

# MONITORING GOALS

**Jose Luis Pérez**

**FAA Technical Center - Atlantic City, NJ**

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# SAFETY GOALS

- Basis for Safety Goals - Adherence to Manual on Implementation of a 300 m (1,000 ft) Vertical Separation Minimum Between FL 290 and FL 410 Inclusive (Doc 9574)
- Doc 9574 Global System Performance Specification based on application of collision risk methodology
- ICAO's Review of the General Concept of Separation Panel (RGCSP) intended Doc 9574 provide for safe RVSM implementation in the future

# TWO ASPECTS OF SAFETY GOALS

- Need to ensure that individual operators and aircraft meet applicable safety goals
- Need to ensure that the airspace system as a whole meets applicable safety goal - the Target Level of Safety (TLS)
- Monitoring of aircraft height-keeping performance assists in confirming that both aspects of safety goals are satisfied

# MONITORING PERFORMANCE- THE MAJOR PROBLEM



***FL 350 = Constant Pressure Altitude***

***FL 350 Geometric Height***



# HEIGHT-KEEPING PERFORMANCE ERRORS

***FL 350 Geometric Height***



***Aircraft geometric height***

***Total Vertical Error (TVE)  
= Altimetry System Error +  
Assigned Altitude Deviation  
= ASE + AAD***

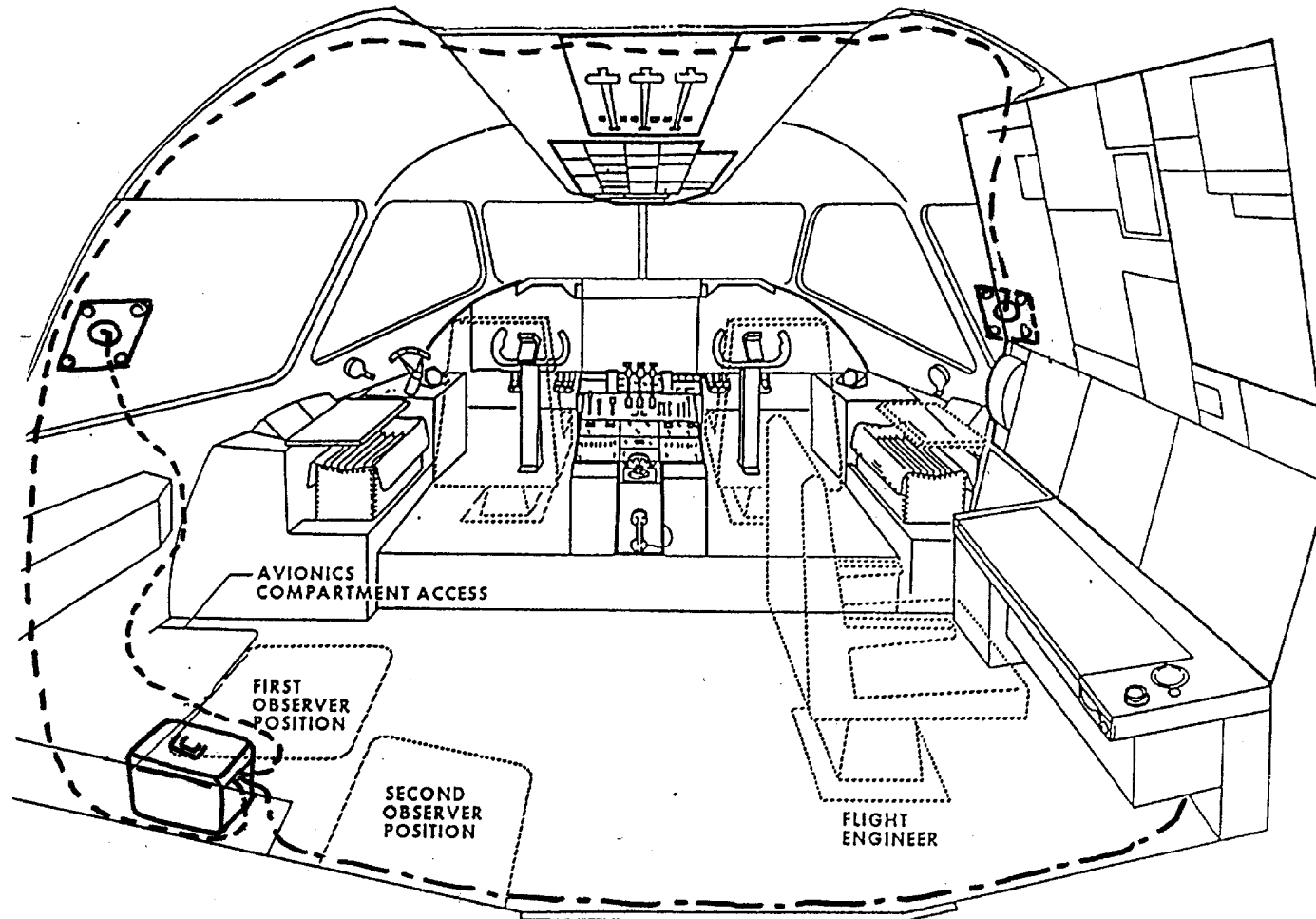
# MONITORING AND THE STATE APPROVAL PROCESS

- GPS-based Monitoring System (GMS), improved with enhanced GPS Monitoring Unit, plays a prominent role in supporting operator/aircraft satisfaction of monitoring requirements associated with RVSM approval process
- Focus on monitoring requirements for RVSM approval

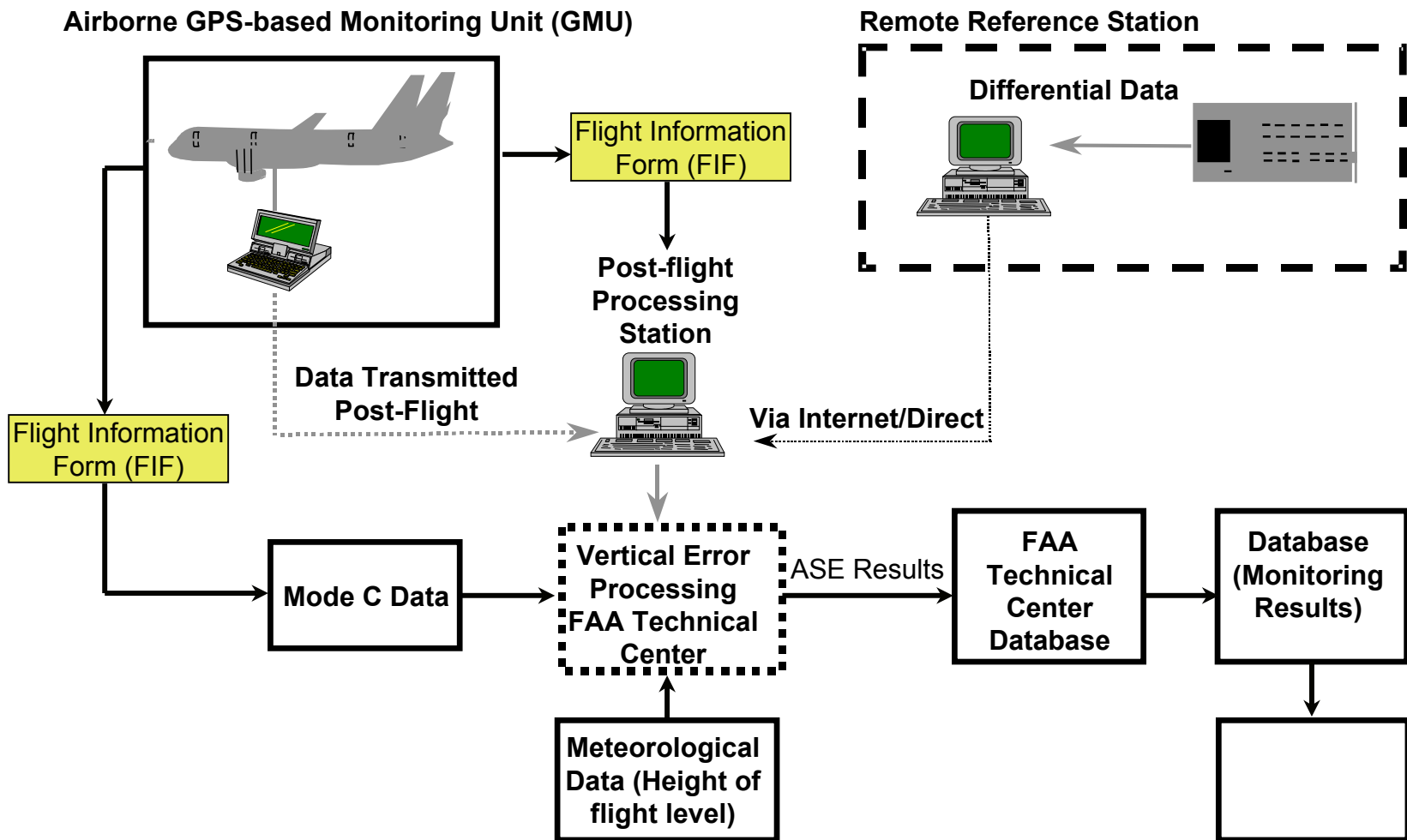
# GPS Monitoring Unit (GMU)



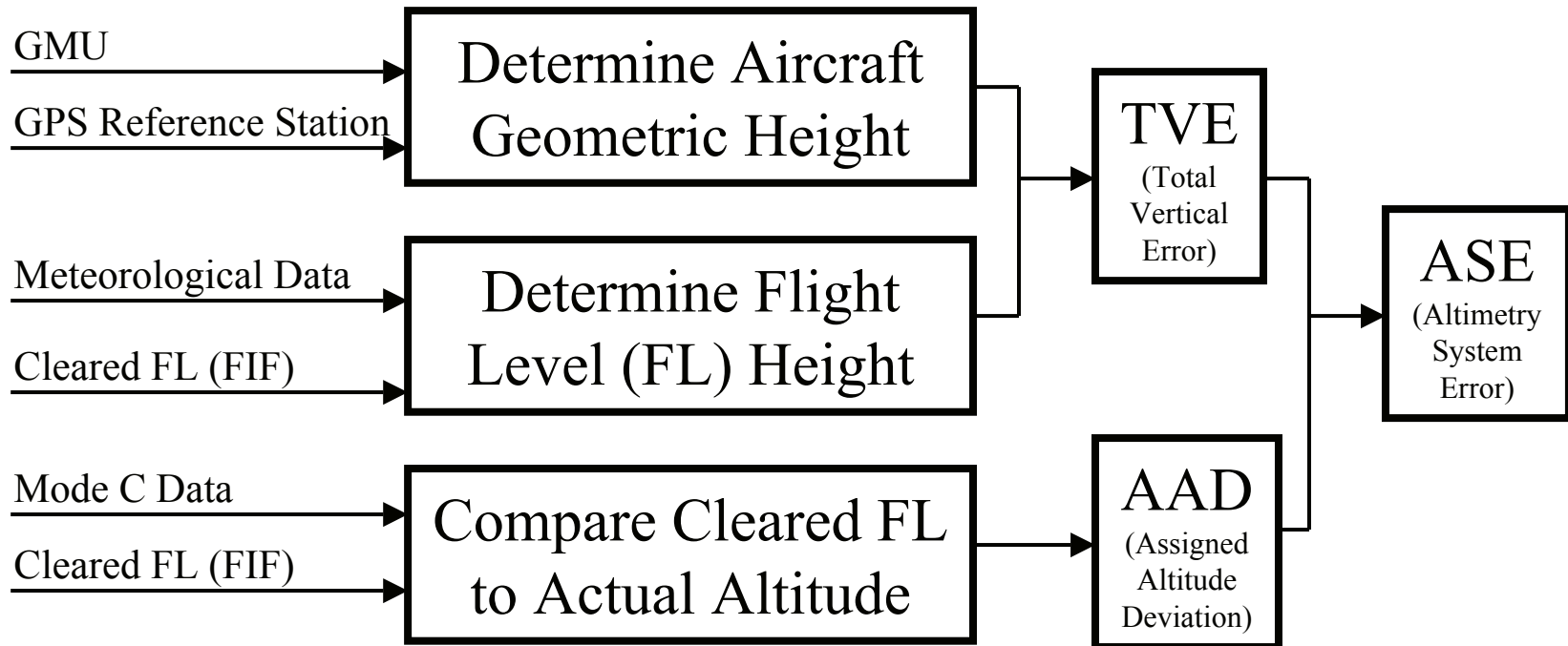
# Typical GMU Installation



# GPS-Based Monitoring System Data Flow

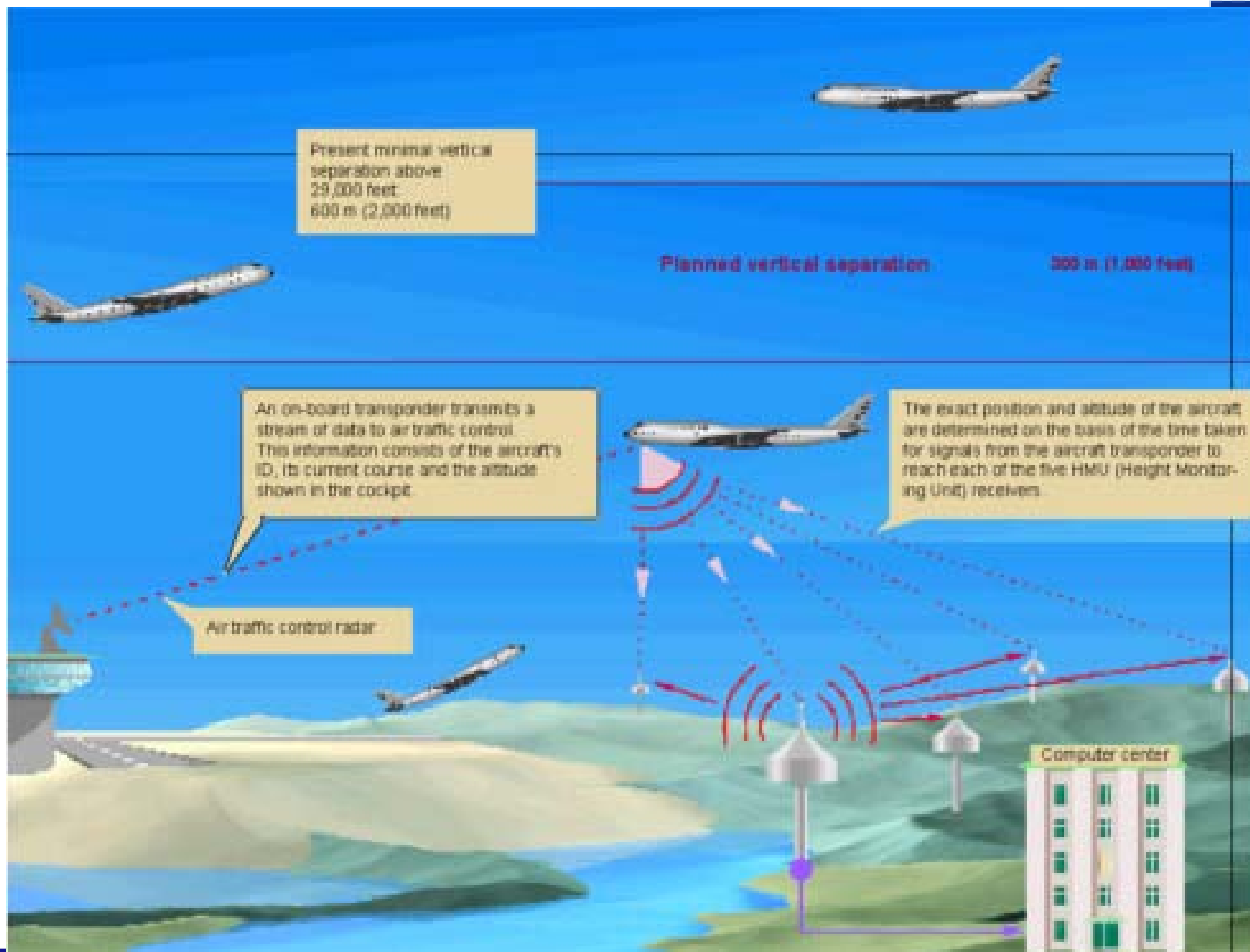


# Vertical Error Calculation Process



# Height Monitoring Unit (HMU)

- Ground-based system capable of monitoring height-keeping performance of an aircraft within (roughly) 40-nm of ground stations and producing estimate of ASE in near real-time
  
- Advantage: able to monitor large number of aircraft per day (conceptually, all which pass over ground stations)
  
- Disadvantage: aircraft must fly over HMU site



# MONITORING GOALS ASSOCIATED WITH STATE RVSM APPROVAL

# MINIMUM AIRCRAFT SYSTEM PERFORMANCE SPECIFICATION (MASPS)

- Performance which aircraft group must be capable of achieving in service, regardless of airspace where RVSM is applied
  - Mean altimetry system error (ASE) of the group < 80 ft in magnitude
  - Sum of the absolute value of the mean plus 3 standard deviations of ASE for group < 245 ft
  - Errors in altitude-keeping symmetric about a mean of 0 ft, have a standard deviation < 43 ft and have error frequency which decreases at least exponentially with increasing error magnitude

# Monitoring Goals

- ➔ INITIAL MONITORING. In application to the appropriate State authority for RVSM approval, operators must show plan for meeting monitoring requirements necessary to receive RVSM approval.
- ➔ AIRCRAFT STATUS FOR MONITORING. RVSM airworthiness approval must be granted prior to an aircraft being monitored. Any exception to this rule will be coordinated with the State authority.
- ➔ FOLLOW-ON MONITORING. Monitoring will continue after initial RVSM implementation. A follow-on sampling program for additional operator aircraft will be defined later.

# SATISFACTION OF MONITORING GOALS

- RMA administers RVSM monitoring program.
- RMA has access to NAT, Asia Pacific and Eurocontrol monitoring results - monitoring results obtained from other Regions applicable to satisfaction of RVSM monitoring requirements
- RMA coordinates with States and operators regarding individual-operator monitoring requirements
- RMA coordinates with States to confirm satisfaction of individual-operator requirements.

# MONITORING GOALS – Category 1

**Monitoring is REQUIRED IN ACCORDANCE WITH THIS CHART, HOWEVER, IT IS NOT REQUIRED TO BE COMPLETED PRIOR TO OPERATIONAL APPROVAL**

MONITORING CATEGORY	AIRCRAFT TYPE	MINIMUM OPERATOR MONITORING FOR EACH AIRCRAFT GROUP
<p><b>1</b></p> <p>Group approved <u>and</u> monitoring data indicates performance in accordance with RVSM standards.</p> <p><b>Group Definition:</b> aircraft have been manufactured to a nominally identical design and build and for RVSM airworthiness approval fall into a group established in an RVSM certification document (e.g., Service Bulletin, Supplemental Type Certificate, Type Certificate Data Sheet).</p>	<p>[A30B, A306], [A312 (GE), A313(GE)], [A312 (PW), A313(PW)], A318, [ A319, A320, A321], [A332, A333], [A342, A343], A344, A345, A346</p> <p>B712, [B721, B722], [B733, B734, B735], B737(Cargo) [B736, B737/BBJ, B738/BBJ, B739], [B741, B742, B743], B74S, B744 (5” Probe), B744 (10” Probe), B752, B753, [B762, B763], B764, B772, B773</p> <p>CL60(600/601), CL60(604), C560, [CRJ1, CRJ2], CRJ7, DC10, [E135, E145], F100, GLF4, GLF5, LJ60,</p> <p>L101, MD10, MD11, MD80 (All series), MD90</p>	<p>Two airframes from each fleet* of an operator to be monitored as soon as possible but <b>not later than 6 months after the issue of RVSM operational approval <u>or</u> not later than 6 months after the start of North American RVSM operations, <u>whichever occurs later.</u></b></p> <p>* <i>Note. For the purposes of monitoring, aircraft within parenthesis [ ] may be considered as belonging to the same monitoring group. For example, an operator with six A332 and four A333 aircraft may monitor one A332 and one A333 <b>or</b> two A332 aircraft <b>or</b> two A333 aircraft.</i></p>

# MONITORING GOALS – Category 2

<p>2</p>	<p>Group approved but insufficient monitoring data collected to move aircraft to Monitoring Category 1. Group definition applies.</p>	<p>Other group aircraft other than those listed above including:</p> <p>A124, ASTR, B703, B731, B732, BE20, BE40, C500, C25A, C25B, C525, C550**, C56X, C650, C750, CRJ9, [DC86, DC87], DC93, DC95, F2TH, [FA50 FA50EX], F70, [F900, F900EX], FA20, FA10, GLF2(II), GLF(IIB), GLF3, GALX, GLEX, H25B(700), H25B(800), H25C, IL62, IL76, IL86, IL96, J328, L29(2), L29(731), LJ31, [LJ35, LJ36], LJ45, LJ55, SBR1, T134, T154, T204, P180, PRM1, YK42</p>	<p>60% of airframes from each fleet of an operator (round up if fractional), as soon as possible but <b>not later than 6 months after the issue of RVSM operational approval or not later than 6 months after the start of North American RVSM operations, <u>whichever occurs later.</u></b></p> <p>** Refer to aircraft group table for detail on C550 monitoring</p>
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\*Note: If 60 percent of the North American fleet yields a fractional number, round up to the next whole aircraft (e.g., for a fleet of 2 aircraft,  $0.6 \times 2 = 1.2$ ; therefore, 2 aircraft must be monitored).

# MONITORING GOALS – Category 3

<p><b>3</b></p>	<p>Non-Group</p> <p><b><u>Non-group Definition:</u></b> aircraft that do not fall under the group definition <u>and</u> for RVSM airworthiness approval are presented as an individual airframe.</p>	<p>Non-group approved aircraft</p>	<p>100% of aircraft shall be monitored as soon as possible but <b>not later than 6 months after the issue of RVSM operational approval or not later than 6 months after the start of North American RVSM operations, <u>whichever occurs later.</u></b></p>
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# Process to Perform Monitoring

- Use of GPS-Based Monitoring System in CAR/SAM RVSM implementation Program Being Coordinated Through IATA
- Expect procedures for use of system will be published soon
- May be possible to employ North American ground-based monitoring system in CAR/SAM in future