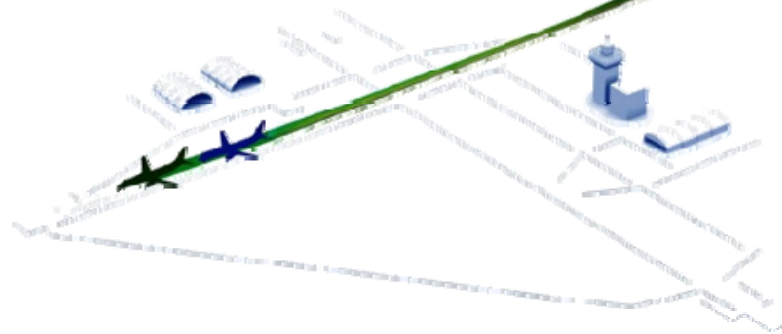


PBN

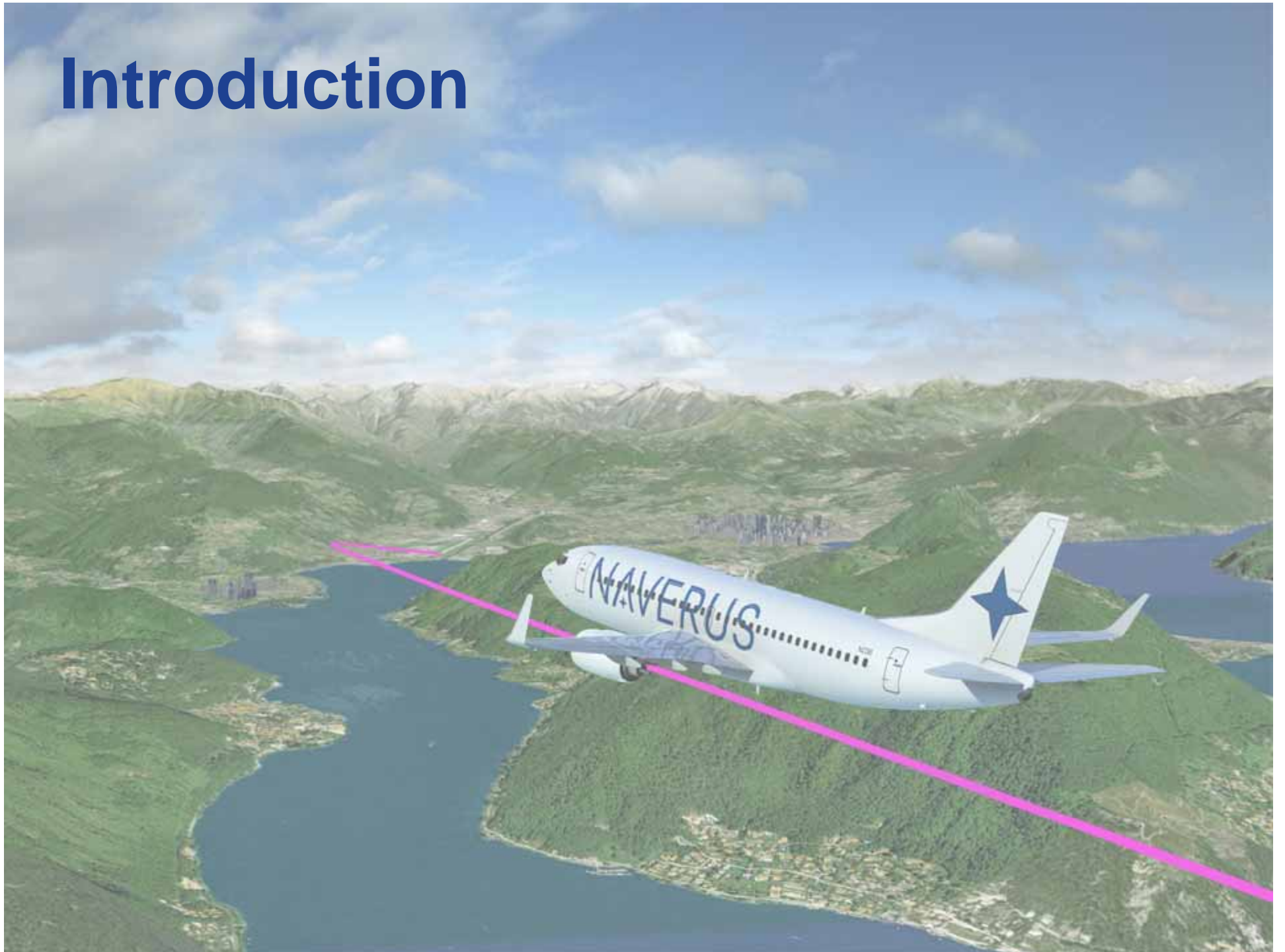
The role of commercial organisations in developing State PBN capability



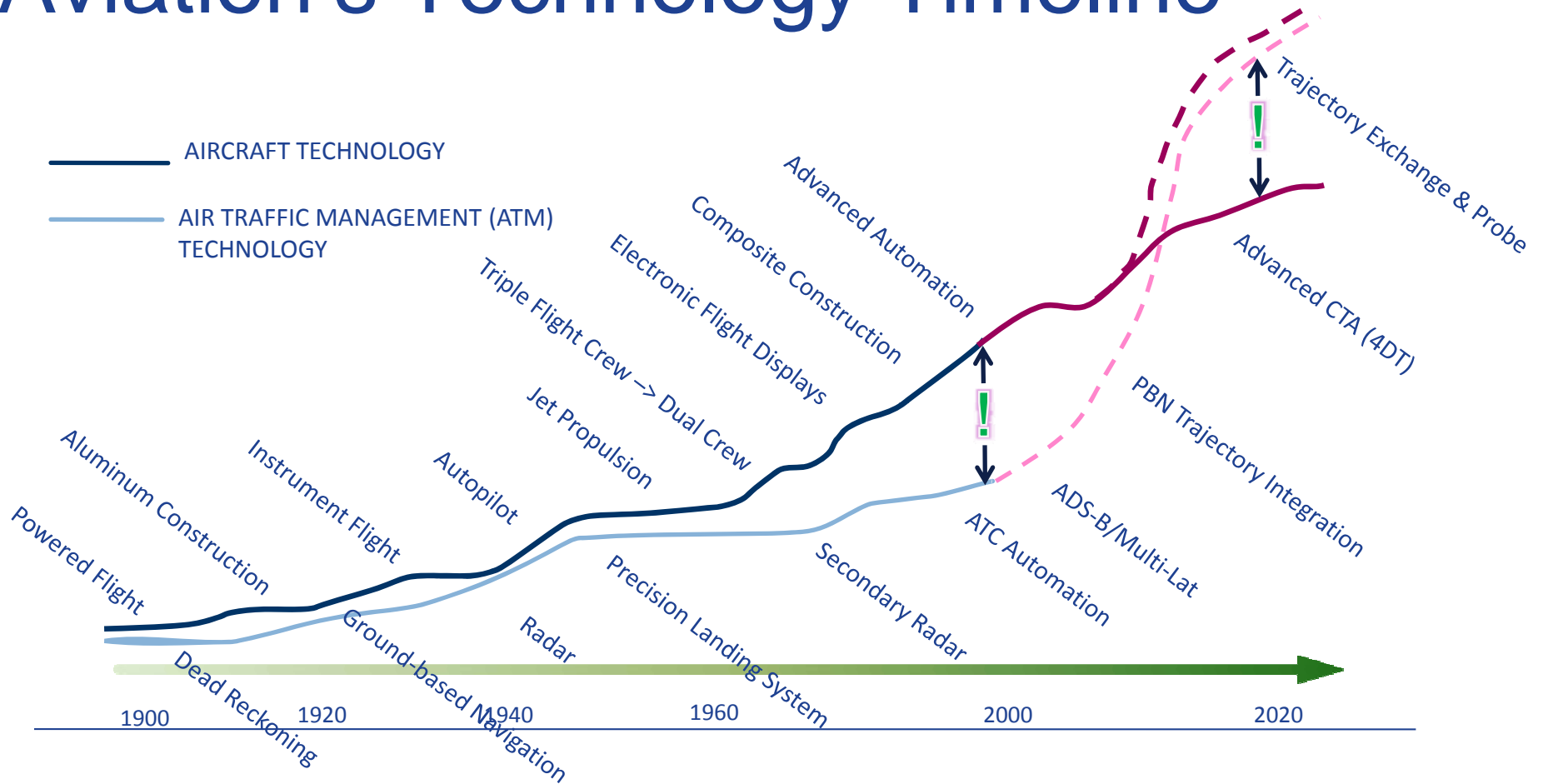
May 2011



Introduction



Aviation's Technology Timeline



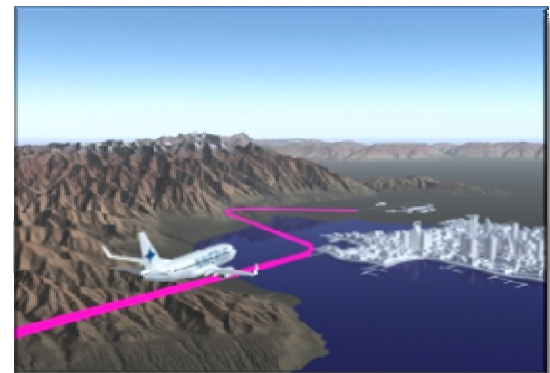
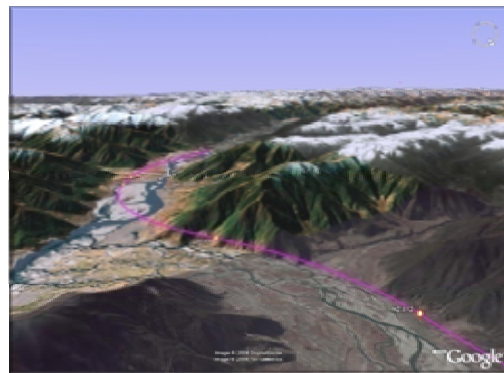
These milestones represent individual technology improvements

ATM technology has not kept pace with aircraft-based technology.....

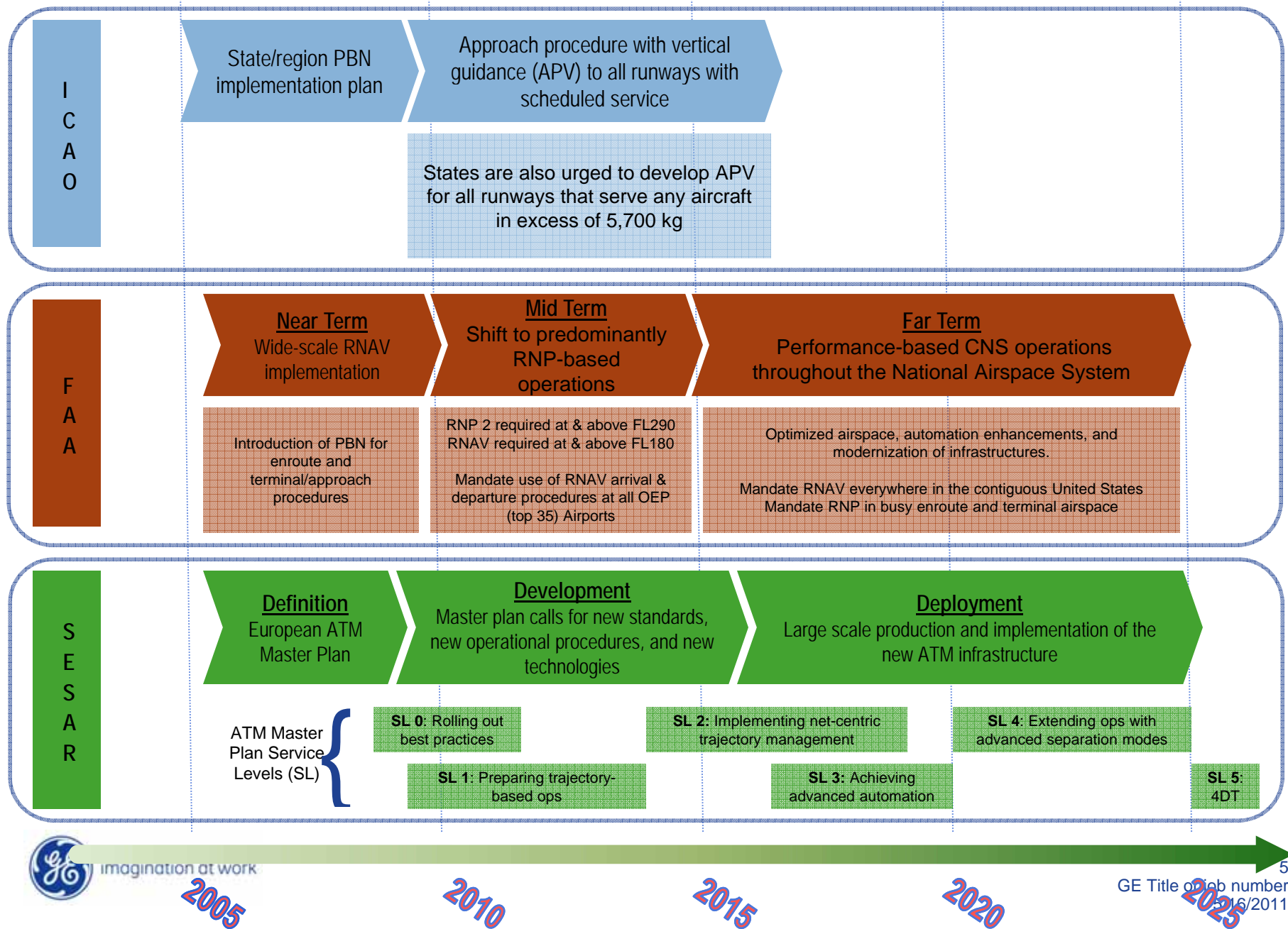
How Do You Close the Gap?

✦ PBN is the Foundation of Future Navigation:

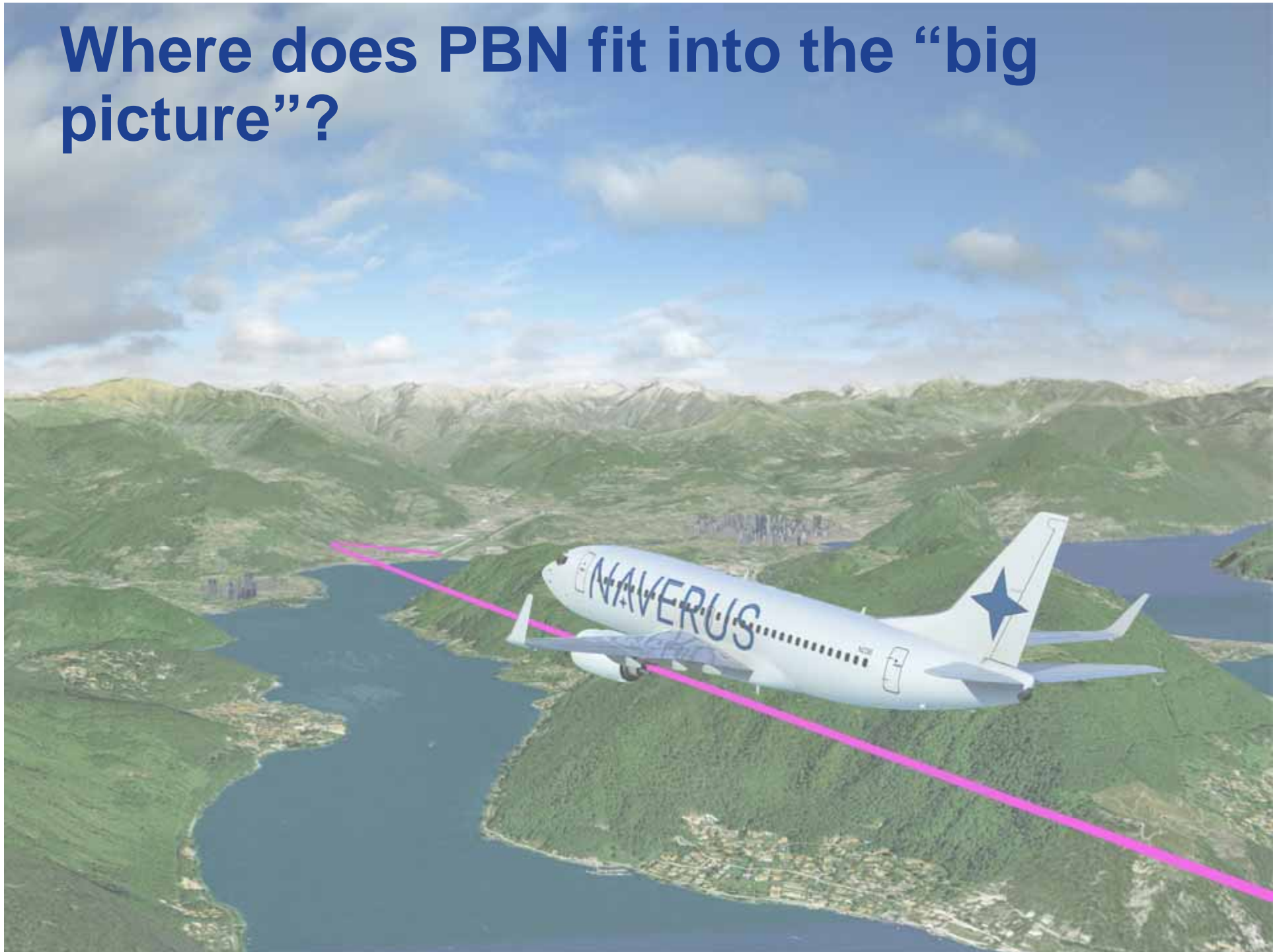
- › Allows the transition from ground-based to aircraft-based navigation
- › Enables aircraft to fly optimal, predetermined flight paths using:
 - GPS
 - Flight Management Systems
 - PBN procedures
- › Transitions from ground-based to aircraft-based



Global & Regional PBN Initiatives



Where does PBN fit into the “big picture”?



Juneau, Alaska, USA



Challenge

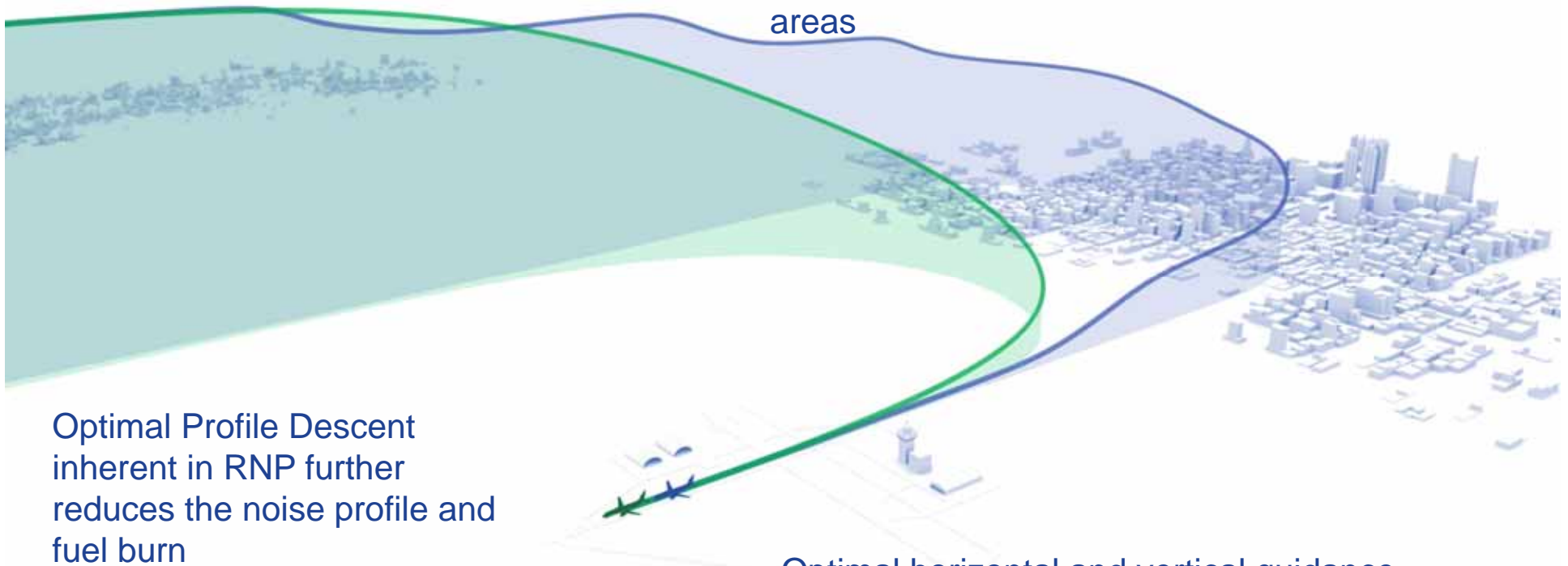
Mountainous terrain surrounding the Juneau airport
Aircraft were forced to use a variety of non-precision procedures with high Decision Altitudes (DAs),
Departures often delayed by days while waiting for sufficient visibility
Dangerous missed approach procedures
RNP to provide significant fuel savings

Solution

RNP arrivals
RNP departures
Precise navigation of the Gastineau Channel
Revenue service RNP procedures began in 1996

The RNP benefit extends beyond terrain challenged airspace

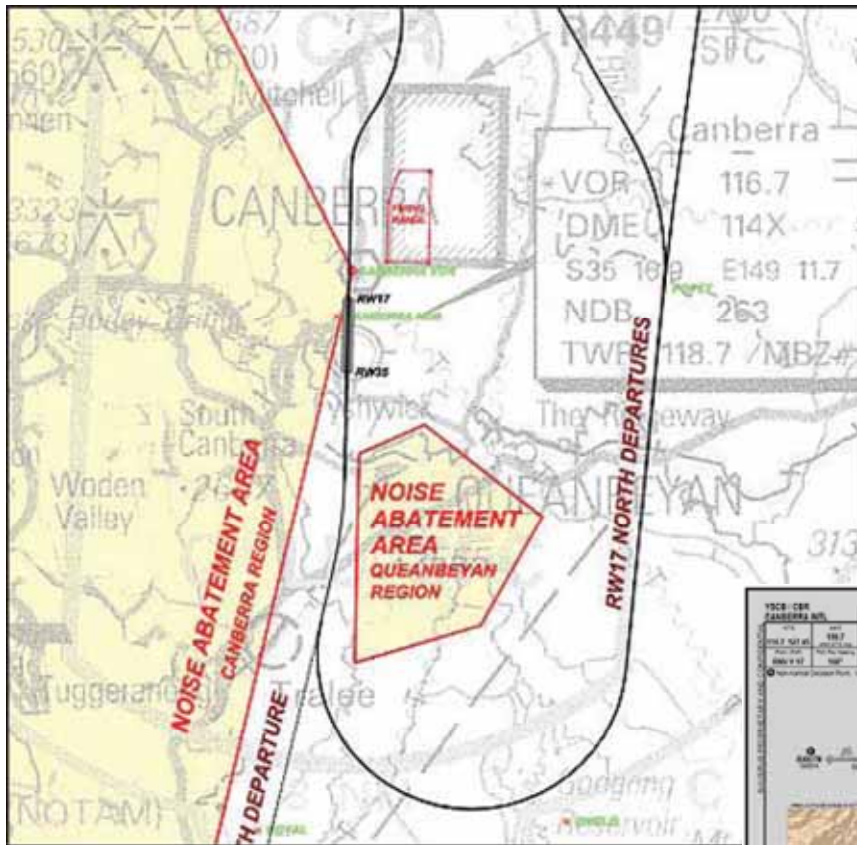
Like terrain avoidance, precise RNP procedures can be engineered to avoid busy airspace and noise sensitive or restricted areas



Optimal Profile Descent inherent in RNP further reduces the noise profile and fuel burn

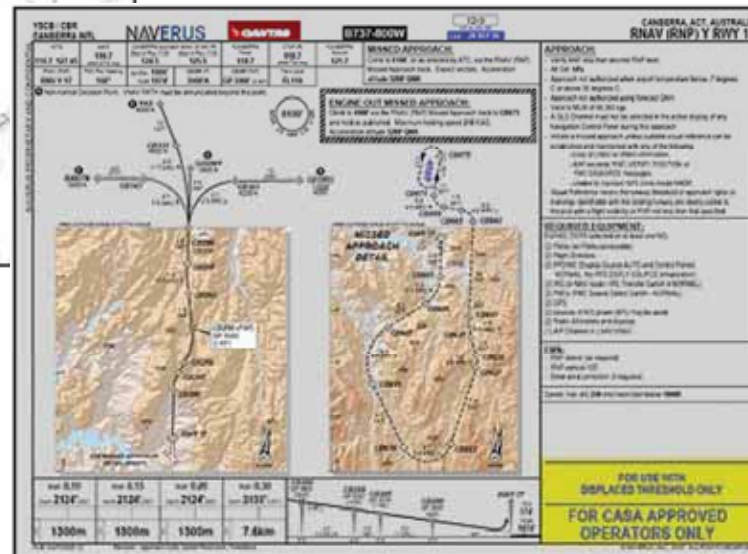
Optimal horizontal and vertical guidance reduces track miles flown and saves flight time

Canberra procedures address large noise abatement areas and airspace restrictions



Naverus and Qantas worked with Canberra ATC to thread RNP procedures through the existing airspace constraints

- Reduced Decision Altitude minima to RW17 to 250' (a 1126' improvement)
- Full lateral and vertical guidance throughout the procedure



Operation & Environmental Savings

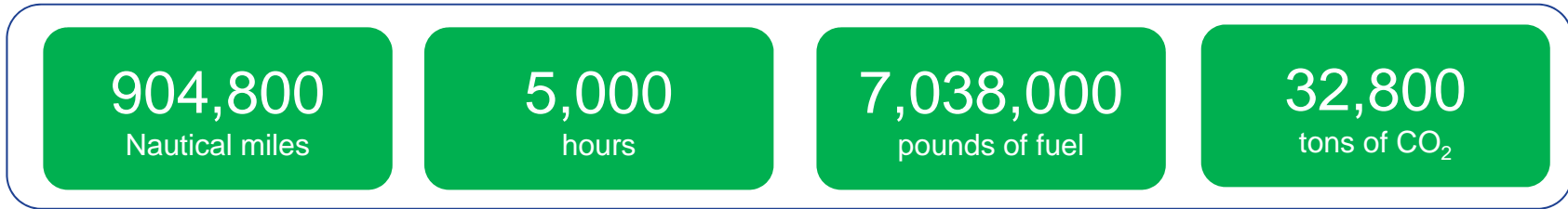
For every nautical mile saved using RNP, a typical 737 operator saves 25 lb of fuel and 80 lb of CO₂

Using Naverus' RNP flight paths, on every flight WestJet saves an average of

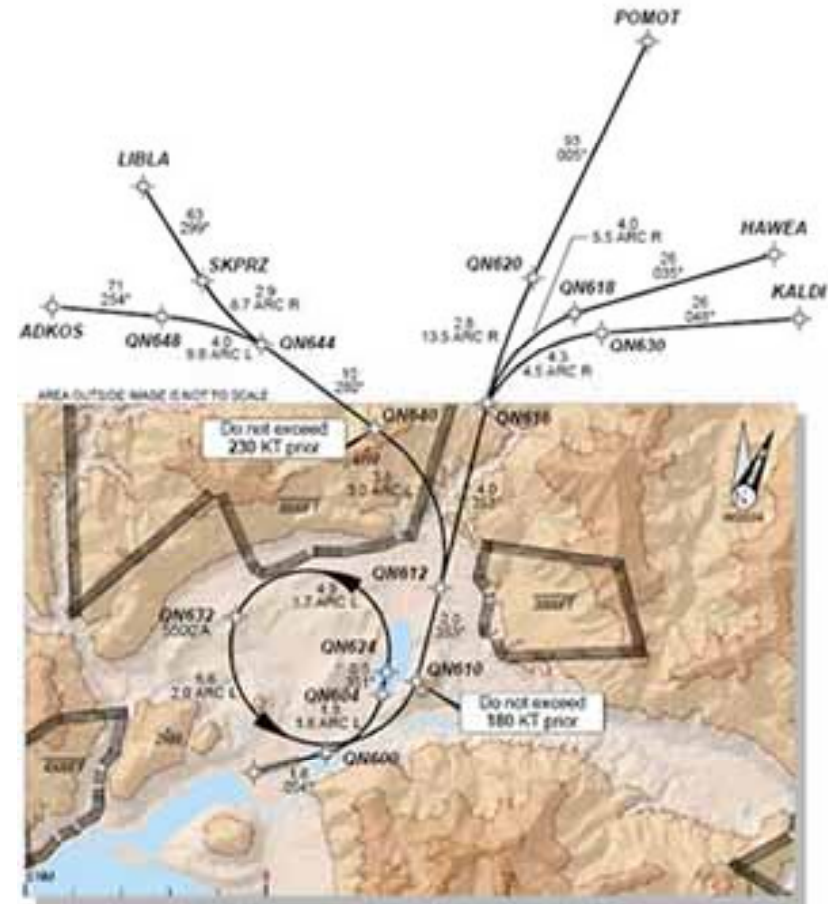


- 10 NM
- 254 lb fuel
- 800 lb CO₂

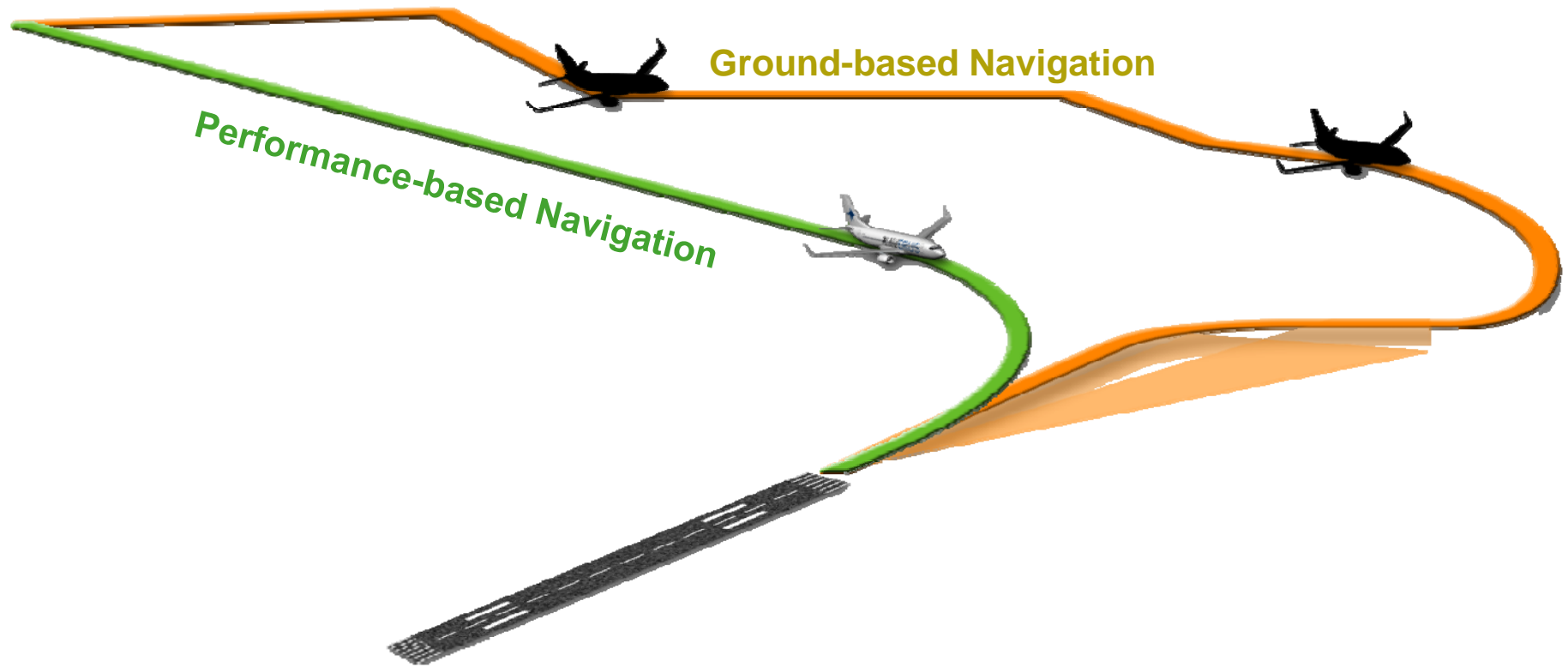
WestJet's annual savings using RNP



New Zealand (Queenstown)

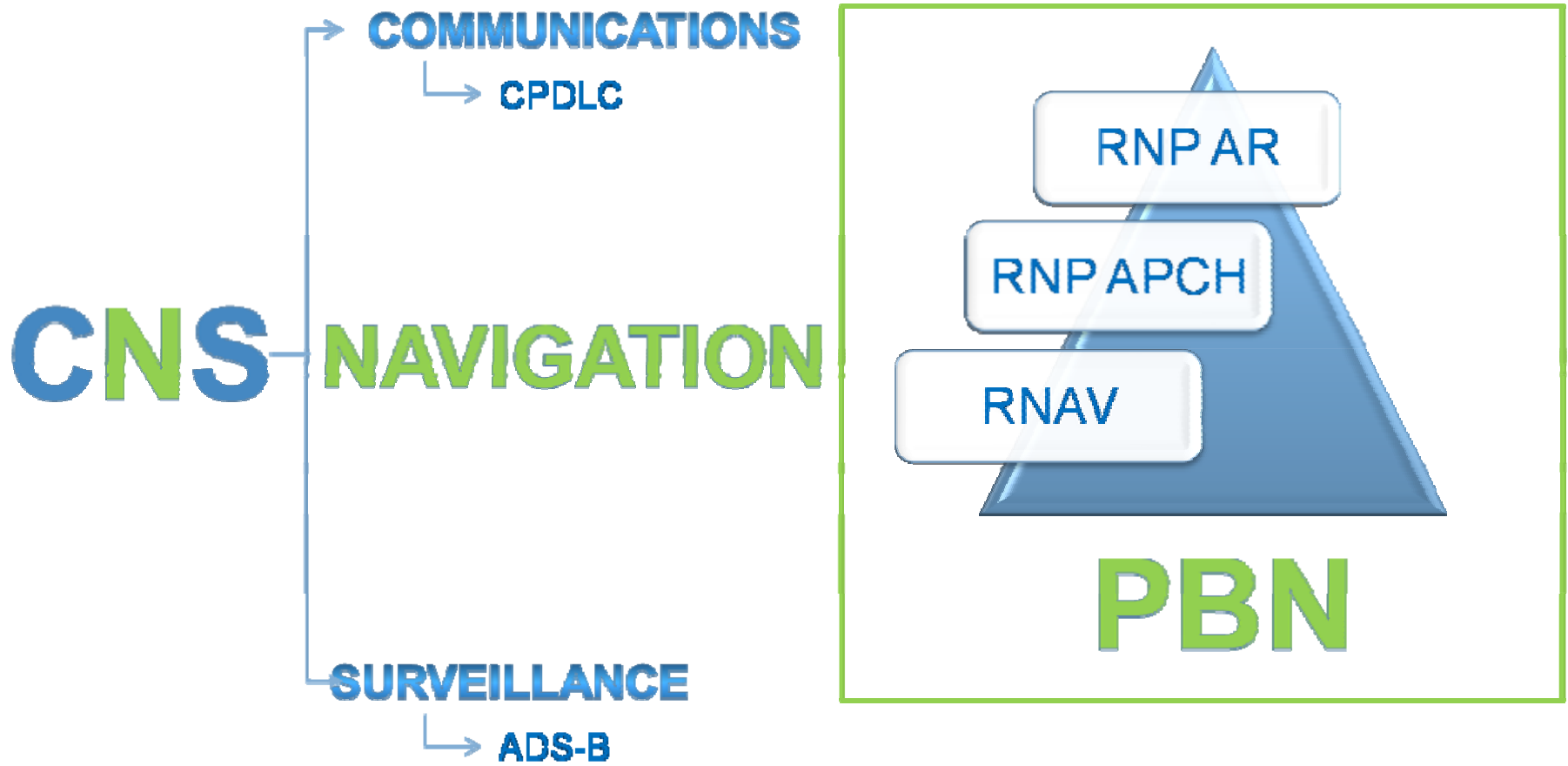


Improving Air Traffic Management (ATM)



PBN helps solve ATM inefficiencies by closing the technology gap.

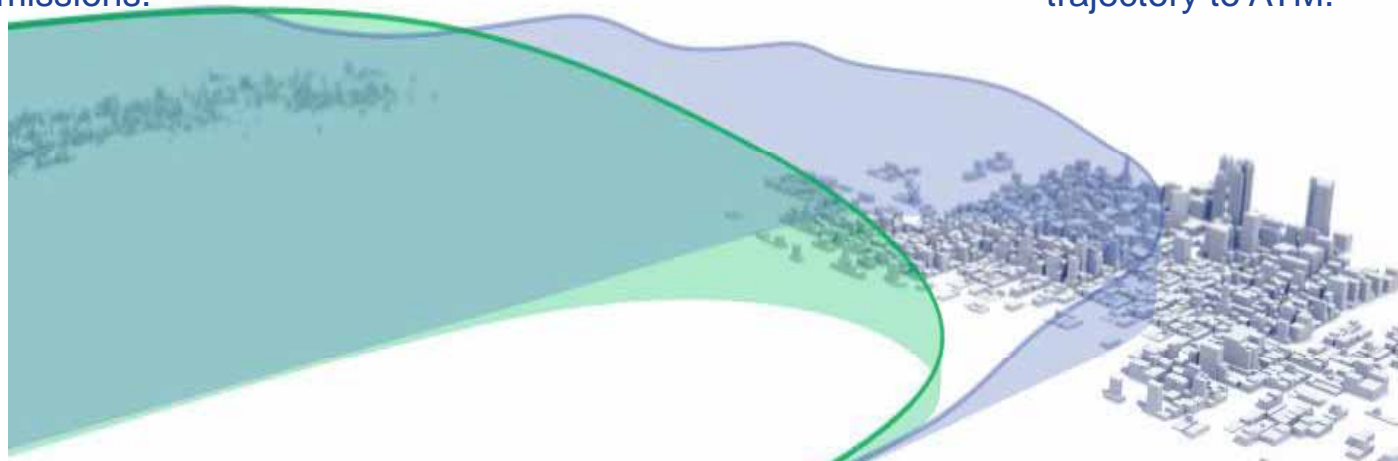
PBN is a Central Component of Airspace Modernization



4D Flight Management Integrated with ATM

Continuous Descent Arrivals

Reduce noise, fuel consumption and emissions.

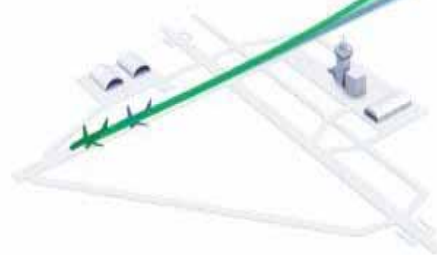


4D Trajectory Reporting

Providing the user-preferred trajectory to ATM.

Precise Arrival Time Control

5 second time control to any point in the flight (including the runway threshold itself).



Required Navigation Performance

Precise lateral and vertical path definition and control reducing distance flown and providing increased predictability to ATM.

The benefits of PBN are being realized today around the world

SAFETY



- Safe access into terrain and weather challenged airports
- Automatic missed approach procedures, even beyond decision altitude
- Pre-loaded engine-out procedures,

ECONOMICS



- Shorter flight tracks and Optimum Profile Descent (OPD) saves fuel
- Lower variance means more predictable operations

ACCESS



- Access markets not possible with conventional navigation
- Lower landing minima reduces weather cancellations and diversions

ENVIRONMENT



- Reduces emissions through reduced fuel consumed
- Less noise due to lower thrust levels

CAPACITY



- Increased payloads
- Reduced aircraft separation

Where to begin?



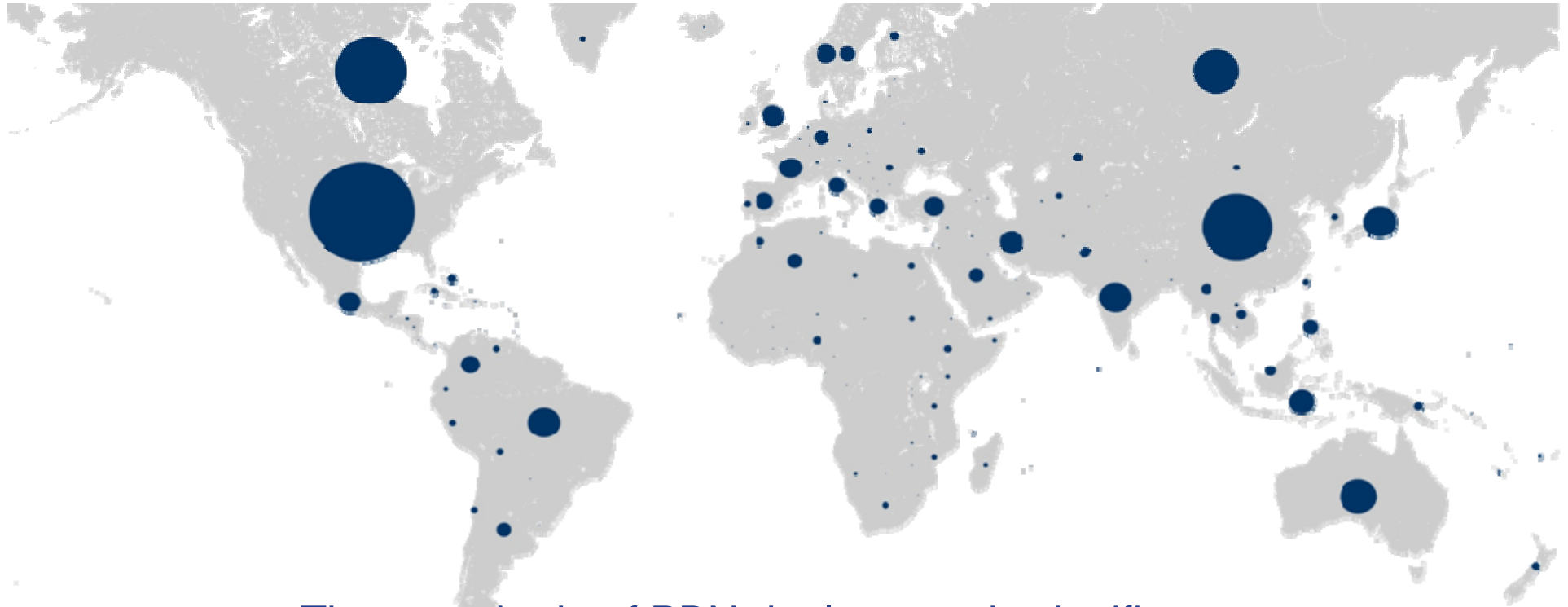
ICAO's PBN Global Goals

ICAO Resolution A36-23:

- State-specific PBN implementation plan by 2009
- Approach procedures with vertical guidance (APV) to all instrument runway ends:
 - ✓ 30% by 2010
 - ✓ 70% by 2014
 - ✓ 100% by 2016

Industry declaration in support of the resolution signed by 10 major organizations representing the air transportation community's stakeholders in 2009

ICAO A36-23 → A37-11



The magnitude of PBN deployment is significant

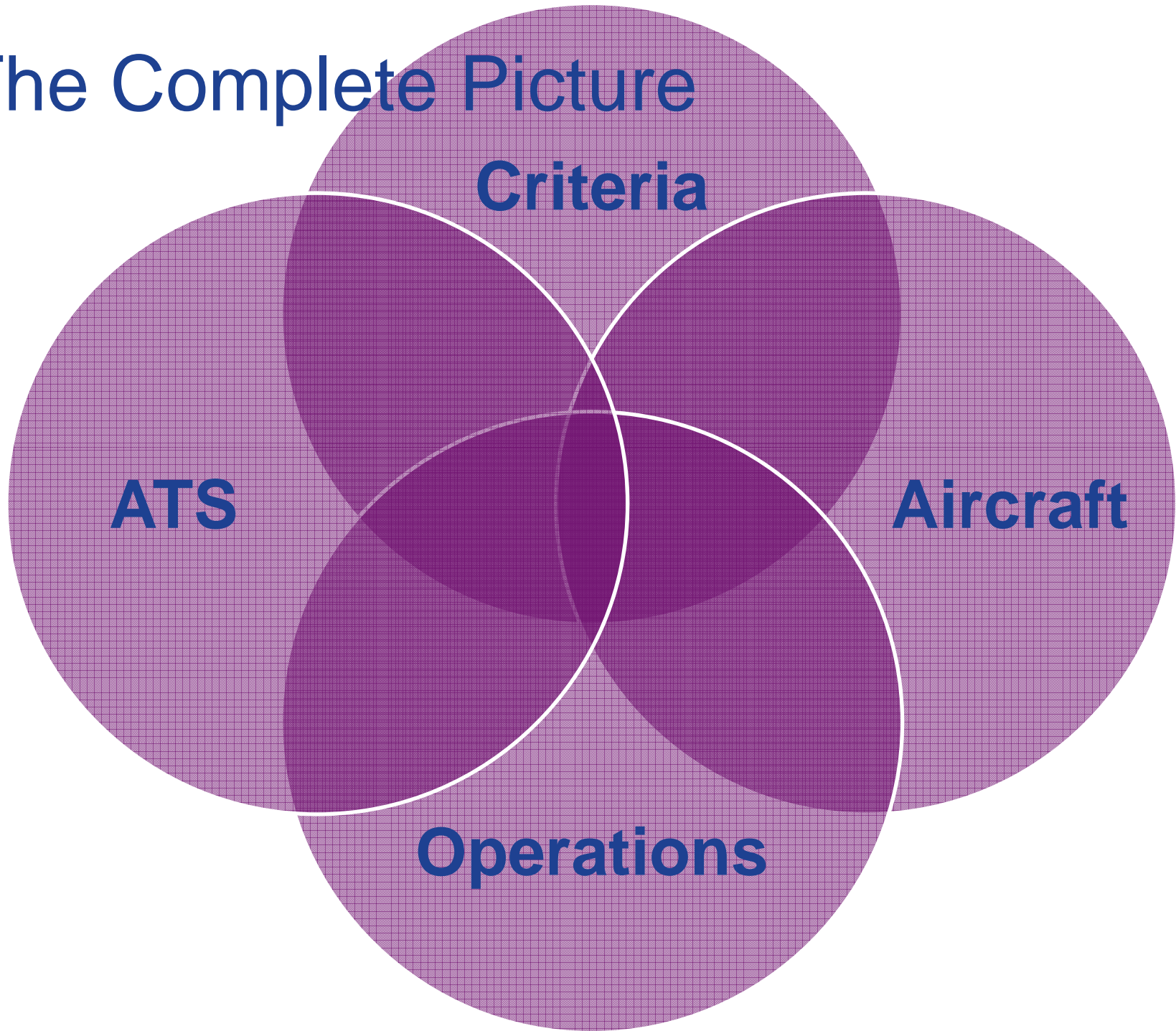
The International Civil Aviation Organization (ICAO) has called for approach procedures with vertical guidance to all instrument runway ends by 2016

Nearly 3,000 airports in over 200 countries need RNP

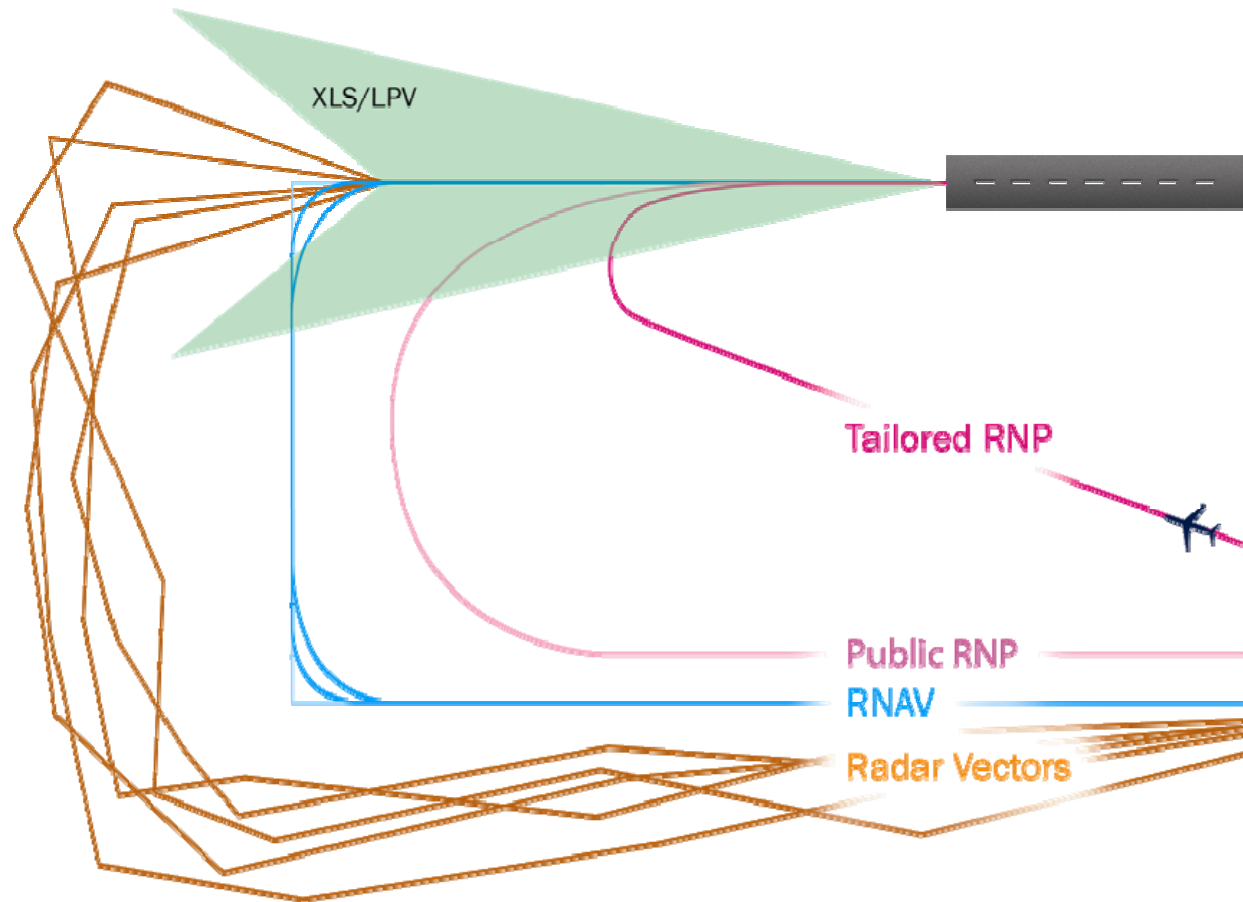
Approximately 700 airlines and aircraft operators will need to qualify for RNP operations

The Complete Picture

Criteria

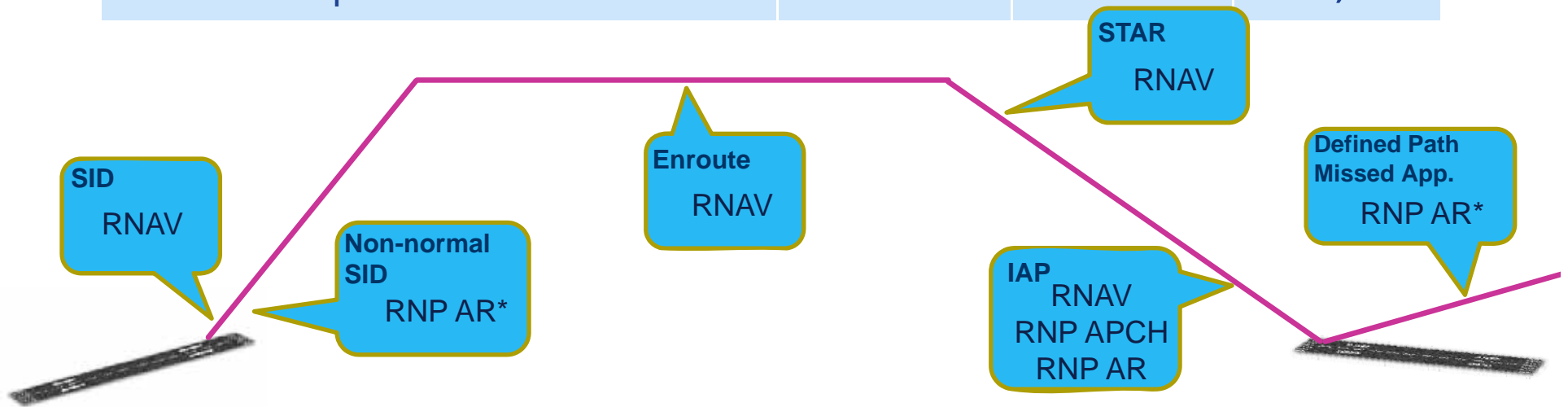


PBN Simplified



PBN Applications

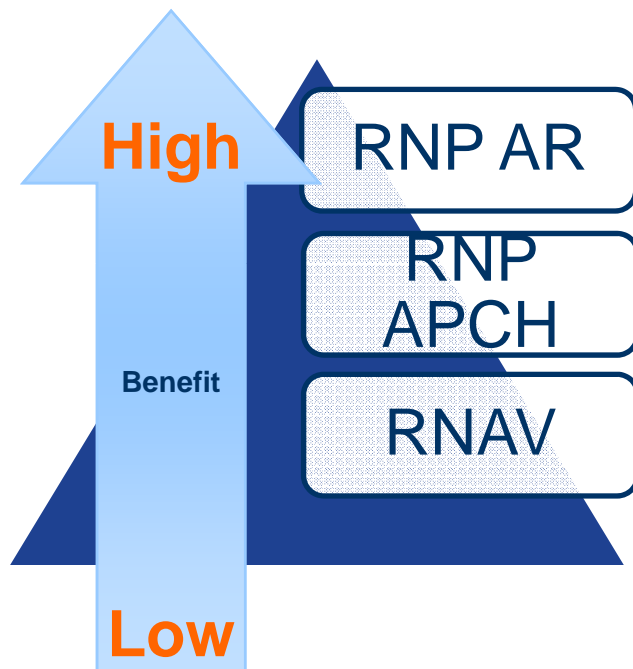
Features	RNAV	RNP APCH	RNP AR
Straight Path (TF legs)	✈	✈	✈
Vertical Guidance		✈	✈
Monitoring & Alerting		✈	✈
Predefined Curved Path (RF legs)			✈
Tailored to Specific Aircraft			✈*



* Available only with RNP AR procedures designed using GE Criteria

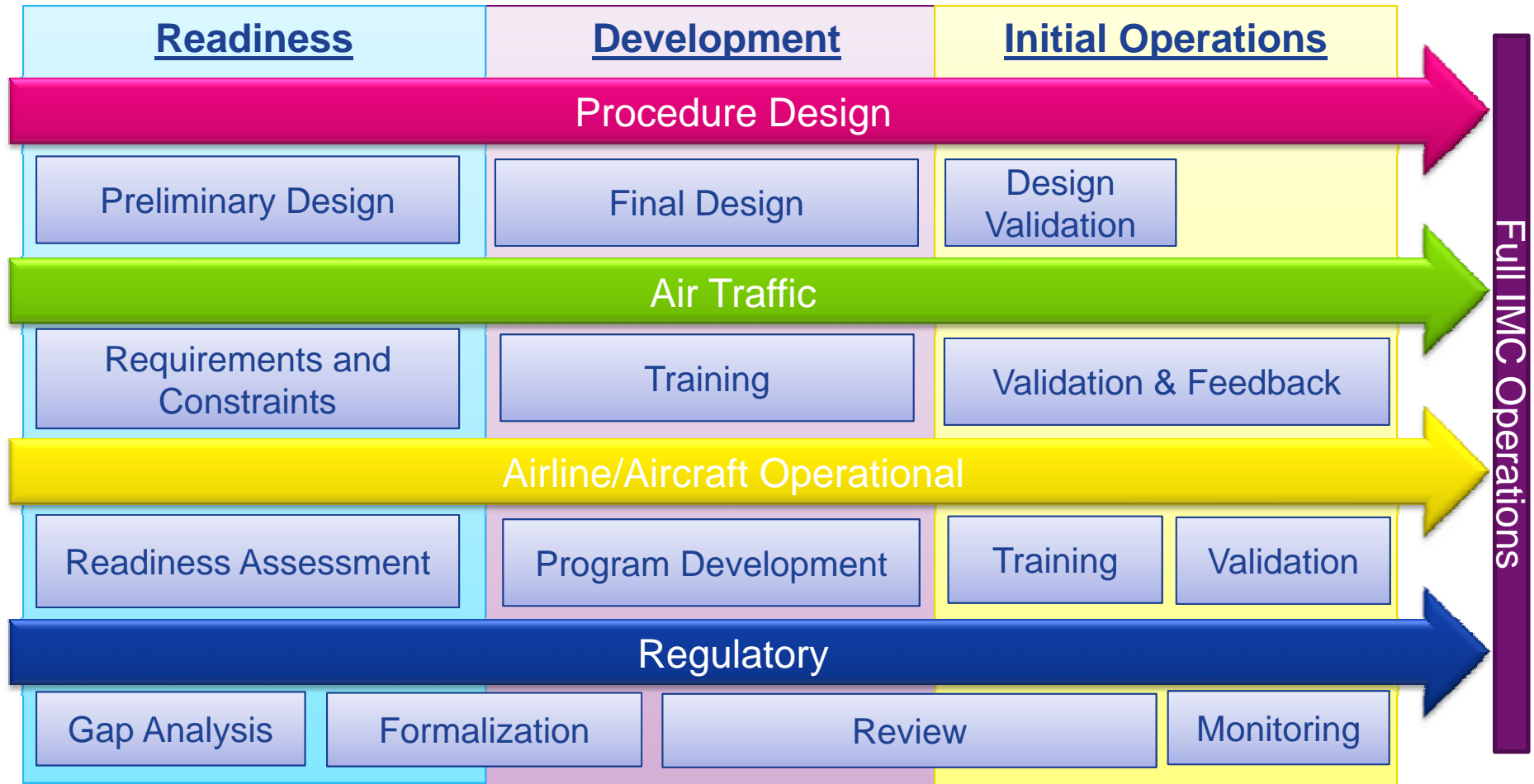
PBN for Multiple Applications

PBN procedures differ in capability, yielding increasingly significant benefits with higher performance application



Design Criteria	Description
ICAO/PANS-OPS, FAA, Tailored	RNP procedures containing curved paths that require operational authorization for aircraft and aircrew
ICAO/PANS-OPS, FAA	All categories of RNP APCH procedures including LNAV & APV
ICAO/PANS-OPS, FAA	Area Navigation terminal area procedures (SID, STAR)

RNP AR Project Roadmap



How can we help?



Experienced PBN team

EXPERT STAFF

- ✦ Technical Pilots with extensive airline operations experience and solid technical backgrounds
- ✦ Air Traffic Controllers
- ✦ Aircraft Dispatchers
- ✦ Aircraft Performance Engineers
- ✦ Procedure Path Designers
- ✦ Safety Management Specialists
- ✦ Quality Management Specialists
- ✦ Regulatory Affairs Specialists
- ✦ Program Management

GE NAVERUS CREDENTIALS

- ✦ FAA authorized RNP consultant
- ✦ FAA qualified RNP AR designer
- ✦ FAA authorized RNP flight validation capability
- ✦ Official certification to design and deploy PBN procedures in Australia, Canada, China and New Zealand
- ✦ ICAO registered supplier of PBN services
- ✦ ISO 9002-2008 registered for PBN procedure development, support and maintenance
- ✦ IATA Strategic Partner



GE Naverus offers multiple PBN solutions

Offering	Customer
Consulting Services	
National PBN Assessment	ANSP, ATM Organization, FAB
RNP Readiness Assessment	Airline, Other Operator
RNP Operations Approval Support	Airline, Other Operator
Other Consulting Services	Airline, Regulator, ATM Organizations
PBN Procedure Design & Deployment	
RNAV	ANSP, ICAO State, Airport, Airline, Other Operator
RNP APCH	ANSP, ICAO State, Airport, Airline, Other Operator
RNP AR	ANSP, ICAO State, Airport, Airline, Other Operator
Maintenance & Support Services (MSS)	
Procedure Monitoring, Alerting, and Revision Services	ANSP, ICAO State, Airport, Airline, Other Operator
Procedure Optimization Services	ANSP, ICAO State, Airport, Airline, Other Operator
Operator Support Service	Airline, Other Operator

Naverus RNP Availability Forecast Service (NRAFS)

Airline, Other Operator

National PBN Assessment

PROBLEM

Integrating a network of useful Performance-based Navigation into an established airspace system is difficult.

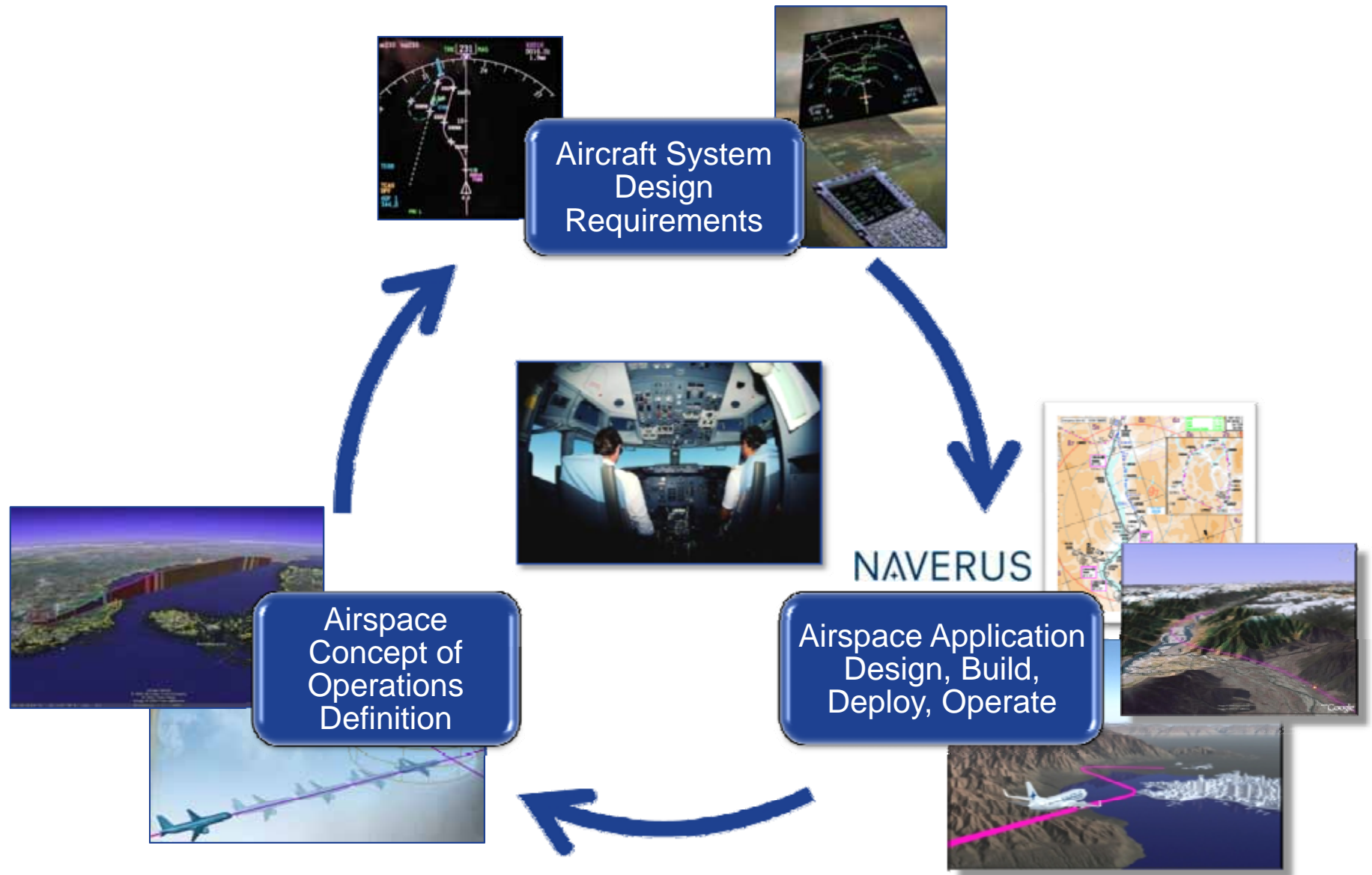
CONSIDERATION

Multiple factors must be considered, key stakeholders must be engaged, expertise may be limited.

SOLUTION

The National PBN Assessment provides the specific guidance airspace management organizations need to tailor regional PBN plans that benefit all of its stakeholders, in accordance with ICAO PBN global goals.

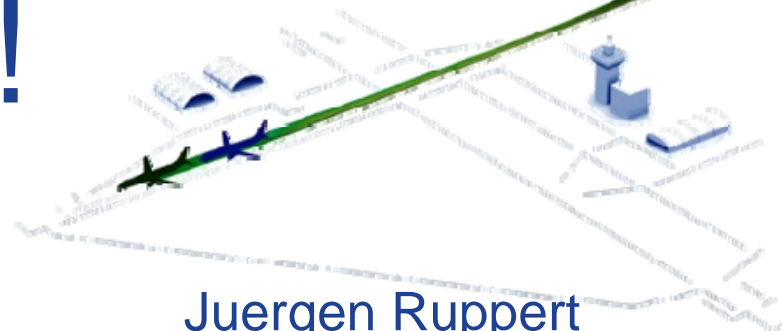
GE Integrated Capability



GE PBN Services



Thank You!



Juergen Ruppert
PBN Director Australasia
juergen.ruppert@ge.com