole like this

Balgo & Longreach



Mount ADS-B ½ way up



Tower replacement project!

UAP Status & Schedule

- Ground stations
 - SITE TESTS in Progress
 - Melbourne & Bundaberg GS networked
- TAAATS Changes
 - Delivery in Version 51 Mid 2005
 - 1000 Asterix reports/second
- ADS-B Bypass & Ultimate fallback
 - Direct ADS-B to MMI
 - Development by AsA
 - Bypass FAT complete
- RAIM prediction system improvements
 - Contract with Volpe USA
 - Delivery in next month
- OPERATIONAL END 2005/EARLY 2006



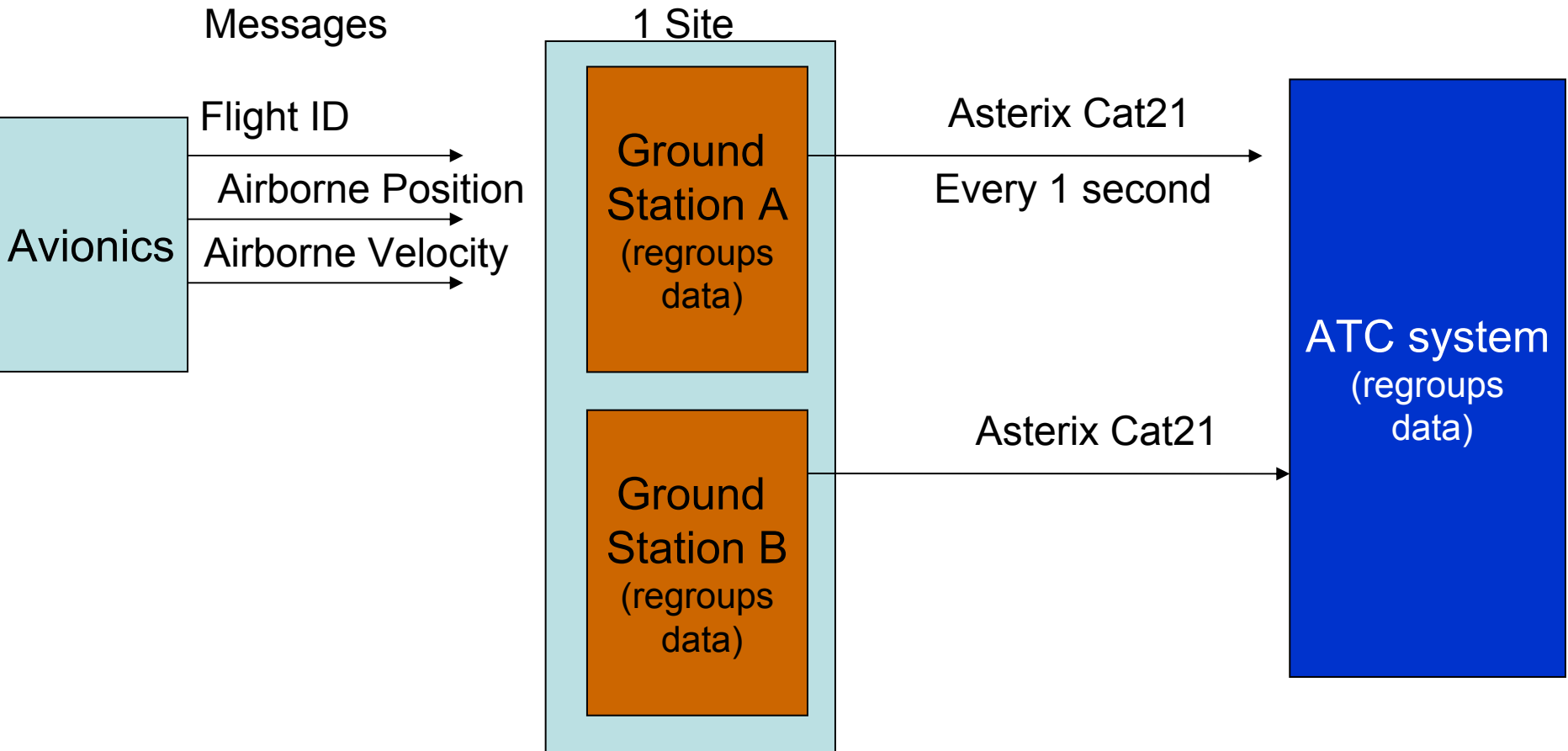
Doongan :
Mount ADS-B Above 1st Guy

Ground station System Design

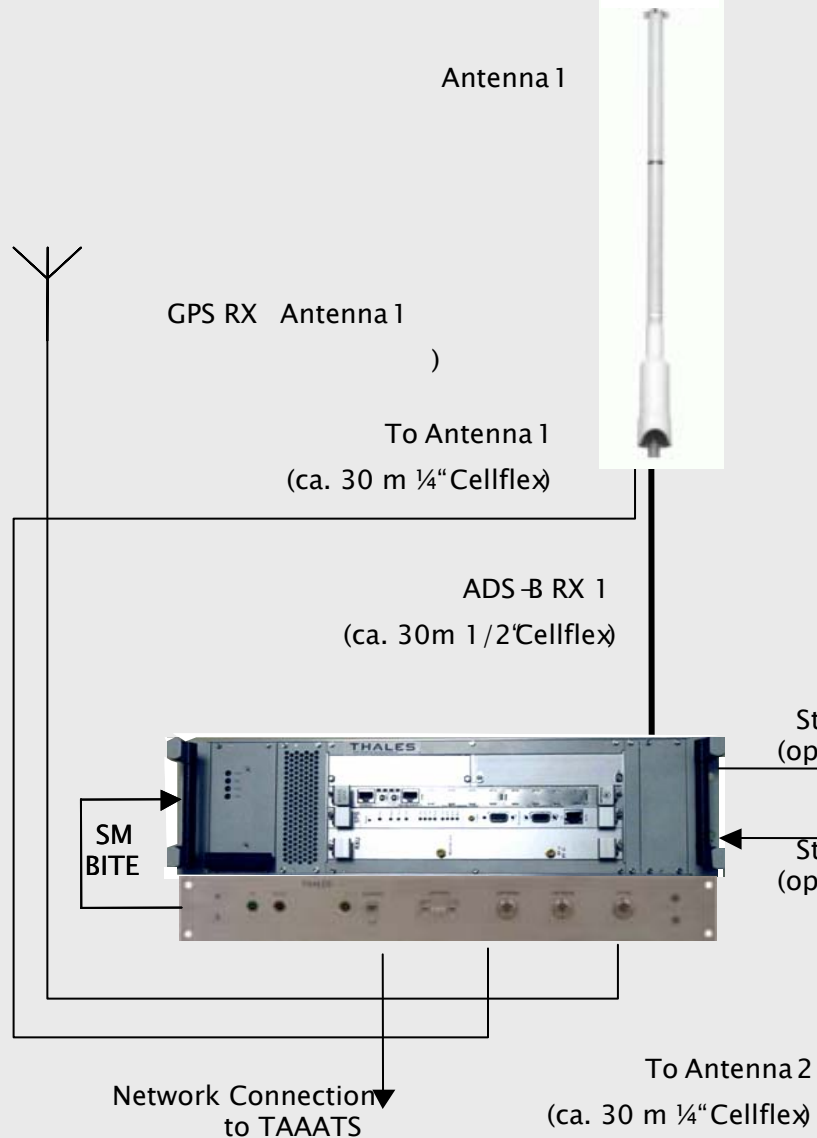


- High sensitivity
- 12dB ADS-B antenna
- 24v DC 100w Ground station
- Outputs Asterix Cat21 at defined rate
- Supports DO260 & DO260A
- Extensive Monitoring & Control at each centre for every Ground station
- Includes Site monitor
 - End-end signal check inc antenna
 - Includes GPS position data

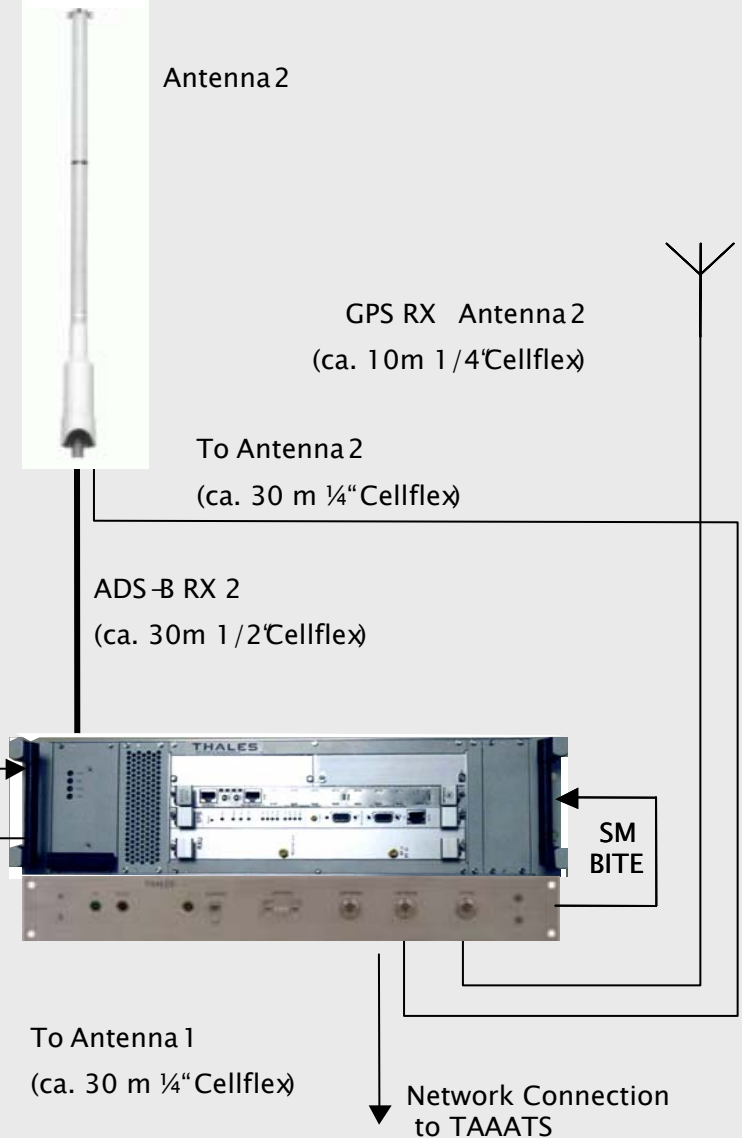
UAP System Design



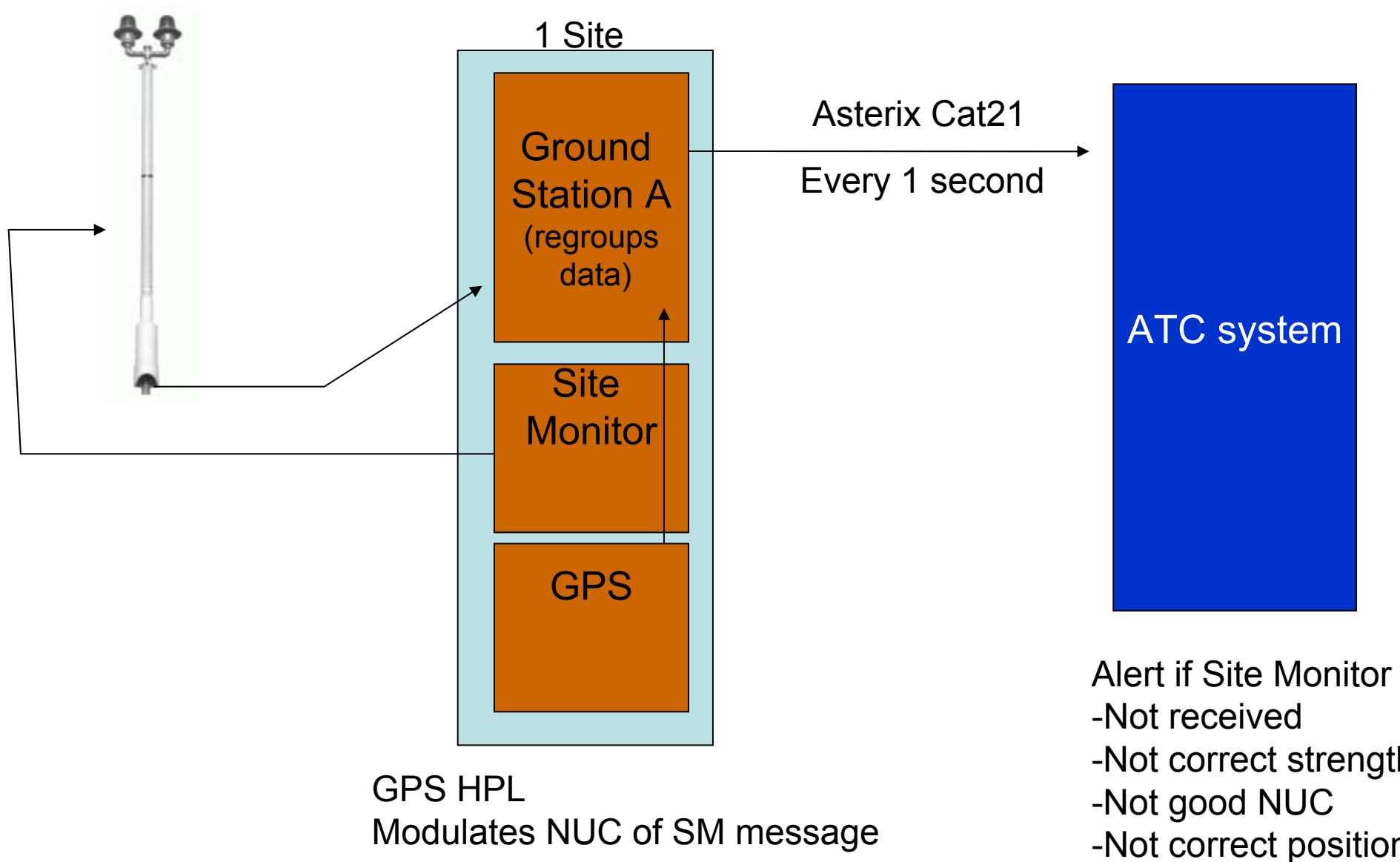
Ground Station 1



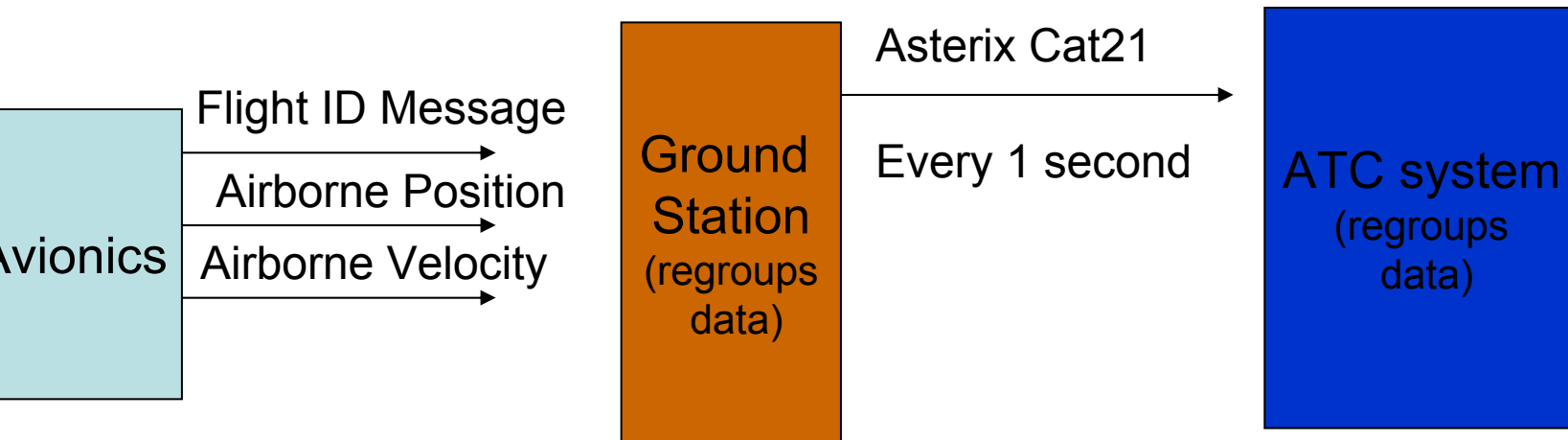
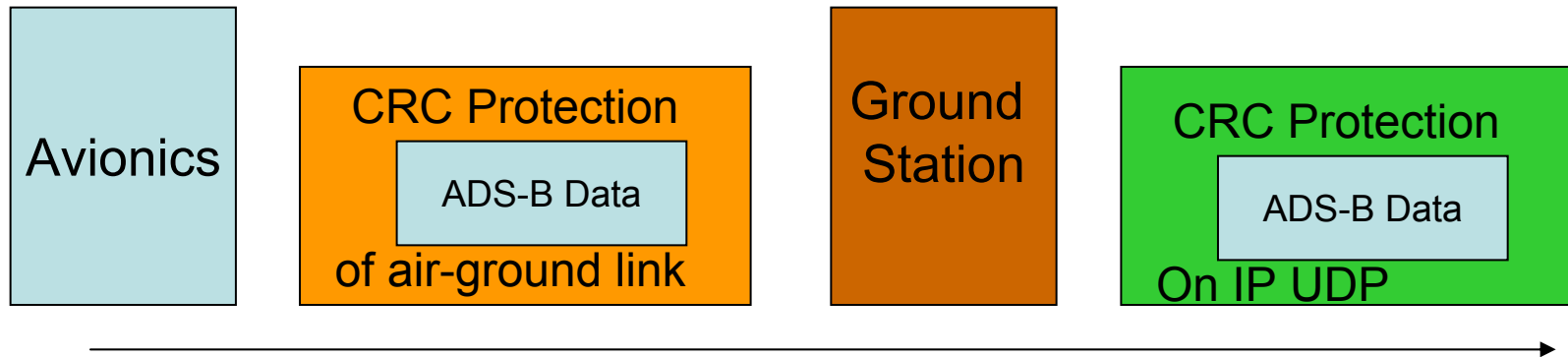
Ground Station 2



UAP Site Monitor Design



ADS-B message processing chain



ADS-B on TAAATS Building Melbourne

ADS-B GS Test Bed

- On display to Melbourne controllers

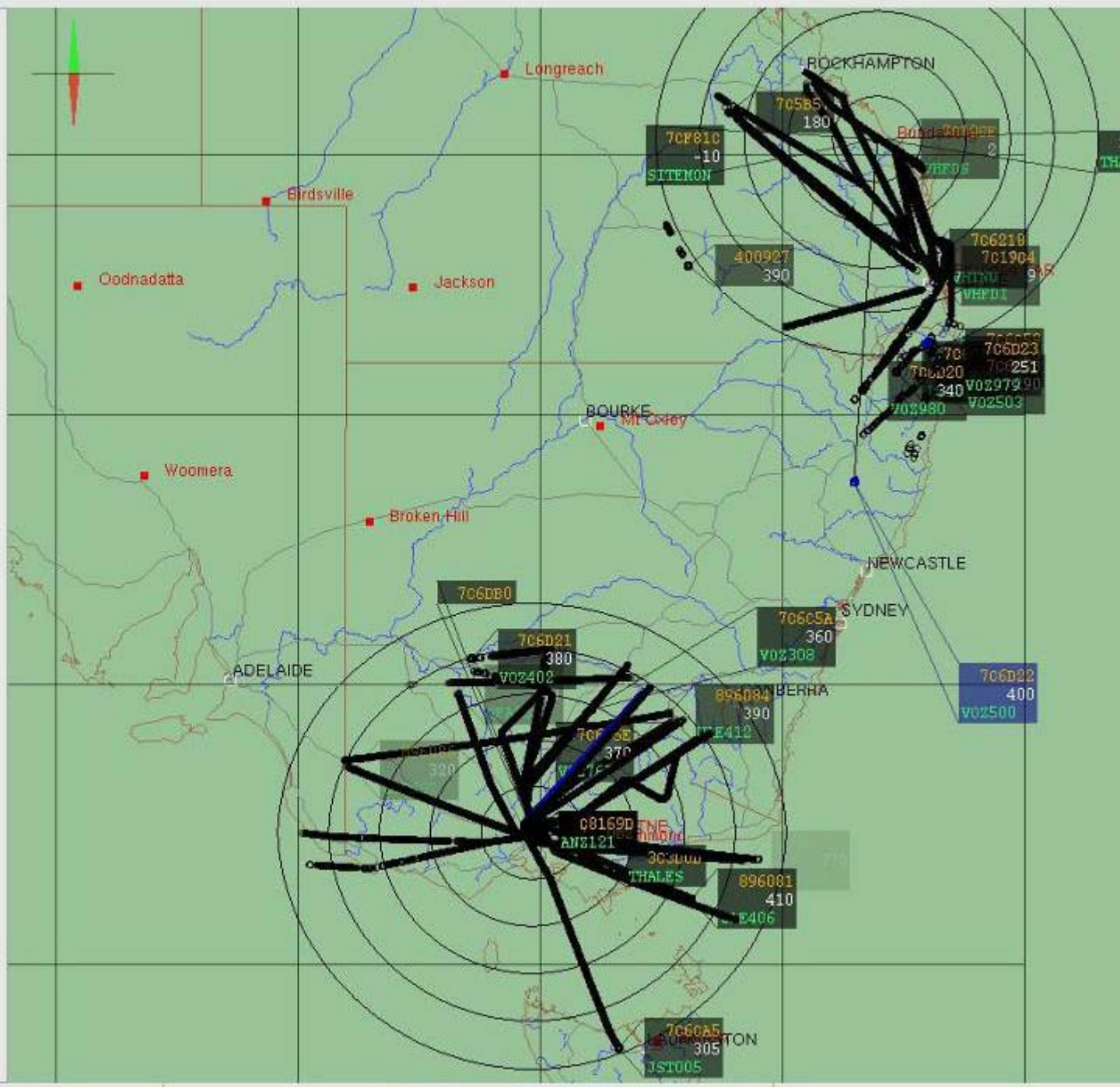
Network of this and Bundaberg UAP ground station on Remote Control Display





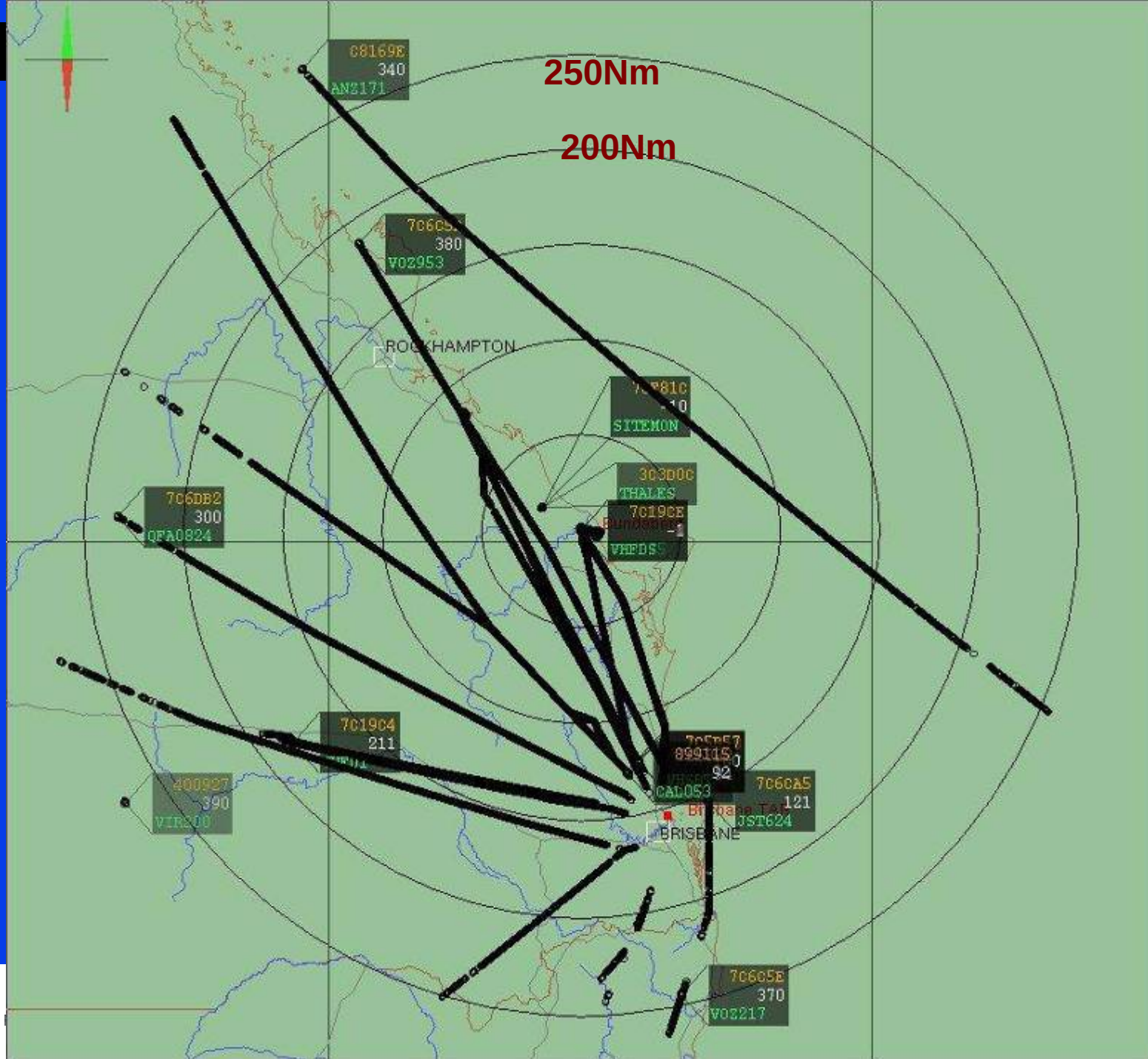
et Details

Source: sic: 110, sac: 4
et Address: 7C6D22
et Ident.: VOZ500
Of Day: 20:55:03
84 Lat Lon: -31.260395° 151.484492°
Level: 400.00 FL
Altitude: 41375 ft
nd Speed: 411.33 kts
Angle: 206.56 °
peed: ---
Air Speed: ---
ing: ---
Accuracy: 2
Vert. Rate: ---
Vert. Rate: -62.50 ft/min
et Status: 0
e of Merit (NUC-P):
AC: 0
MN: 0
DC: 0
PA: 7
er Cat.: ---
et Report Descriptor:
DCR: 0
GBS: 0
SIM: 0
TST: 0
RAB: 0
SAA: 0
SPI: 0
VN: 0
ATP: 1
ARC: 1
Tech. Ind.:
DTI: ---
MDS: ---
UAT: ---
VDL: ---
OTR: ---
l Ampl.: 30
wk: ---



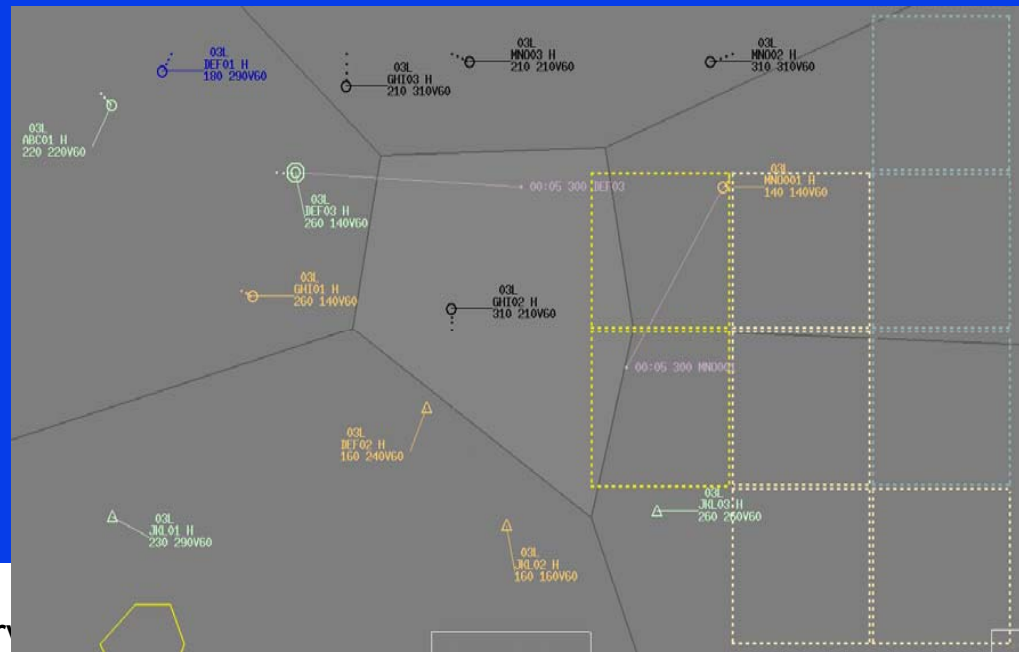
Target Address:	7C531C
Target Ident.:	QFA88
Time Of Day:	00:34:24
WGS84 Lat Lon:	-36.851900° 144.147341°
Flight Level:	168.50 FL
Geo. Altitude:	---
Ground Speed:	---
Track Angle:	---
Air Speed:	---
True Air Speed:	---
Heading:	---
Vel. Accuracy:	---
Baro. Vert. Rate:	---
Geo. Vert. Rate:	---
Target Status:	0
Figure of Merit (NUC-P):	
AC:	0
PA:	0
Emitter Cat.:	---
Target Report Descriptor:	
DCR:	0
GBS:	0
SIM:	0
TST:	0
RAB:	0
SAA:	0
SPI:	0
VN:	0
ATP:	1
ARC:	1
Signal Ampl.:	4C



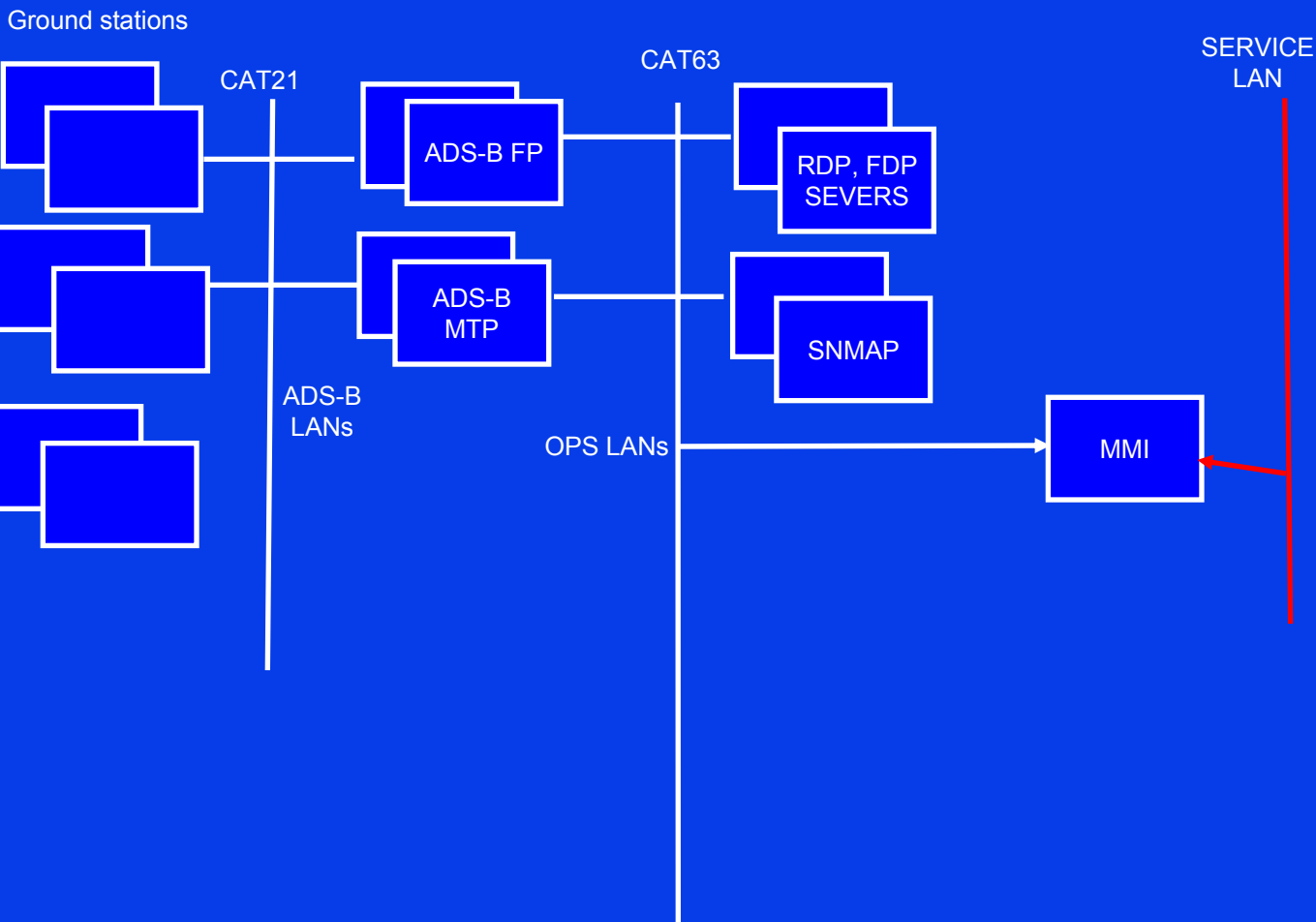


ATC system changes for UAP

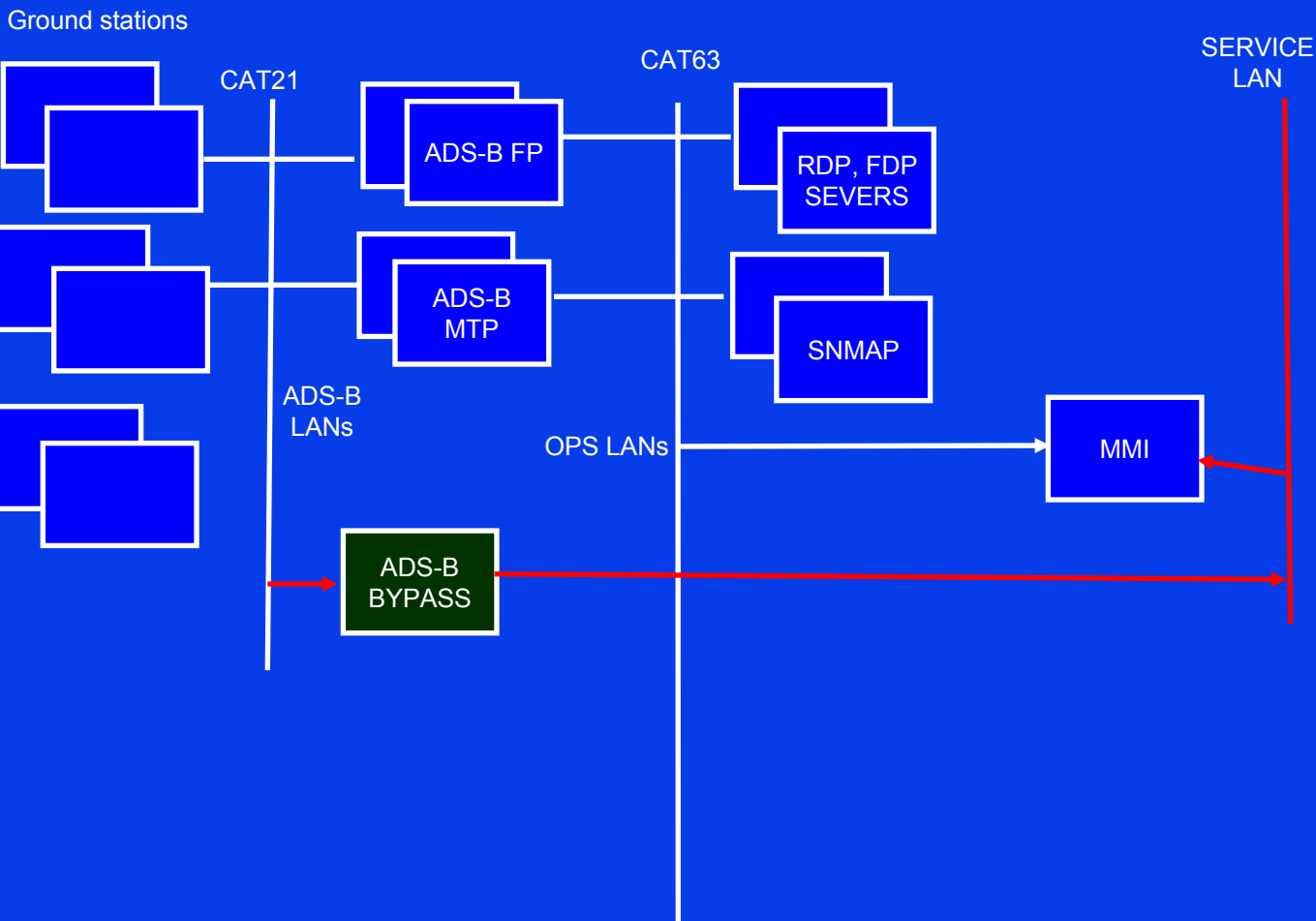
- New Interface
- Multiple symbols
- Graphical ADS-B outage prediction system
- Change “coupling” to flight plan → use Flight ID, abandon 24 bit code except for exceptions



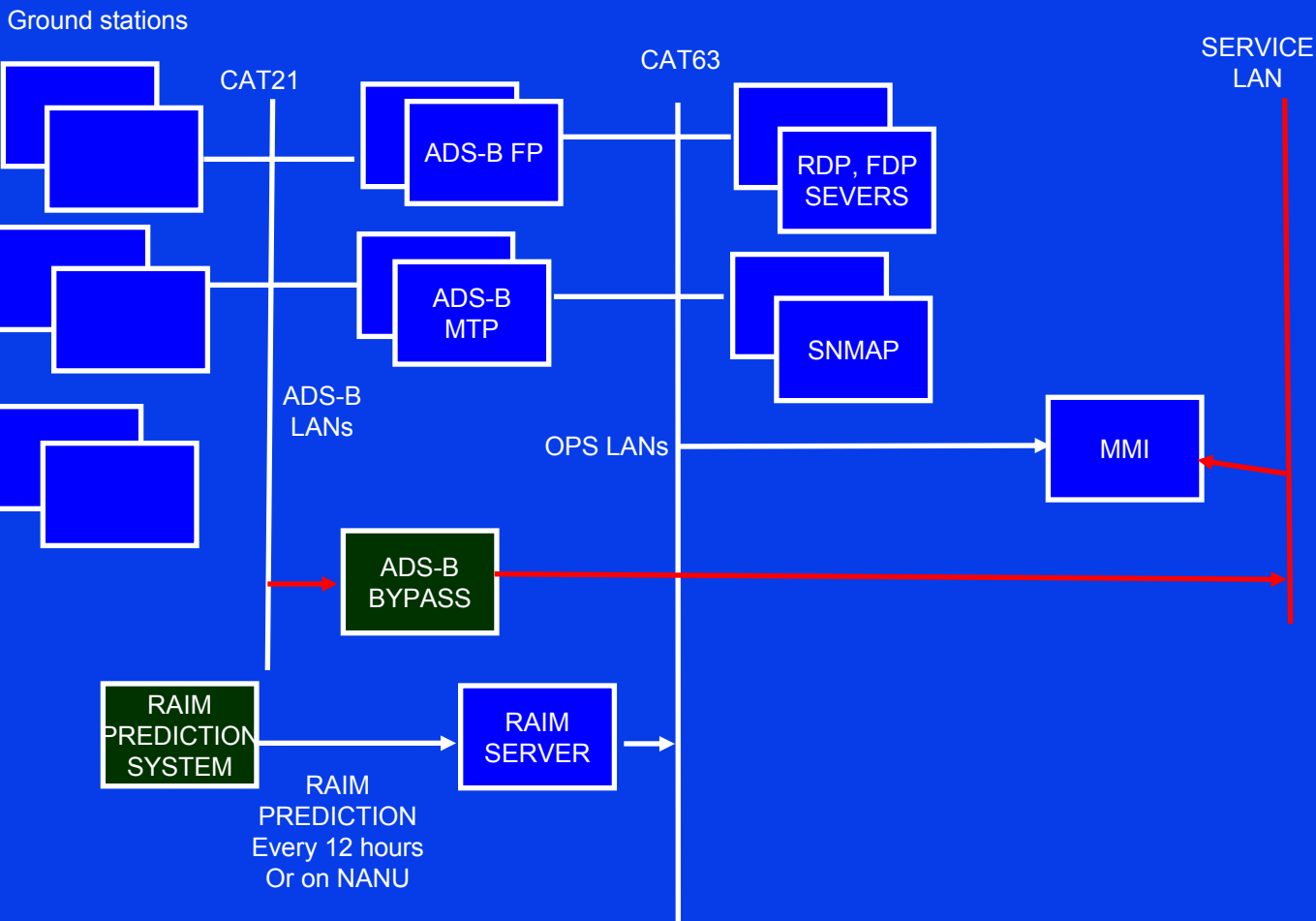
Eurocat ADS-B architecture



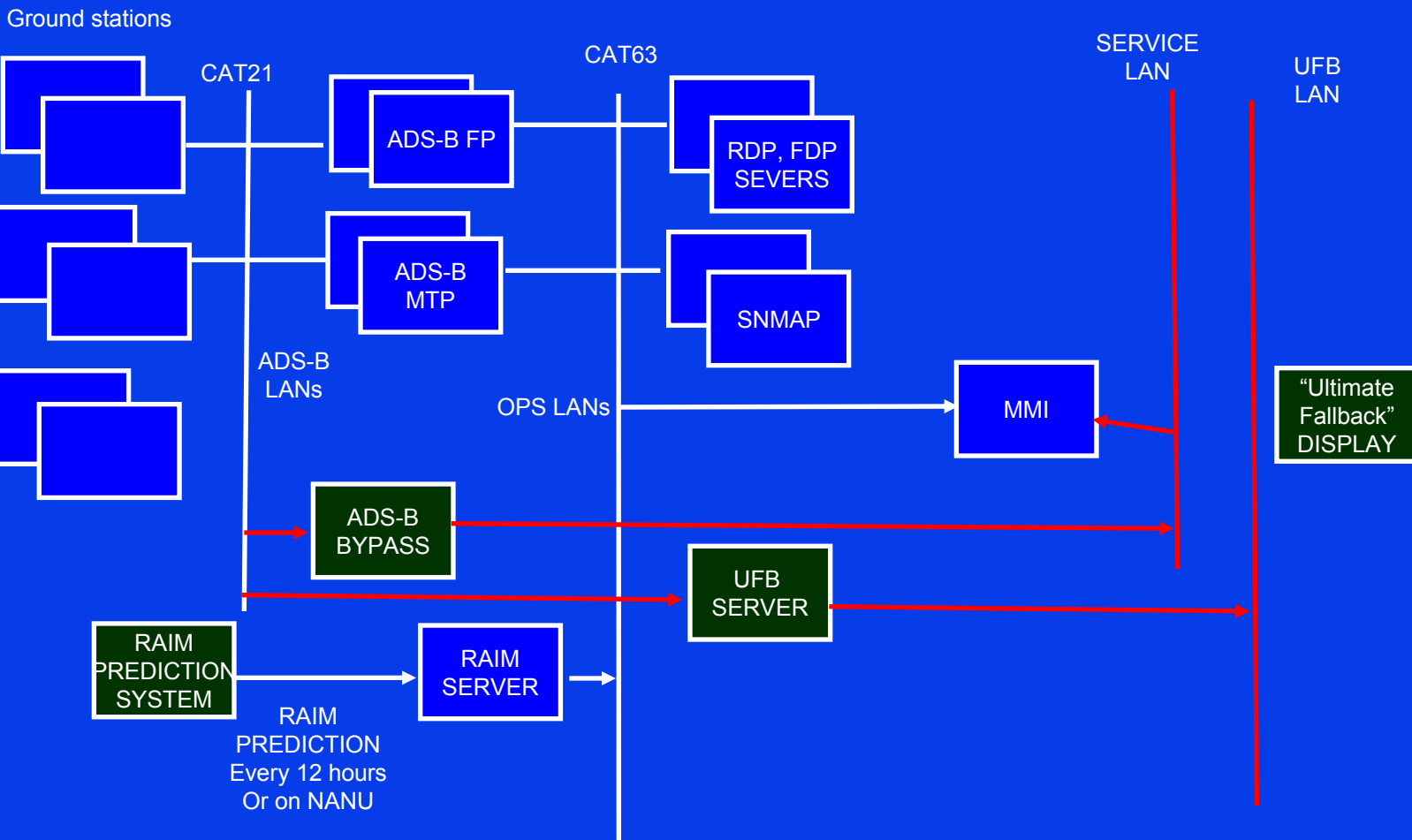
Eurocat ADS-B architecture



Eurocat ADS-B architecture



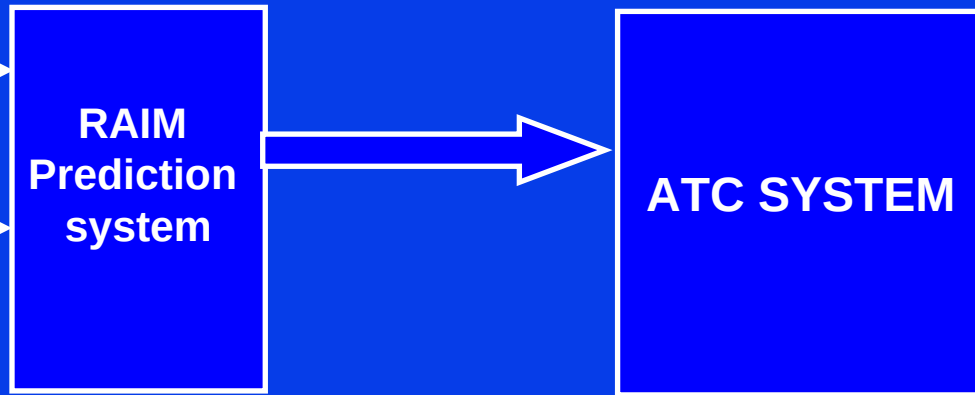
Eurocat ADS-B architecture



“RAIM” prediction on controller screen

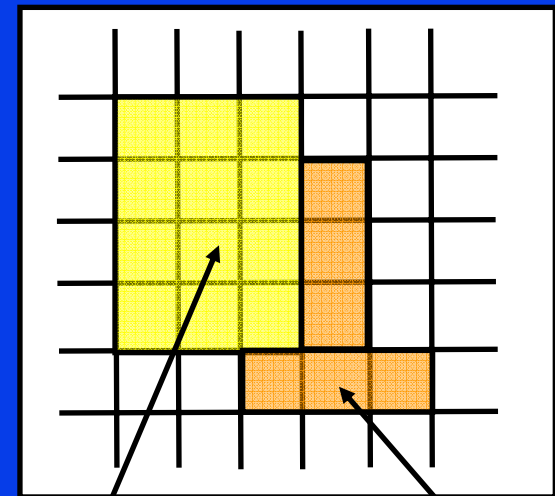
MANAC

NU



LIST OF ADS-B OUTAGES during next 72 hours
For each 1 deg * 1 deg (lat/long) cell

Warning message of any outage in
controllers sector volume
Ability to visualise overlay RAIM MAP



Outage predicted at
Current time

Outage expected
in next 20 minutes

RAIM prediction

- Current system
 - predicts outage for airport NPA (when $HPL > 0.3Nm$)
 - Assumes TSO129 basic unit
 - Pessimistic because Airlines use better than basic TSO129
 - GPS NOTAM style text output
- New System
 - Predicts outages for $1^\circ * 1^\circ$ cells (when $HPL > 0.5Nm$)
 - Graphical output to controller
 - Tailorable for
 - SA on-off
 - TSO129 or TSO145
 - Use Geo or not
- Challenge will be tailoring wisely !

Future UAP Steps

- An ADS-B Mandate with Lower Airspace Project
- A “second window” that tracks with aircraft pair
- Integrated ADS-B / Radar fusion MRTS
- New Mode S radars for terminal areas
 - Remove need for 4 digit octal codes
 - Coupling based on Flight ID

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ASTRA Stakeholders



Department of
Defence



Guild of Air Pilot &
Air Navigators



RAPAC



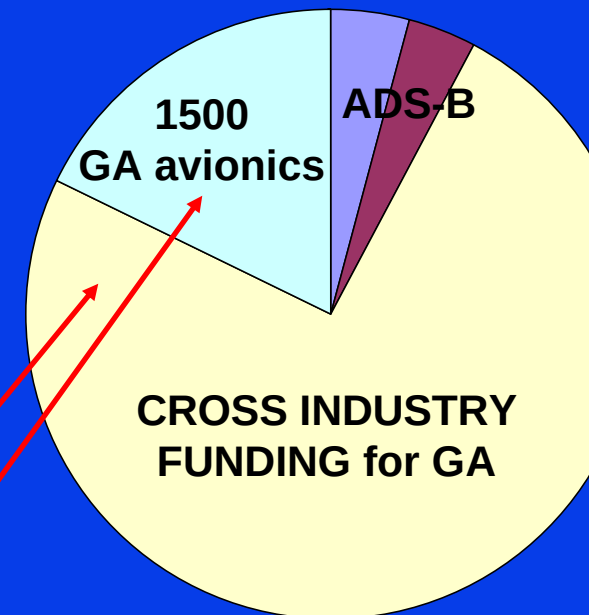
ASTRA formed ABIT

- ADS-B IMPLEMENTATION TEAM (ABIT)
 - 4 meetings
 - All Industry
- REQUESTED REGULATOR to commence mandate process
- INITIATED Cross Industry Business Case
- DEFINED scope of LAP
- Expected to support LAP in next months

What is LAP?

Scope as agreed by ABIT includes:

- CASA approval of sole means GPS using TSO145/6
- CASA Mandate for fitment of ADS-B and TSO 145/6 GPS – several scenarios - 2009
- 11 ADS-B ground stations at existing radar sites
- Decommissioning of a large number of Nav aids
- Decommissioning of enroute radars by 2010
- Extended surveillance at ~10 additional “hot spots”
- A **cross industry funding package** to support the fitment of ADS-B avionics to General Aviation
- Initial purchase of 1500 low end GA avionics to ensure product availability at a competitive price



ADS-B Lower Airspace Project (LAP)

STATUS

- NOT yet approved – building a business case & negotiating with stakeholders
 - Decisions in 1st Half 2005
- Mandate process for 2009 started – CASA discussion paper
- Cross Industry funding package seems likely
- General aviation TSOs available
- We are building Industry Awareness

Envisaged LAP result

AIR TRANSPORT

ADS-B OUT + OPTIONAL CDTI
(self funded)



IFR GA

ADS-B OUT + TSO146 NAV
+ OPTIONAL CDTI
(industry funding < 5700Kg)



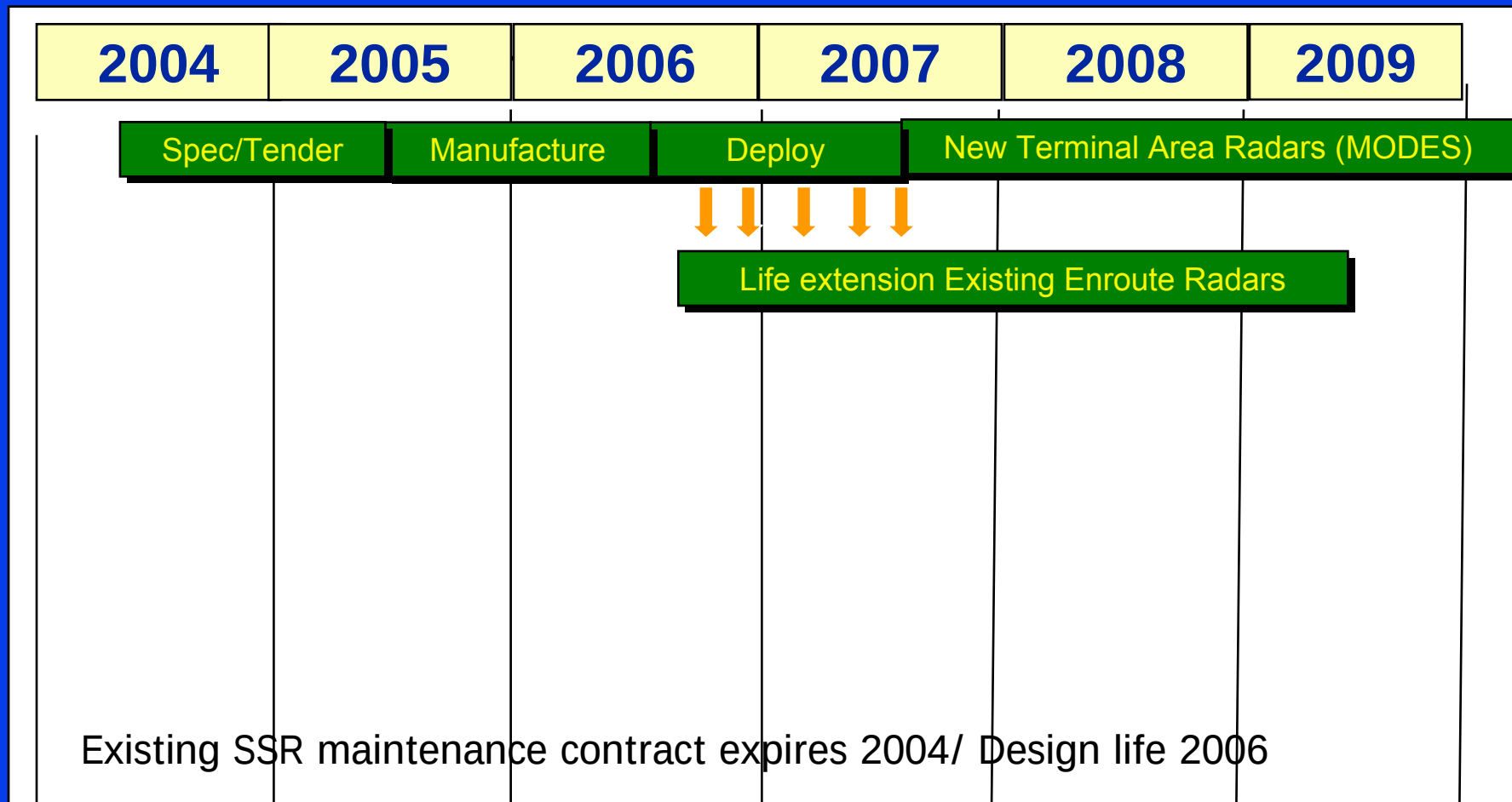
VFR GA

ADS-B OUT +
TSO145 driven PDA MOVING MAP/ TERRAIN
(industry funding < 5700Kg)

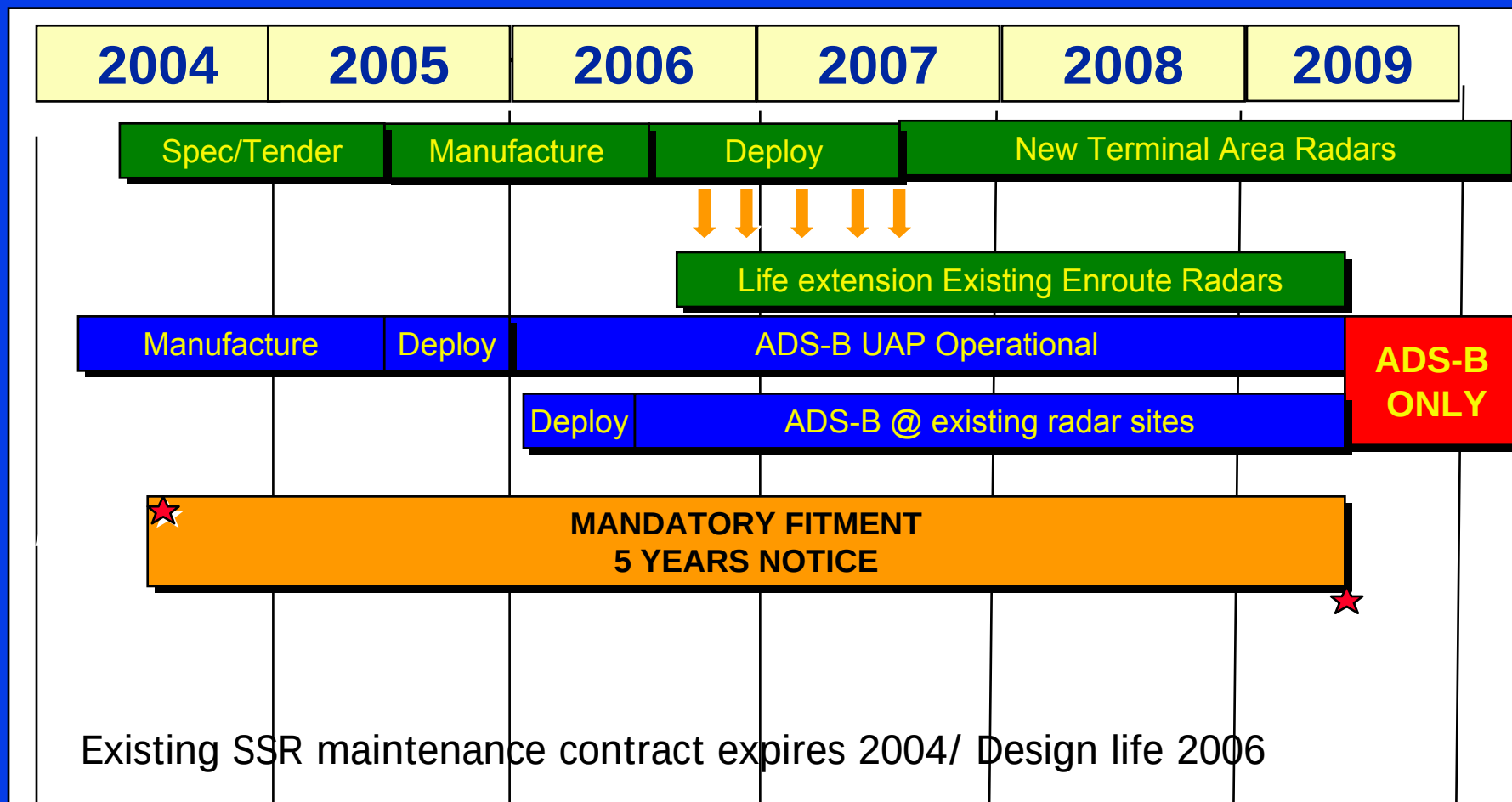
LAP has major impact on Upper Airspace

- UAP : Optional equipage in NRA airspace
 - Safety benefit
 - Small efficiency benefit
 - Limited numbers of conflict pairs
- LAP : Mandatory equipage in 2009
 - Larger safety benefit
 - Much larger efficiency benefit
 - User Preferred Route enabler impact
 - In more dense enroute (RAD) airspace

Australia plans to replace Terminal Area radars & extend life of Enroute SSR only radars



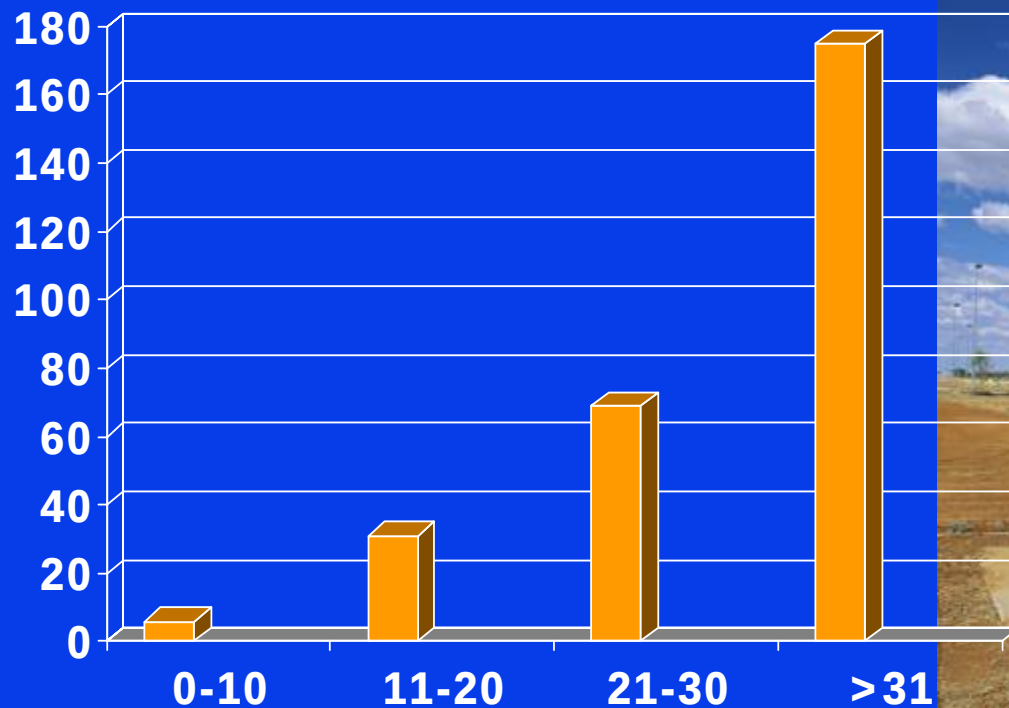
But envisages replacement in 2009 with ADS-B



Current Navaid Baseline - NDB

→ 284 Facilities

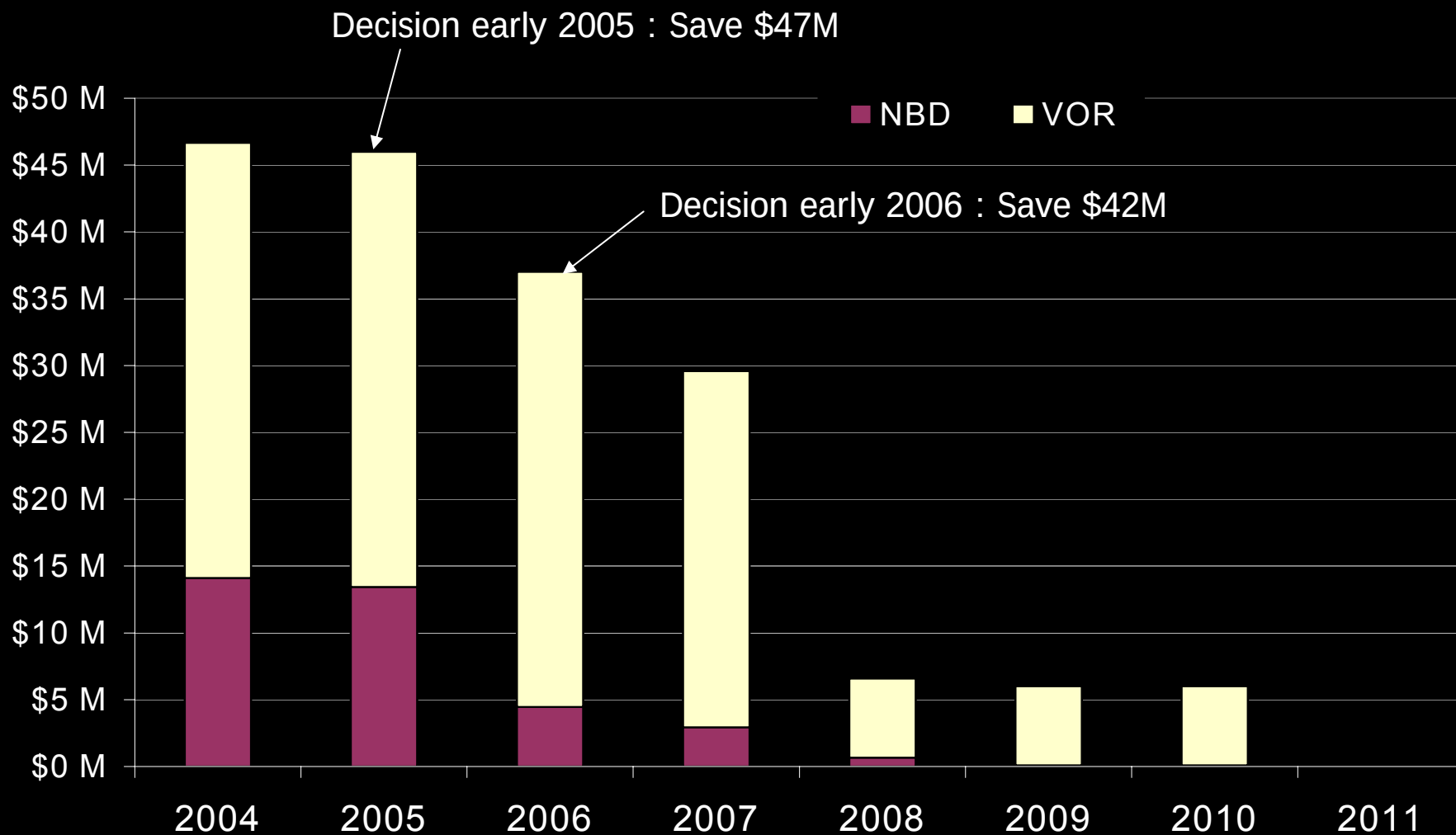
→ Airservices 239, Defence 11, Private 34



• 60% over 30 years old



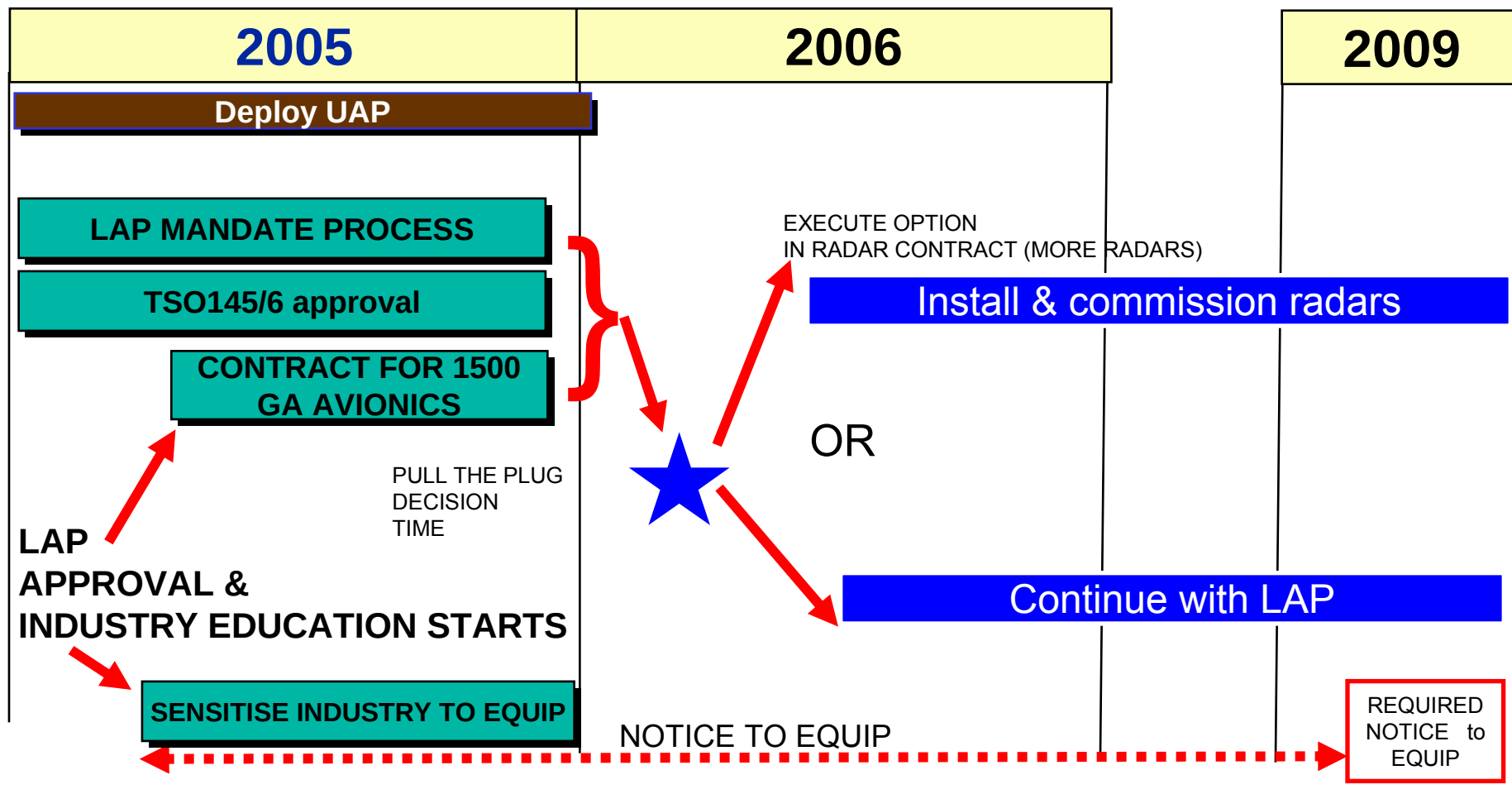
Navaid Savings Disappear each year



Critical pillars for LAP

- TSO145/6 Navigators approved for sole means (expected mid 2005)
- Adequate notice for avionics installation (5 years) before end of life of enroute radars (risk unacceptable in 2010)
- Low end avionics available, funding, GA acceptance
- ADS-B Mandate in place (CASA + Government) **for 2009**
- If not → Execute option for enroute radars in March 2006

LAP IF APPROVED EARLY 2005



Why ABIT wants a mandate?

- To provide same service in enroute radar airspace after these radars are decommissioned & increase benefits in NRA airspace
- To provide opportunity for air-air surveillance
 - Enhanced “see & avoid”, perhaps in trail climb
 - Opportunity for Airspace changes (Airspace reform)
- To move towards ASTRA strategic objective
 - All users known to one another
 - Efficiency & safety
 - Flexibility and access to airspace

CASA and LAP

- Mandate ADS-B fitment
 - Discussion paper published on Web
 - NPRM expected to be issued in APRIL/MAY 05
 - Possible NFRM to be issued in September 05
- Expect TSO145/146 avionics to be approved for sole means navigation by mid/late 2005

CASA OPTIONS in DP

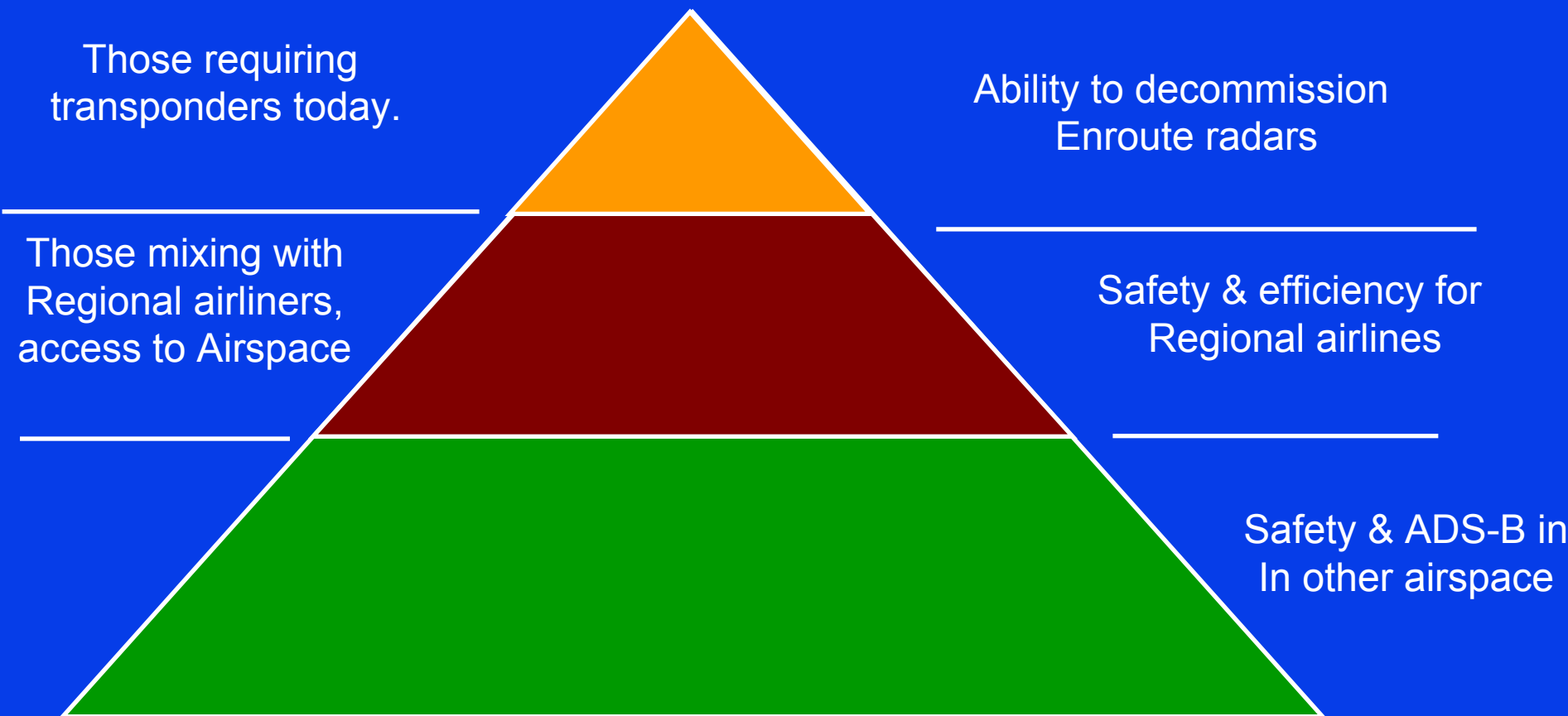
1. Facilitate use of ADS-B : Voluntary equipage
2. Voluntary ADS-B plus increased SSR transponder mandate
3. Encourage ADS-B : Subsidy & no mandate
4. MANDATE
 - 4a : Those required to have SSR + IFR + UAV
 - **4b : Plus fare carrying passengers**
 - **4c : 4a plus all in CTR/MBZ**
 - **4d : All with radio + IFR, UAV, balloons**
 - 4e : Universal equipage

Access Economics CBA

Four scenarios have been examined :

A	Replace 11 Enroute radars and maintain current Navaid infrastructure	Voluntary ADS-B fitment – - UAP - base case	
B	Install ADS-B instead of 11 radars & rationalise Navaids (85%)	ADS-B required for current transponder mandate 4300 aircraft	
C	Add ADS-B receivers at 10 hotspots & rationalise Navaids (90%)	ADS-B required for current transponder mandate + defined hot spot areas 5800 aircraft	
D	Support air-air ADS-B and future surveillance & rationalise Navaids (90%)	Universal fitment to all with VHF radios	

Fitment debate



ADS-B Lower Airspace Project (LAP)

Major characteristics

- NOT yet approved – building a business case & negotiating with stakeholders
- GA equip with “ADS-B out” if sharing airspace with regional airline aircraft
 - Needs to be mandatory in appropriate airspace if benefits are to flow
 - Subsidised GA equipage
 - GA avionics are not YET priced low enough
- Those that wish self equip with Cockpit Display of traffic
 - Enhanced “see and avoid”
 - Provides altitude, identity, velocity vector, vertical rate of other aircraft
 - Reduced operating time (\$ savings) & safety
- Airservices Australia : Avoid ENROUTE radar replacement

ADS-B Mandate

- Air Transport Category – equipage clearer
- Regional Aircraft the problem area
 - Airframers slow to come on board
 - TDR94 transponder not yet ADS-B capable (later this year)
- General aviation – Several options & choices
- CASA Project Team has issued a discussion paper and has received Industry comment

Summarise Last 12 Months

- What have we achieved in Australia in 12 months
 - Commissioned ADS-B in the ATC system inc Safety Case (Bundaberg)
 - Obtained 5nm separation approval (Bundaberg)
 - Purchased UAP systems & moved towards deployment this year
 - Tested new UAP ground station, Remote control & Supporting systems
 - On time
 - Defined & published LAP TSO standards
 - Installed ADS-B at radar site and did comparative test
 - Purchased ADS-B in demo for GA with 1090ES receiver and started demos
- Worked with stakeholders
 - ABIT initiated (50-70 people to meetings)
 - LAP defined and almost ready to approve (LAP cross Industry business case)
 - Initiated regulator work towards a mandate.
 - Established arrangement with SITA
 - GA Information packages on WEB



Application

Some conclusions

- ADS-B is as much about SMALLER aircraft as BIG aircraft
 - Regional airframe manufacturers remain a significant problem
 - : SAAB, Embrarer, ATR, BAe etc
 - Note Importance of GA for enhanced see & avoid operations
 - : Need low price (low functionality options)
 - : Without GA fitted, benefits will be limited in some environments
- ADS-B fitment mandates may occur earlier than thought
 - By cost & safety sensitive states (as requested by stakeholders)
- Good enough is better than perfection
 - Schedule matters to safety
 - Delay ADS-B → delays safety improvements in Asia Pacific

Questions ?

More details on Airservices Website

<http://www.airservicesaustralia.com/pilotcentre/projects/adsb/adsb.htm>

Contact me :

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ADS-B & Radar Velocity vectors

(B200 Sharp turn)

