



Automation & Ancillary systems

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from the ground up



ADS-B Aspects of ATC Systems

- Design & integration
- ATC & Flight planning aspects
- RAIM prediction systems
- Bypass aspects
- Site monitoring aspects



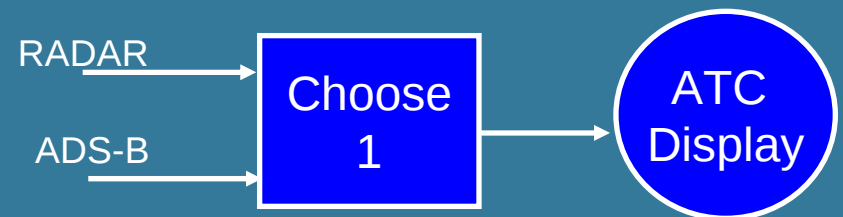
ATC System Considerations

- Matching ADS-B tracks to flight plans : How?
- Test for duplicate 24 bit codes
- Track handling capacity
- Merging with radar tracks
- All aircraft equipped?
 - Will coverage be lost at end of radar coverage?
 - Aircraft equipped indicator?
- Safety alerts
- SPI & Emergency processing
- Controller display (needs to know ADS-B?)
- Prediction of inadequate GPS geometry?
- Bypass processing
- Site monitor processing



ATC System able to process ADS-B

- Two methods:
 - Integrated tracker
 - Meld ADS-B and Radar data
 - Priority tracks
 - Display ADS-B or Radar data





ADS-B Integration in Australia

- Receives ASTERIX format ADS-B tracks
- Tracks linked to FDP (FlightID or 24 bit code)
- Includes Safety Net alerts (MSAW etc)
- Updates to training simulators
- Updates to recording and analysis tools
- RAIM prediction display

Radar Tracks



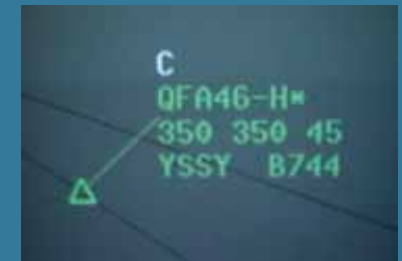
ADS - B tracks



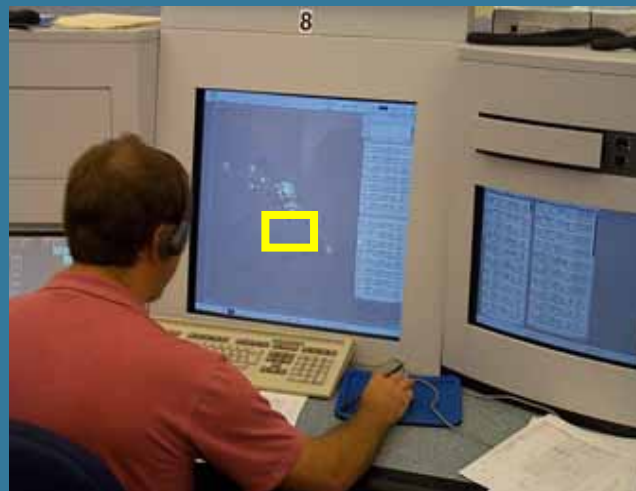
**NEW
SYMBOLS**



ADS- C tracks

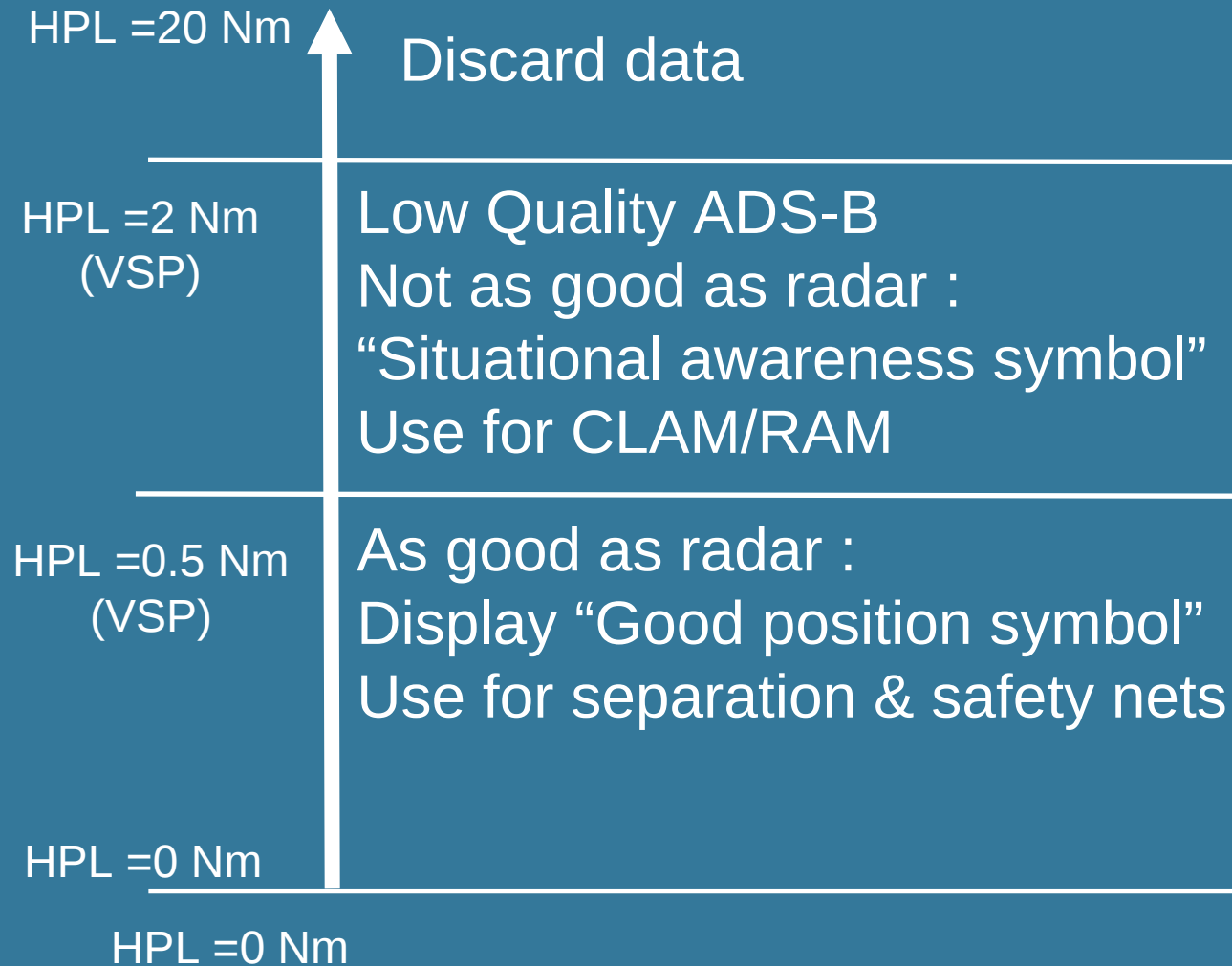


Flight Plan
tracks





Data “quality” (integrity)





ADS-B / Flight plan association

- Either method, in priority order
 - ADS-B track Target ID matches Flight Plan callsignOr
 - 2nd priority - ICAO 24 bit address matches flight plan
- Noting that we also require:
 - Track inside a corridor of flight plan route
 - Flight plan “armed” by ATC flight coordination (taxi or inbound co-ord)
 - Track within time parameter of expected position



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ATC Considerations

- ATC procedures
- Phraseology
- Flight planning
- Loss of GPS contingency
- ATC standards and rules
- Separation standards



Flight Planning Requirements

Australian Domestic Flight Notification Form (V2001/01)										Page ____ / ____	
7. Aircraft Identification Q F A 1 2 3										8. (a) Flight Rules IFR VFR IFR/VFR VFR/IFR	
9. No. Type H M L N or S and/or (NMFAD/LS/VOR) D F G H I J L O R T U V W Z										Surveillance Equip E	
13. DEP Aerodrome ETD		15. Cruising Speed N (Knots) M (Mach)		Level A F		16. DEST Aerodrome HR MIN		Total EET HR MIN		ALTN Aerodrome	
15. Route											
18. (a) (info relevant to Stage 1)											
(Stage 2) 8. (b) I IFR V VFR Y IFR/VFR Z VFR/IFR											
13. DEP Aerodrome ETD		15. Cruising Speed N (Knots) M (Mach)		Level A F		16. DEST Aerodrome HR MIN		Total EET HR MIN		ALTN Aerodrome	
15. Route											
18. (a) (info relevant to Stage 2)											
(Stage 3) 8. (b) I IFR V VFR Y IFR/VFR Z VFR/IFR											
13. DEP Aerodrome ETD		15. Cruising Speed N (Knots) M (Mach)		Level A F		16. DEST Aerodrome HR MIN		Total EET HR MIN		ALTN Aerodrome	
15. Route											
18. (a) (info relevant to Stage 3)											
18. (b) (information relevant to all stages) REG/VH CODE/ 7C17CB RMK/ADSB PER/											
STS / SARTIME Date / Time Arr Dep				To CENSAR		Location		Dest Tel No:			

Acft ID that matches Flight ID

“E” in surveillance equipment (Mode S transponder with identification, pressure altitude and extended squitter transmission capabilities)
[Subject to ICAO ratification]

ICAO 24 bit address if idents do not match

ADS-B equipped indication (temporary)



Coupling on Flight ID or ICAO 24 Bit Address

Check for match of “Flight ID” and FPL ACID

Australian Domestic Flight Notification Form (v2001.01) Page ____ / ____																					
7. Aircraft Identification QFA123				8. (a) Flight Rules V Y Z				Type of Flight S N G M													
9. No.	Type	Wake Turb Cat	10. Nav/Com Equip (Circle the equipment carried by the aircraft that the pilot is qualified to use)				Survival Equipment														
			H M L	N or S and/or D	F	G	H	I	J	L	O	R	T	U	V	W	Z	N	A	C	D
13. DEP Aerodrome		ETD	15. Cruising Speed N (Knots) M (Mach)		Level A F	16. DEST Aerodrome		Total EET HR MIN		ALTN Aerodrome											
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18. (a) (info relevant to Stage 1)																					
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15. Route																					
18. (a) (info relevant to Stage 2)																					
(Stage 3)																					
13. DEP Aerodrome		ETD	15. Cruising Speed N (Knots) M (Mach)		Level A F	16. DEST Aerodrome		Total EET HR MIN		ALTN Aerodrome											
15. Route																					
18. (a) (info relevant to Stage 3)																					
18. (b) (information relevant to all stages)																					
REG/VH																					
PER/																					
STS / SARTIME			To			Location			Dest Tel No:												
Date / Time			Arr			CENSAR			Dep												

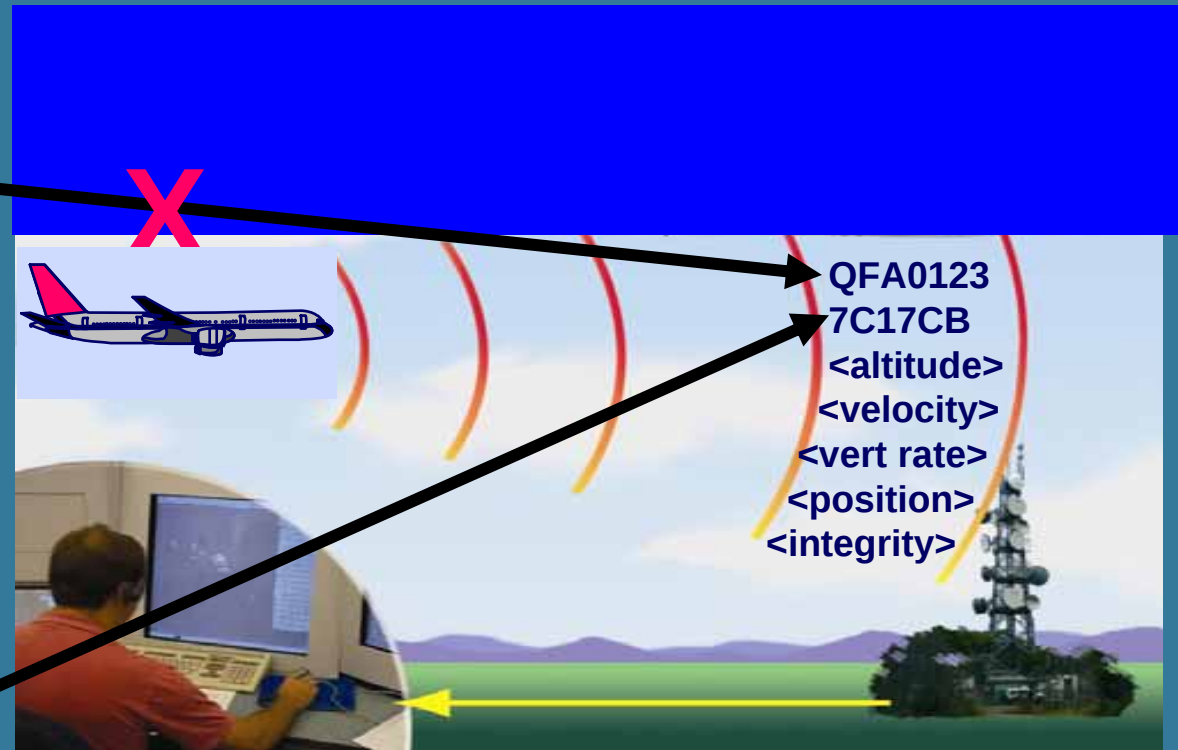




Coupling on Flight ID or ICAO 24 Bit Address

If no identification match, check for 24 bit address match

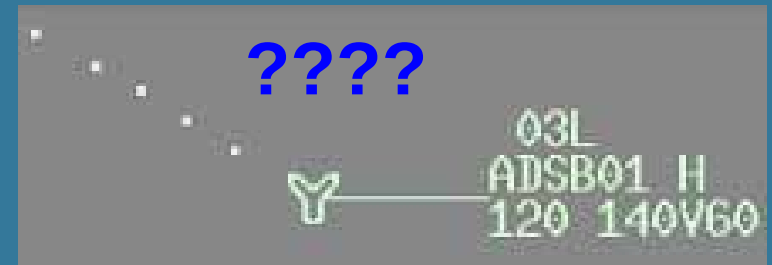
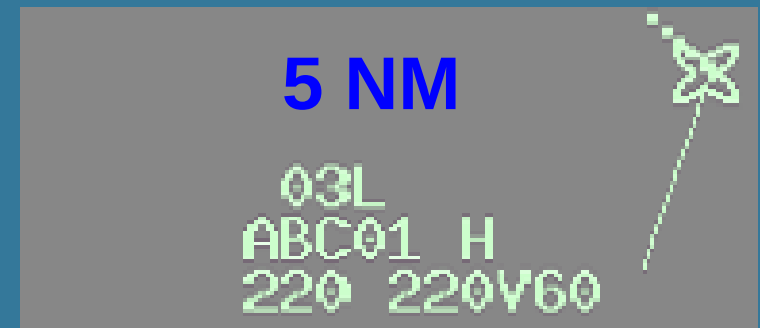
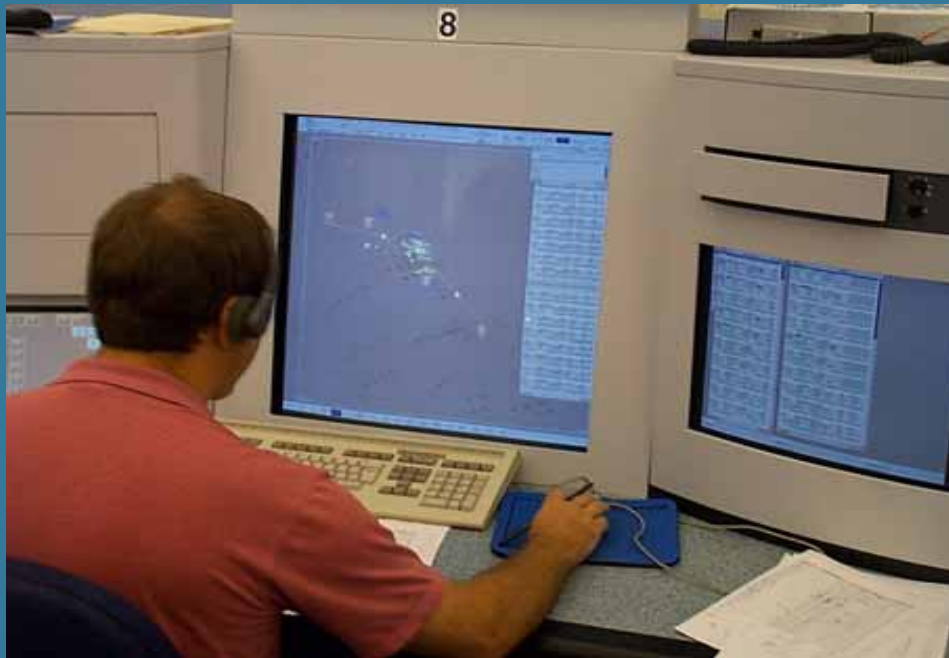
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9. No.		Type		Wake Turb Cat		10. Nav/Com Equip (Circle the equipment carried by the aircraft that the pilot is qualified to use)														
						H M L N or S and/or D F G H I J L O R T U V W Z N A C D														
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STS / SARTIME				To				Location				Dest Tel No:								
Date / Time				Arr				CENSAR				Dep								





Separation Standards

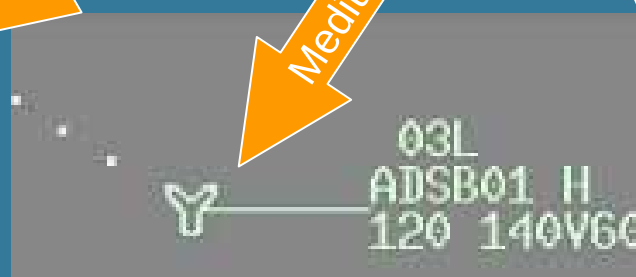
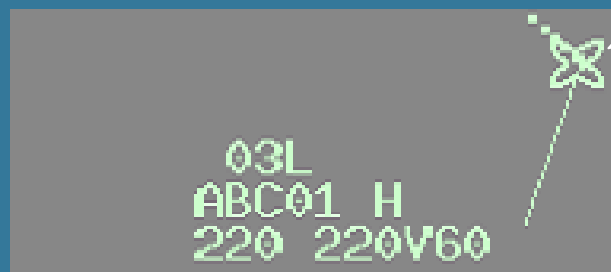
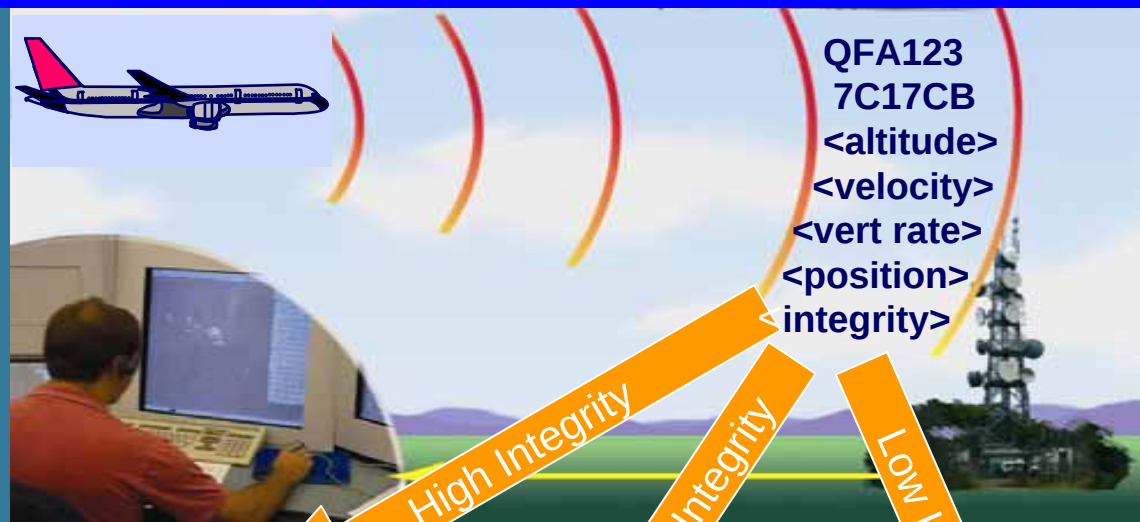
- Based on position integrity
- Class 1 Minimum Separation Standard = 5 NM
- Class 2 Minimum Separation Standard = ??





Separation Standards

- Position integrity value broadcast in ADS-B messages





Phraseology Changes

- References to ADS-B broadcast use TRANSMIT(ION)
 - TRANSMIT IDENT
 - STOP A-D-S-B TRANSMIT
 - STOP A-D-S-B ALTITUDE TRANSMISSION
- References to surveillance service termination (radar or ADS-B)
 - IDENTIFICATION TERMINATED
- Other changes – see AIP Amendments

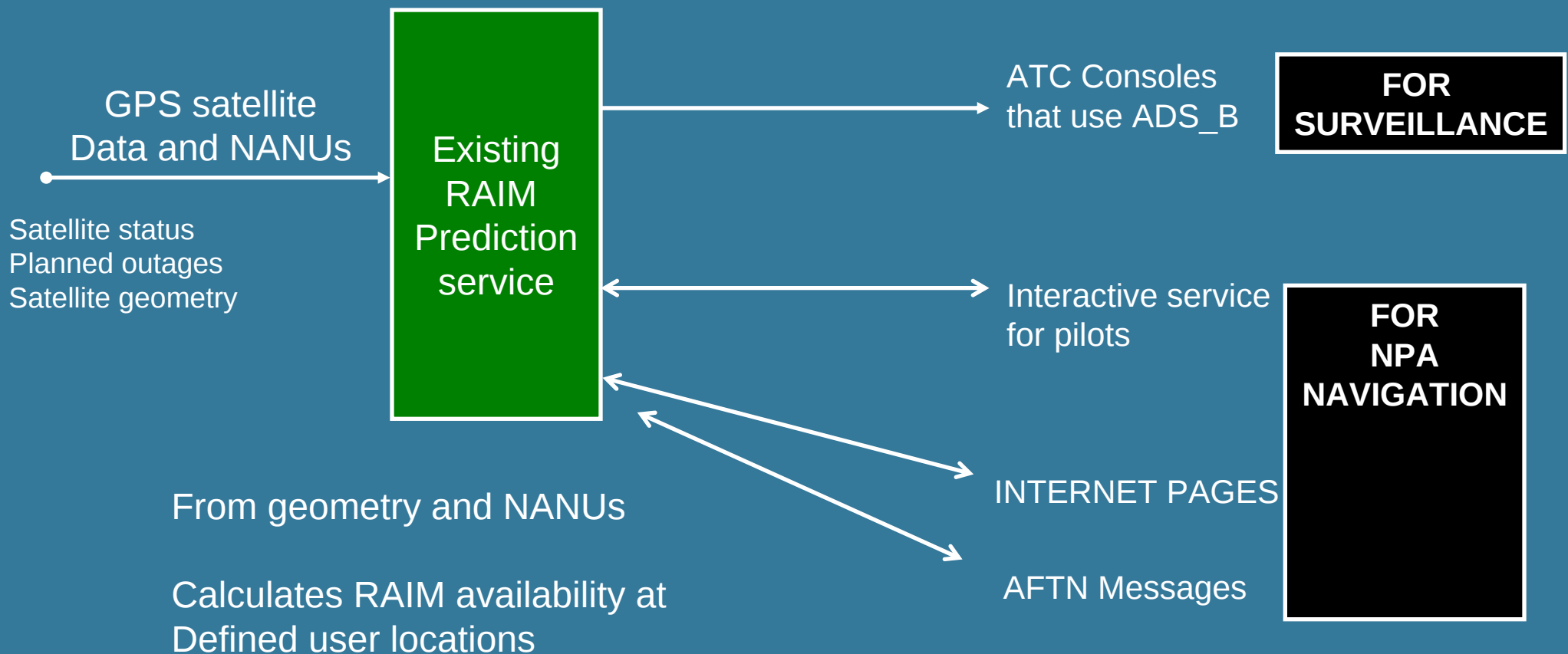


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RAIM Prediction for ADS-B





“RAIM” prediction on controller screen

ALMANAC

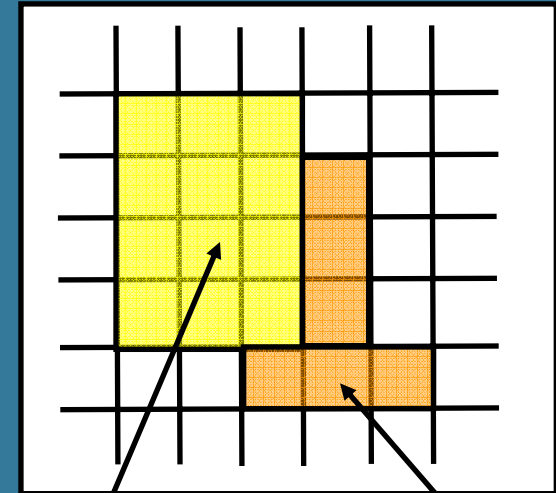
NANU

**RAIM
Prediction
system**

ATC SYSTEM

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
Optional ability to visualise overlay RAIM
MAP



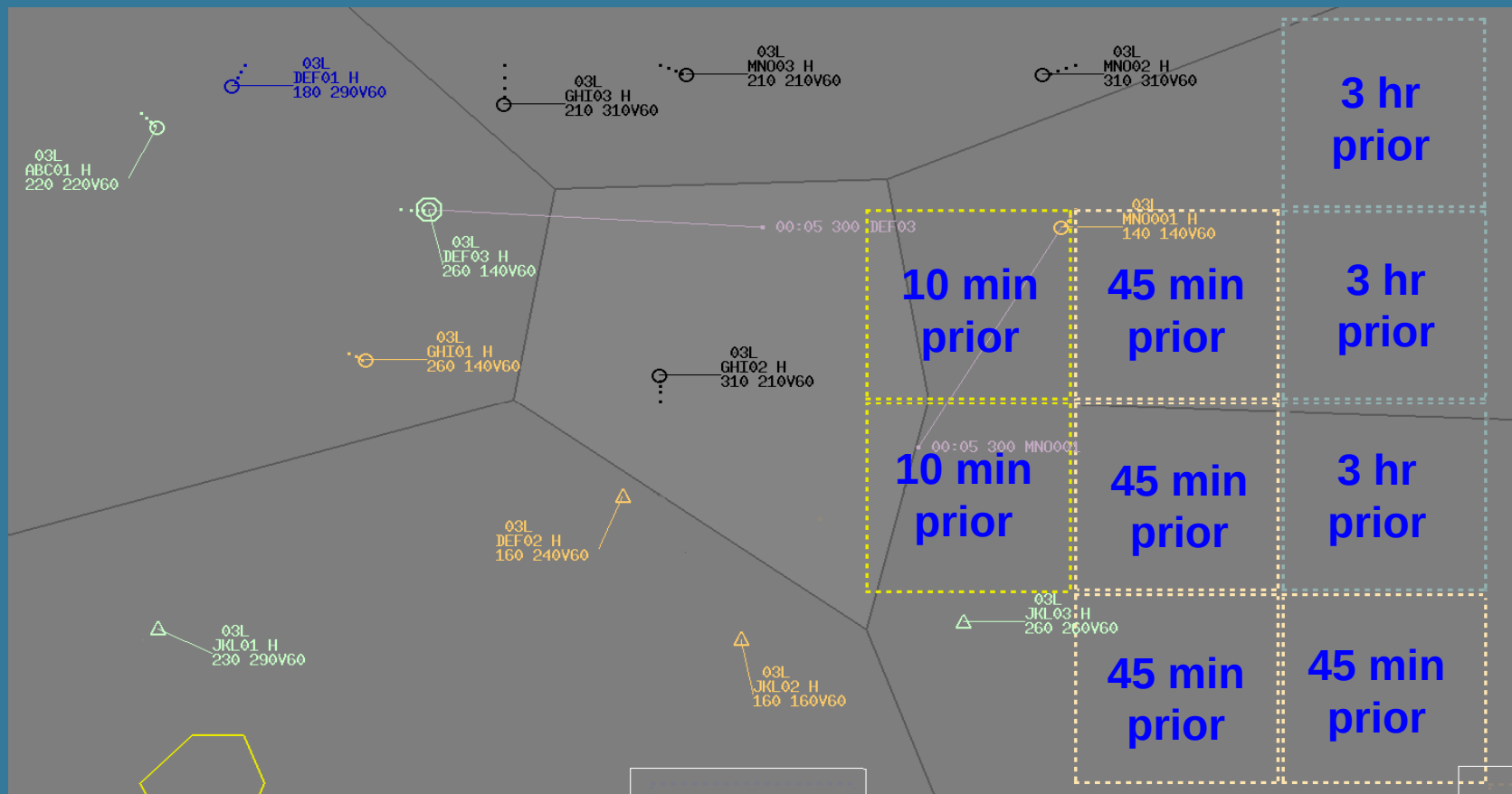
Outage predicted at
Current time

Outage expected
in next 20 minutes



RAIM Processing

- Areas of predicted RAIM outages shown as 1° X 1° cells
 - Procedural separation standards apply in outage areas





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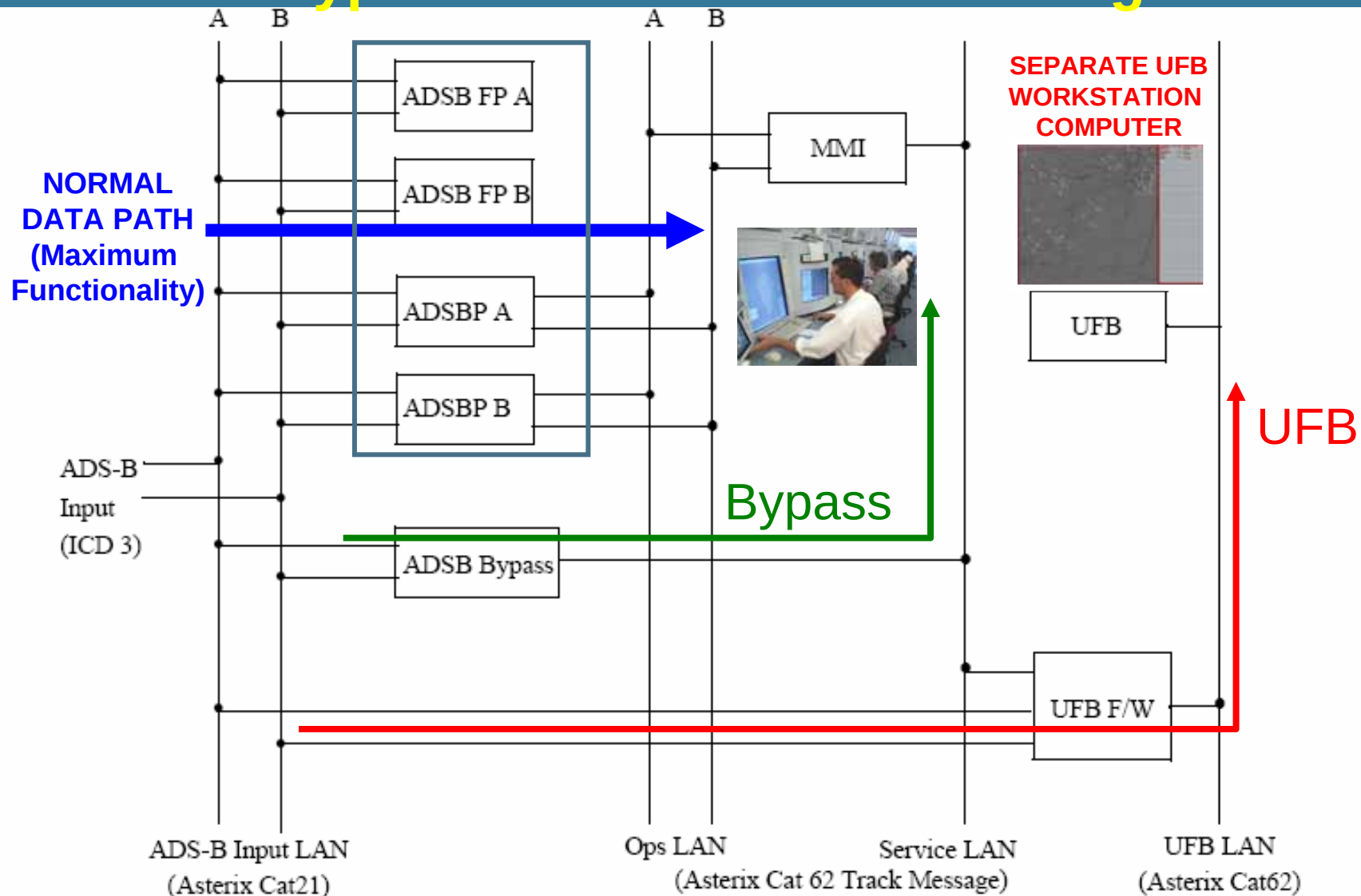
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Bypass system



ADS-B Bypass & UFB Functional Diagram



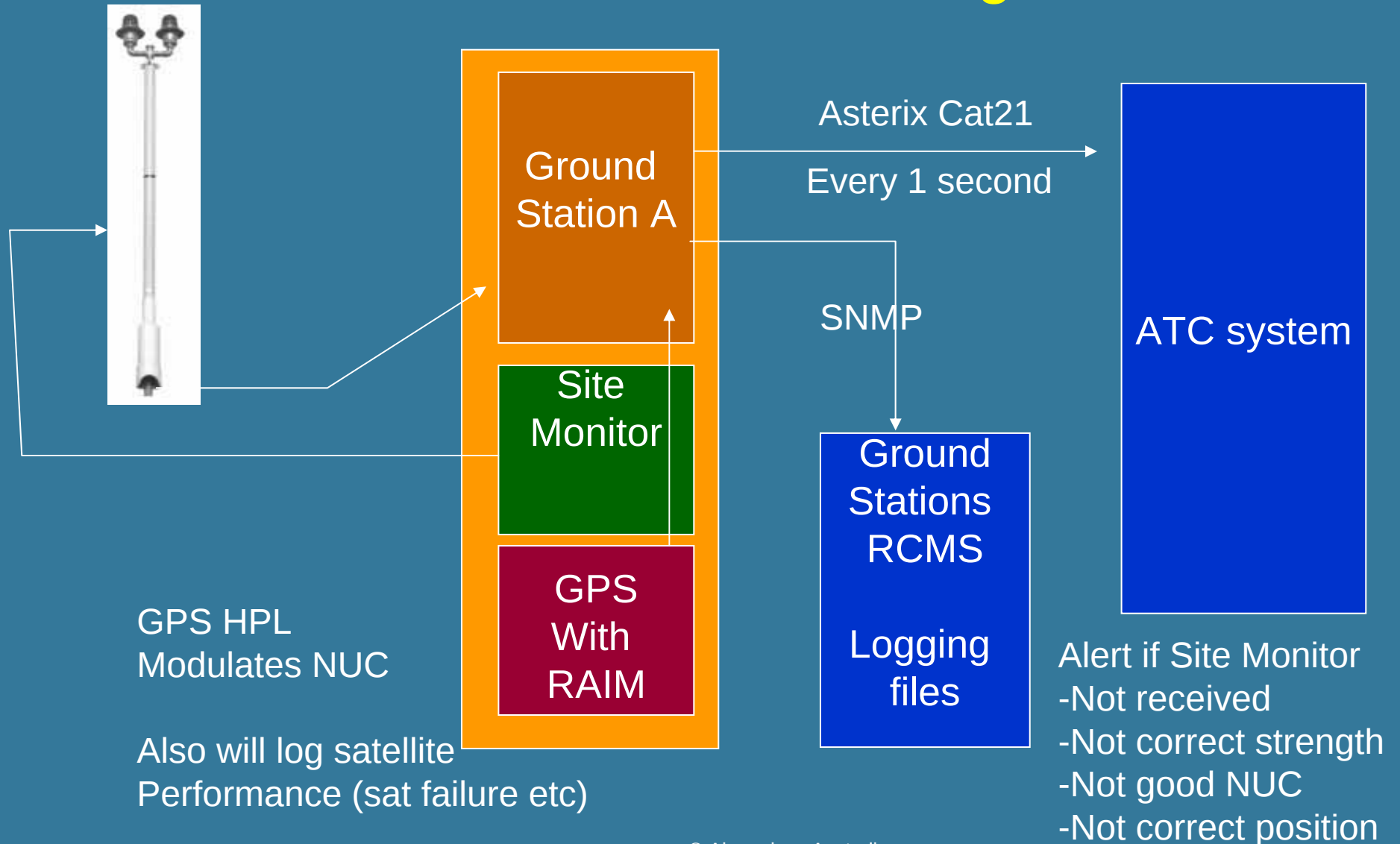


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UAP Site Monitor Design





Site monitor functions

- End to end message processing check
- Antenna & RF reception check
- Position monitoring (GPS vs known position)
 - Indicative of aircraft performance (not absolute)
- GPS satellite ranging error check
 - RAIM algorithm (HP adequate)
 - Satellite exclusion monitoring
- Logging – post event analysis



Discussion

More details on Airservices Website

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

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