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NEXTGEN SURVEILLANCE

UNLEASHING THE POTENTIAL OF ADS-B

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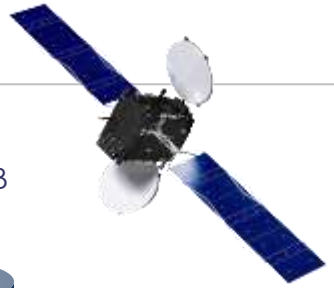
ADS-B: EVERY LETTER COUNTS

ADS-B: EVERY LETTER COUNTS

From Mode A to ADS-B DO-260B (v2)



Mode A
4 digits ID

Mode C
4 digits ID
Altitude

Mode S (ELS+EHS)
Flight ID
Selected altitude
Mach number
Roll angle
Track angle
Track angle rate
TAS/IAS/GS/VS

DO-260
GPS position
Flight ID
Velocity
NUC

DO-260A
GPS position
Flight ID
Velocity
NIC and NACp

DO-260B
GPS position
Flight ID
Velocity
Changed how
NIC, NACp
and SIL are set
Length/Width
…

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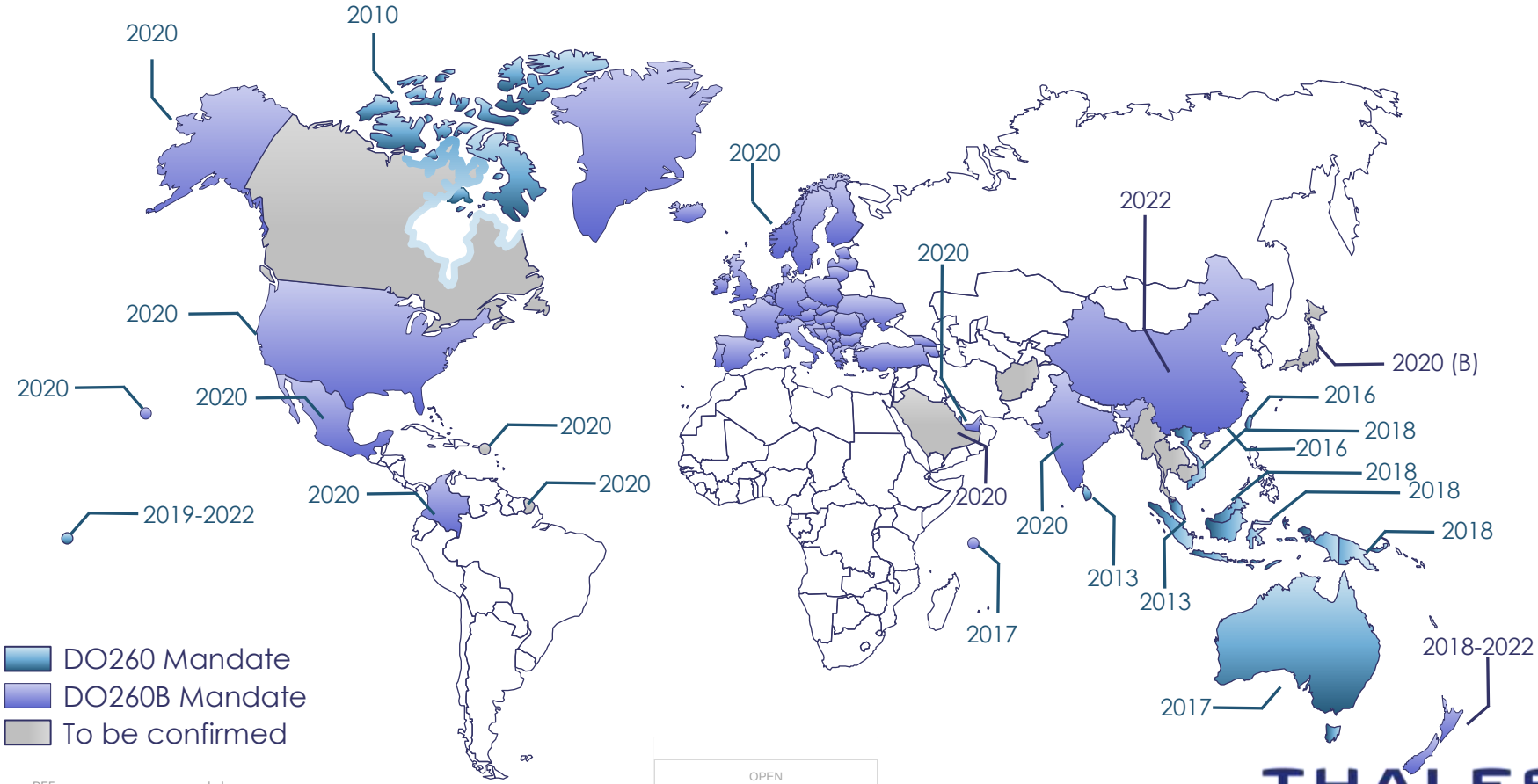
ADS-B OUT MANDATES WORLDWIDE



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THE US GNSS SOURCE REQUIREMENT

14CFR §91-225 equipment & use

§ 91.225 Automatic Dependent Surveillance-Broadcast (ADS-B) Out equipment and use.

(a) After January 1, 2020, and unless otherwise authorized by ATC, no person may operate an aircraft in Class A airspace unless the aircraft has equipment installed that—

(1) Meets the requirements in TSO-C166b, Extended Squitter Automatic Dependent Surveillance-Broadcast (ADS-B) and Traffic Information Service-Broadcast (TIS-B) Equipment Operating on the Radio Frequency of 1090 Megahertz (MHz); and

(2) Meets the requirements of §91.227.

(b) After January 1, 2020, and unless otherwise authorized by ATC, no person may operate an aircraft below 18,000 feet MSL and in airspace described in paragraph (d) of this section unless the aircraft has equipment installed that—

(1) Meets the requirements in—

(i) TSO-C166b; or

(ii) TSO-C154c, Universal Access Transceiver (UAT) Automatic Dependent Surveillance-Broadcast (ADS-B) Equipment Operating on the Frequency of 978 MHz;

(2) Meets the requirements of §91.227.

(c) Operators with equipment in-

Ref.

14CFR §91-227 equipment perf. Req.

(1) For aircraft broadcasting ADS-B Out as required under §91.225 (a) and (b)—

(i) The aircraft's NAC_P must be less than 0.05 nautical miles;

(ii) The aircraft's NAC_V must be less than 10 meters per second;

(iii) The aircraft's NIC must be less than 0.2 nautical miles;

(iv) The aircraft's SDA must be 2; and

(v) The aircraft's SIL must be 3.

(2) Changes in NAC_P, NAC_V, SDA, and SIL must be broadcast within 10 seconds.

(3) Changes in NIC must be broadcast within 12 seconds.

(d) *Minimum Broadcast Message Element Set for ADS-B Out.* Each aircraft must broadcast the following information, as defined in TSO-C166b or TSO-C154c. The pilot must enter information for message elements listed in

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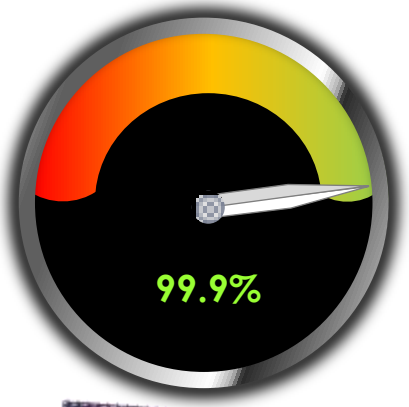
AVAILABILITY OF THE GNSS SOURCE

TSO C129 (SA ON)

TSO C196 (SA AWARE)

TSO C145/146 (SBAS)



EQUIVALENT TO CURRENT RADAR'S SYSTEM AVAILABILITY →

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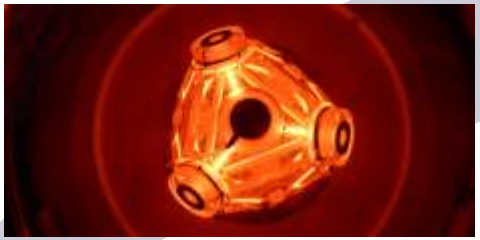
HOW TO GET 99,9% AVAILABILITY BY 2025 and beyond?

FAA TOOL
http://www.sapt.faa.gov/
Or equivalent

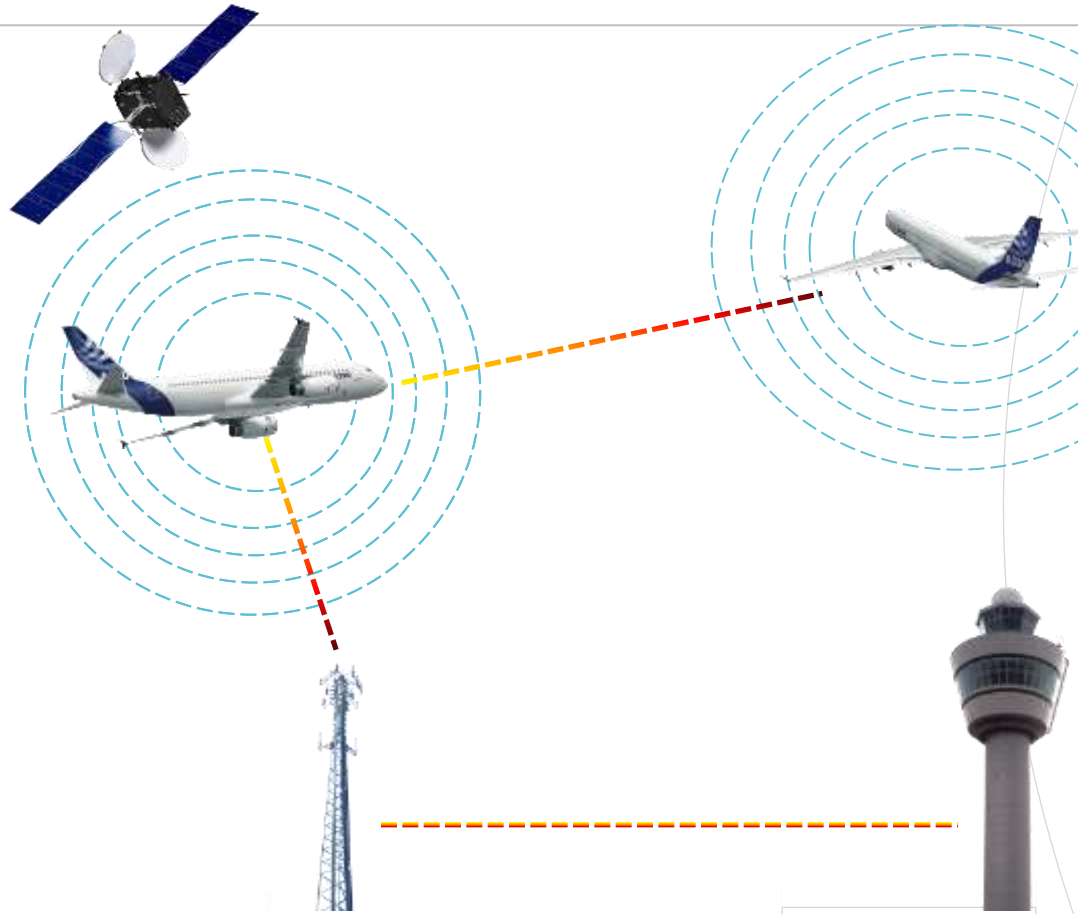


HYBRID IRS/GNSS

MMR SBAS

MULTI
CONSTELLATION
GNSS

From ADS-B OUT to ADS-B IN



ADS-B IN FUNCTIONS TODAY

ITP
In-Trail Procedures

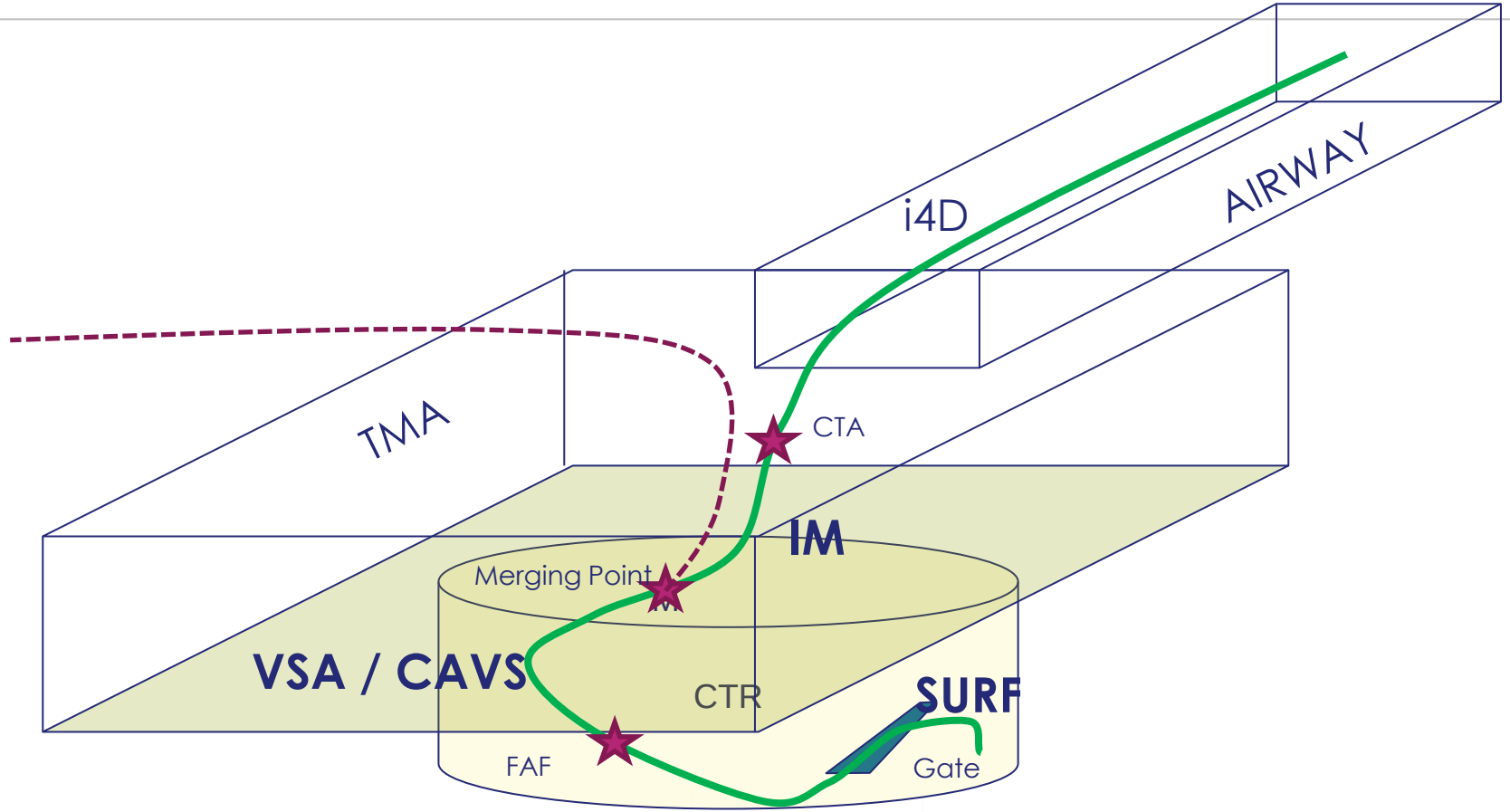
VSA
Enhanced Visual Separation on Approach

IM / M&S
Merging & Spacing

SAMM/SURF
Surface Area Movement

CAVS
CDTI Assisted Visual Separation

HOW ADS-B IN IS INTEGRATED INTO THE AIRSPACE



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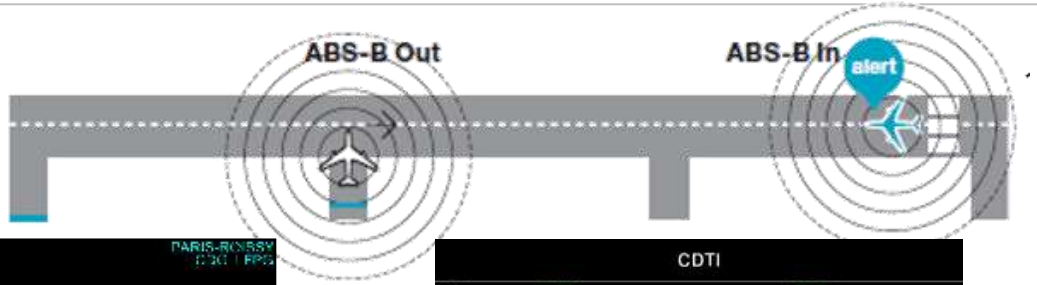
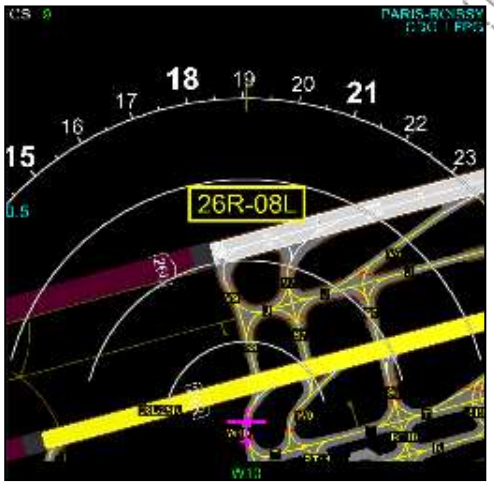
SURF-A / SURF-IA: ADDRESSING RUNWAY INCURSIONS





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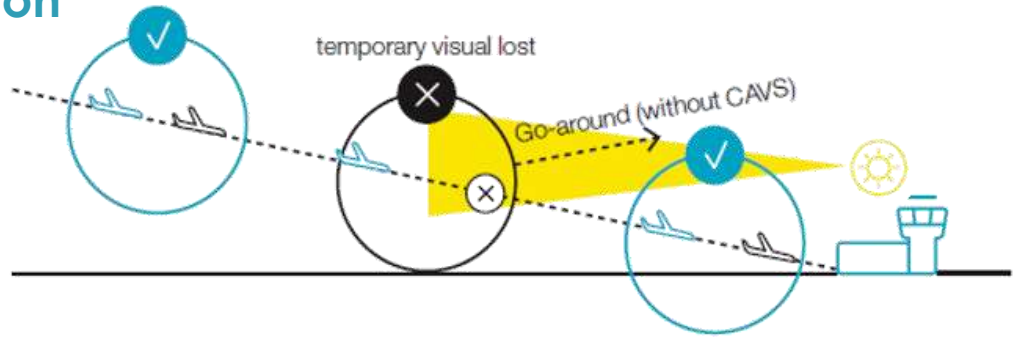
VSA/CAVS OVERVIEW

In initial VMC operation

After getting OTW/CDTI identification

- Operation in 4 steps
  - Visual acquisition
  - Clearence acceptance
  - Maintaining separation
  - Termination



Allows to continue even with loss OTW windows

CAVS is Key to Manage Spacing from Aircraft Ahead
Enabling Reduced Flight Time and Distance

VSA/CAVS FLIGHT TEST (JUNEYAO, APR 27th 2017)

VSA Demonstration with favorable visibility conditions

- During the final approach of 20nm, the separation is about 2.5 to 3nm
- VS 7.5 to 10 NM typical without VSA.

CAVS BENEFITS SUMMARY

FAA CAVS Benefit Analysis Report (2016)

- indicated savings in time and distance flown in marginal weather conditions
- AAL CAVS evaluations show, within the last 25 nm to the runway, flight time savings of
  - 52 to 134 seconds
  - 6.4 to 14.6% less time on average
- Flight Deck Display of Traffic-to-Follow Situational Awareness Aided Flight Crew in More Efficient Spacing

ADS-B In Benefits

- ☑ Increased Situational Awareness
- ☑ Reduced missed approaches
- ☑ Higher achievable throughput
- ☑ Decreased spacing buffer
- ☑ Less delay vectoring
- ☑ Fuel Savings
- ○ Better Block Time predictability
- ○ Ground Departure Delay (GDP)
- ☑ Passenger Value of Time (PVT)

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INTERVALL MANAGEMENT OVERVIEW

From distance to time sepation

- Time based separation (Requires TBS ground system)
- Take into account the external condition (wind)

Increase accuracy at the threshold.

Reduce the IAT sigma up to +/- 5 sec.

Operations (under development)

- Single Runway Operation - Reduce in trail separation buffer
- Dependent Converging and Crossing Runway Operations (DCCR) – reduces runway crossing/converging buffers
- Dependent Staggered Arrivals w/ 1 Target (DSA1) and Parallel Approach (PA) – both apps reduce diagonal separation buffer; PA reduces diagonal separation as well

Adaptation to existing or new arrival procedures

Airborne Non-Integrated Architectures (no FMS or Datalink) Support
Consistently 5s IAT without significant Pilot additional workload

The Inter Arrival Time Sigma (MITRE/FAA Study Dec 2016)

ADS-B OUT Worldwide stepping stone to ADS-B IN

Industry* promotes Tactical Airborne ADS-B Based IM

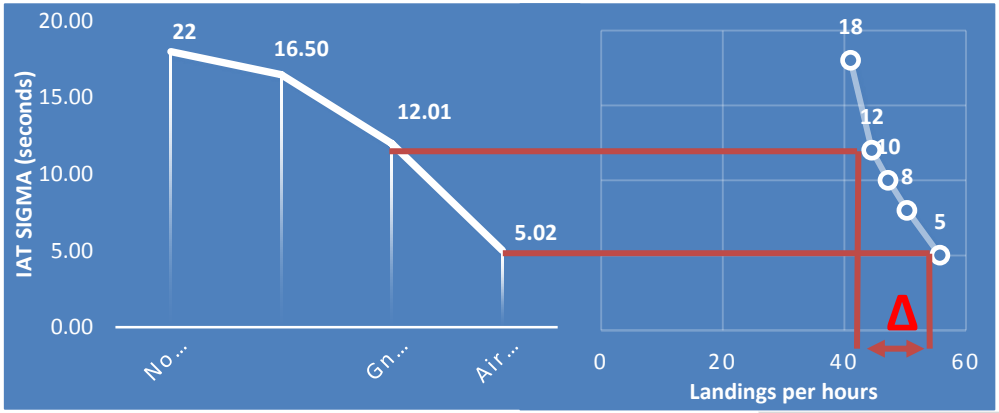
- As supplement to Strategical Ground Based Tools
- For various approaches/runways configurations and weather conditions

Optimum traffic is achieved

- NOT with minimal spacing, but
- With smallest standard deviation around any given point in Time

Throughput

- IAT Sigma = 12.0 sec: 44.5 ac/hr
- IAT Sigma = 10.0 sec: 47.2 ac/hr
- IAT Sigma = 8.0 sec: 50.3 ac/hr
- IAT Sigma = 5.0 sec: 55.7 ac/hr



- **The Metric: Inter Arrival Time (IAT) Sigma****
  - +3.3 AC/hr: No Metering to Metering (TBFM)
  - Δ +3.1 AC/hr: Metering to GIM-TSAS
  - +11.2 AC/hr: GIM-S + TSAS + FIM
- **IM IAT sigma value has a dramatic impact on runway throughput**

* RTCA SC186 WG 4 /EUROCAE WG 51 and Equip 2020 WG 4 are
**Source FAA/Mitre: Interval Management: DSA /PSA Benefits 12/6/16

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IM BENEFITS SUMMARY

Low-variance IAT consistent spacing on approach results in:

- Higher arrival throughput during peak hours in terminal area
  - Lower probability of vectoring ("path stretching")
  - Holding patterns on final
  - Reducing Distance and Time flown
  - Avoid Ground Delay Departure at airport of origin
- With Positive effect on
  - Airline Block Time predictability, and
  - FAA Ground Delay Program (GDP) planning

MITRE Study about ADS-B In Interval Management

- Spacing performance or Inter-Arrival Time variance (IAT) based on real operations and fast-time simulations (e.g.: UPS 2007, ATD1 2017 etc.)
  - When IAT goes from 18 seconds (today) to 5 seconds with IMS, arrival rates could increase from 38 to 55 aircraft per hour

ADS-B In Benefits

- Increased Situational Awareness
- Reduced missed approaches
- Higher achievable throughput
- Decreased spacing buffer
- Less delay vectoring
- Fuel Savings
- Better Block Time predictability
- Ground Departure Delay (GDP)
- Passenger Value of Time (PVT)

IMS Control of IAT Helps Reach Maximum Runway Capacity. For More Capacity at That Stage, the Only Alternative: Build a New Runway!

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THANK YOU

UNLEASHING THE POTENTIAL OF ADS-B

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