Intelligent Approach

Enhancing airport resilience and runway capacity

What is Intelligent Approach?

Intelligent Approach

Building on the experience with Time Based Separation

Adaptive controller tools to safely optimise arrival spacing for all conditions, including:

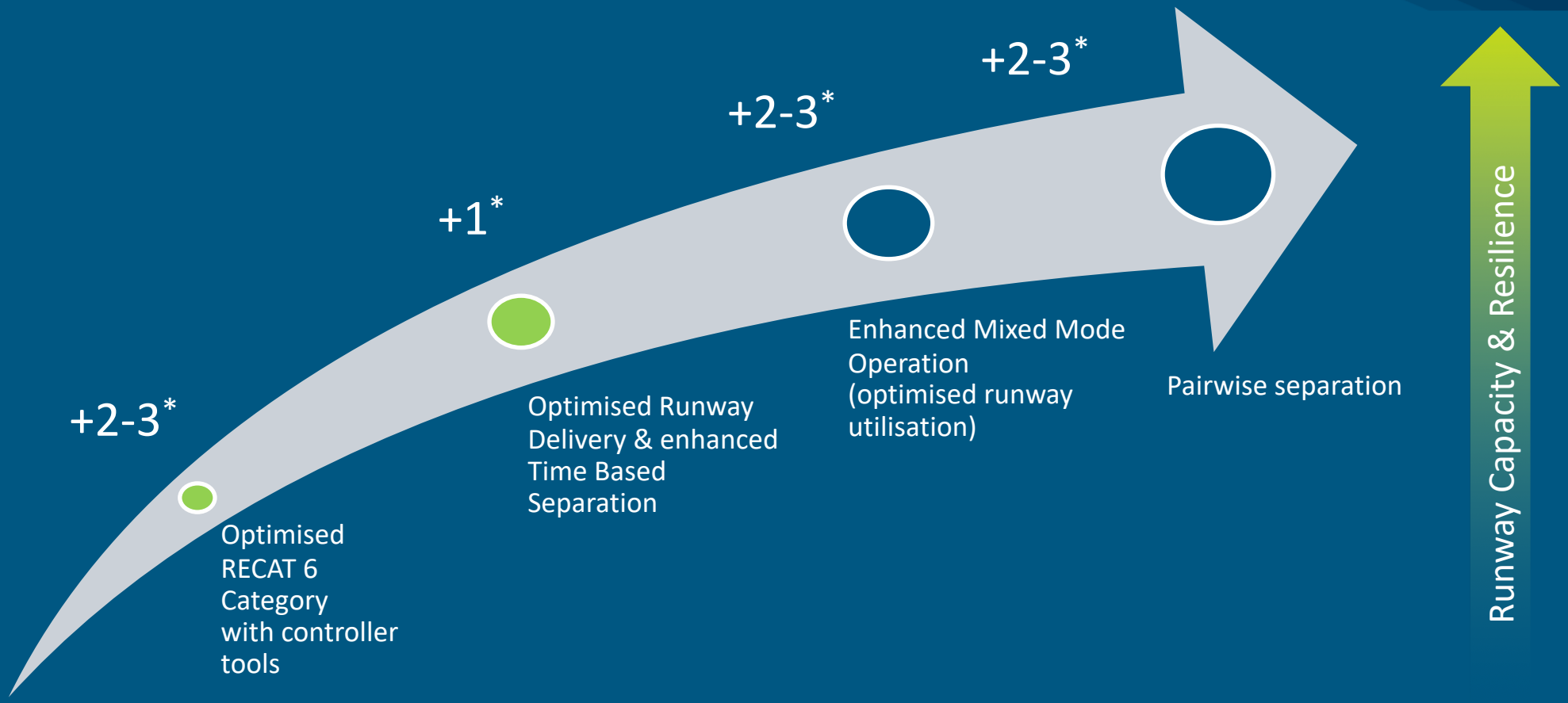
- Optimised wake vortex spacing (RECAT, ORD & Pairwise)
  = additional runway capacity & consistency
- Optimised spacing for mixed mode (arrival/departure) runways
  = additional runway capacity & safety
- Time Based Separation providing mitigation for lost capacity due headwinds
  = resilience
- Improved consistency of operational service delivery
  = better overall on time performance

Intelligent Approach is modular in design and can be easily integrated into customer existing ATM system

Optimisation Of Runway Capacity & Resilience

for any airport & runway configuration

Intelligent Approach

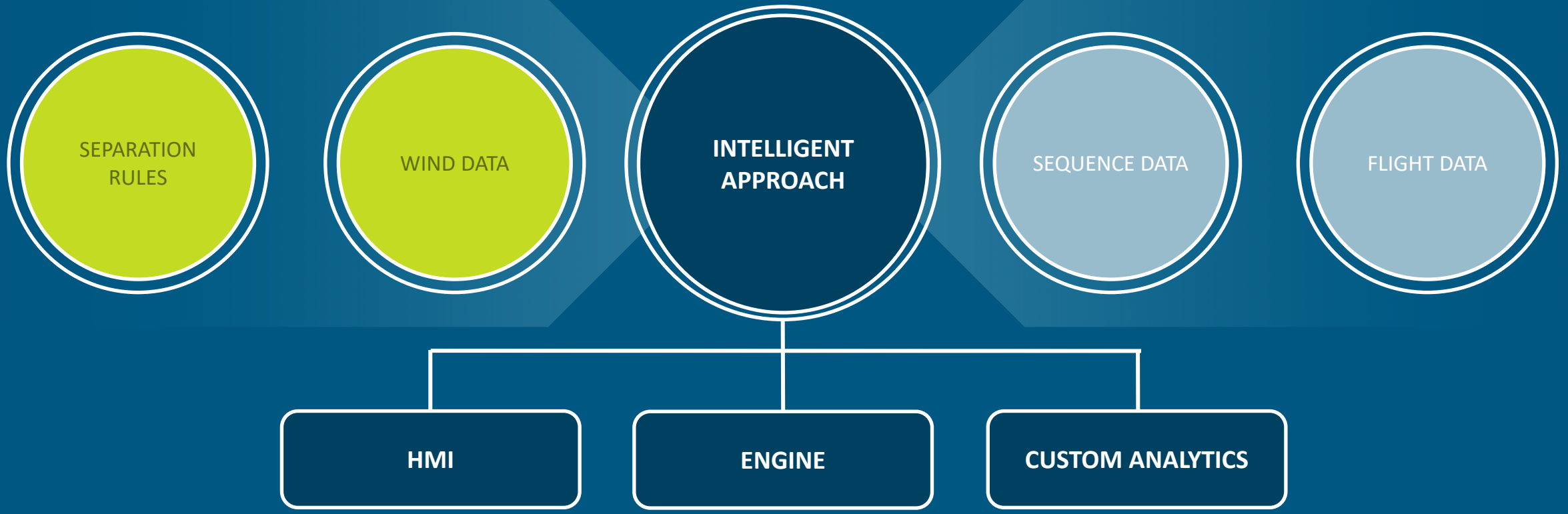


*Indicative Capacity Gain will vary with traffic mix, runway strategy & current wake vortex rules used

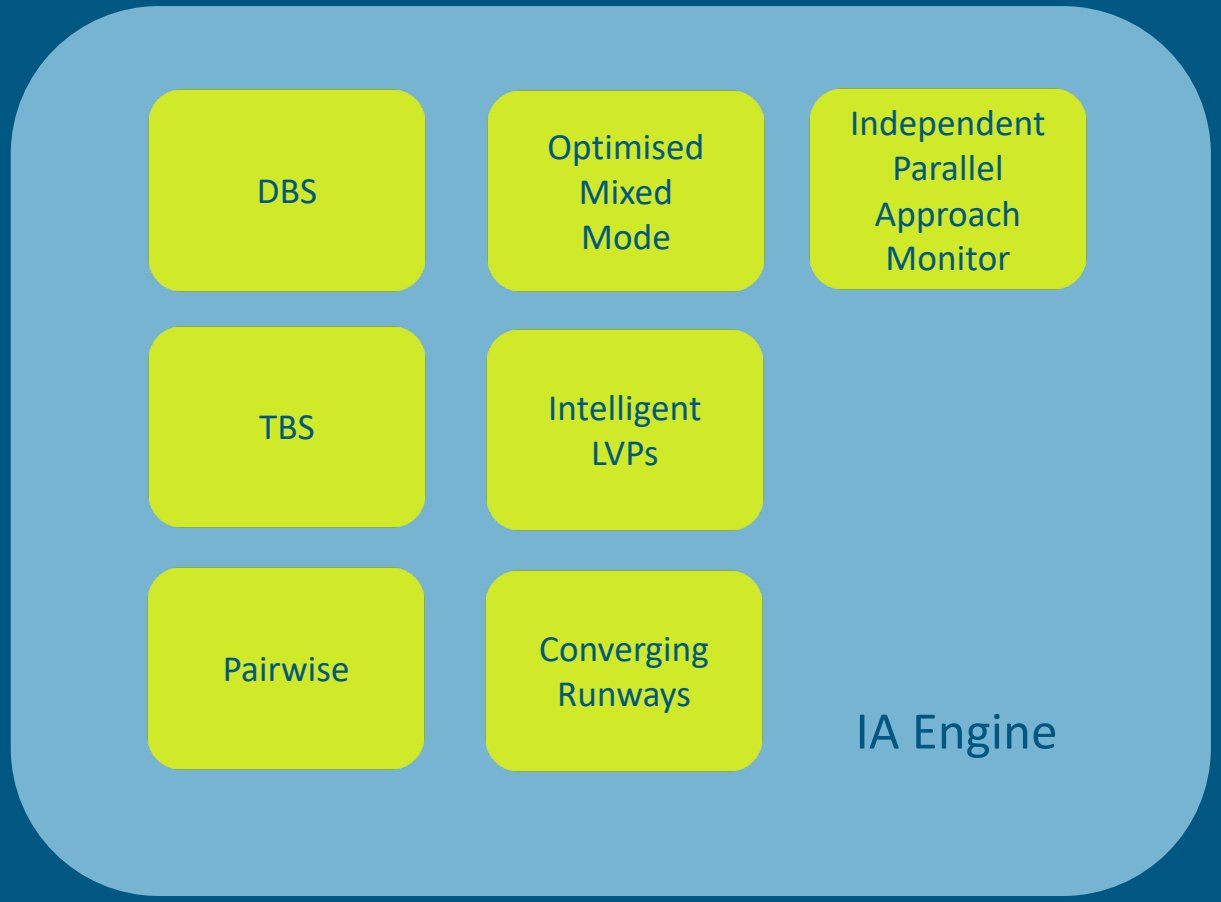
Modular Design

works with existing ATM systems

Intelligent Approach



Intelligent Approach Application features



Distance Based Separation (DBS)

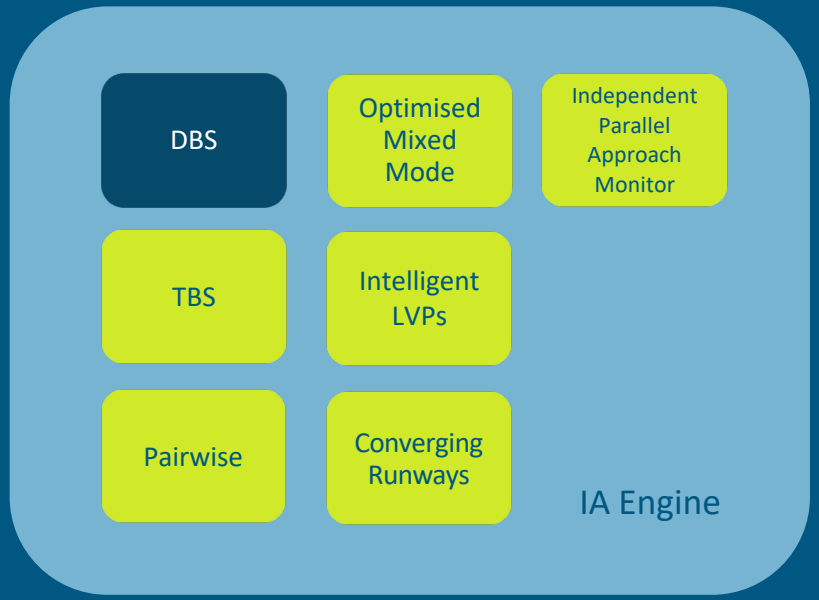
First deployed at Heathrow February 2015

Intelligent Approach

- Improves the consistency of approach spacing
- Provides controllers with visual indication of the required separation between aircraft with optimised wake spacing rules
- Simplifies the implementation of RECAT (6 or 7 Category) Wake Vortex Separation

Benefits

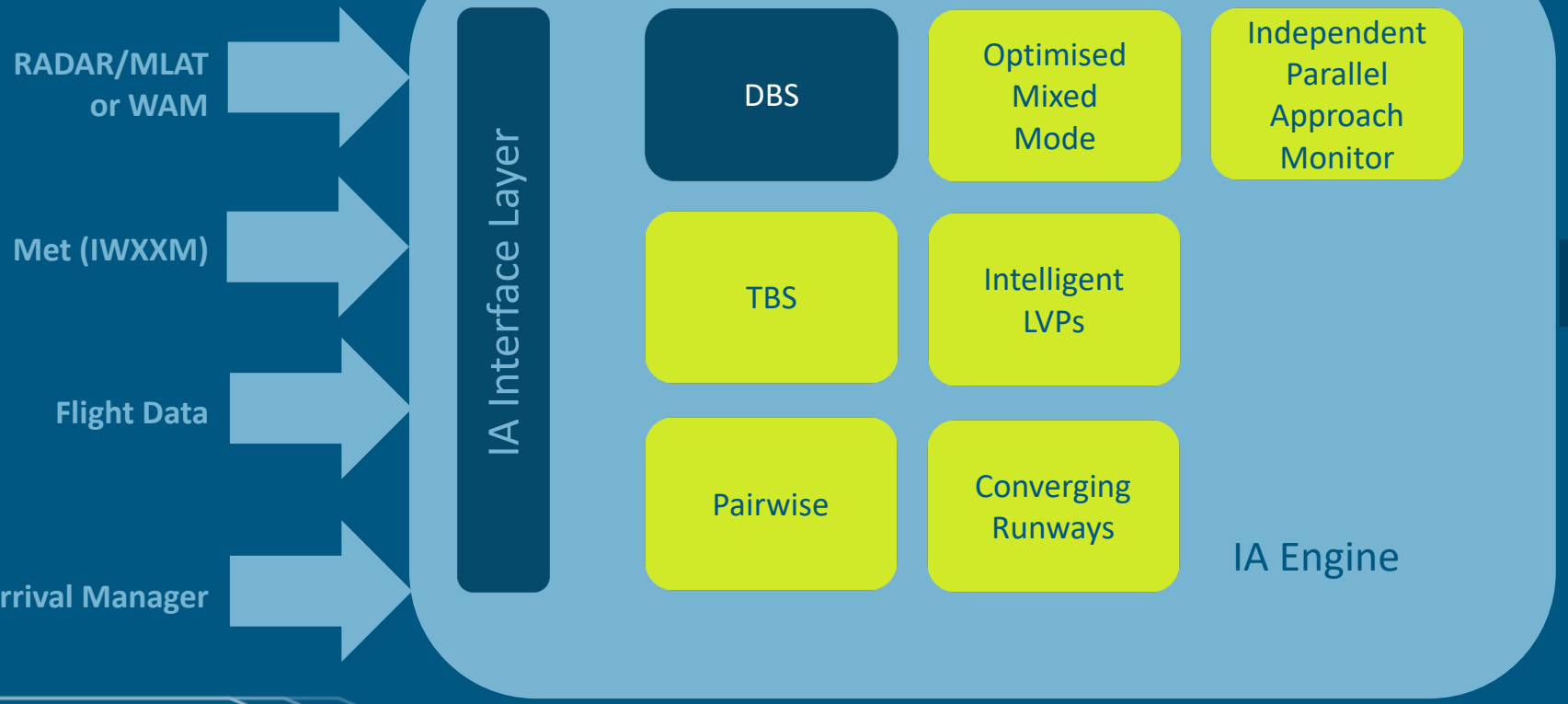
- Typical capacity gain +2-3 landings per hour (may be higher for some airfields)



DBS Implementation

Intelligent Approach

Uses Existing Customer ATM System output data



Simple changes to Customer HMI to Display DBS indications

Controller HMI

ASTERIX Like Output

Time Based Separation (TBS)

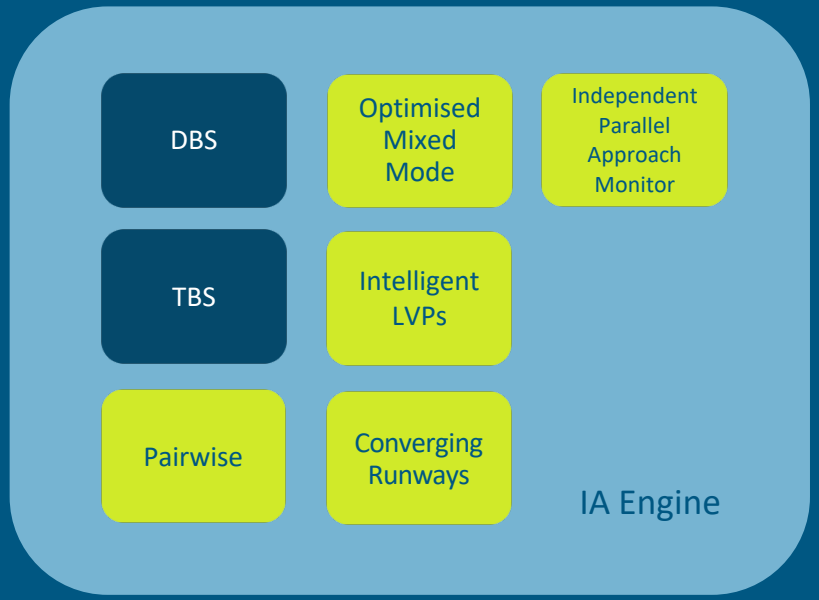
In operation at Heathrow since March 2015

Intelligent Approach

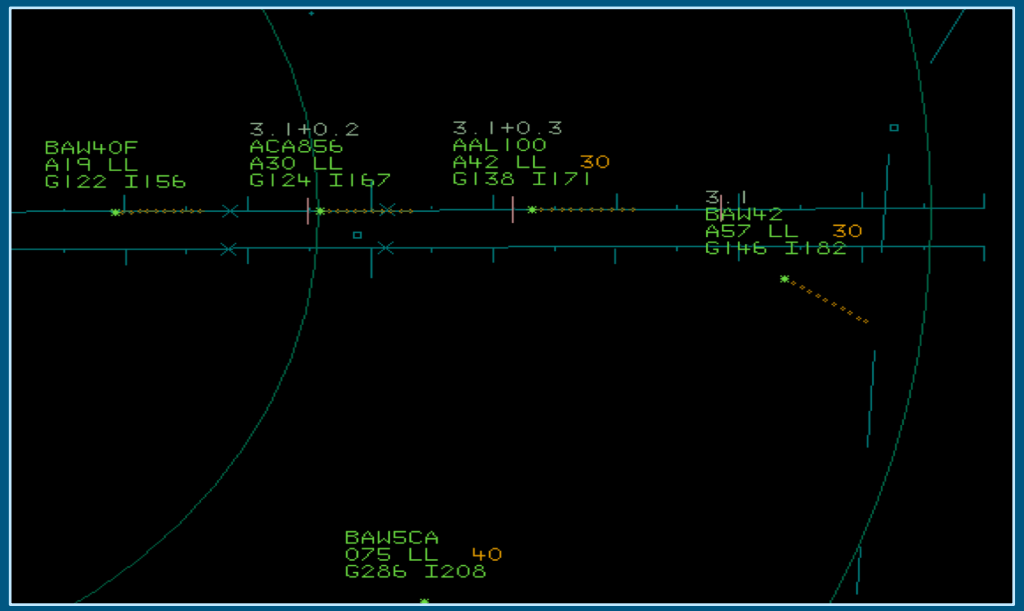
- Dynamically adjusts final approach separation for headwind component keeping spacing equivalent to 5-7 knot headwind
- Allows controllers to manage changing wind conditions

Benefits

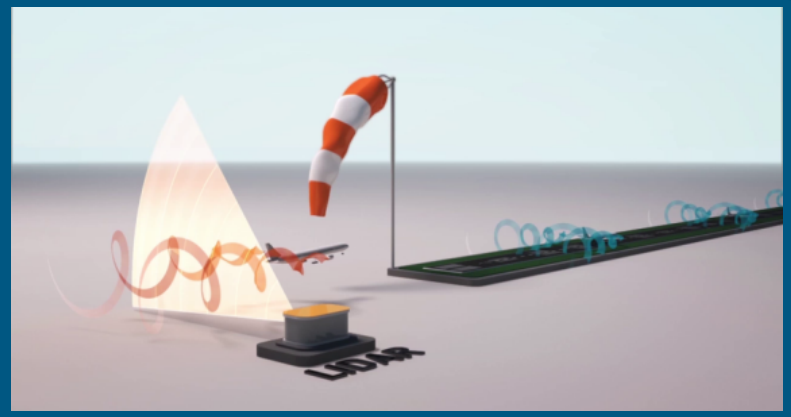
- Typical capacity gain +2.6 landings per hour in headwinds on final approach >20 knots
- No increase in wake encounters or go-arounds



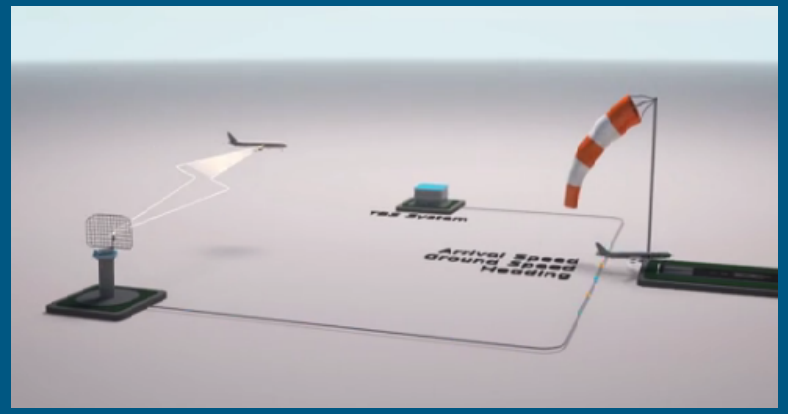
Intelligent Approach Features



Controller HMI with Dynamic separation
Indicators based on DBS/TBS rules and Actual winds



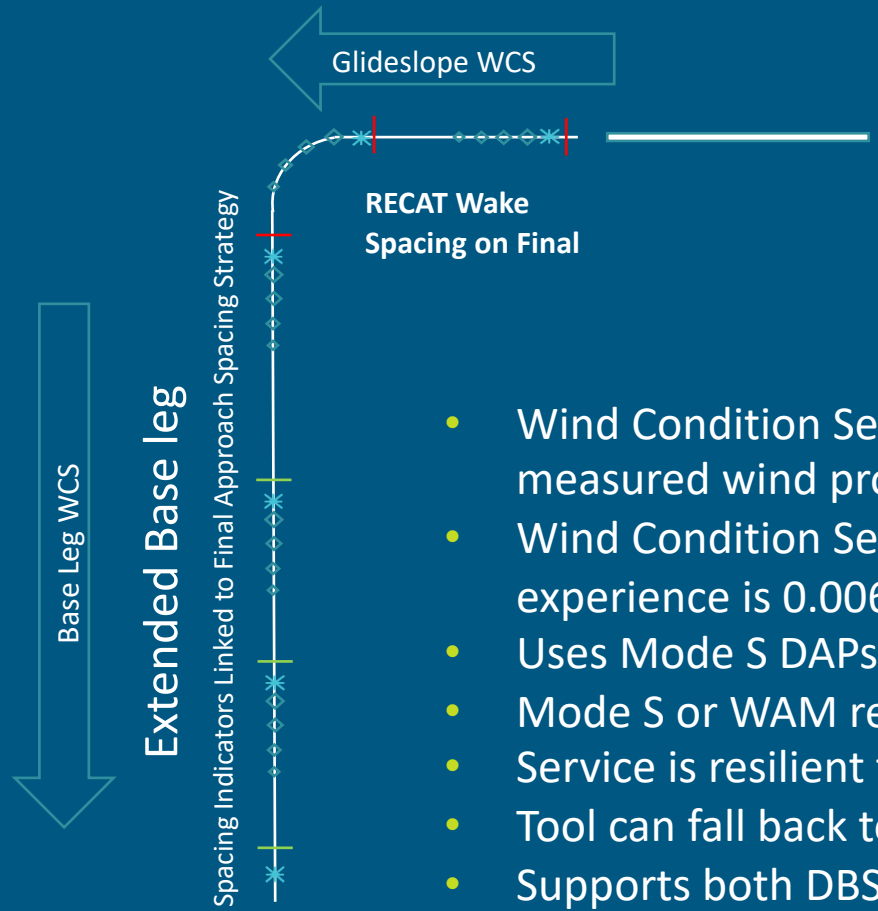
Time based wake rules.
Safety case based on LIDAR wake vortex measurements from 150,000 movements supported by SESAR/Eurocontrol

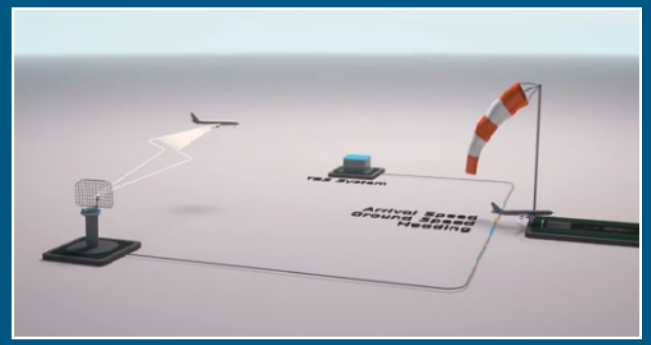


Real time wind data derived from Mode S downlinked aircraft parameters

Wind Condition Service

Intelligent Approach





Real time wind data derived from Mode S downlinked aircraft parameters

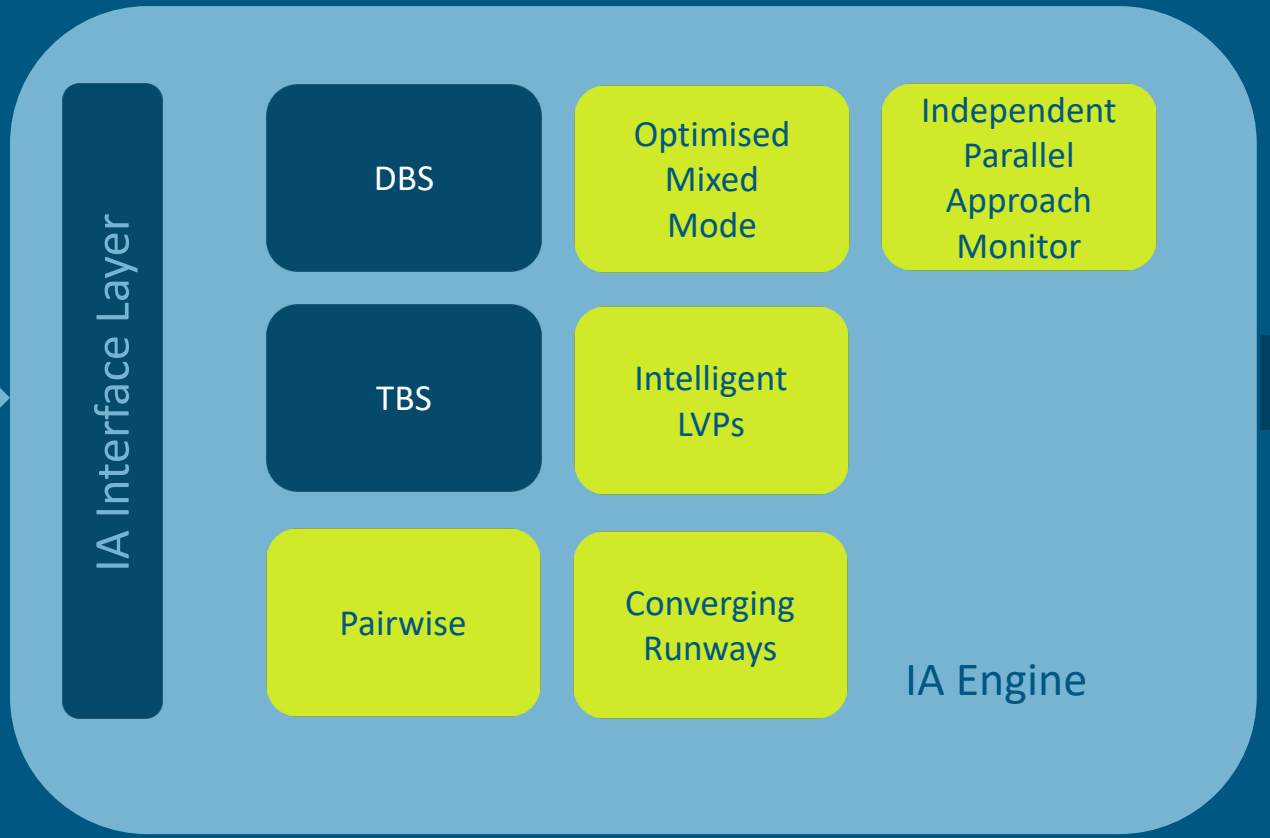
- Wind Condition Service allows accurate spacing indicators based on actual real time measured wind profile
- Wind Condition Service already proven at Heathrow and is highly accurate (Heathrow experience is 0.006% errors up to 10 knots)
- Uses Mode S DAPs data to support calculation of wind profile
- Mode S or WAM required (most ADS-B squitters lack IAS)
- Service is resilient to intermittent loss of data
- Tool can fall back to groundspeed algorithm if Mode S data lost
- Supports both DBS and TBS operations as required

TBS Implementation

Intelligent Approach

Uses Existing Customer ATM System output data

Mode S DAPS From WAM or RADAR



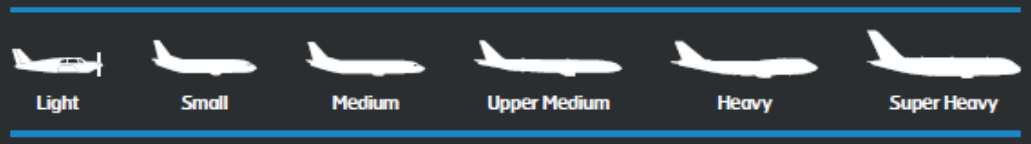
Simple changes to Customer HMI to Display TBS indications

Controller HMI

ASTERIX Like Output

Pairwise Separation

Intelligent Approach

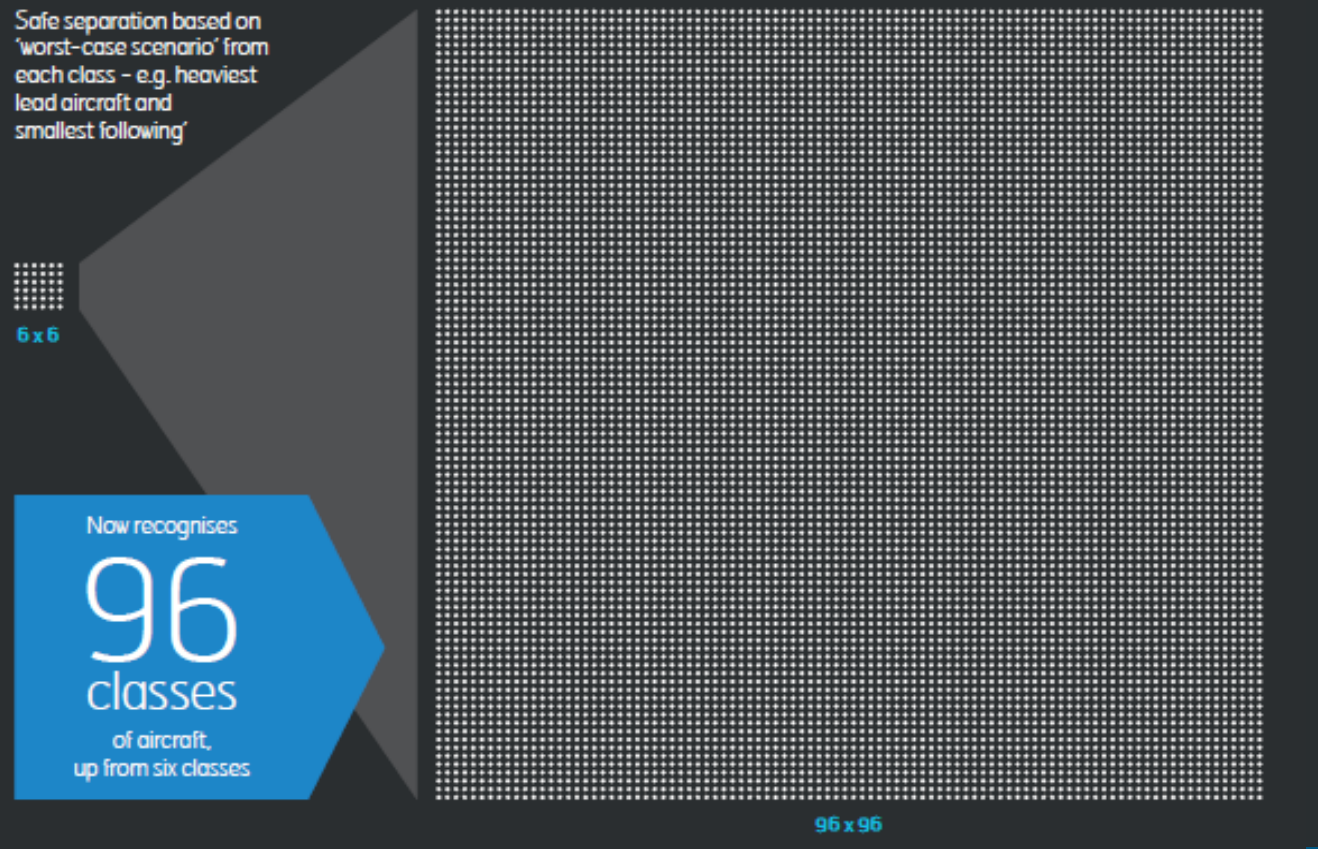


Pairwise Separation identifies safe separation distances between specific types of aircraft not just the wake vortex category

Target Winter 2021/22
London Heathrow

+2 landings/hour

Development starts
May 2019



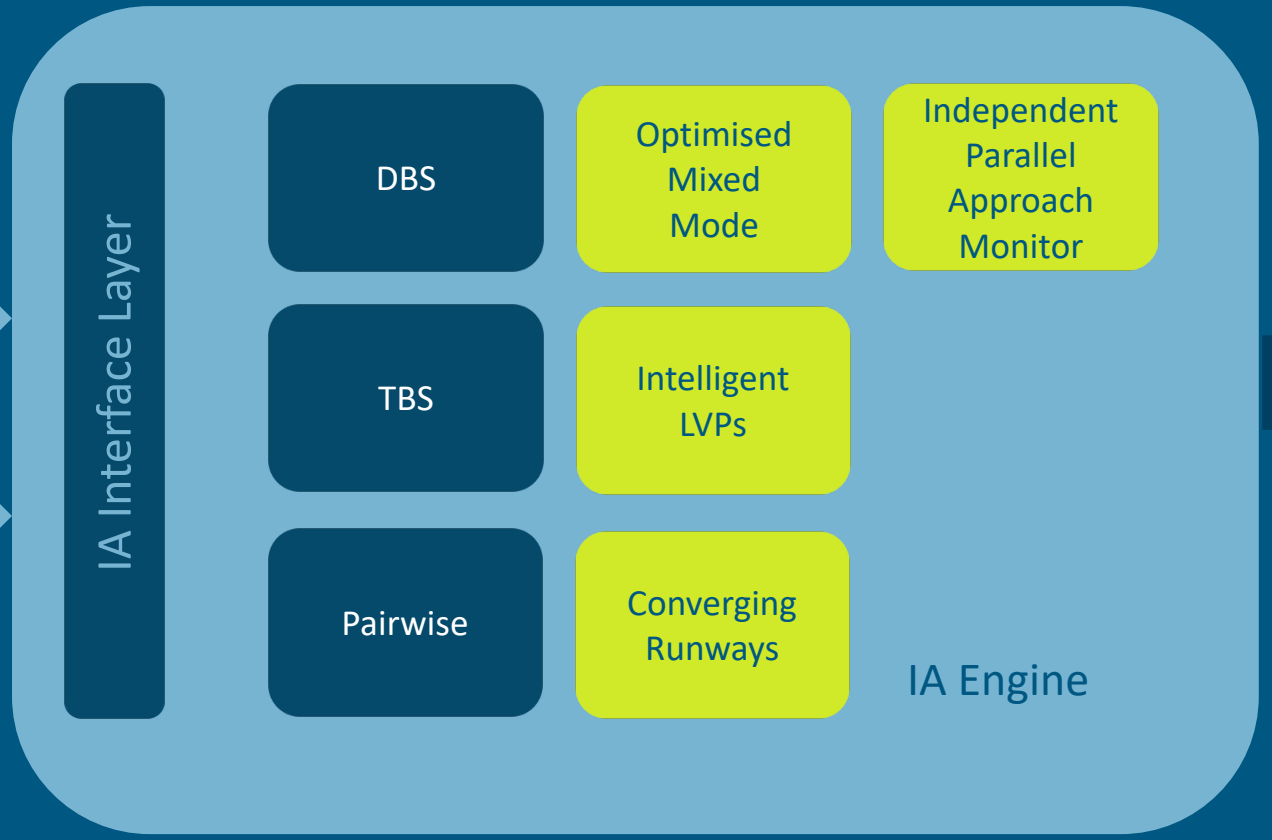
Pairwise Implementation with TBS

Intelligent Approach

Uses Existing Customer ATM System output data

Mode S DAPS From WAM or RADAR

Separations defined by Aircraft type

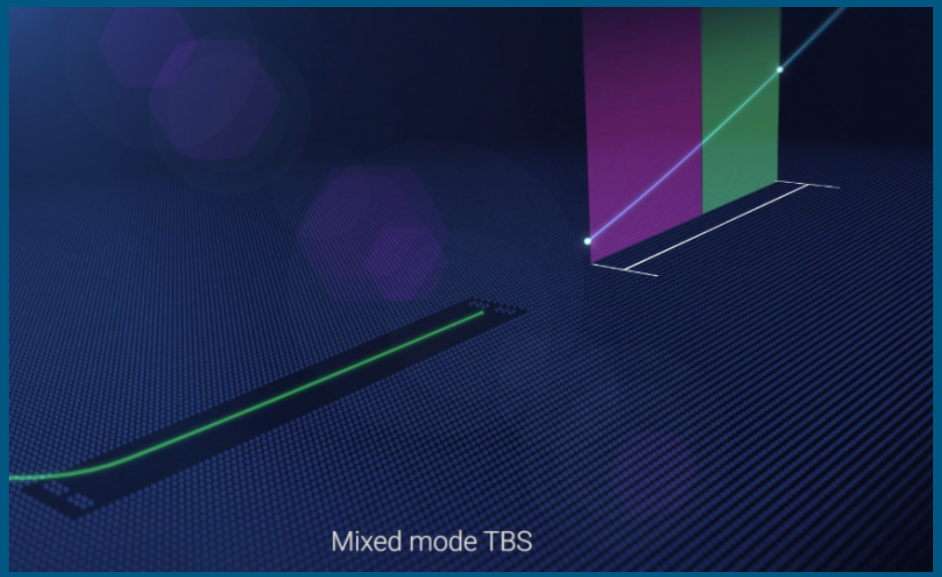


Change to Customer HMI to Display Pairwise indications

Controller HMI

ASTERIX Like Output

Optimising Mixed Mode Runways



Target 2022 Gatwick

New capability being developed for Mixed Mode runway based on SESAR simulations:

- Intelligent Approach is fed the gapping policy from AMAN-DMAN
- IA is fed the departure sequence from either DMAN or Tower Strips System

Gatwick simulation experience suggests this could increase runway capacity by 2-3 movements

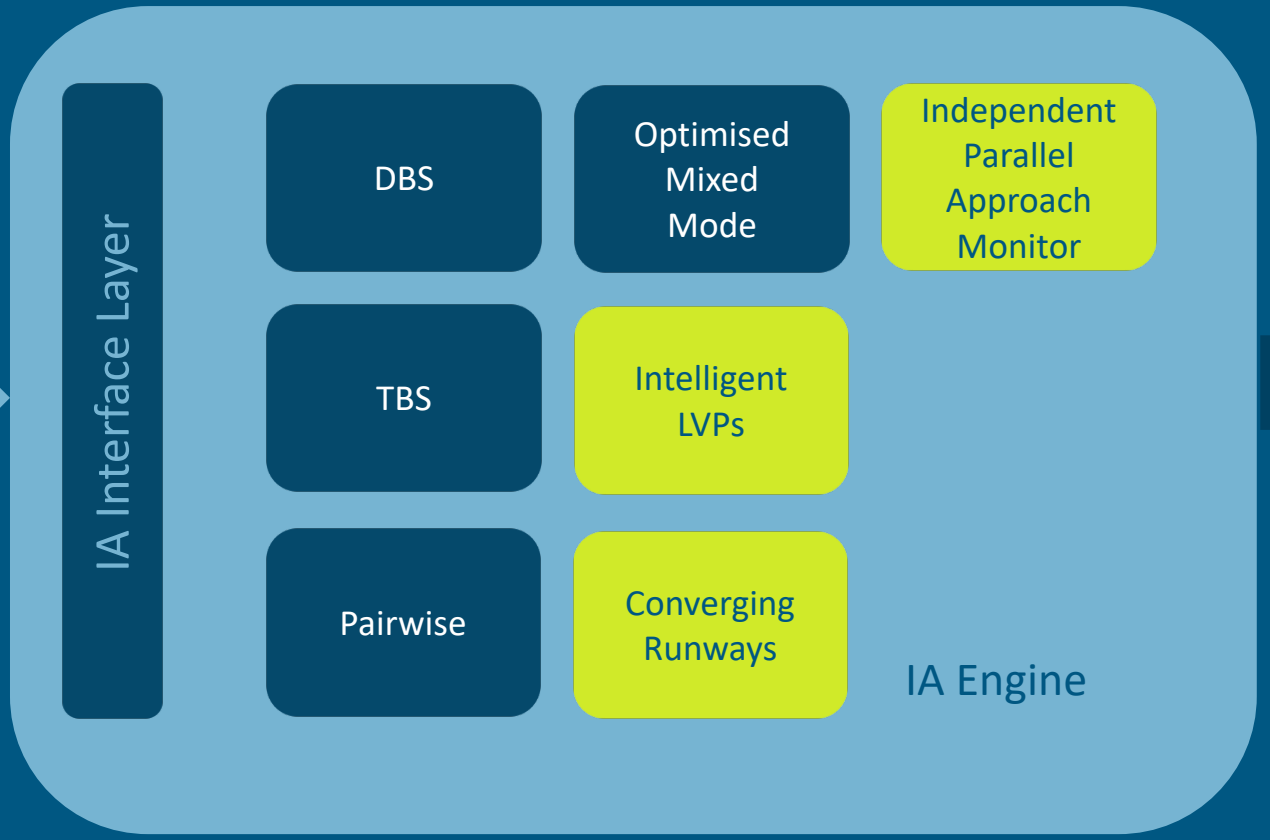
Development starts in May 2019

Optimised Mixed Mode

Intelligent Approach

Tower System provides departure sequence

Departure Sequence From EFS or DMAN



Change to Customer HMI to Display OMM indications

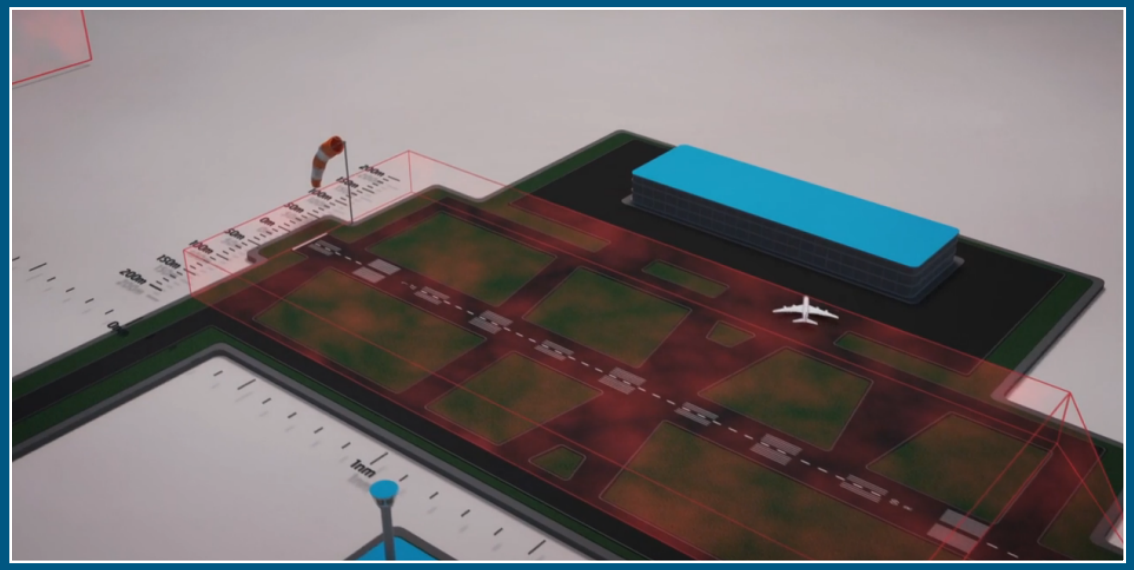
Controller HMI

ASTERIX Like Output

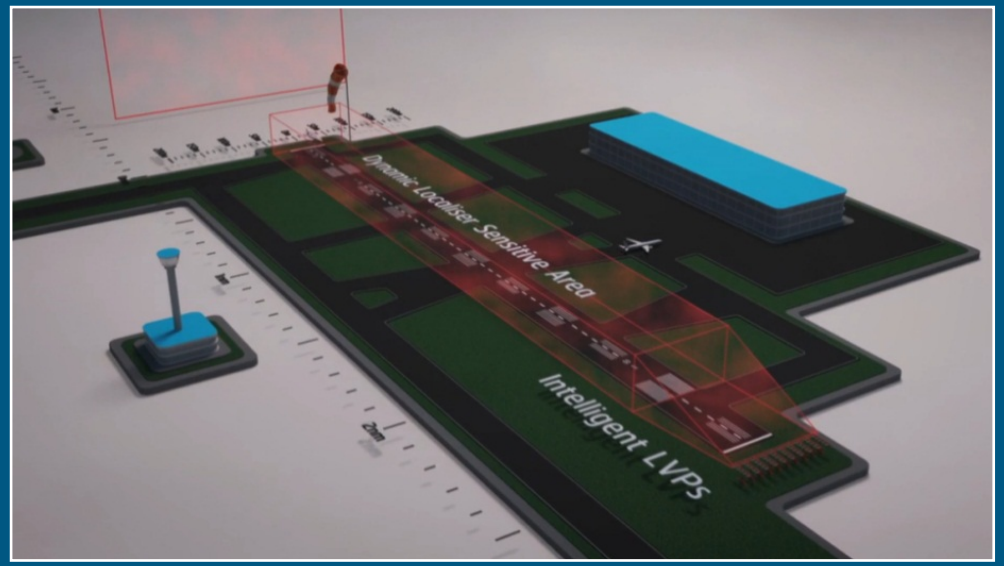
Intelligent LVPs

Intelligent Approach

- Reducing fog delays by 50%
- Automated indicators for LVP spacing based on “Dynamic Localiser Sensitive Area” & NATS safety case using Landing Clearance Trigger Line



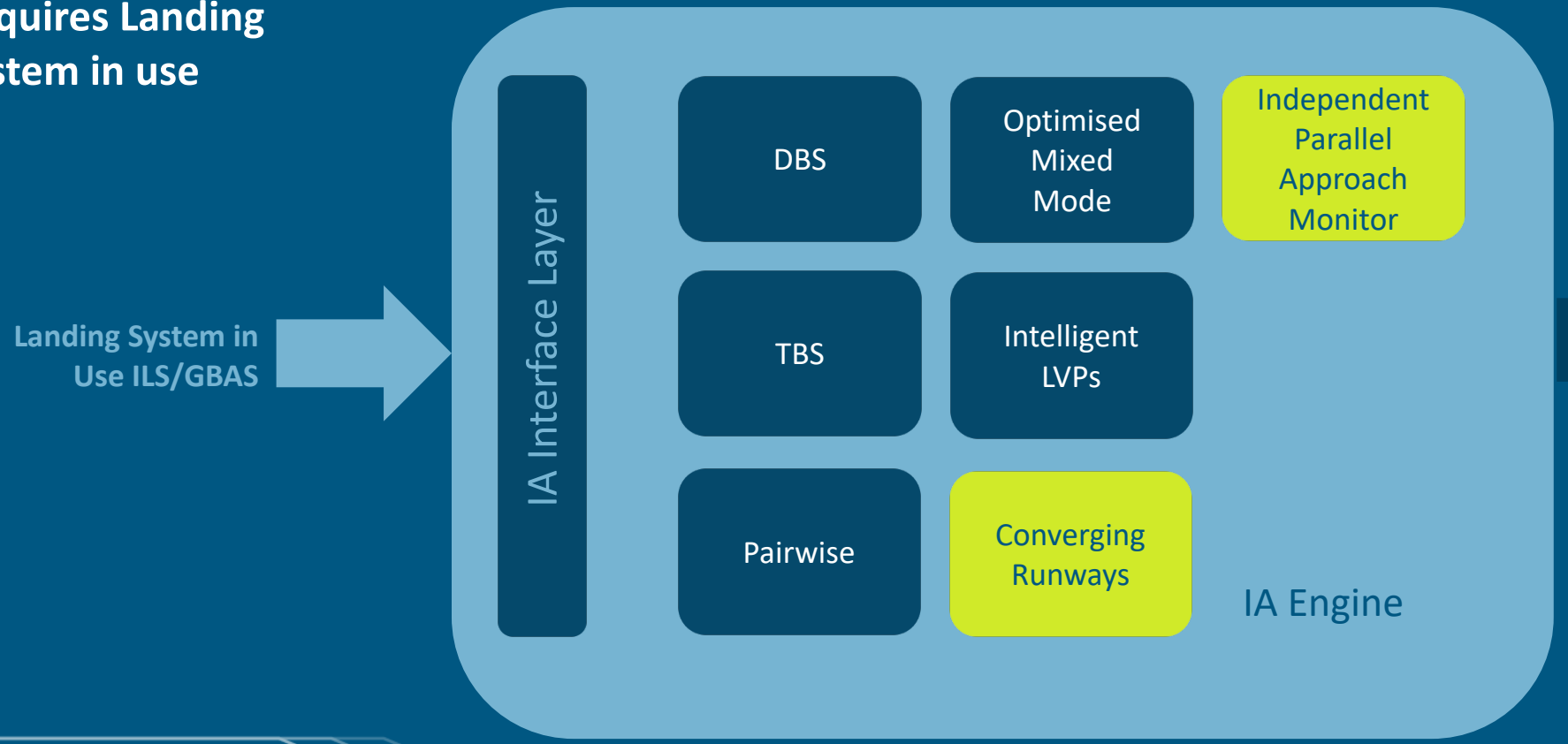
- Spacing on final dictated by aircraft type in front, ILS & airport characteristics & landing system in use + Rules built into the IA tool - simple for approach controller



Intelligent LVPs

Intelligent Approach

Requires Landing System in use

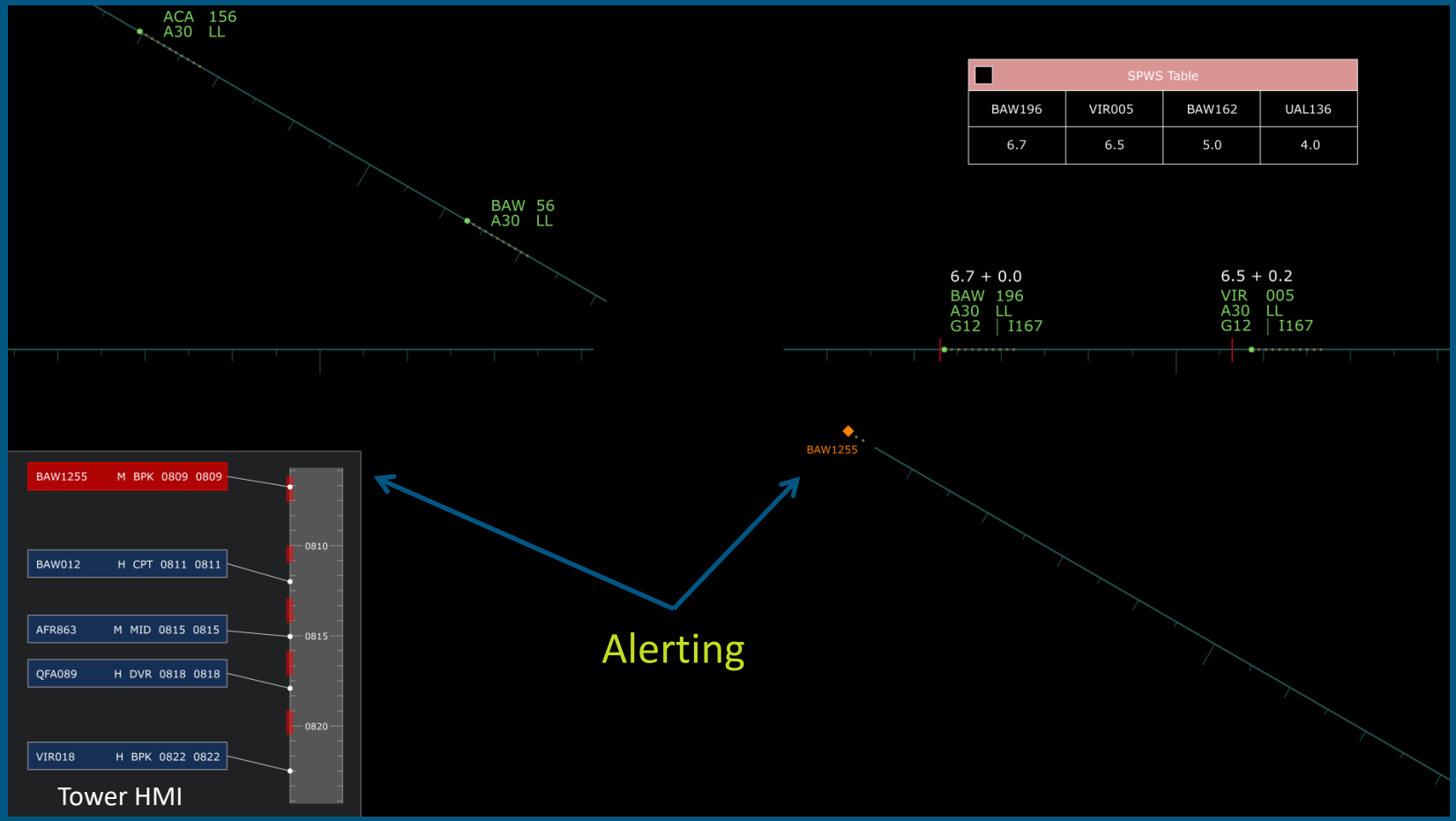


Adaptation of IA HMI

Controller HMI

ASTERIX Like Output

Converging Runways Concept



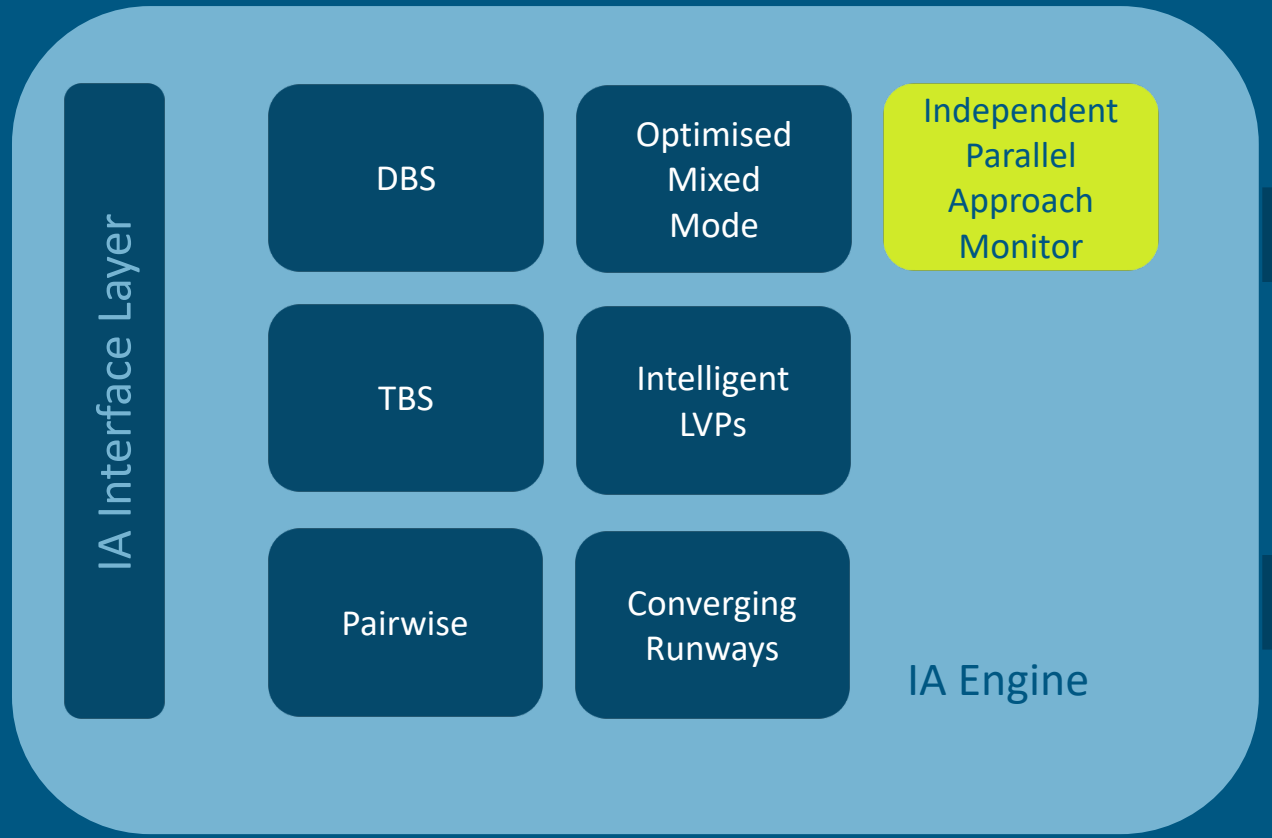
Separation takes into account Configuration of runways and approach + missed approach, winds, runway occupancy & wake

Converging Runways

Intelligent Approach

Runway RADAR

Dependent Runways is existing function in both DBS/TBS mode, so no change



Tower/Approach alerting

Tower HMI

Approach HMI

ASTERIX Like Output

Independent Parallel Approach

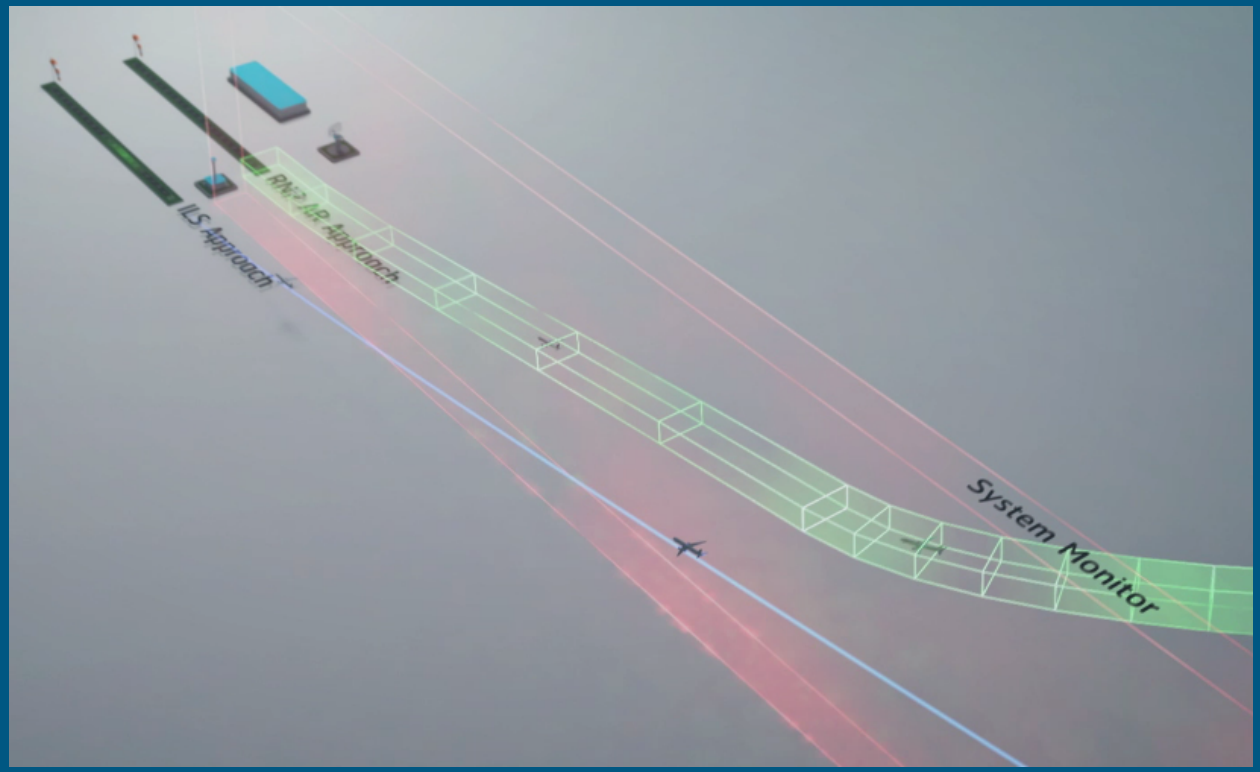
Intelligent Approach

Independent operations to closely spaced parallel runways

System Monitor to replace SOIR monitor controllers

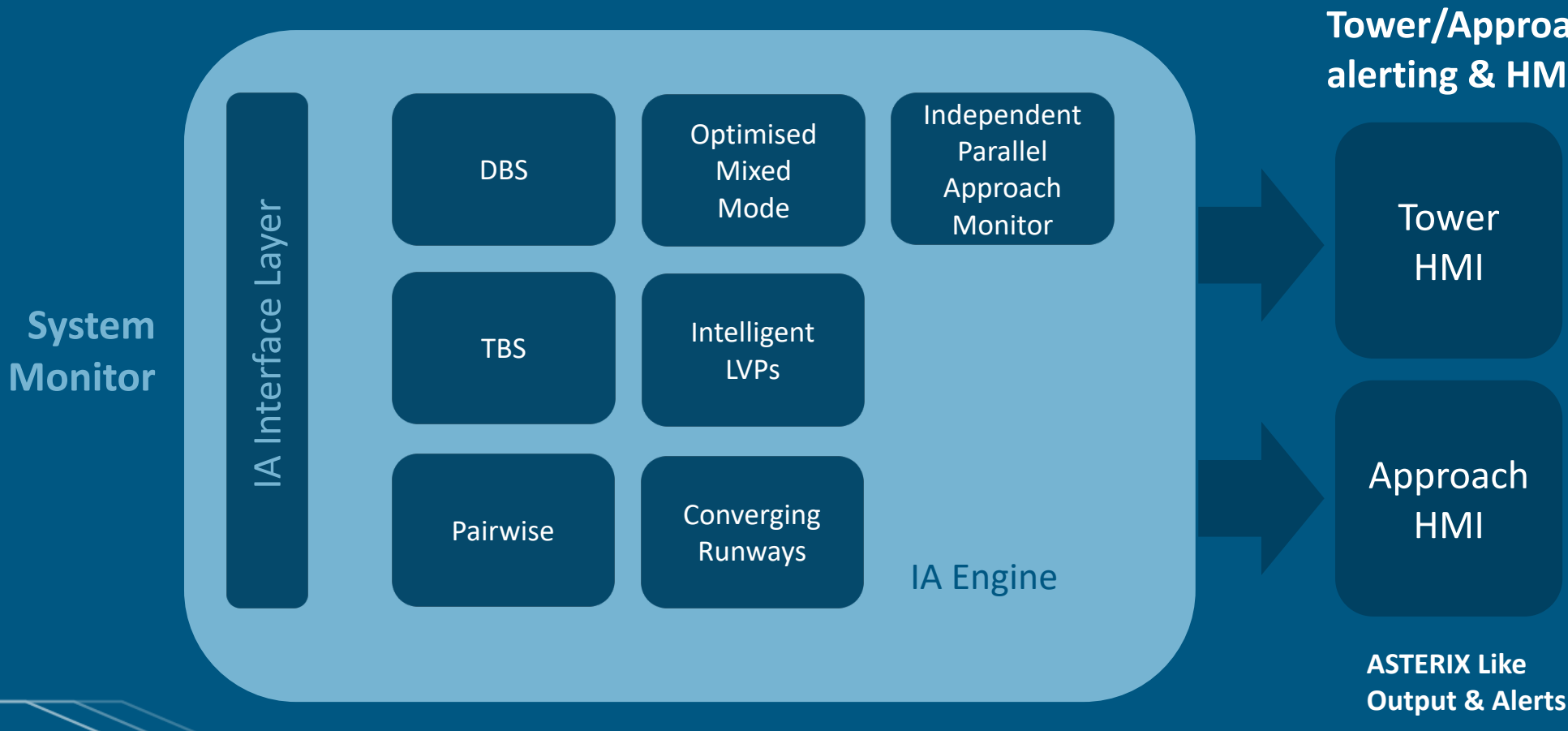
In Project Definition Phase & has been fully simulated & safety concept supported by regulator

Target 2022 (subject to airspace consultation)



Independent Parallel Approach

Intelligent Approach




Intelligent
Approach
Time & Distance Based Separation
Experience with World first implementation at Heathrow Airport
NATS
LSG
Sky Chefs
info@intelligentapproach.aero

Summary experience at Heathrow (TBS)

Intelligent Approach

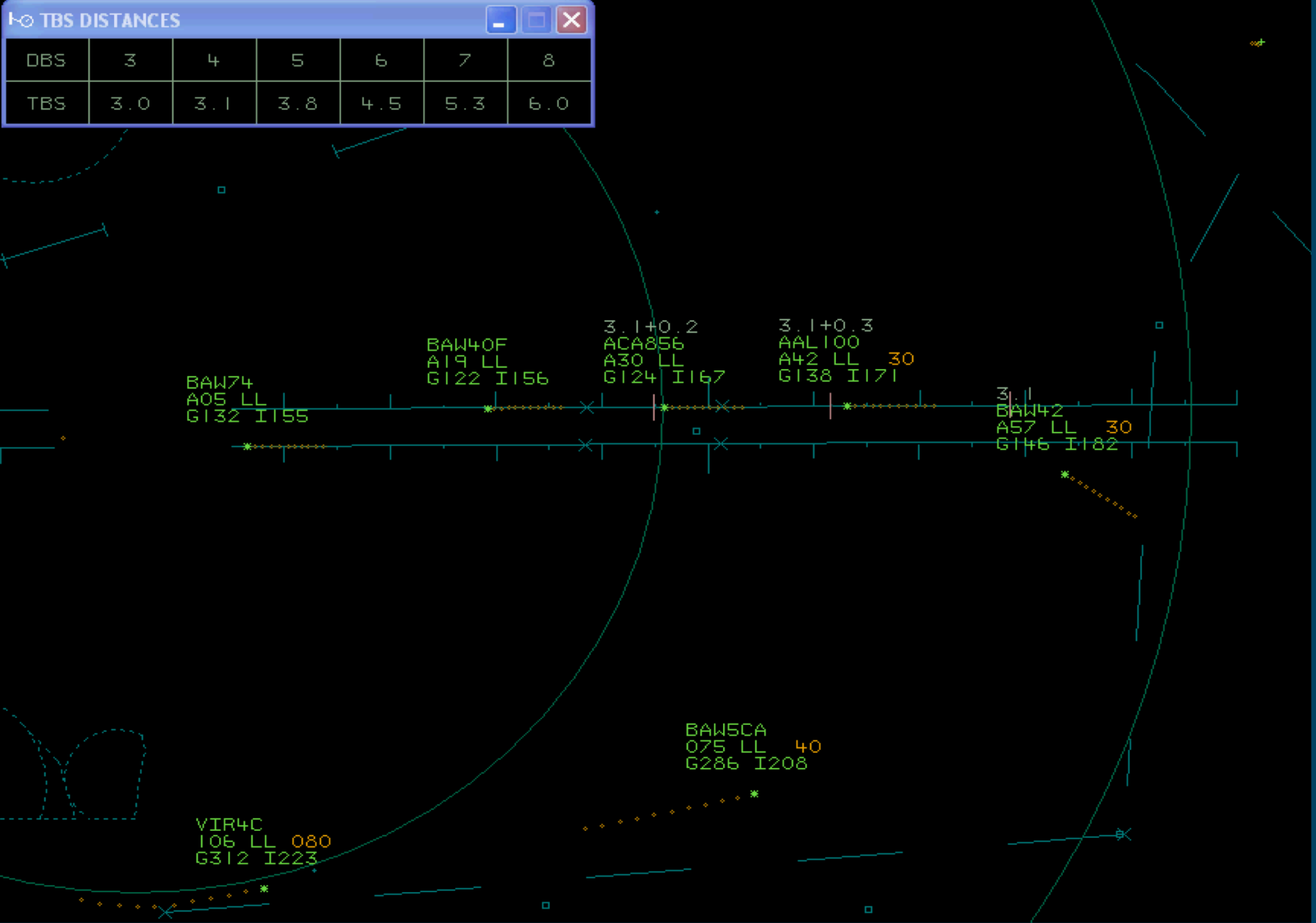
TBS went live 24 March 2015 and has been in operation at all times in all wind conditions since then

eTBS (RECAT+ORD) live 16 March 2018

- >62% reduction in Arrival (ATFM) delays due headwinds & more stability in landing & flow rates
- Over 230,000 minutes per annum reduction in Heathrow average airborne holding
- Reduction in Wake Turbulence Encounter Reports & Go Around rate
- Average landing rate increased by 2.2-4.2 landings per hour
- Arrival spacing savings equivalent to over 30 minutes extra landings per day (TBS +eTBS)
- No Tactical flight cancellations due headwinds
- **Overall savings inc. holding & delay > €30m p.a.***

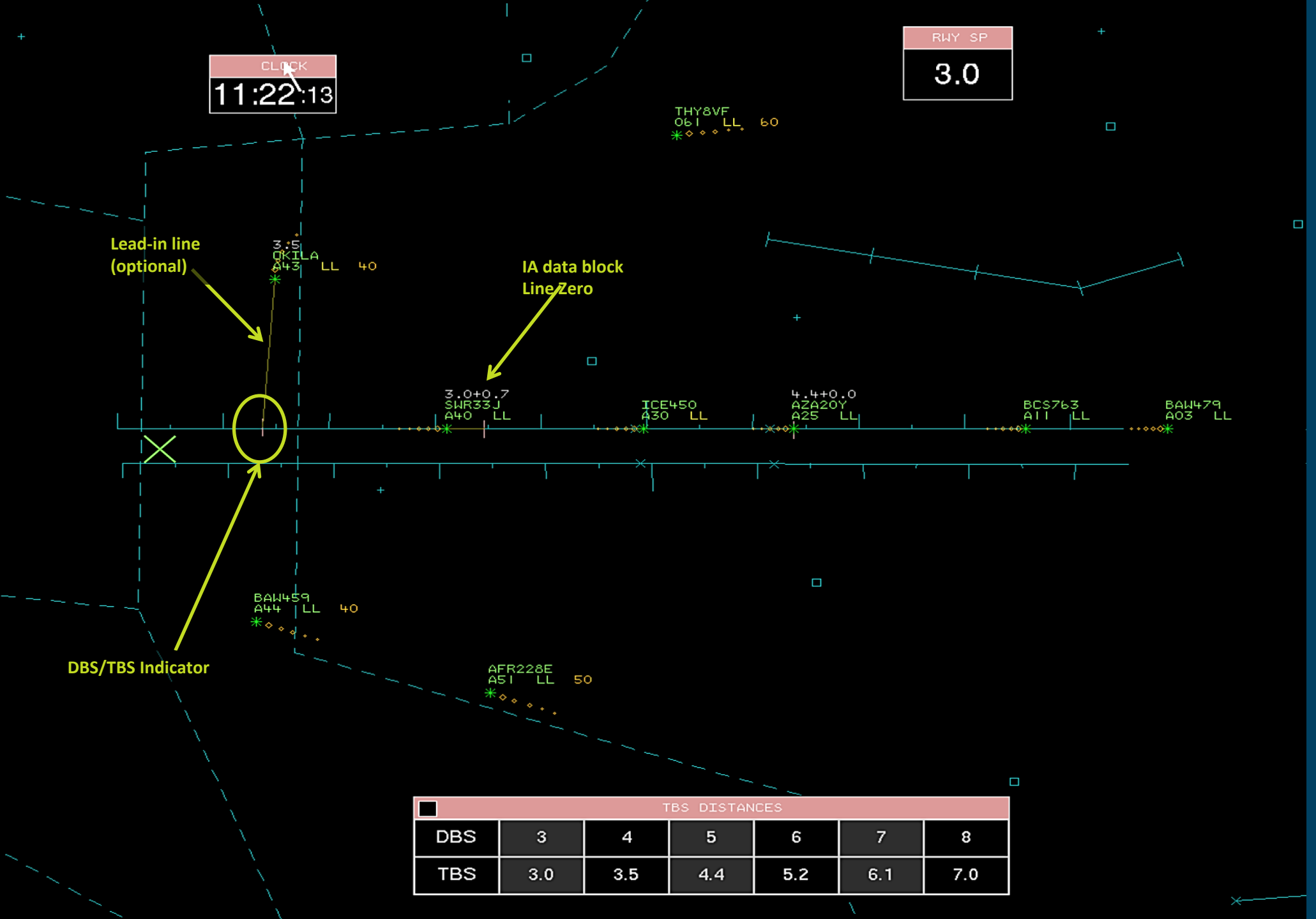
*based on fuel price of €469/mT & €81/min delay cost including primary arrival delay & estimate of rotational delay

Happy ATC, happy airport & happy airlines…



29 March 2015 RADAR Replay

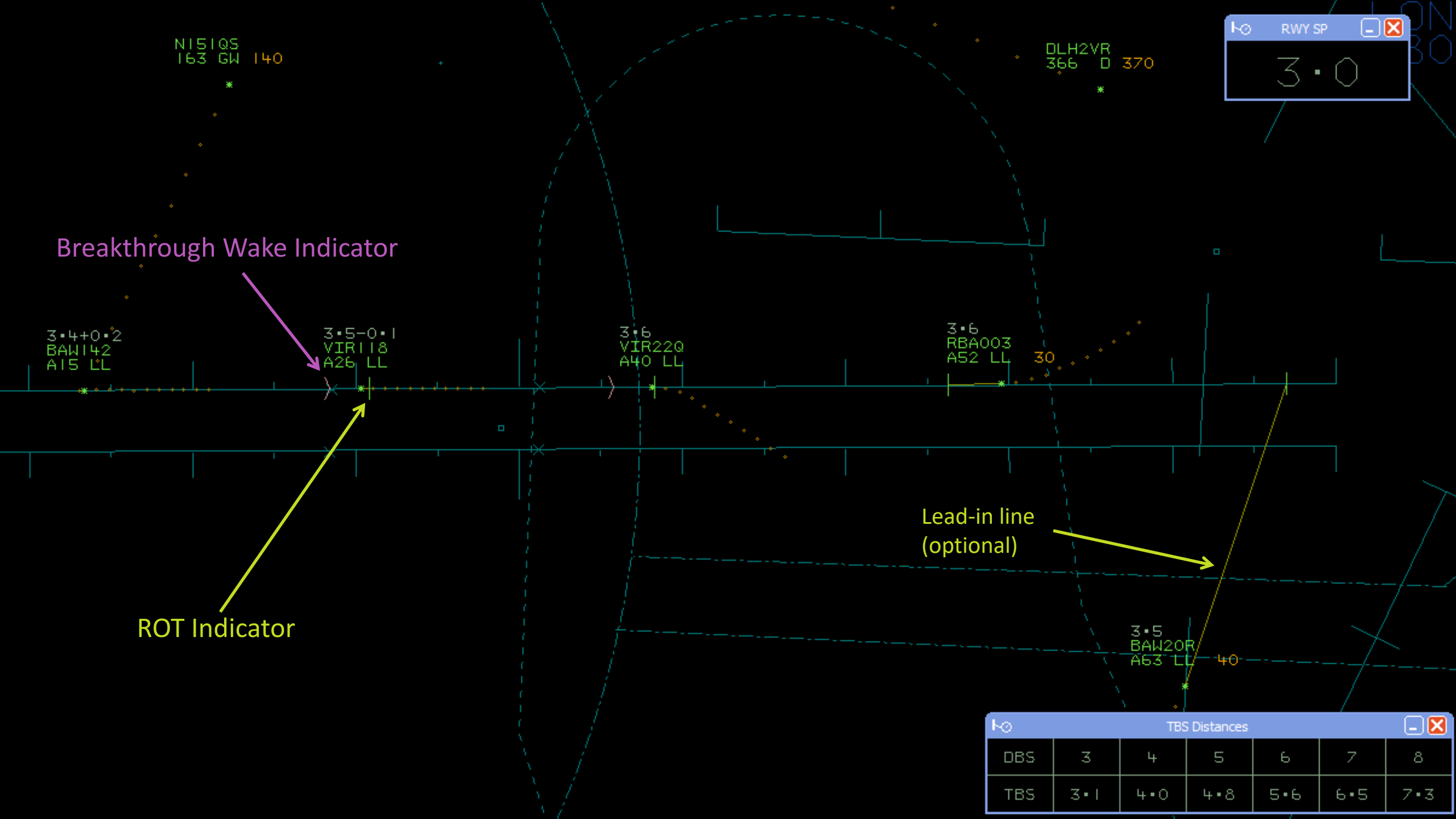
Live operation replay 29th March 2015, headwind at 3000ft 55kts.



TBS DISTANCES						
DBS	3	4	5	6	7	8
TBS	3.0	3.5	4.4	5.2	6.1	7.0

Spacing Indicators

- Linked to preceding aircraft
- Calculated to 0.1nm
- Baselined to 5-7 kts headwind
- ROT indicators shown in different colour (green)
- Tool follows controller actions to finalise sequence
- No change to speeds/vectoring technique required

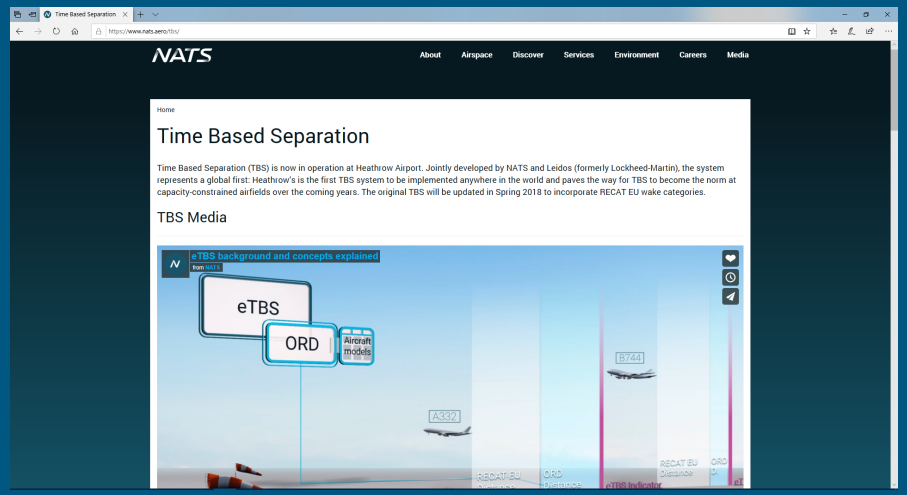

N151QS
163 GW 140
DLH2VR
366 D 370
RWY SP
3.0
Breakthrough Wake Indicator
3.4+0.2
BAW142
A15 LL
3.5-0.1
VIR118
A26 LL
3.6
VIR22Q
A40 LL
3.6
RBA003
A52 LL
30
Lead-in line
(optional)
ROT Indicator
3.5
BAW20R
A63 LL
40
TBS Distances
DBS 3 4 5 6 7 8
TBS 3.1 4.0 4.8 5.6 6.5 7.3

Support for Implementation

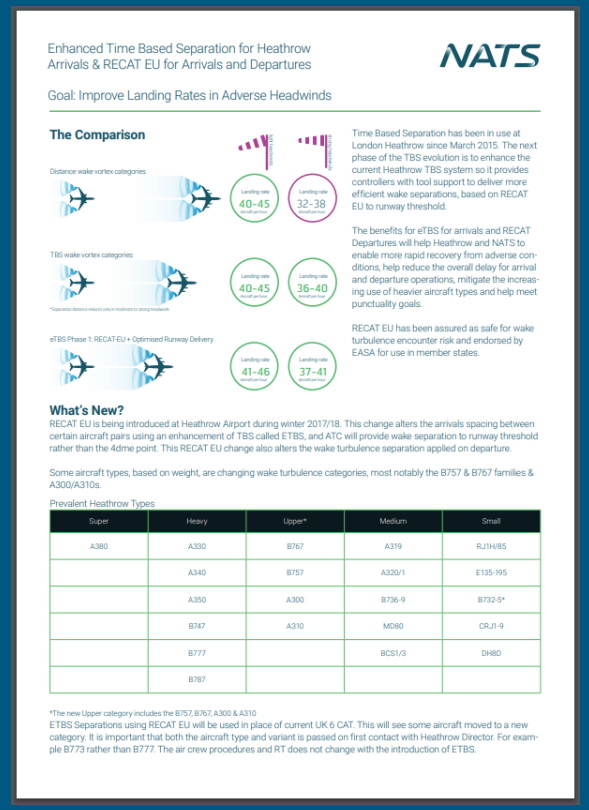
Intelligent Approach

Airline/Crew Briefing Materials

Intelligent Approach



Crew briefing video for Time Based Separation at Heathrow



Enhanced Time Based Separation for Heathrow Arrivals & RECAT EU for Arrivals and Departures

NATS

Goal: Improve Landing Rates in Adverse Headwinds

The Comparison

Distance wake vortex categories

40-45 | 32-38

TBS wake vortex categories

40-45 | 36-40

eTBS Phase 1: RECAT-EU + Optimised Runway Delivery

41-46 | 37-41

Time Based Separation has been in use at London Heathrow since March 2015. The next phase of the TBS evolution is to enhance the current Heathrow TBS system so it provides controllers with tool support to deliver more efficient wake separations, based on RECAT EU to runway threshold.

The benefits for eTBS for arrivals and RECAT Departures will help Heathrow and NATS to enable more rapid recovery from adverse conditions, help reduce the overall delay for arrival and departure operations, mitigate the increasing use of heavier aircraft types and help meet punctuality goals.

RECAT EU has been assured as safe for wake turbulence encounter risk and endorsed by EASA for use in member states.

What's New?

RECAT EU is being introduced at Heathrow Airport during winter 2017/18. This change alters the arrivals spacing between certain aircraft pairs using an enhancement of TBS called ETBS, and ATC will provide wake separation to runway threshold rather than the 4dme point. This RECAT EU change also alters the wake turbulence separation applied on departure.

Some aircraft types, based on weight, are changing wake turbulence categories, most notably the B757 & B767 families & A300/A310s.

Prevalent Heathrow Types

Super	Heavy	Upper*	Medium	Small
A380	A330	B767	A319	RJ1H/85
	A340	B757	A320/1	E135-195
	A350	A300	B736-9	B732-5*
	B747	A310	MD80	CRJ1-9
	B777		BCS1/3	DH8D
	B787			

*The new Upper category includes the B757, B767, A300 & A310

ETBS Separations using RECAT EU will be used in place of current UK 6 CAT. This will see some aircraft moved to a new category. It is important that both the aircraft type and variant is passed on first contact with Heathrow Director. For example B773 rather than B777. The air crew procedures and RT does not change with the introduction of ETBS.

www.nats.aero/TBS

Features of solution – can be offered as modules

Intelligent Approach

- **NATS/Leidos IA™ solution can be offered as a complete turn-key package or tailored to customer needs including:**
- IA Tools
- Safety Case & support with local regulator
- Training (typically train the trainer) for Engineering & ATC
- Configuration for customer airspace and MOPS
- Support for HMI development from TBS Core Team ATCOs
- Technical integration

- **Is proven and in operation and can be delivered as modules**
- DBS (RECAT)
- TBS
- Tools continue to be developed and will soon also offer Static Pairwise separation & optimised Mixed Mode

Typical Deployment Timescale

Intelligent Approach

- Typically will require 12-18 months to implement from start of programme
- NATS/Leidos adopt an “Agile” approach to delivery
- Dependencies include:
  - Radar data for evaluation, tuning of local airspace model and test
  - ROT data
  - METARs
  - Customer resource to support implementation and tuning of tool to customer airspace and MOPs