



International Civil Aviation Organization

WORKING PAPER

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NAVIGATION SYSTEMS PANEL (NSP)

FIRST MEETING

Montréal, 8 to 15 April 2015

GPS INTERFERENCE EVENT – SYDNEY, AUSTRALIA

(Presented by Australia)

SUMMARY

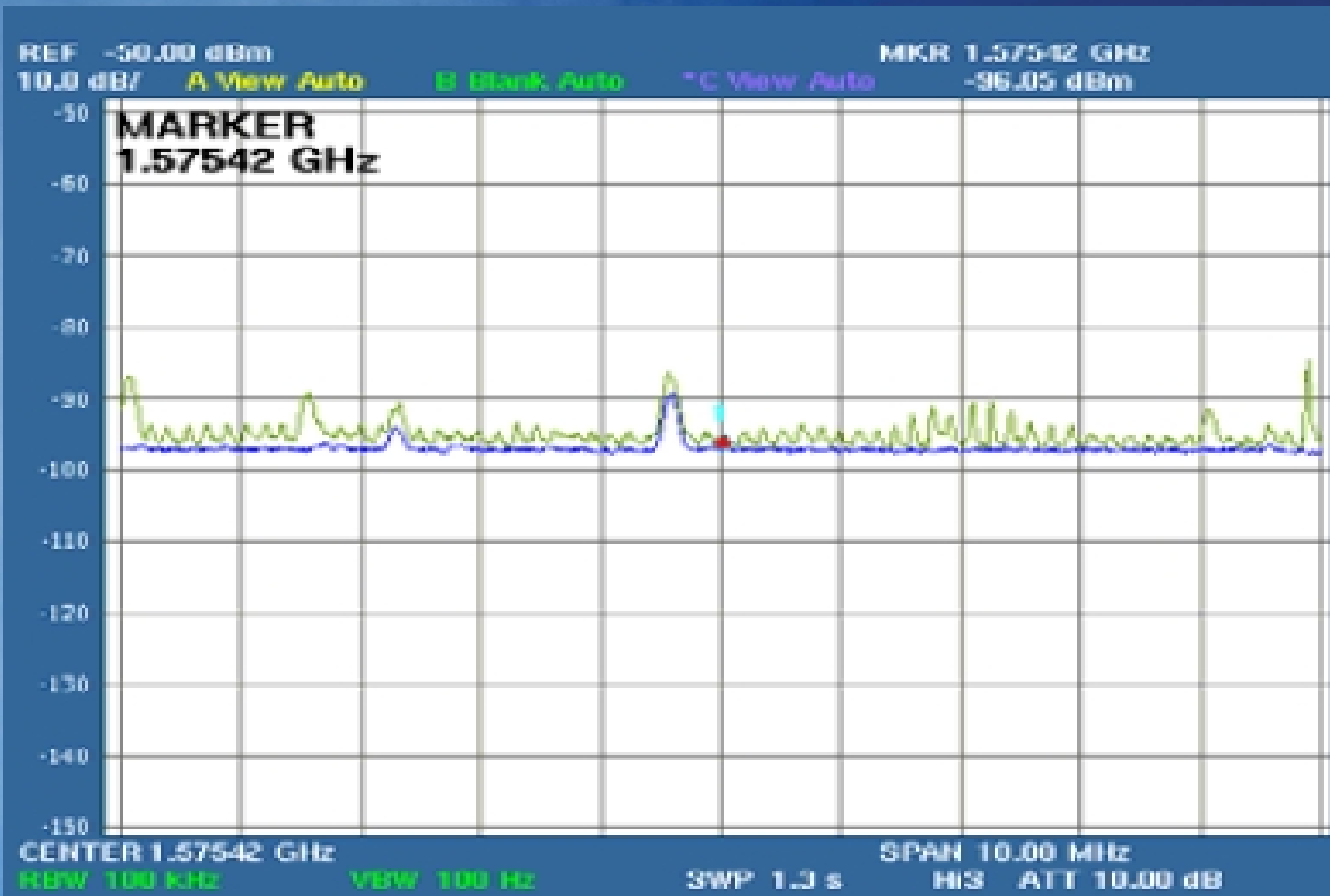
This Information Paper introduces a slide presentation on the GPS Interference Event at Sydney, Australian on 26 February 2015.

The presentation describes:

- the interference event
- the operational impact
- use of ADS-B to localise the source of the interference
- use of GPS units associated with Wide Area Multilateration system to localise the source of interference
- avionics that did not behave as expected during the event
- the advantages of recording the output from the aircraft GPS

1. **SEE PRESENTATION SLIDES BELOW**

GPS Interference Sydney 26 Feb 15



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Technology &
Asset Planning

Contents



- Initial Report
- WAM Rx Unit (GPS) behavior
- Geoscience Australia GPS Monitoring
- Sydney Airport
- ACMA
- Defence
- GPS Constellation
- RAIM
- Initial Conclusion

Initial Report



Observations Reported by ATC:

- *Aircraft arriving and departing Sydney reporting loss of GPS. Aircraft within 20NM of Sydney below 7000 ft*
- *All RWY directions affected*
- *Reports received from large number of aircraft, various types and companies*
- *Whole TMA area is affected – very unusual*
- *Normally RAIM outages go un-noticed i.e. pilots don't report to ATC*

Later reports

Affected Area had increased to 45NM

Contingency provisions invoked:

- Increased use of radar vectors
- ILS for approach guidance

- GBAS
 - normal operation
 - no interference detected
 - Logs reviewed / checked

- Velos (ADS-B on airport vehicles)
 - normal operation

- Aircraft on ground
 - normal operation

- Defence Joint Operations Centre (JOC)
 - No GPS jamming activity known (admitted)

- Defence Spectrum Office
 - No GPS jamming activity known (admitted)
 - investigating

Constellation State - NANUs



GPS NANU & Operational Advisory's:

- One NANU of possible relevance #2015010:
 - On approximately 26 Feb 2015 SVN27 will resume transmitting L-band utilizing PRN26.
 - At L-band activation, SVN27/PRN26 will be unusable until further notice.
 - Additionally, no broadcast almanacs will include SVN27/PRN26

- Not considered relevant:
 - PRN26 not in broadcast almanac - TSO avionics should ignore
 - GPS avionics operating normally everywhere else in the country
 - No reports by other GPS users of difficulty

- NOT a Constellation issue

RAIM Prediction



0030 UTC 26/02/15 AIRSERVICES AUSTRALIA
GPS RAIM PREDICTION
YSSY

TSO-C129(A) (AND EQUIVALENT)
FAULT DETECTION
1502260239 TIL 1502260300
1502270235 TIL 1502270256

GPS RAIM FD UNAVBL FOR NPA
TSO-C146A (AND EQUIVALENT)
FAULT DETECTION ONLY

NO GPS RAIM FD OUTAGES FOR NPA
TSO-C146A (AND EQUIVALENT)
FAULT DETECTION AND EXCLUSION
1502260041 TIL 1502260108
1502260317 TIL 1502260326
1502262143 TIL 1502262149
1502270037 TIL 1502270108
1502270313 TIL 1502270322

Not Lack of RAIM

Multi-Lateration Stations



Some stations report loss of of GPS

Initial Conclusion



- Not a Constellation issue
- Not lack of RAIM
- Local Interference source
 - Probably ground level
 - Terrain shielding many ground GPS receivers
 - Visible to aircraft in the air
 - Range/strength of interference suggests more than a PPD or “ebay jammer”

ACMA (RF Interference)



- 11:05a
 - ACMA field interference investigator briefed and interference detection/monitoring assistance requested
 - ACMA staff positioned at Terry Hills and North Ryde; depending on outcome at those sites will consider also deploying staff to eastern suburbs

- 12:55p
 - Update provided to ACMA
 - affected area out to 45+ NM

 - ACMA advised that staff in position at Terry Hills and Ryde
 - nil detected thus far

 - deploying to third location at eastern suburbs / Bondi Junction

- 01:15p
 - ACMA reported no GPS RFI detected at Terry Hills or Ryde
 - ACMA notified that jamming ceased at 0122UTC, operations now normal

Interference Source Localisation

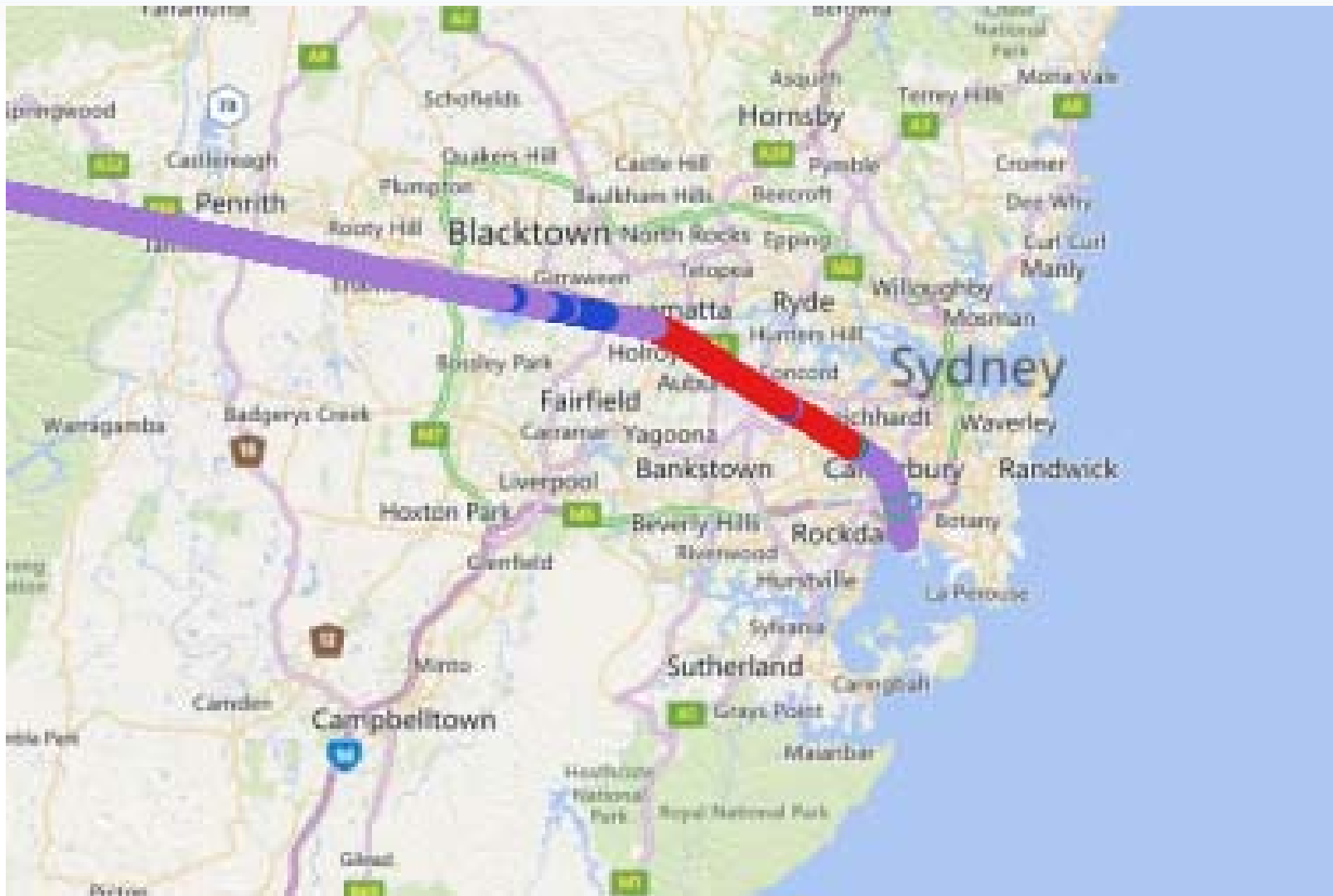


- Need very dense network of monitoring stations
 - Not practical

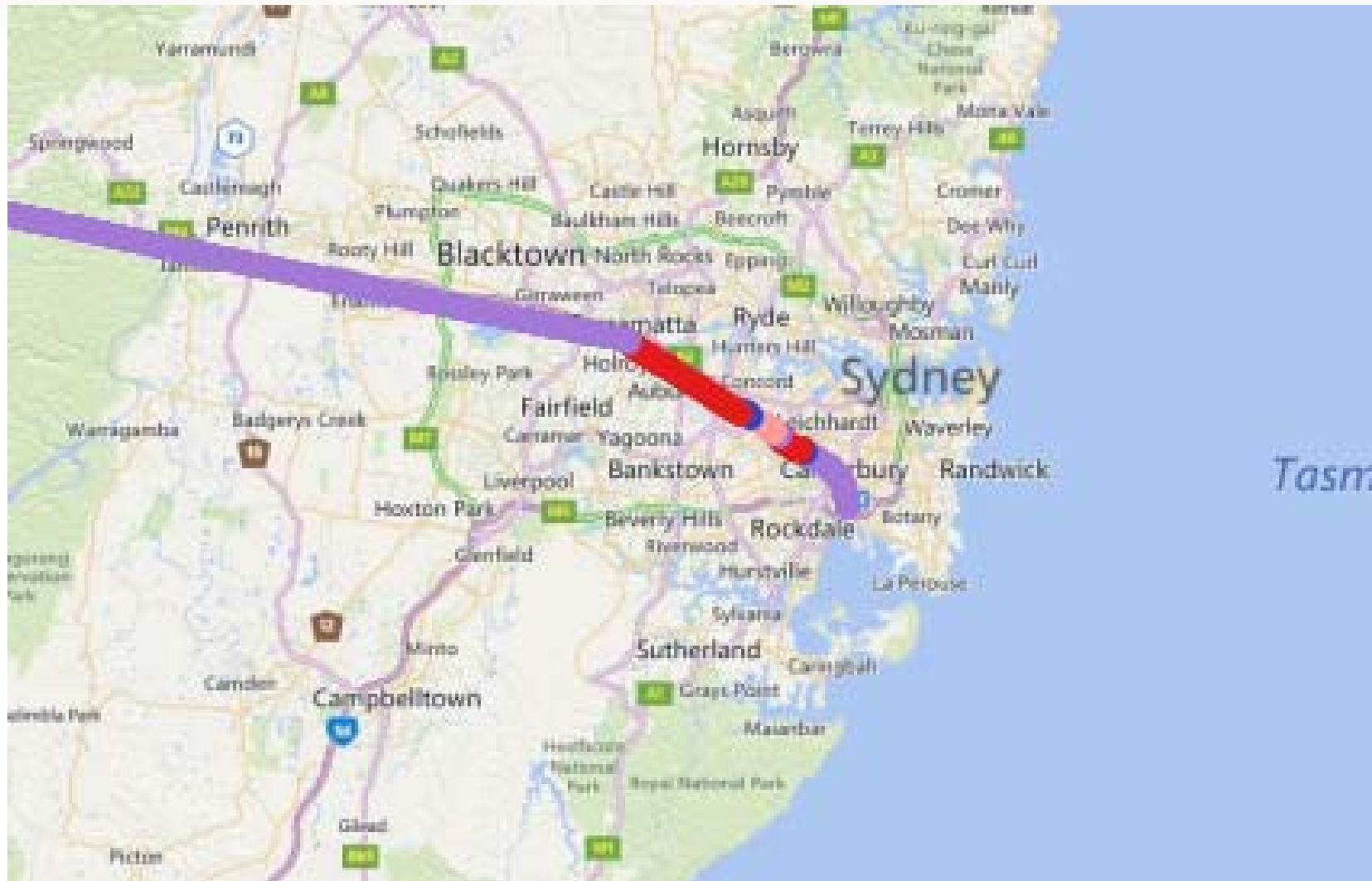
- Paper at ION proposed “crowd source”
 - Use everyone’s smart phone / tablet
 - Show GPS availability (or lack of) by location
 - Creates (tens of) thousands of monitoring stations

- Aircraft use GPS for ADS-B and ADS-B message has position FOM
 - Not such a large number of aircraft (as phones)
 - Aircraft move and rapidly cover area (routes)

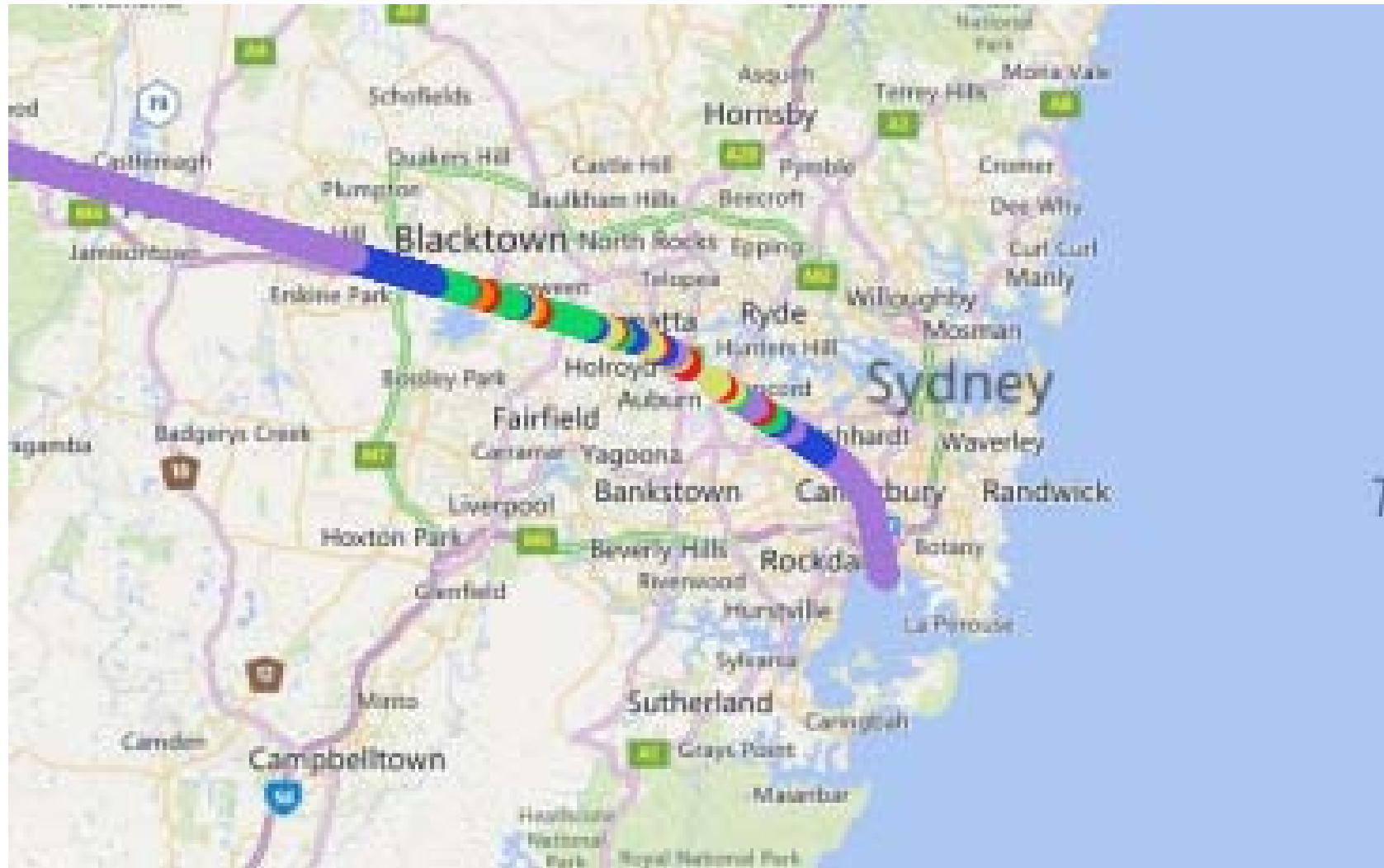
QFA581



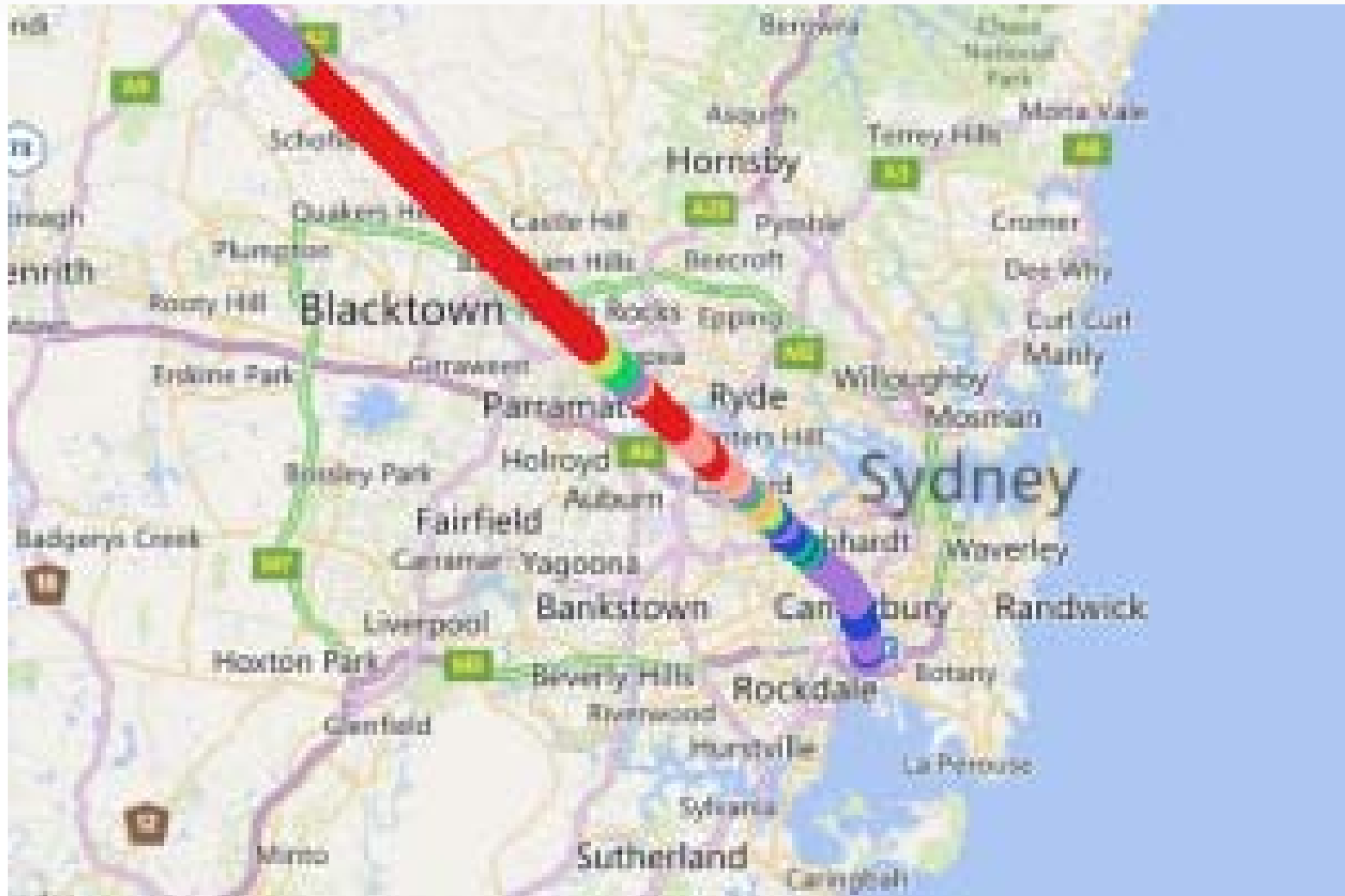
VOZ555



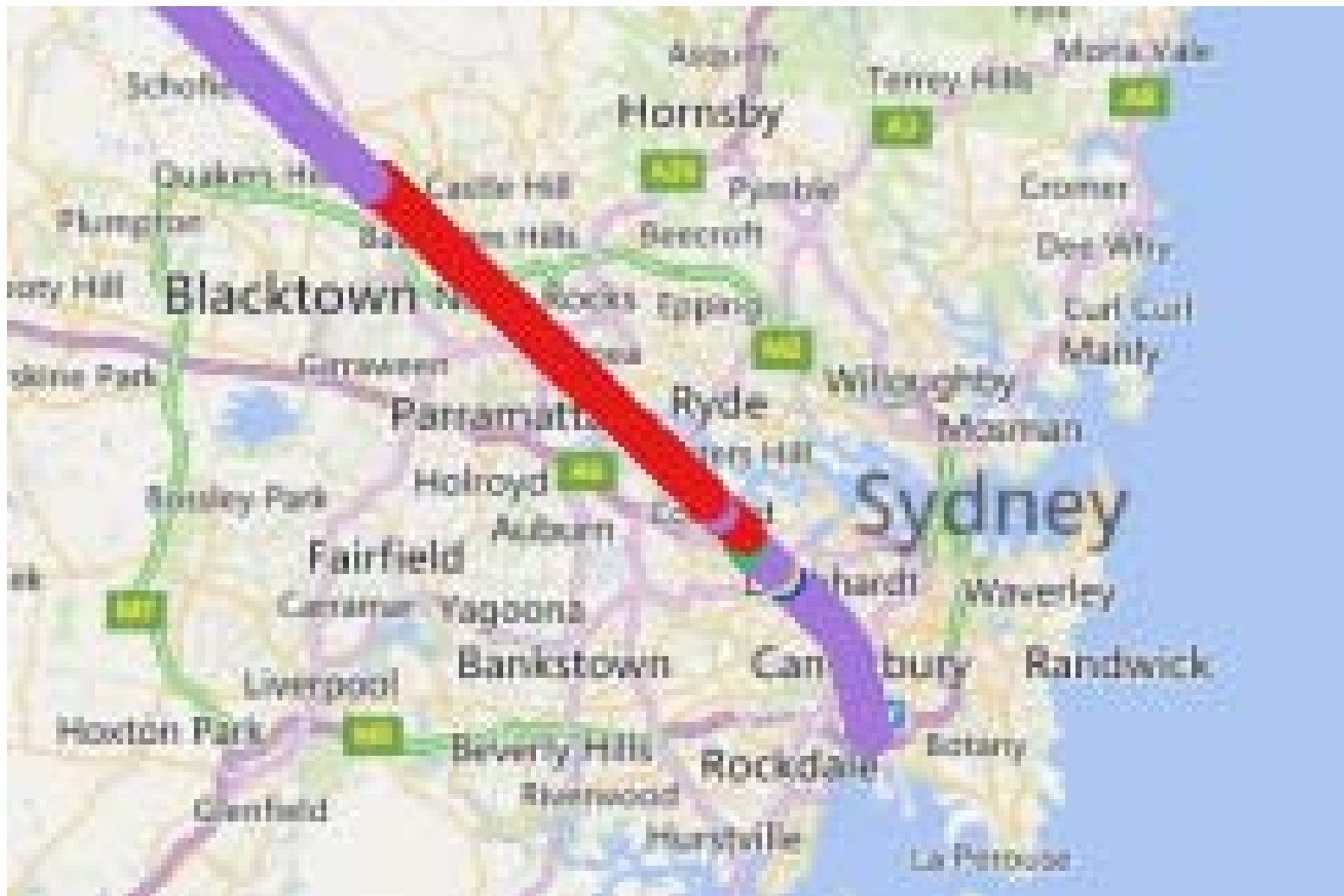
VOZ1627



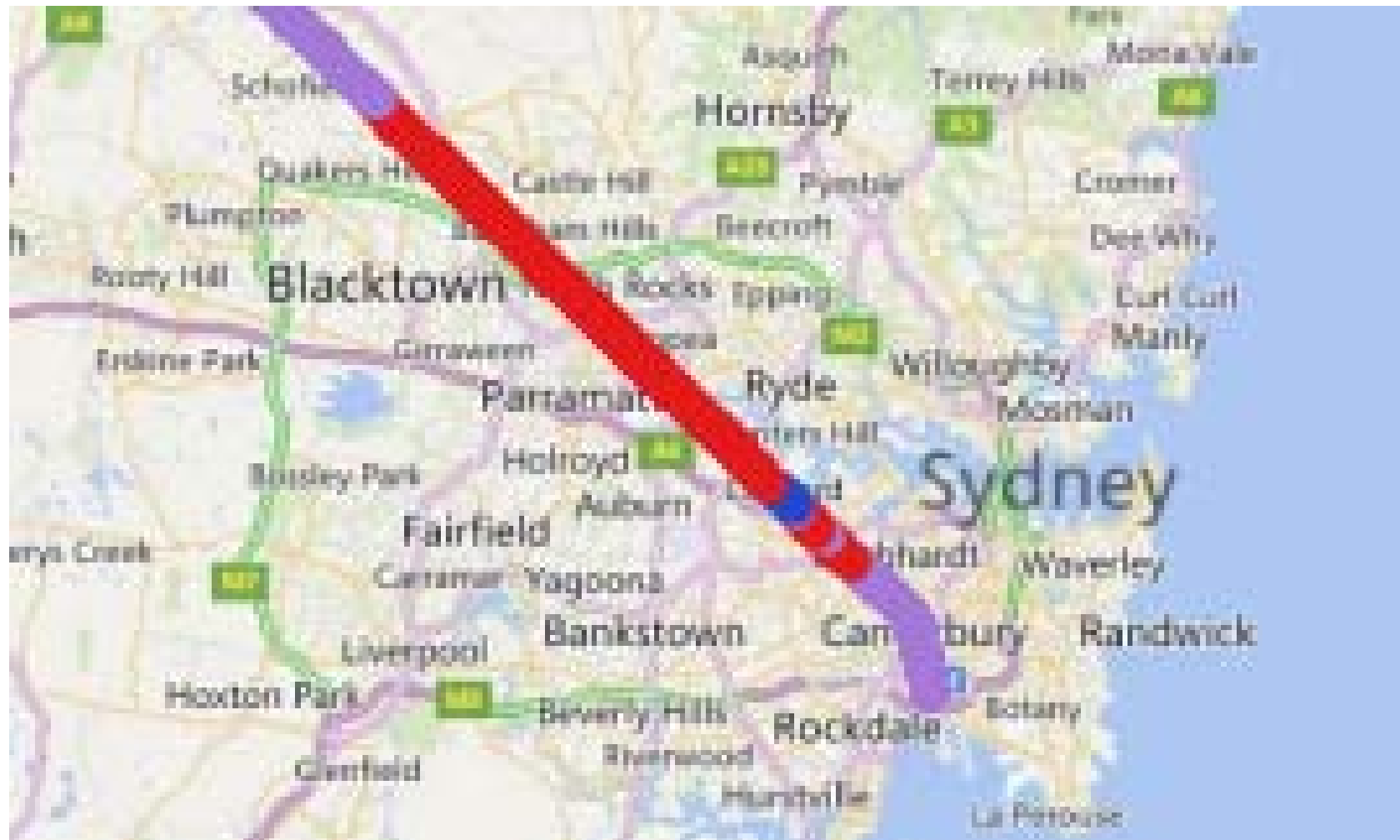
VOZ1519

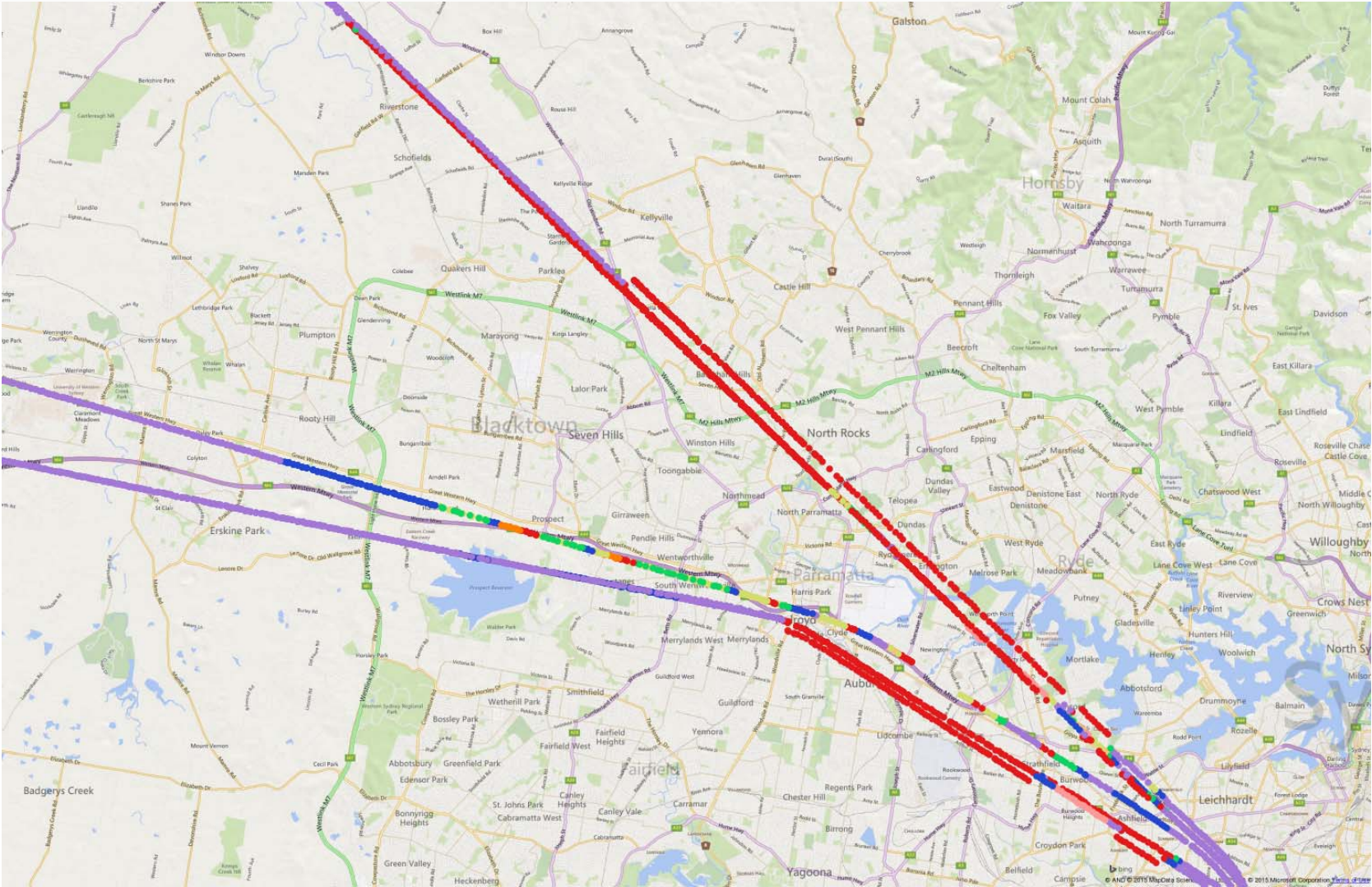


VOZ1351

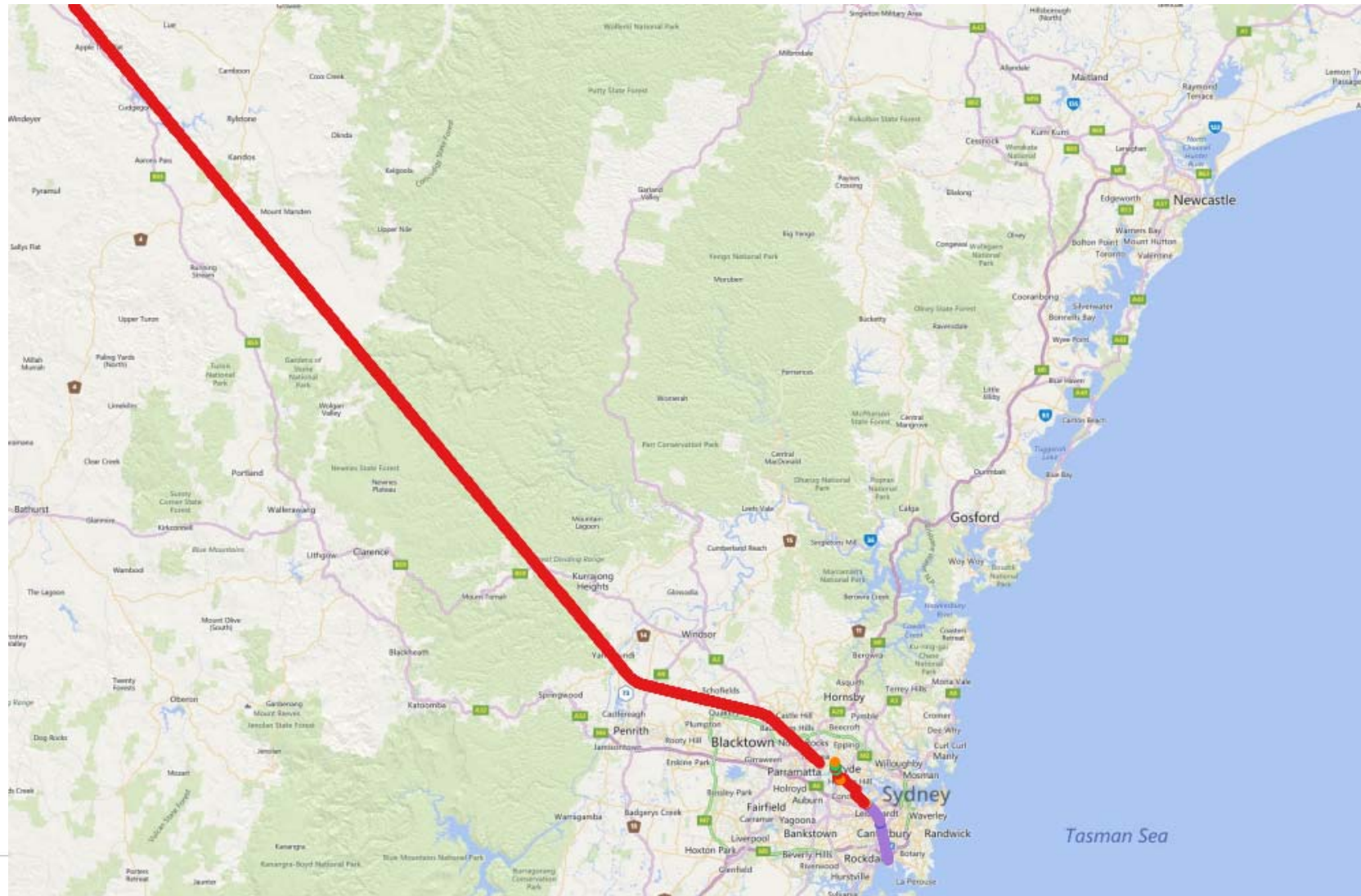


VOZ1281





GPS (partial) lockup ?

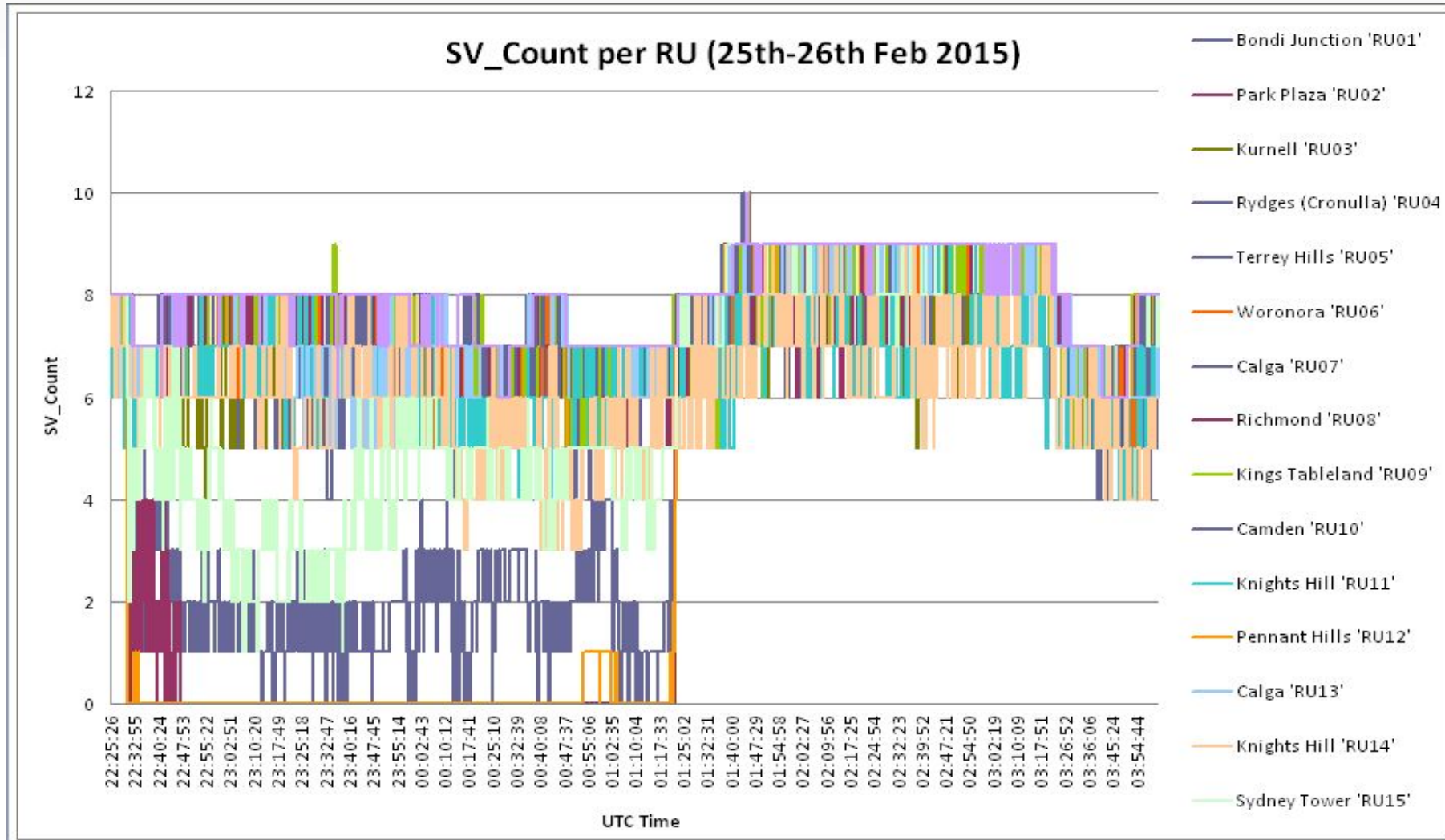


Line of Sight Determination

Map of Multi-Lateration RU Locations



WAM – SV Count at each RU



Signal Lost: 150225 223100 UTC

Returned: 150226 012215 UTC

Duration: 2:51:25

WAM Unit GPS Rx



RU	Location	Height	Affected
▪ RU01:	Bondi Junction	206m	Yes - high
▪ RU02:	Parks Plaza	144m	Yes - severe
▪ RU03:	Kurnell	46m	No
▪ RU04:	Cronulla Rydges	79m	No
▪ RU05:	Terry Hills	251m	No
▪ RU06:	Woronora	349m	No
▪ RU07:	Calga 1	279m	No
▪ RU08:	Richmond RAAF	64m	No
▪ RU09:	Kings Tableland	948m	No
▪ RU10:	Camden Tower	113m	No
▪ RU11:	Knights Hill 1	865m	No
▪ RU12:	Pennant Hills	234m	Yes - severe
▪ RU13:	Calga 2	279m	No
▪ RU14:	Knights Hill 2	872m	Yes - low
▪ RU15:	Sydney ATCT	72m	Yes - medium
▪ RU16:	Sydney TCU	52m	No

Conclusion - Localisation



- Assume Interference Source:
 - Line of sight visible to affected RUs; AND also
 - (due terrain shielding) NOT line of sight visible to non-affected RUs

- Interference Source in North Parramatta / Ryde area
 - Consistent with ADS-B reports

- North Parramatta / Ryde – Aerospace Industrial Precinct
 - Thales
 - BAE Systems
 - Rockwell Collins
 - Honeywell
 - CAE
 - Macquarie University
 - University of Western Sydney

Conclusion – Localisation ...



- A very high density of monitoring stations required to be useful
 - Impractical for fixed monitoring stations
- “crowd sourcing” using mobile phones has potential
 - hard to organise
- ADS-B shows promise as a means of interference location
 - easy for an ANSP to implement
 - probably sufficient to get a ground team close to source
- Aircraft recording of GPS status / maintenance data is useful
 - propose routine recording in QAR (or similar)

Conclusion – Avionics



- 1x Airbus A320 – GPS: Thales TLS755, XPDR: Honeywell TRA67A
 - ADS-B - NUC=0 for the duration the flight in Australia
 - ADS-B - No geometric altitude or geometric vertical rate
 - GPS receiver partial “lock up” ??

- 1x Boeing B777 – GPS: Thales TLS-755, XPDR: Honeywell TRA67
 - ADS-B: incorrect position reports with good NUC for a short period
 - ADS-B: then generated NUC=0 for the remainder of the flight
 - ADS-B: No geometric altitude or geometric vertical rate
 - GPS receiver partial “lock up” ??

- 1x Airbus A330 – GPS: Honeywell RMA-55B, XPDR: ACSS XS950
 - ADS-B: good ADS-B data on departure until 2000 feet
 - ADS-B: Then NIC or NAC=0 for the duration the flight
 - ADS-B: No geometric altitude or geometric vertical rate
 - GPS receiver partial “lock up” ??

- 3x Airbus A320 – GPS: Thales TLS755, XPDR: Honeywell TRA67
 - ADS-B: incorrect position reports with good NUC declaration
 - ADS-B: Obviously wrong – did not miss lead ATC

Conclusion – Aircraft Operations



- Aircraft with inertial (B717 and larger) – no loss of navigation
- ADS-B lost – ADS-B not used at Sydney

- Contingency provisions invoked:
 - Increased use of radar vectors (used at greater range than usual)
 - ILS for approach guidance

- Contingency works satisfactorily
 - No more than trivial delay to arriving aircraft
 - One aircraft elected not to depart

- Occurred during a period of medium traffic
 - ATC estimate 10% reduction in capacity in high traffic periods

Any Thoughts



NSP/1-WP/2

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— END —