airspace | airside | AIRSERVICES AUSTRALIA

ADS-B Performance

APANPIRG ADS-B TASK FORCE SEMINAR
Nadi , Fiji

Greg Dunstone
Technology Development
Airservices Australia

Introduction & Overview

- Ground stations
- ATC systems

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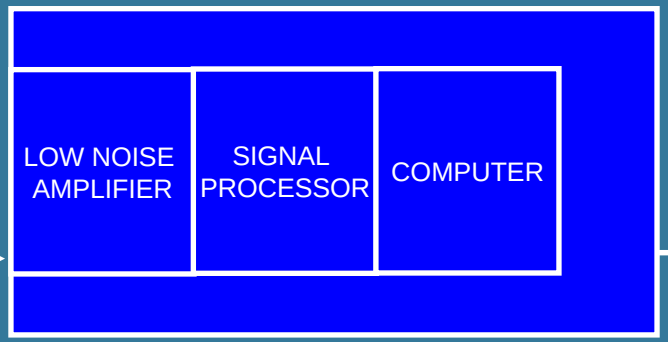
Typical ADS-B Receive only system

DME
OMNI ANTENNA

Thales ATM Ground station

GROUND STATION



RF

MESSAGES TO ATC

MDS= Better than 90 dB

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Some sites power by Solar cells
ADS-B takes only 100 watts!

Ground Surveillance

DOWNLINK MESSAGES

ADS-B OUT

Typically broadcast 2 / second

ASTERIX DATA FORMAT

ADS-B Ground station

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Ground station functions

- Receive and decode messages
  - Position every 0.5 secs
  - Ident every 5 secs
  - Velocity every 0.5 secs
- Collate and package – send every second or so
- Remote monitoring capability

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Asterix Cat 21 Messages

Adobe Acrobat Document

EUROCONTROL STANDARD DOCUMENT

FOR

SURVEILLANCE DATA EXCHANGE

Part 12 : Category 021

ADS-B Messages

SUR.ET1.ST05.2000-STD-12-01

Edition	:	0.23
Edition Date	:	November 2003
Status	:	Working Draft
Class	:	General Public

Table 1 - Data Items of Category 021

Data Item Reference Number	Description	Resolution
I021/010	Data Source Identification	N.A.
I021/020	Emitter Category	N.A.
I021/030	Time of Day	1/128 s
I021/032	Time of Day Accuracy	1/256 s
I021/040	Target Report Descriptor	N.A.
I021/080	Target Address	N.A.
I021/090	Figure of Merit	N.A.
I021/095	Velocity Accuracy	N.A.
I021/110	Trajectory Intent	N.A.
I021/130	Position in WGS-84 co-ordinates	$180/2^{23}$ °
I021/140	Geometric Altitude	6.25 ft
I021/145	Flight Level	¼ FL
I021/146	Intermediate State Selected Altitude	25 ft
I021/148	Final State Selected Altitude	25 ft
I021/150	Air Speed	N.A.
I021/151	True Air Speed	N.A.
I021/152	Magnetic Heading	$360/2^{16}$ °
I021/155	Barometric Vertical Rate	6.25 ft / min
I021/157	Geometric Vertical Rate	6.25 ft / min
I021/160	Ground Vector	N.A.
I021/165	Rate of Turn	¼ °/s
I021/170	Target Identification	N.A.
I021/200	Target Status	N.A.
I021/210	Link Technology Indicator	N.A.
I021/220	Met Report	N.A.
I021/230	Roll Angle	0.01 deg

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Burnett Basin Trial Experience

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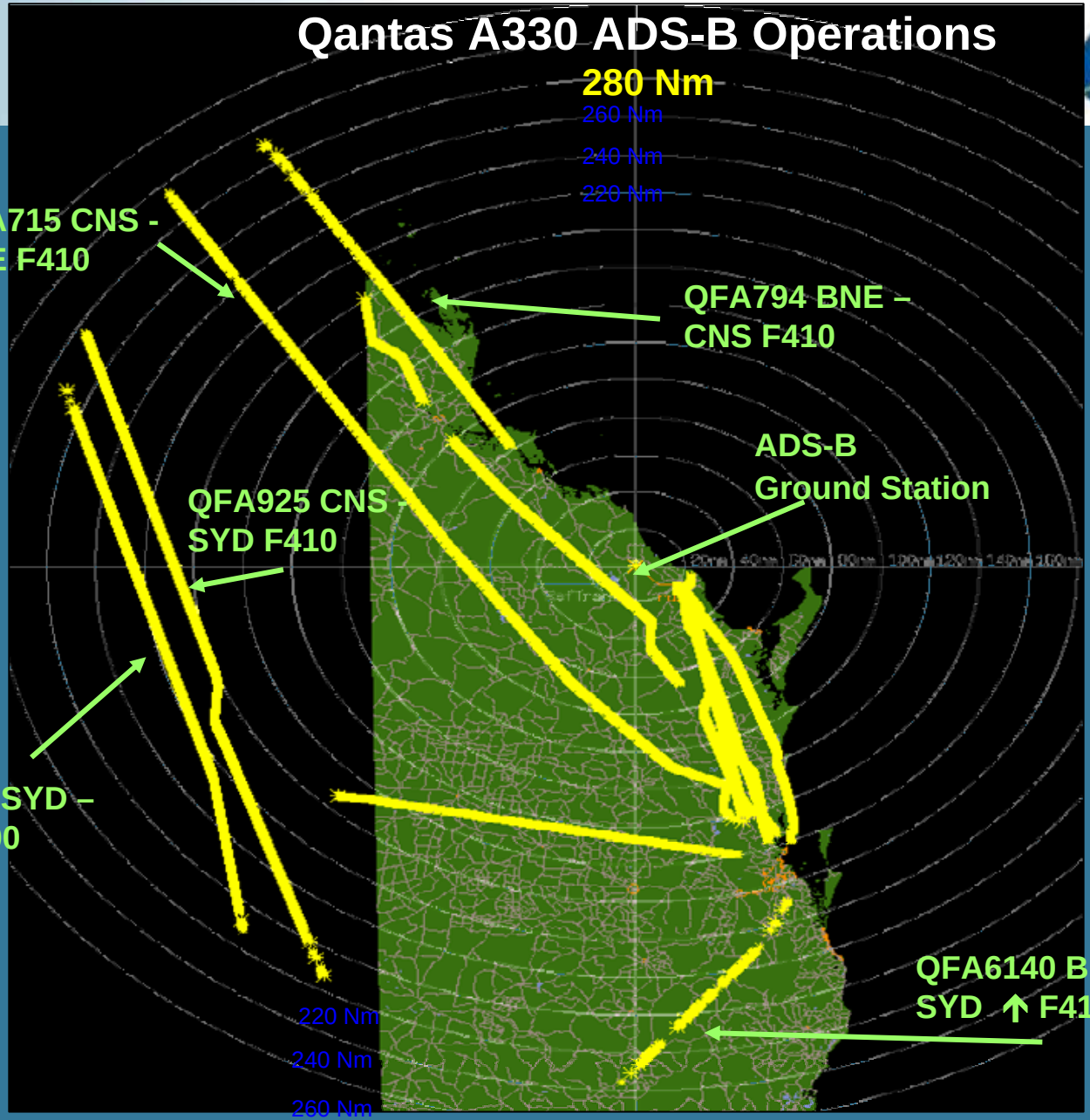
- Mode S ADS-B gives excellent performance in Australia

Sensis Ground station @ Bundaberg



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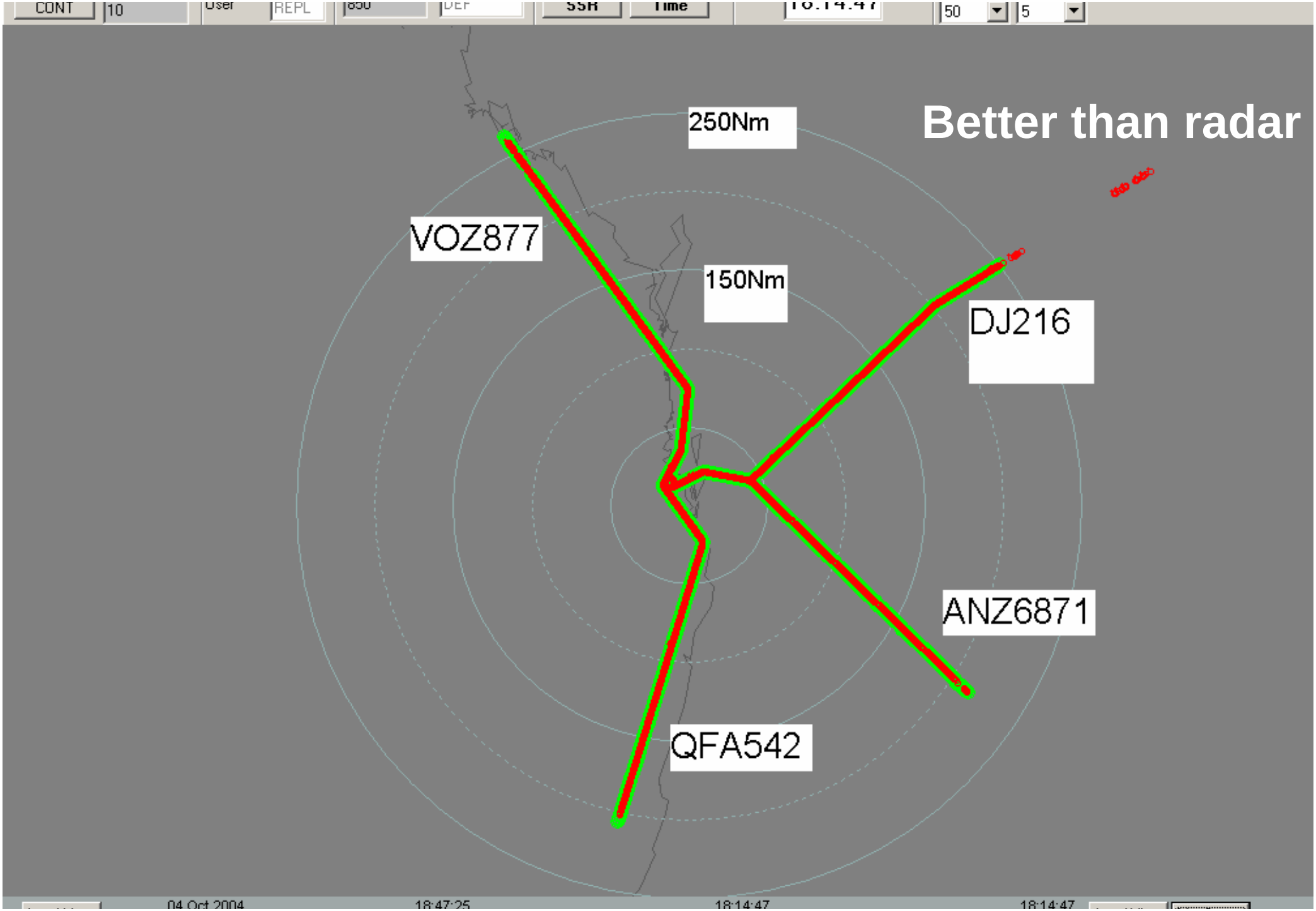
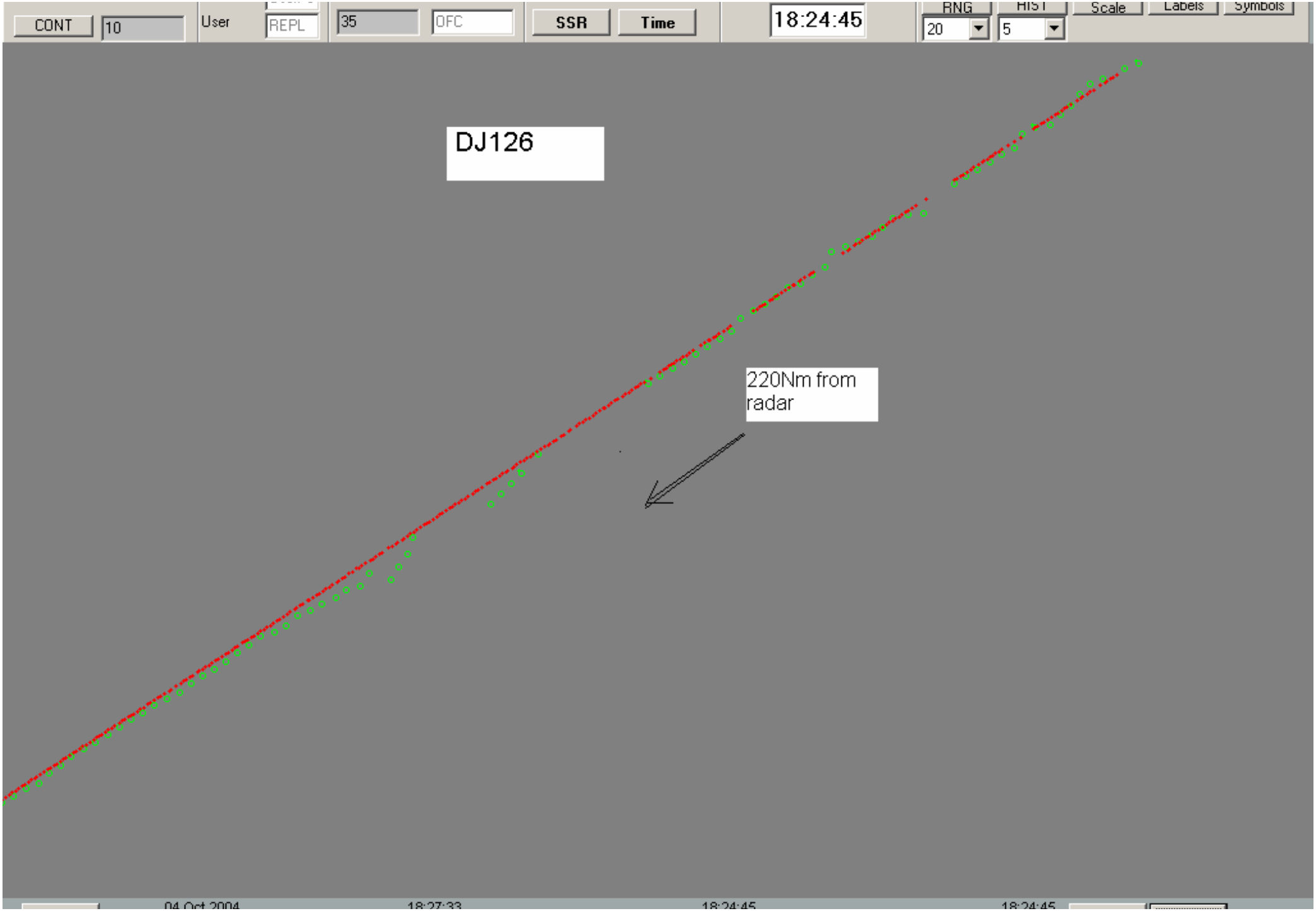
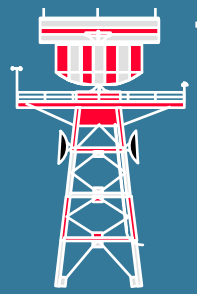
BRISBANE TERMINAL AREA RADAR TOWER
ADS-B ANTENNA

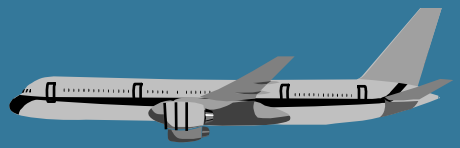

CONT
10
User
REPL
SSR
Time
50
5
Better than radar
250Nm
150Nm
VOZ877
DJ216
ANZ6871
QFA542
04 Oct 2004
18:47:25
18:14:47
18:14:47


CONT
10
User
REPL
35
OFC
SSR
Time
18:24:45
RNG
20
HIST
5
Scale
Labels
Symbols
DJ126
220Nm from radar
04 Oct 2004
18:27:33
18:24:45
18:24:45

Radar



1030 Interrogate



1090 Reply

At least 4-6 replies required every antenna scan

Ie: At least 8-10 successful “messages” required

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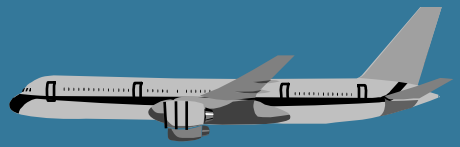
ADS-B



1090 Message

In 5 seconds – 10 position messages

Only 1 needed for 5 second update !

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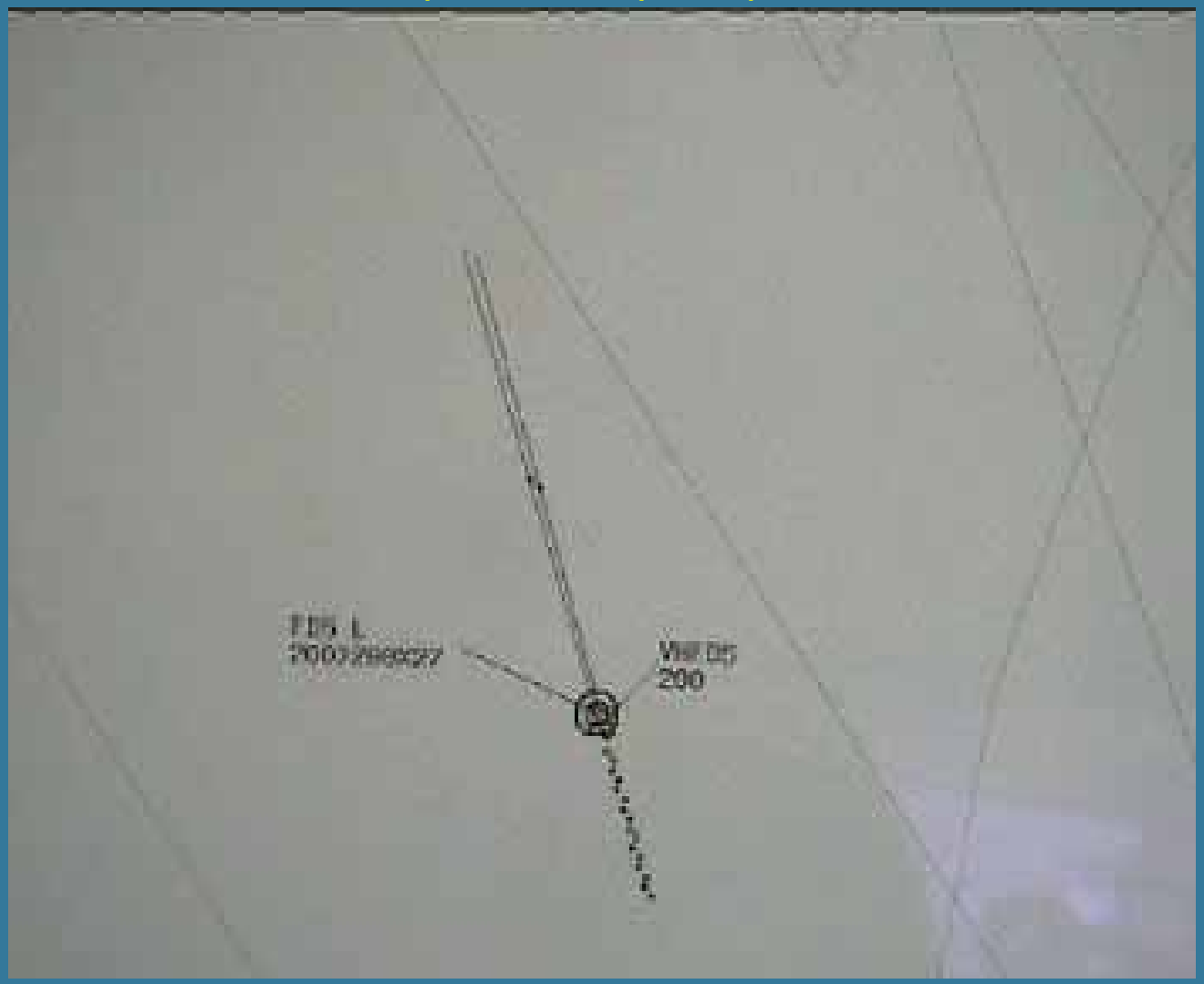
ADS-B & Radar Velocity vectors

(B200 Sharp turn)



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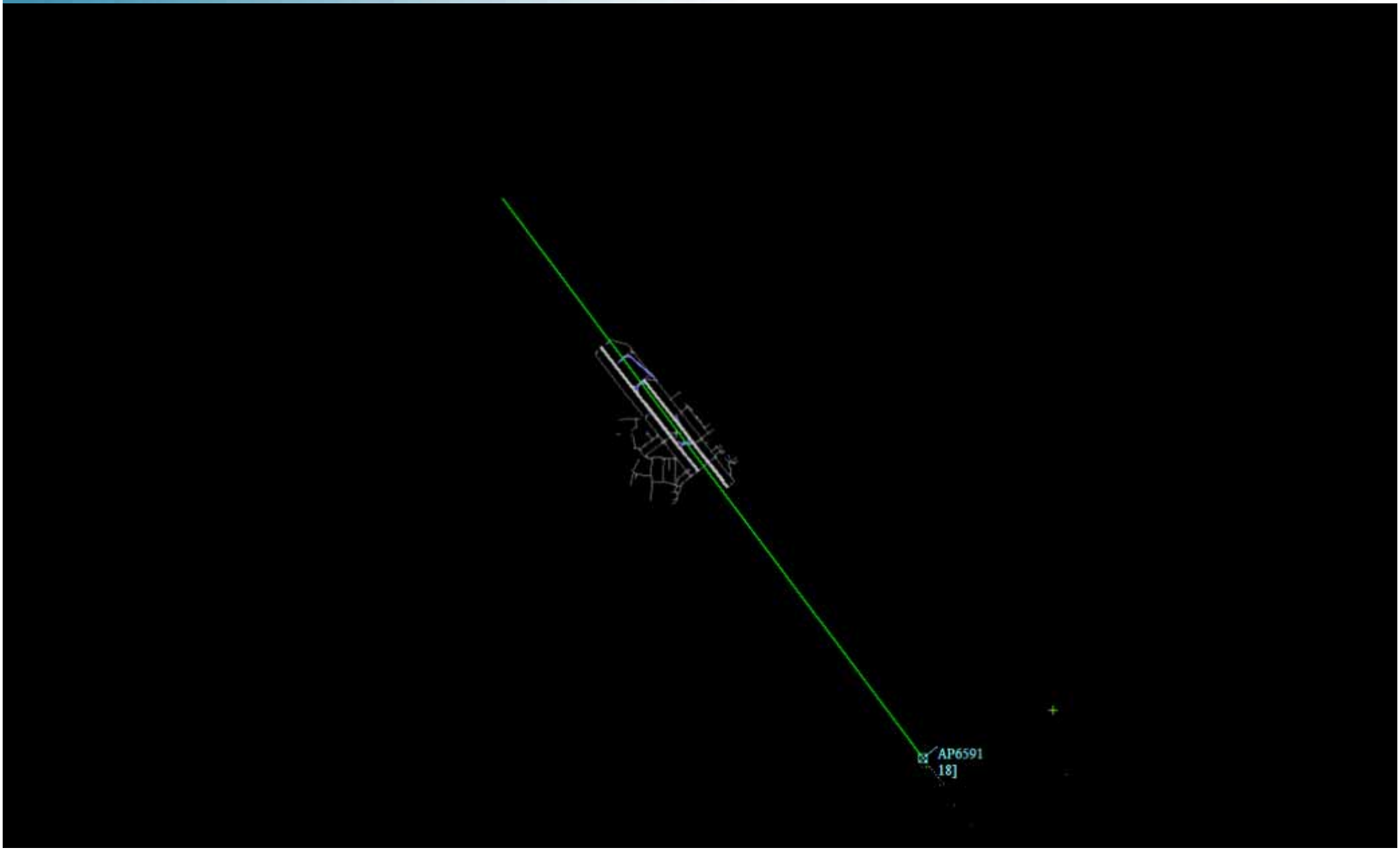
Toulouse France Ground station



Airlines have ADS-B now

ADS-B tracks

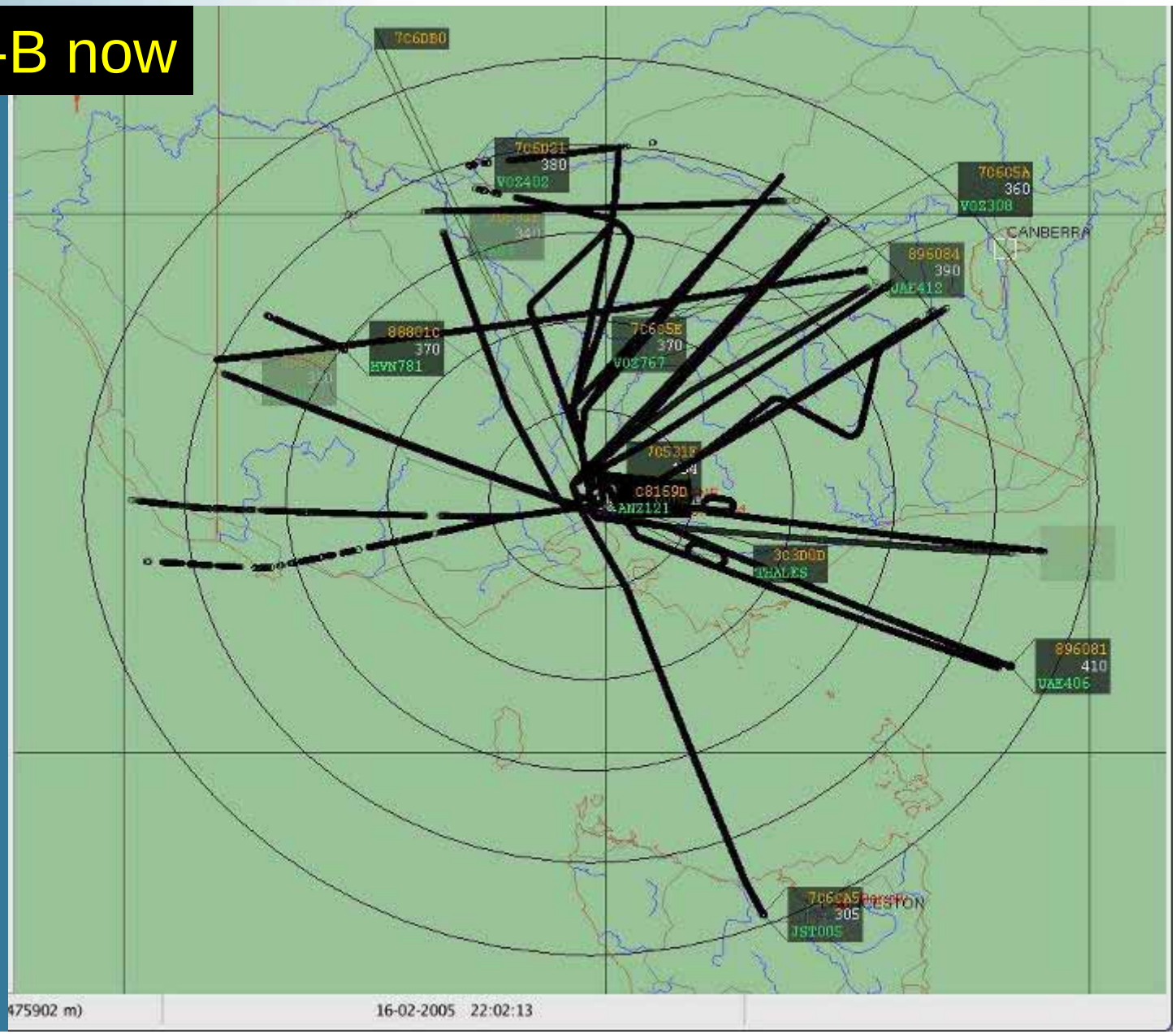
Melbourne Area

Evening 16 Feb 2005

On screen

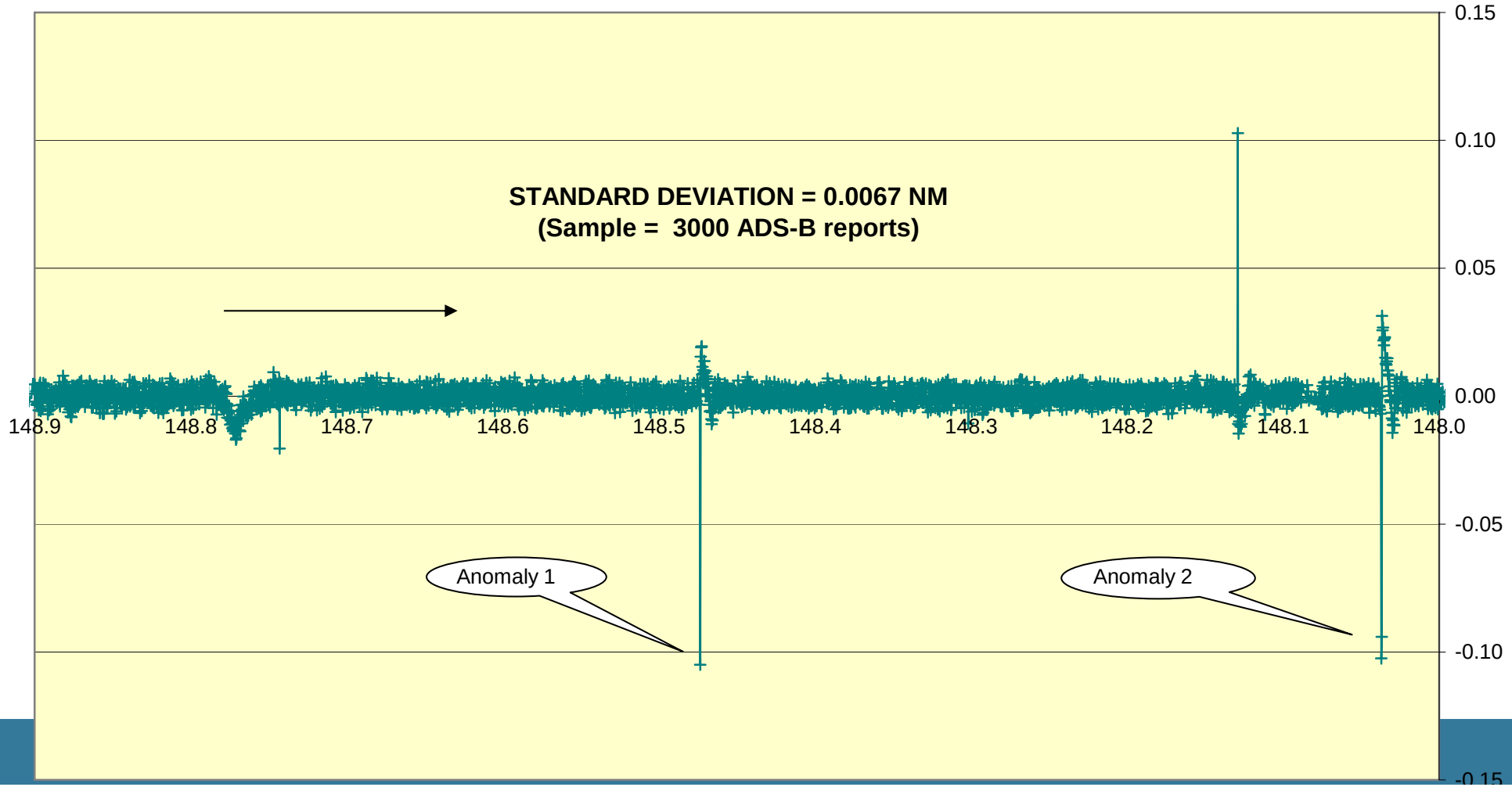
QFA - QANTAS
VOZ - Virgin Blue
UAE - Emirates
JST - Jetstar
ANZ - Air New Zealand
HVN - Vietnam Airlines

50NM range rings



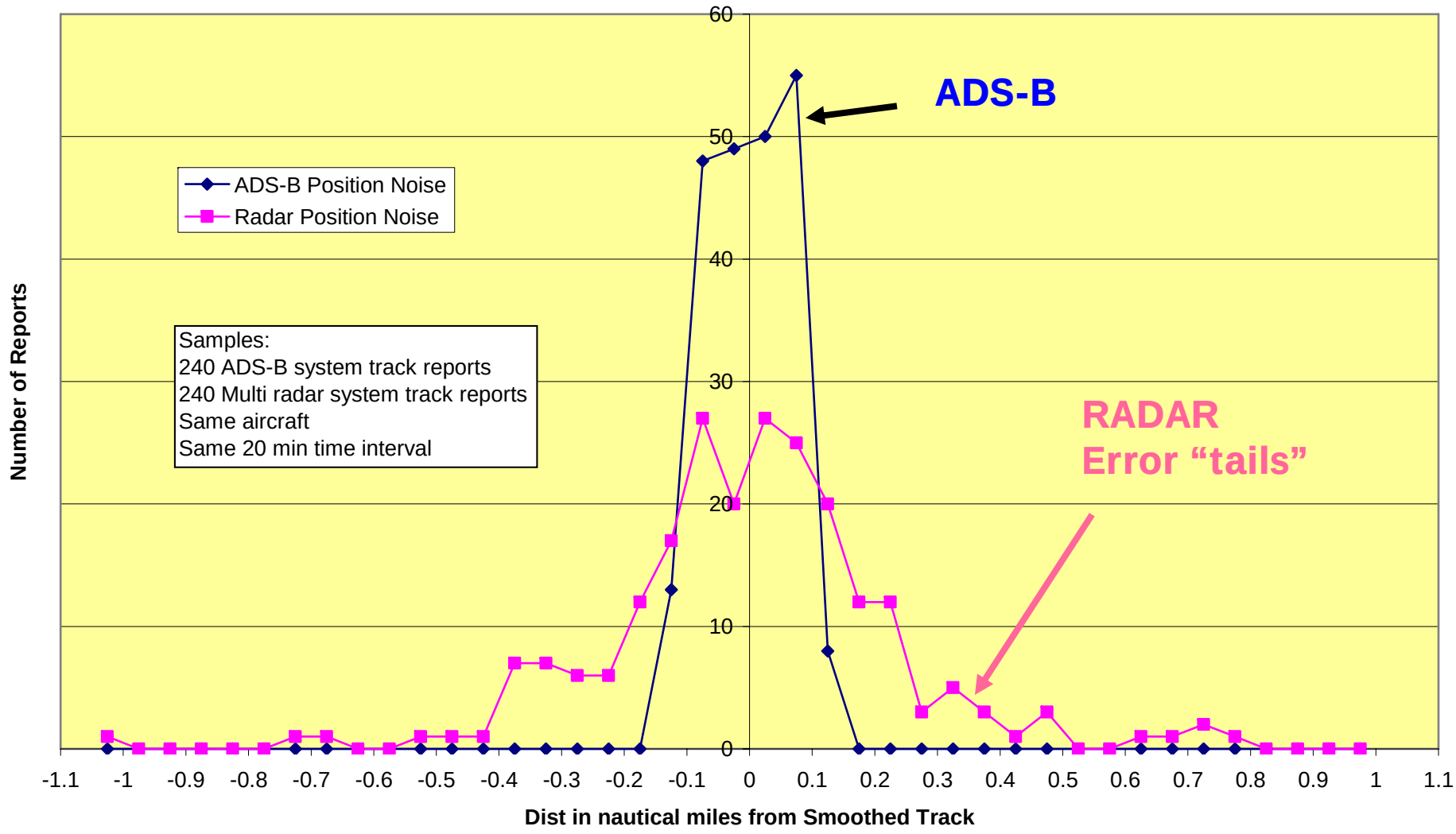
ADS-B “Noise”

POSITION NOISE IN NM
Actual vs Curve Fit



Radar & ADS-B Noise distribution

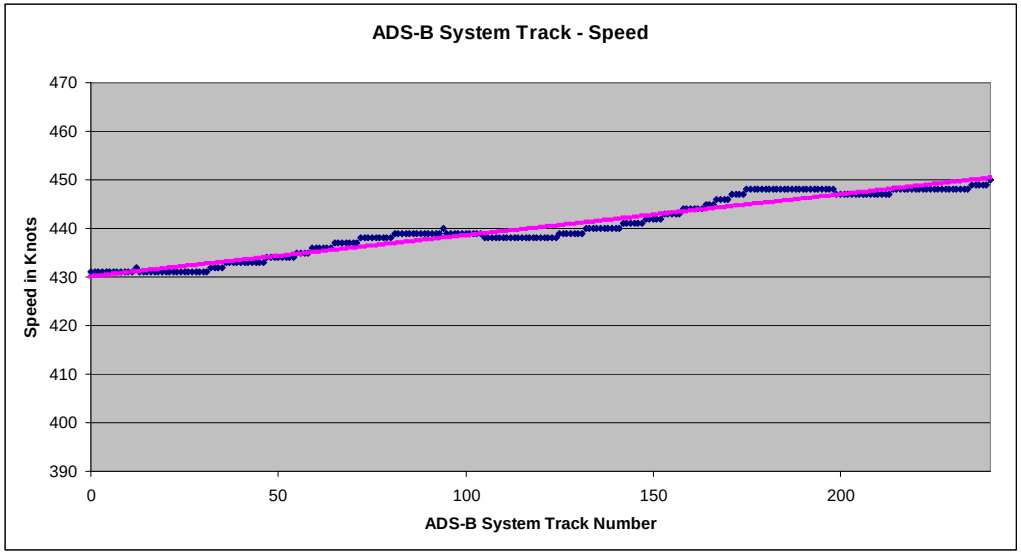
VH-QPC System Tracks : ADS-B Position Noise vs Radar Position Noise

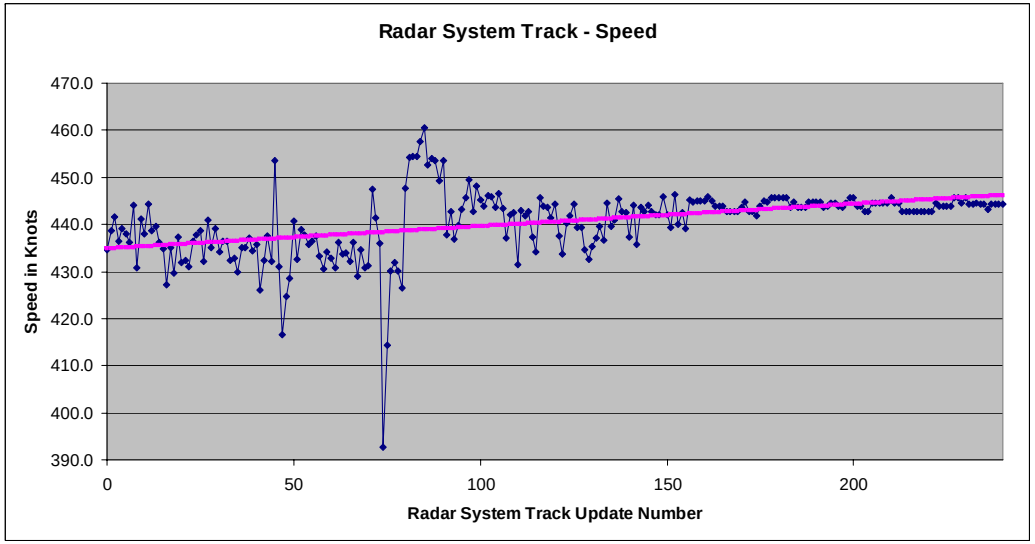


Radar & ADS-B “speed”

ADS_B

RADAR





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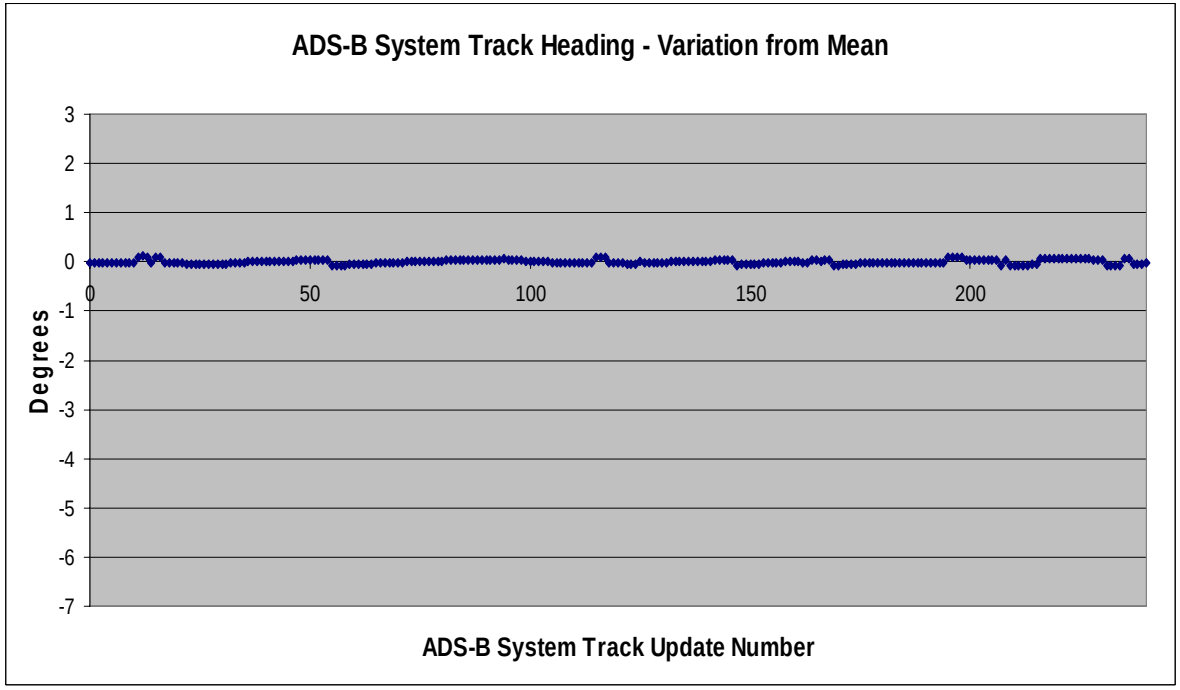
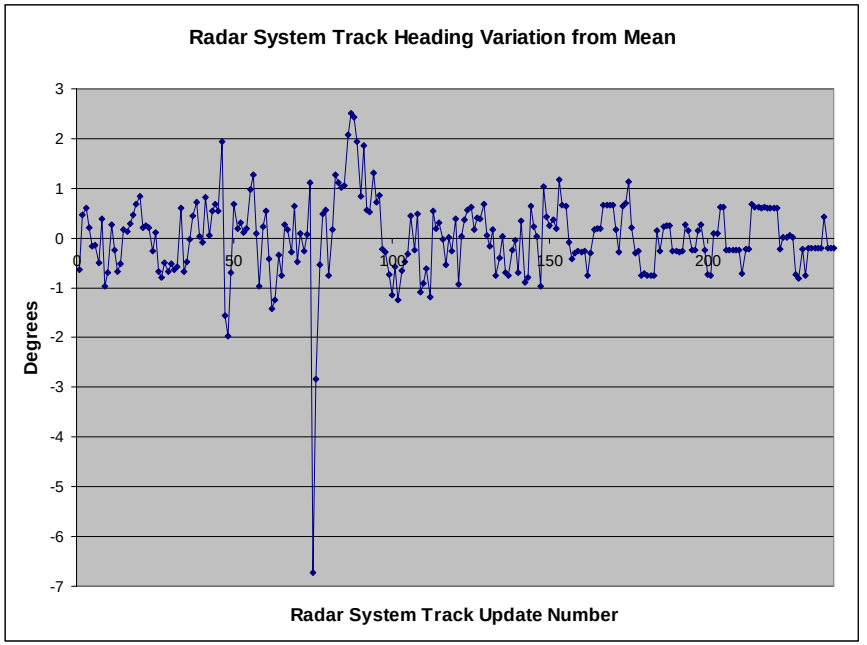
Heading noise

ADS_B



RADAR



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Integrity

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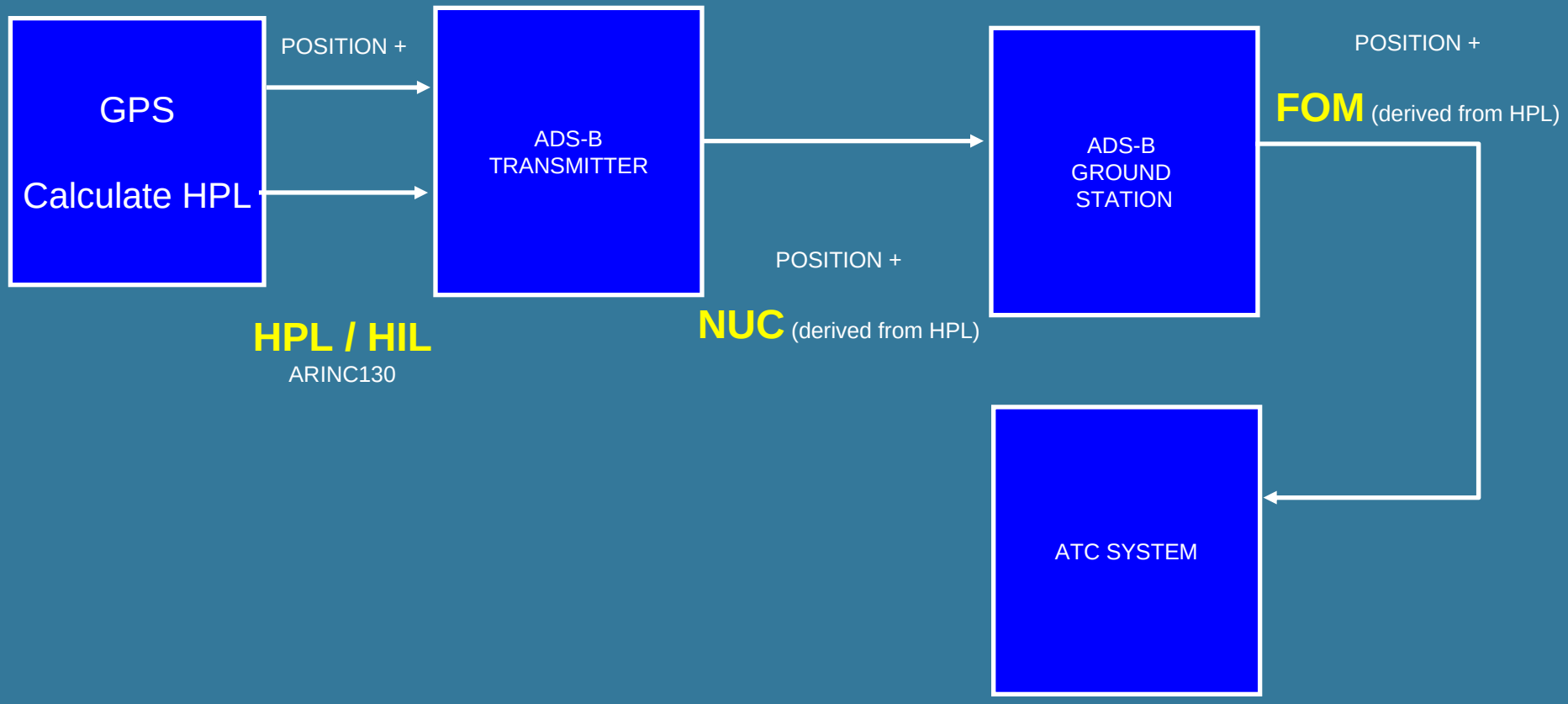
Integrity data



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HPL / HFOM

- HFOM : Accuracy measure assuming that all satellites are operating correctly

- HPL : Integrity measure. Positional data within this limit with high degree of certainty (10^{-5}/ flight hour)
  - Even if a satellite gives false range data
  - Based on GPS receiver ability to detect satellite false range data given
    - ✈Satellite geometry
    - ✈RAIM algorithm capability
    - ✈Assumption SA on/off
    - ✈WAAS signal received
    - ✈Geo satellite received

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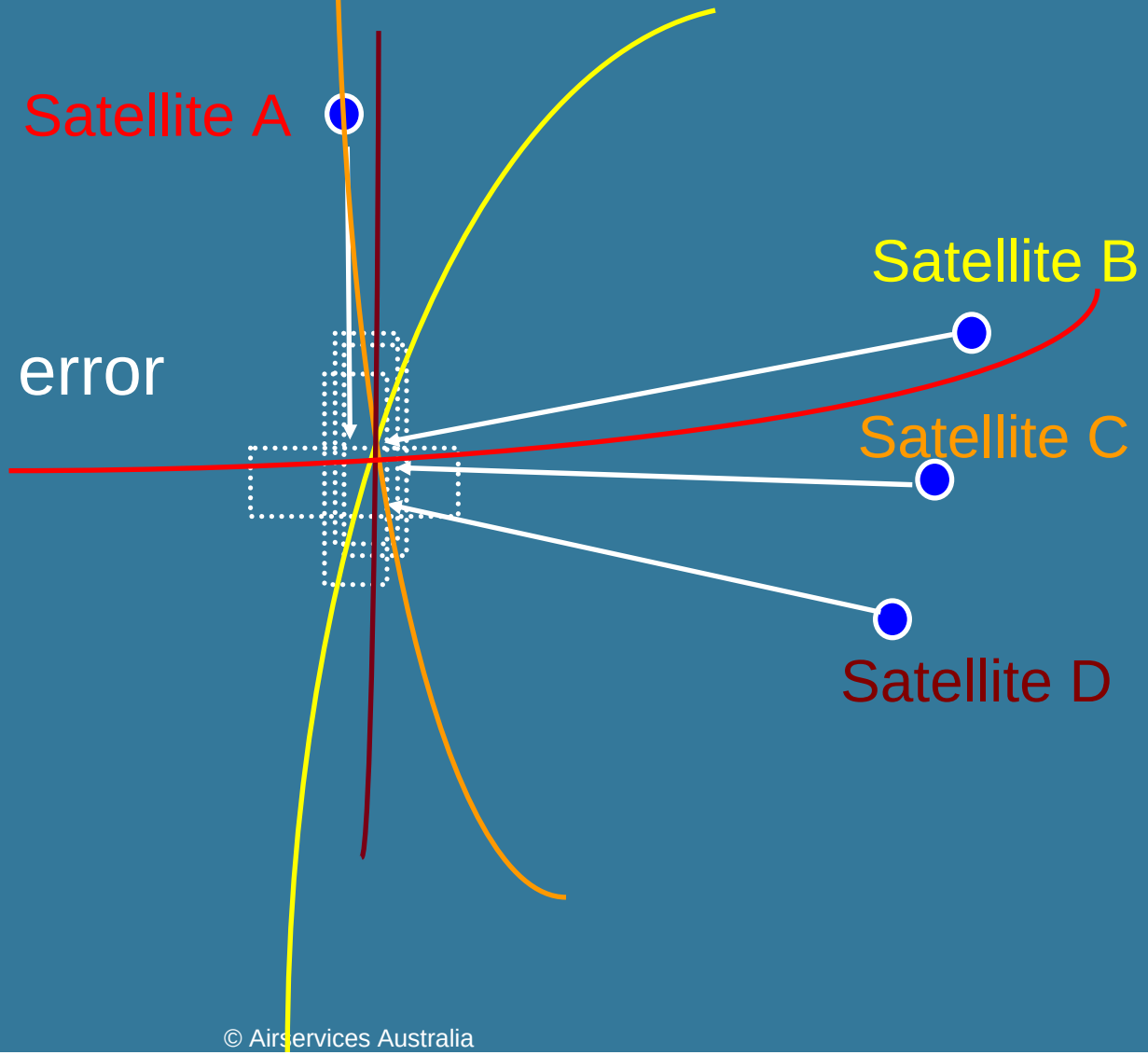
Good HDOP / HFOM – Poor HPL

- Good accuracy
- Poor ability to detect error on Satellite A
- Poor HPL



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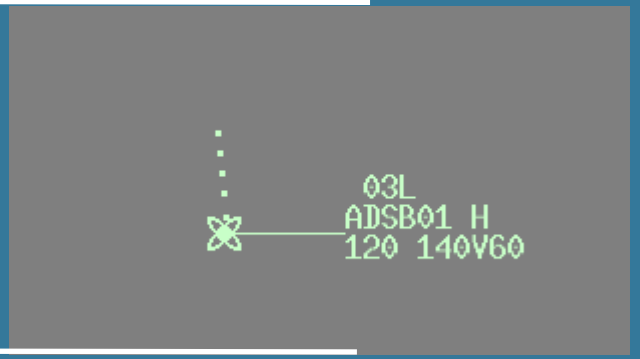
Data “quality” (integrity)

HPL =20 Nm

Discard data

HPL =2 Nm (VSP)

Low Quality ADS-B
Not as good as radar :
“Situational awareness symbol”
Use for CLAM/RAM



HPL =0.5 Nm (VSP)

As good as radar :
Display “Good position symbol”
Use for separation & safety nets

HPL =0 Nm

HPL =0 Nm

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Discussion

More details on Airservices Website

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

Contact me :
Greg Dunstone (02)62684286
greg.dunstone@airservicesaustralia.com

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