Boeing Air Traffic Management Overview and Status

ENRI International Workshop on ATM/CNS – EIWAC 2010

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Tokyo, Japan

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Avionics – Air Traffic Management

Boeing Commercial Airplanes

Topics

- Boeing Airspace Operational Design (AOD) Description
- Near-Term 2008 – 2012: Technology Core Requirements
- Near-Term 2008 – 2012: Operational Concepts and Benefits for Phases of Flight
- Mid-Term 2013 – 2018: Operational Concepts for Phases of Flight

AOD Description

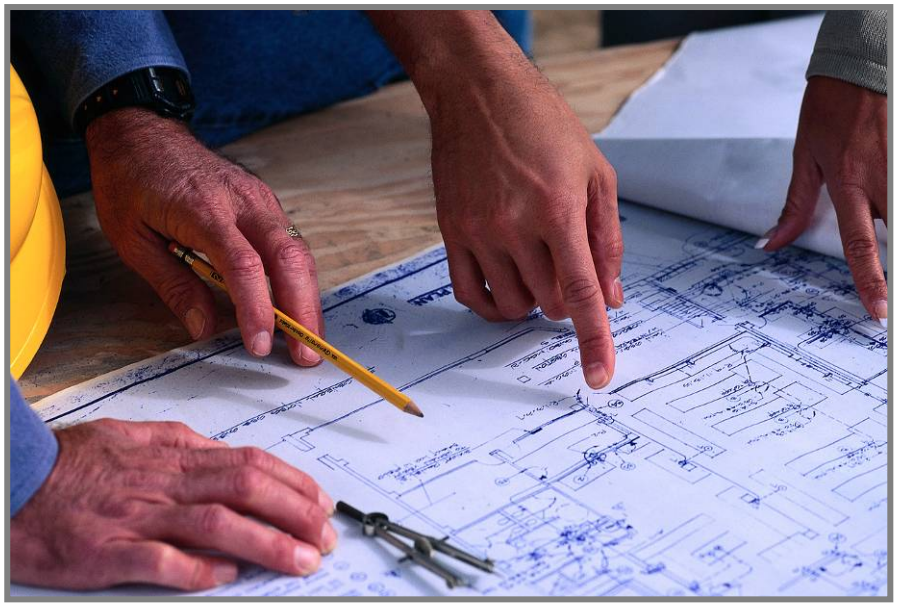
What the Airspace Operational Design is: Timeline

Boeing Commercial Airplanes (BCA) developed the AOD as a blueprint for making airplane upgrades and improving airspace and airport operations

2006 — **AOD V1.0**

2008 – 2012 Near-Term — **AOD V1.5**

2013 – 2018 Mid-Term — **AOD V2.0**

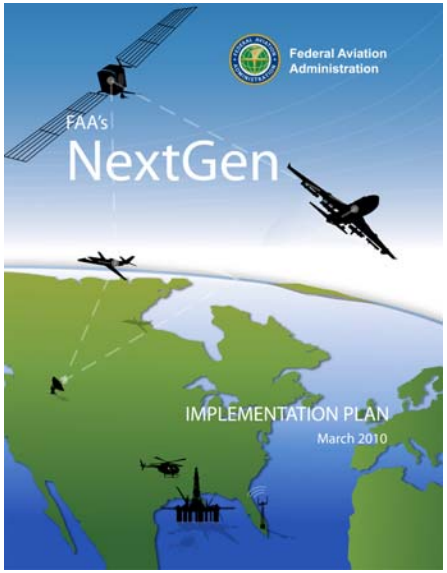


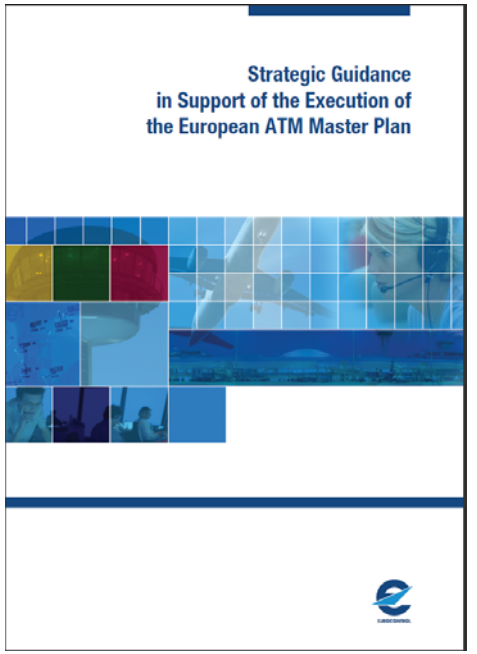
Why the AOD was Created

- Support Boeing's efforts to accelerate the modernization of air traffic management operations
- Improve airspace capacity, safety, and efficiency, and reduce environmental impact for air traffic operations

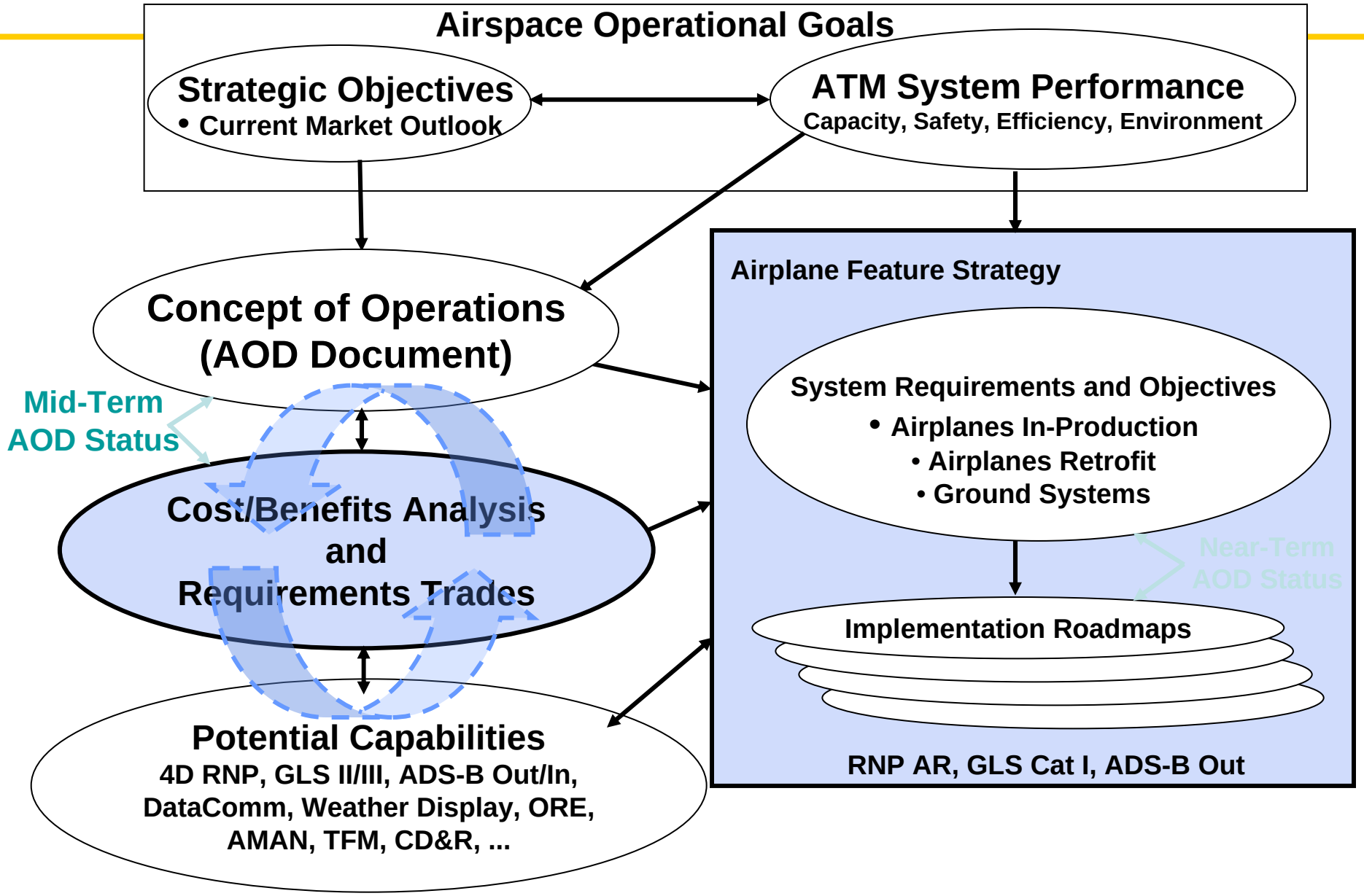
How the AOD will be Implemented

Boeing will implement a single-focused plan by working with key industry stakeholders

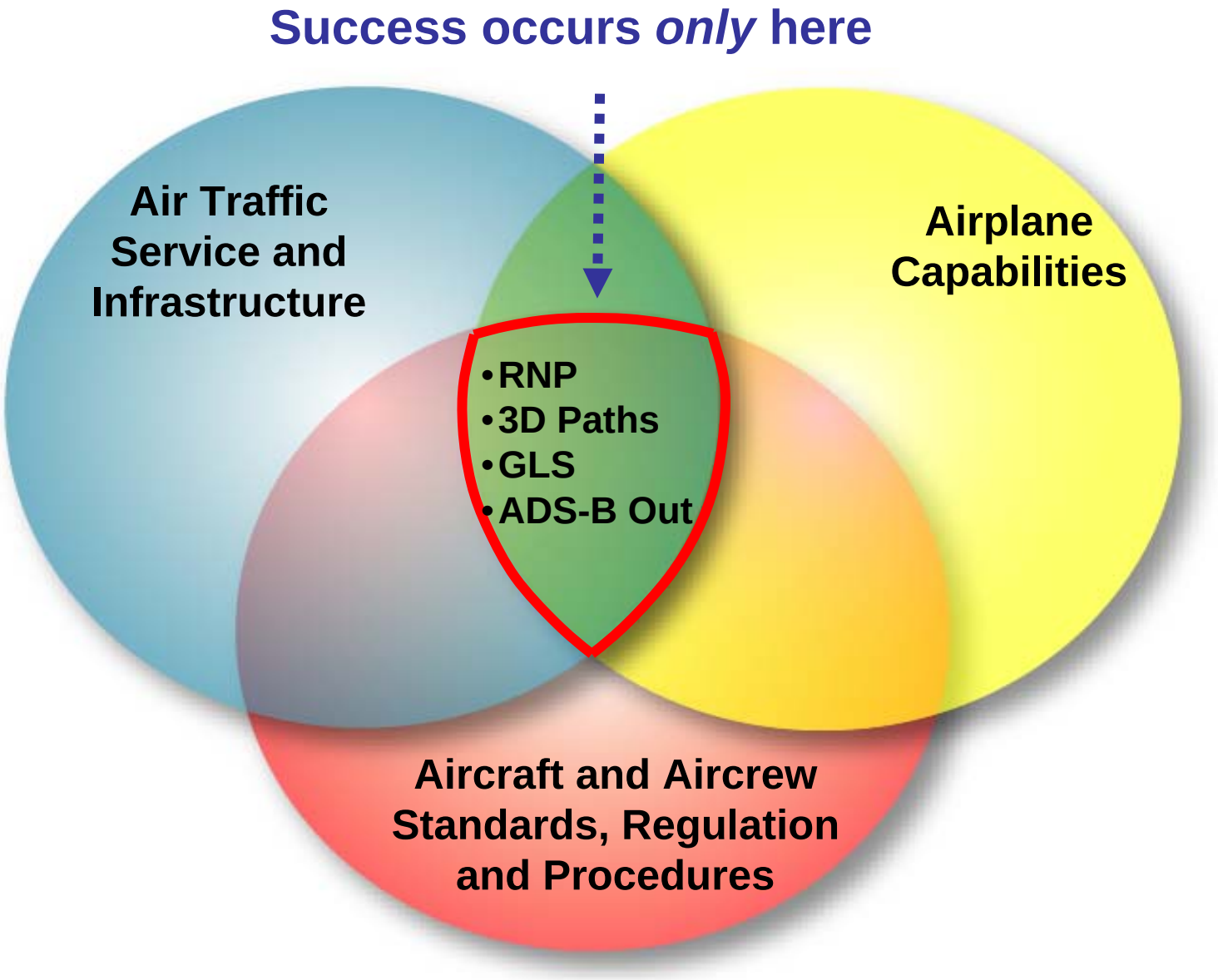




From Concept of Operations to Implementation



What Success Looks Like



Air Transportation System Roadmap

2005 | 2010 | 2015 | 2020 | 2025 | 2030

Airplane Population

Growing Fleet of Highly Capable Aircraft

19,000

36,000

New Airplanes for Growth

29,000

Replacement Airplanes

37% Of Today's Fleet Will Still Be Operating 20 Years From Now

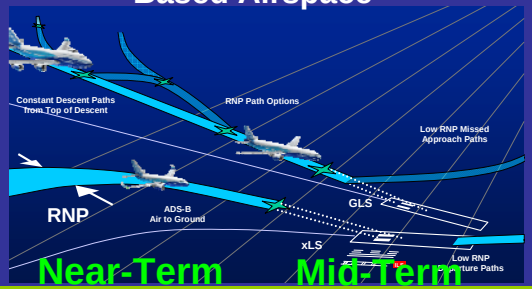
Retained Fleet

7,000

Airspace Design

Manual ATC Intervention, Control by Radar & Navaid

Pre-Defined Performance Based Airspace



Dynamic Performance Based Airspace

Near-Term | Mid-Term

Key Capabilities

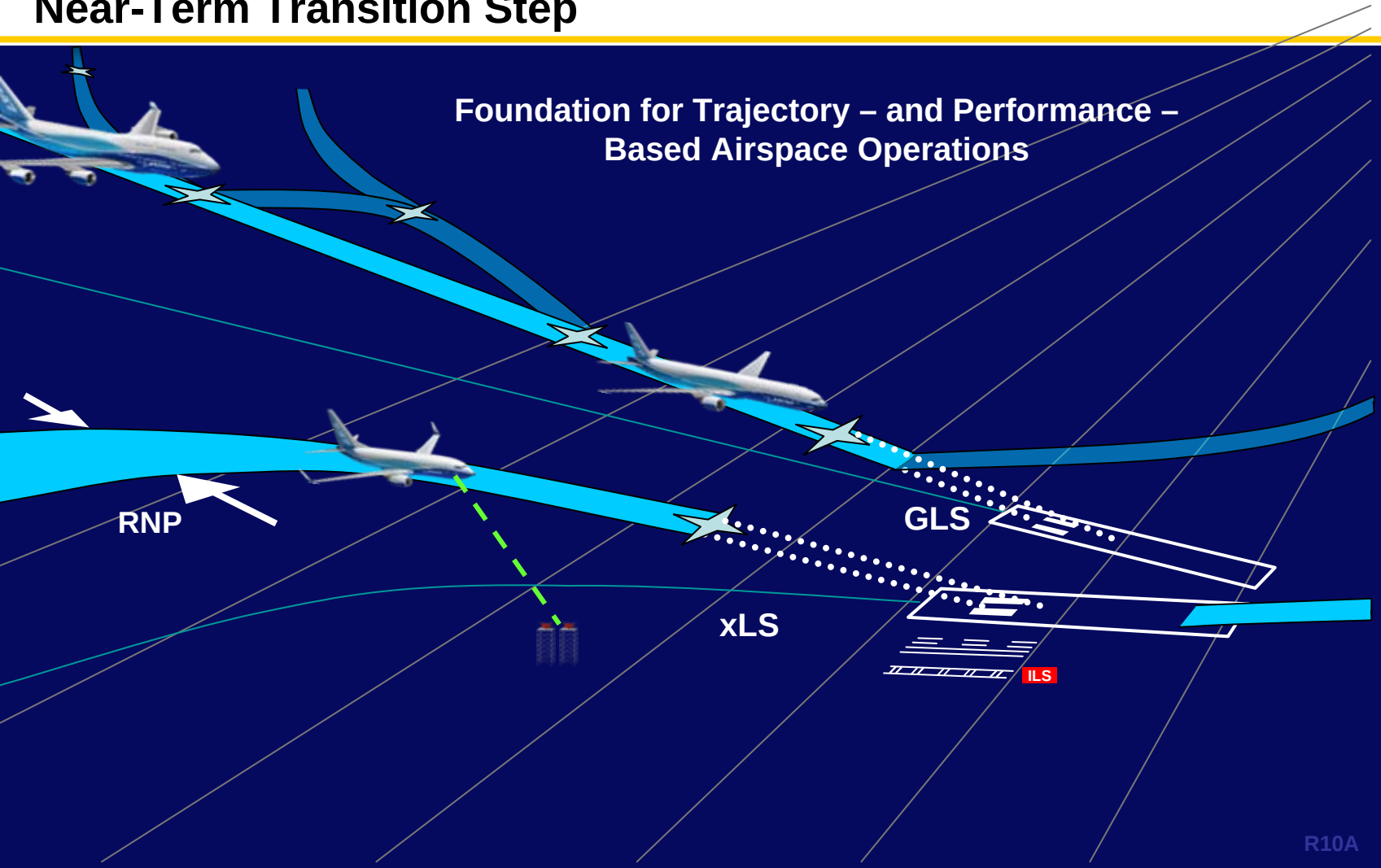
		Near-Term	Mid-Term	
ATM Automation		Time-Based Arrivals Conflict Detection	TFM CATMT Time-Based RNP/RNAV Arrivals Conflict Res.	Enhanced TFM Virtual Tower TRACON Autom. 4D Trajectory-Based Air-Ground Integration Improved Conflict Resolution
Communication	ATS	Voice Integrated Datalink (FANS 1/A)	Polar Satcom Non-Integrated Datalink ATN SWIM Integrated Datalink ATN (FANS 2)	VoIP Future Comm Capability
	AOC	ACARS	Broadband IP	
Navigation		RNAV Enroute RNP SAAAR RNAV Dep/Arr at Major Airports GLS CAT I Early 4D Nav GLS CAT III Expanded Use of RNP	Galileo/GPS III Expanded Use of 4D Nav RNP at Major Airports Opt. Rnwy Exit RNP based Separation	Broad Use of 4D Navigation
Surveillance		Prim. / Sec. Radar ADS-C ADS-B Out ATC Surv. Airborne CDTI SA Airborne Spacing ACAS/ADS-B Integration ADS-B In Separation	Multilateration AMM RAAS ASSA/FAROA/Alerting	Future Datalink Surveillance

R8

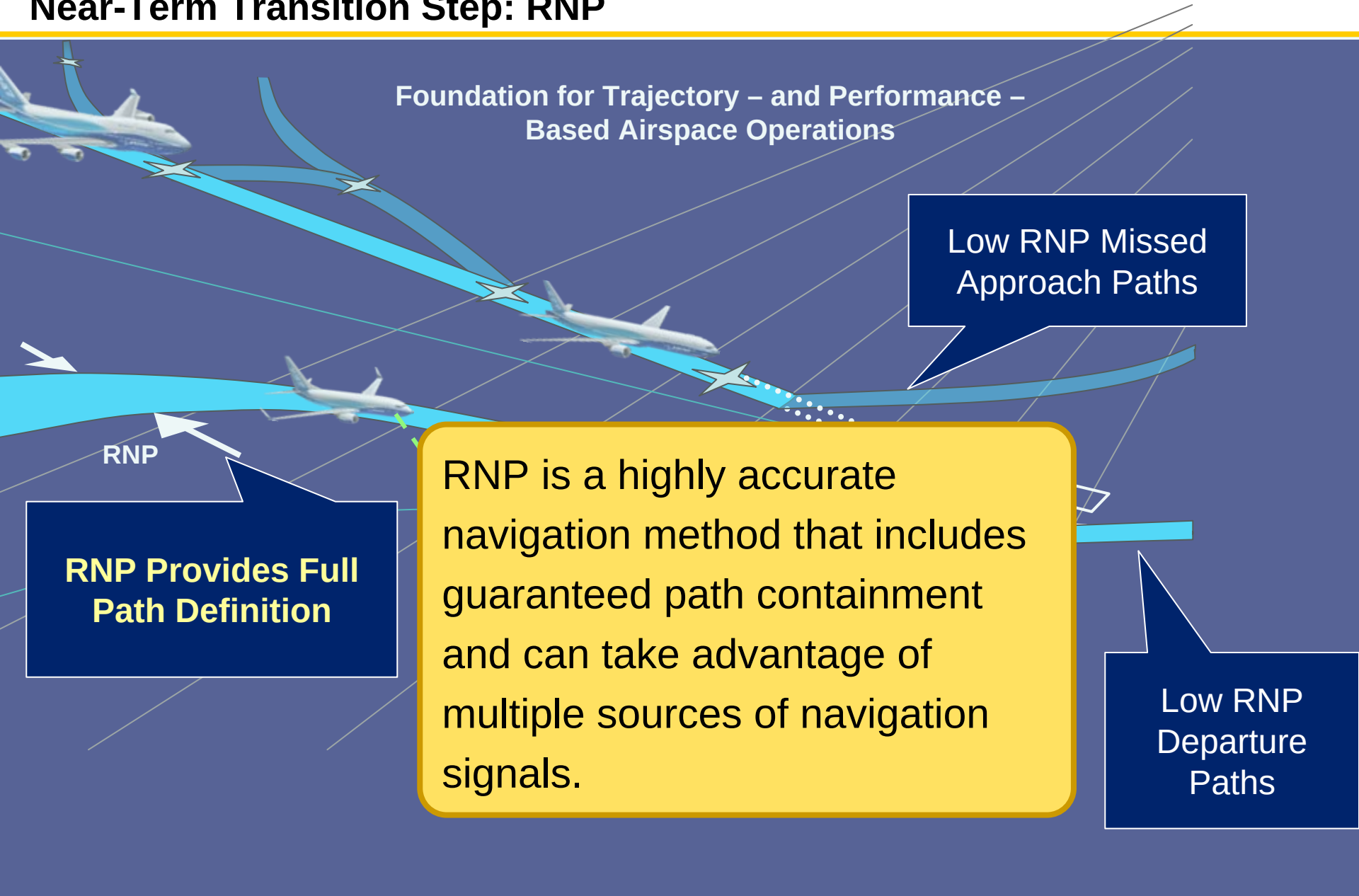
Near Term 2008-2012

Technology Core Requirements

Near-Term Transition Step



Near-Term Transition Step: RNP

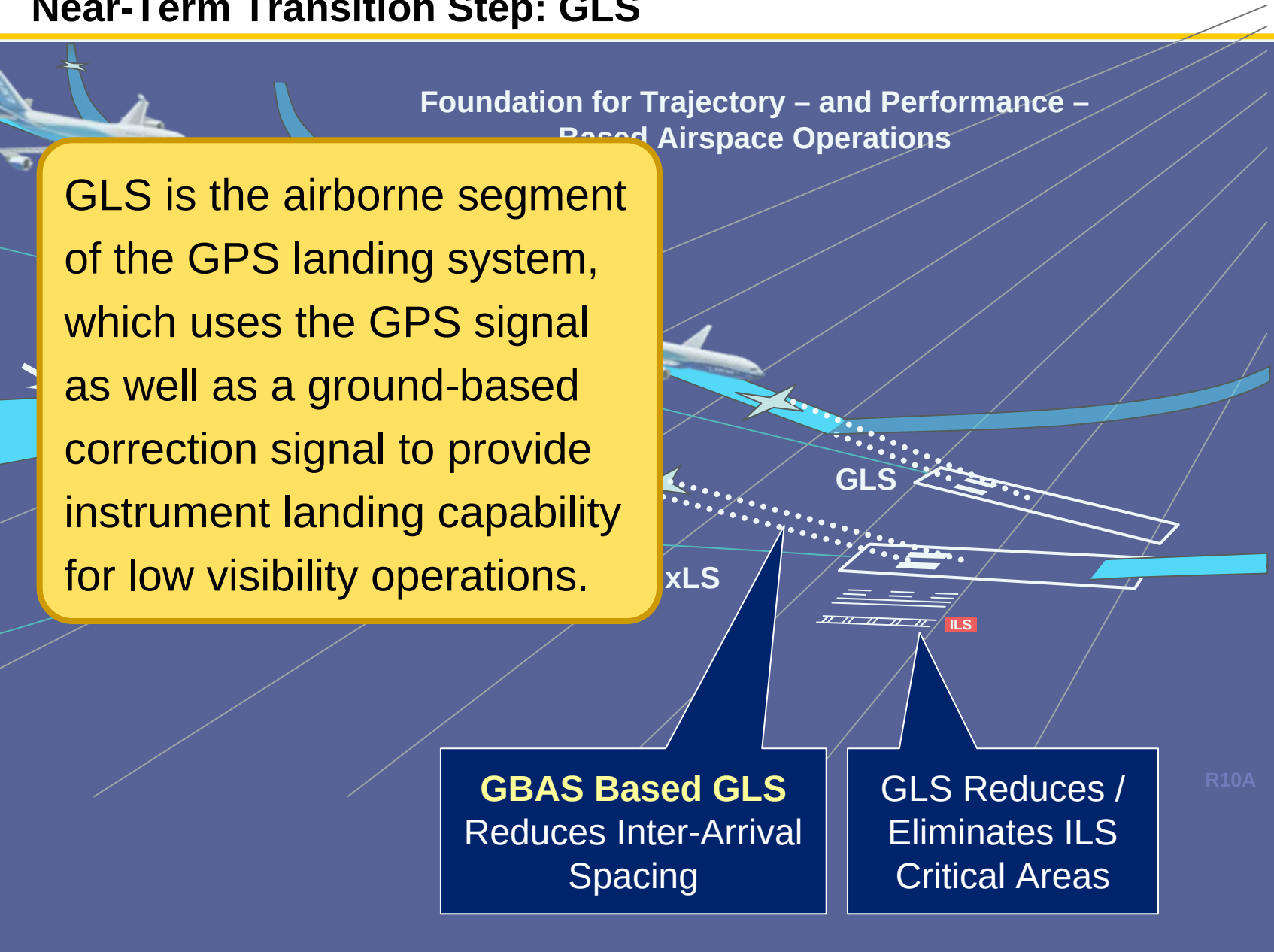


Near-Term Transition Step: 3D-Paths

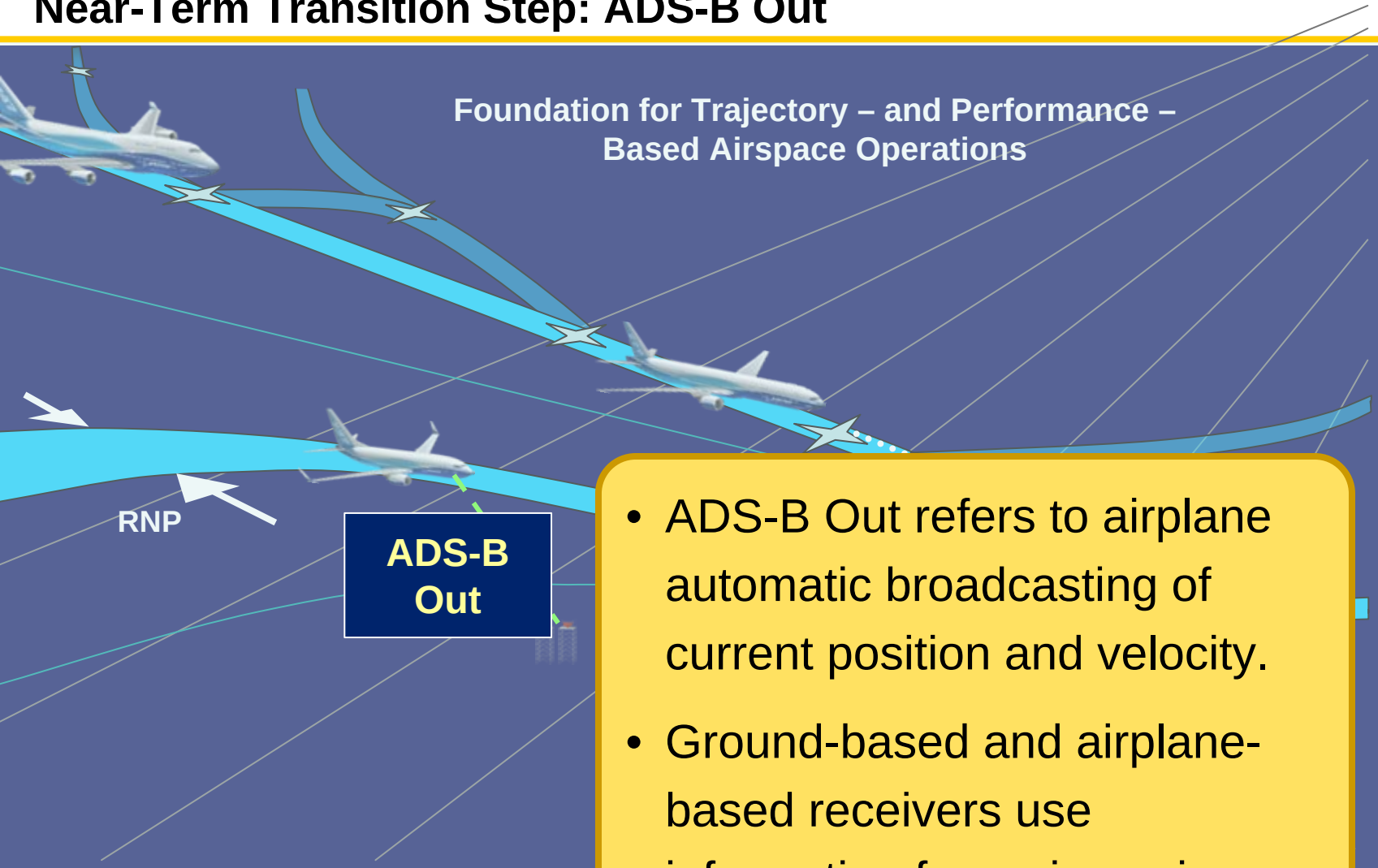
Air Traffic Planning Tools for 3D Path Management

3D Paths enable air traffic controllers, using automation aids, to communicate clearances by voice to the airplane in a form that can be used in the Flight Management System, allowing more accurate navigation and more efficient flight profiles.

Near-Term Transition Step: GLS

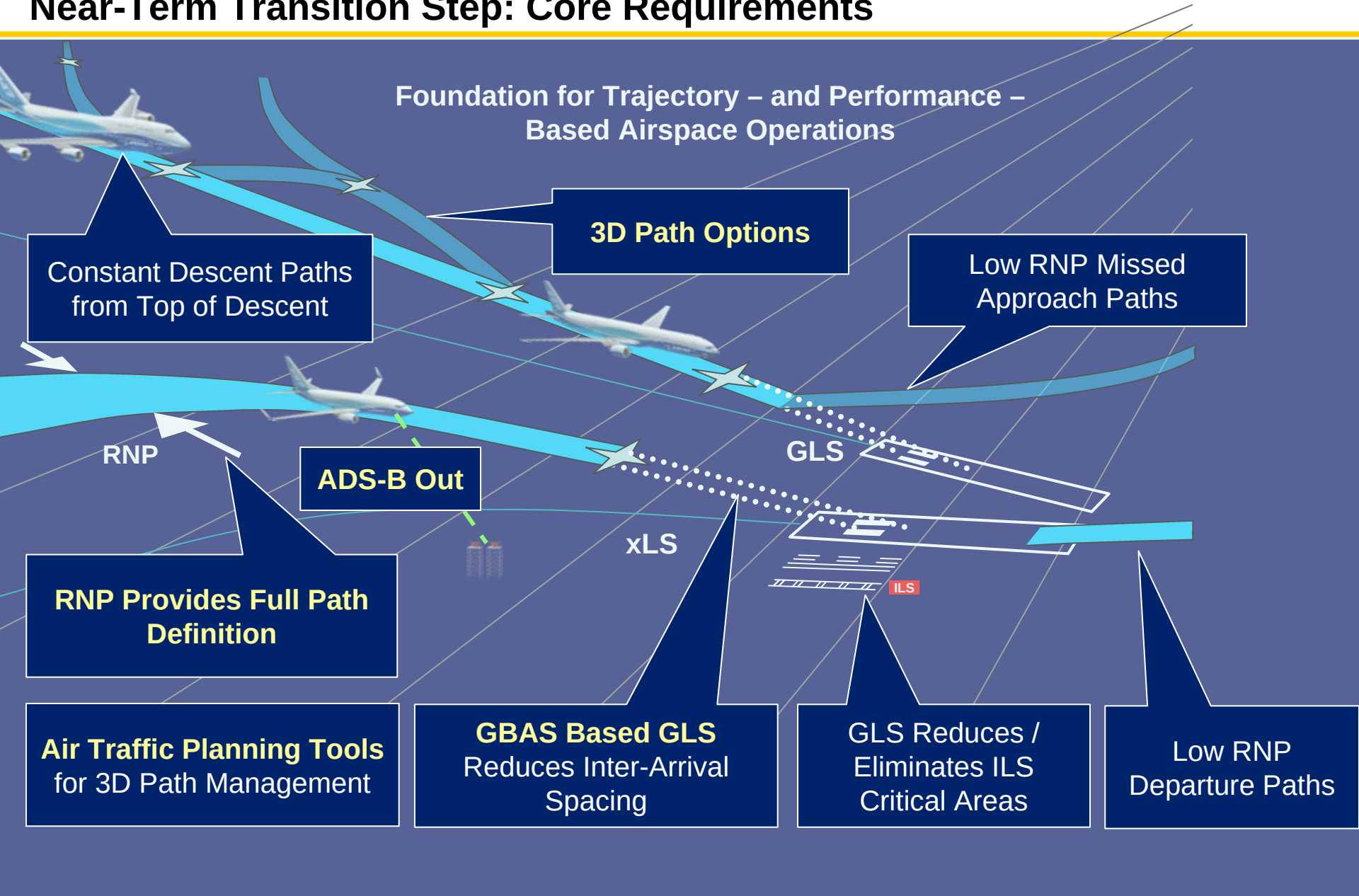


Near-Term Transition Step: ADS-B Out

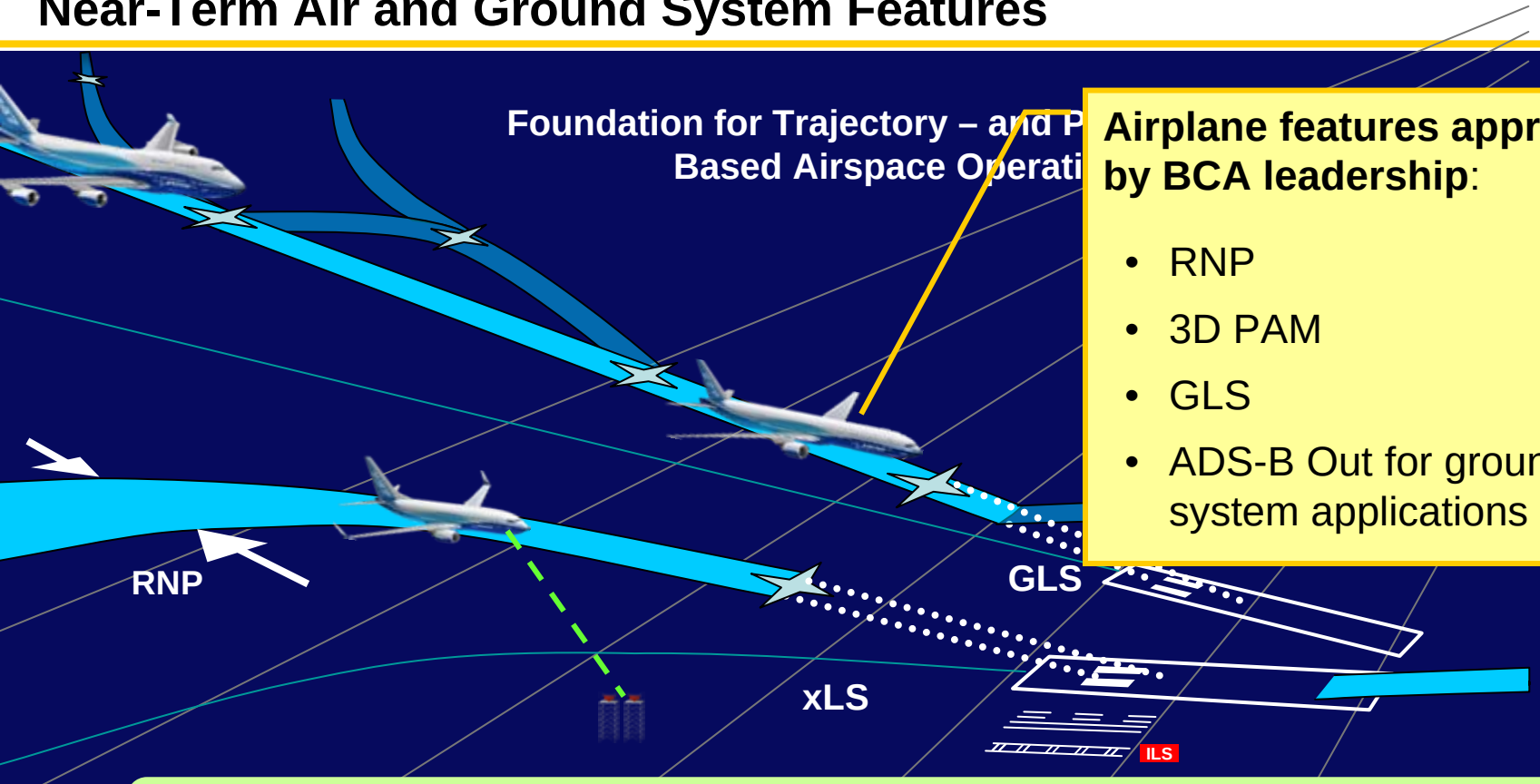


- ADS-B Out refers to airplane automatic broadcasting of current position and velocity.
- Ground-based and airplane-based receivers use information for various air traffic surveillance applications.

Near-Term Transition Step: Core Requirements



Near-Term Air and Ground System Features



Airplane features approved by BCA leadership:

- RNP
- 3D PAM
- GLS
- ADS-B Out for ground system applications

Required Ground System Features:

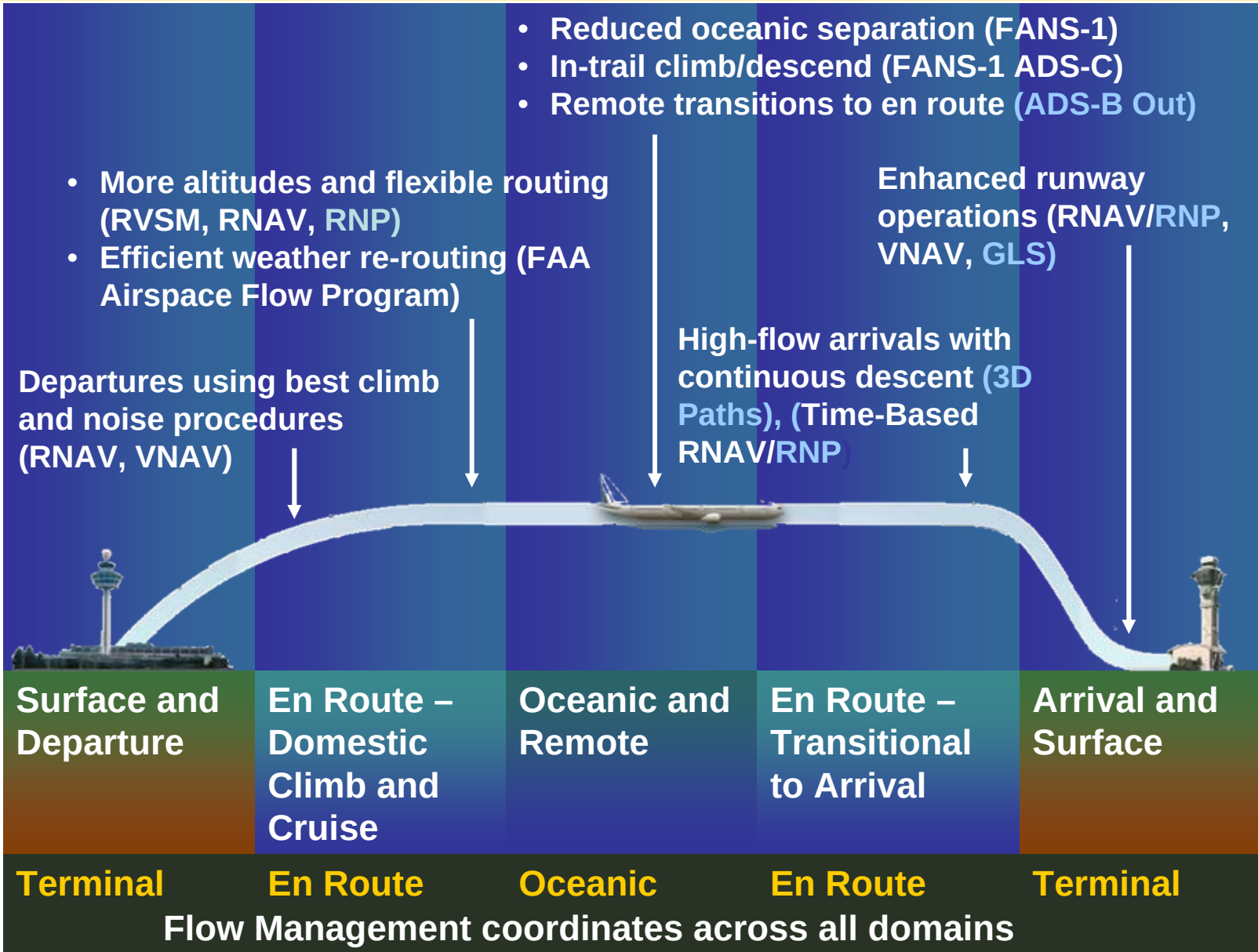
- RNP procedure design and operational approval
- Time-Based RNP/RNAV arrivals automation capabilities
- GPS Local Area Augmentation Systems (GBAS Ground Stations)
- ADS-B receivers, surveillance data processing, ATC displays, ATC communications and changes in separation standards

Near-Term 2008-2012:

Operational Concepts for All Phases of Flight

Near-Term 2008-2012: Operational Concepts and Benefits for Phases of Flight

Overview



Airlines Around World Realize Value of RNP

Airlines Flying RNP Procedures		RNP Level	Value Examples
Alaska Airlines	737NG	0.11	"Palm Springs…27 avoided diverts in three months, 1,890 miles saved"
WestJet	737NG	0.10	"Two RNP procedures, one airport, $2.5 - $3.5 M annual savings…embarking on 90 procedures for 24 destinations"
Qantas	737NG	0.10	• ZQN 3,200' lower approach, 4,000' lower departure • Brisbane 18 miles saved, impacts fuel burn, noise, arrival rate, and emissions • Eight domestic airports including Sydney
Continental	737NG	0.15	• "RNP will sustain or boost capacity" • "Plans for Houston, Newark, Guam, and several sites in South and Central America"
Austrian	737NG	0.15	"Innsbruck minimums reduced by 1,300 feet…reduced diversions, lower fuel burn, improved service reliability"
Air China	757	0.30	"China plans to certify 50 more RNP procedures in a five year period"

Airline Customers are Incorporating AOD Elements

Constant Descent Arrivals

Southwest.com, UPS, Alaska Airlines, Continental Airlines, United, JAL, SAS

RNP (Remote)

Alaska Airlines, WestJet, Qantas, SAS, Air China, Air New Zealand, China Eastern

RNP (Congested)

Alaska Airlines, Continental Airlines, Southwest.com, British Airways, Qantas, Delta, American Airlines

GLS

Qantas, FedEx Express, Continental Airlines, Delta, Air Berlin, TUIfly

MLS

British Airways

Boeing is not pursuing MLS

3-D Path with Path Options*

United, Continental Airlines

*3-D Path Arrival Management trials at DEN in 2009

ADS-B Out

Lufthansa, Continental Airlines, United, Delta, TUIfly, SAS, Ryanair, WestJet, nwa Northwest Airlines, Air China, American Airlines, Air Canada, KLM, Virgin atlantic, Singapore Airlines, Air France, British Airways, Atlas Air, UPS, FedEx Express, cargolux, AirEurope

Mid-Term 2013-2018

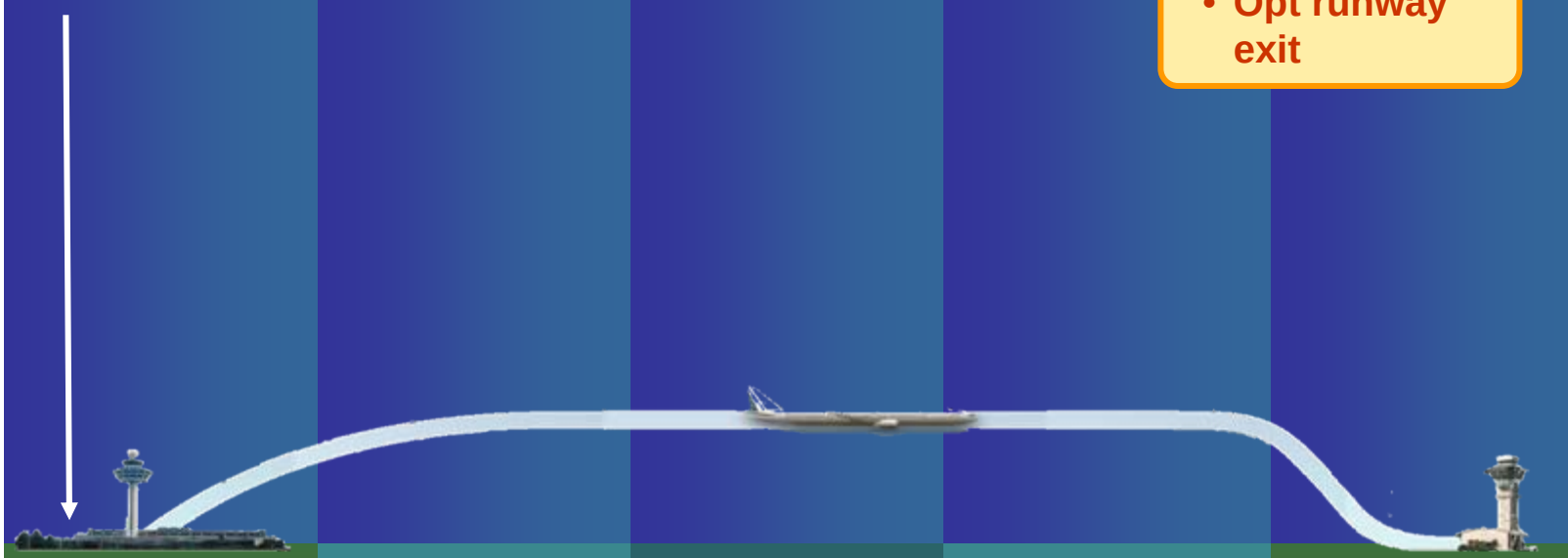
Operational Concepts

Operational Concepts for Phases of Flight

- High throughput surface operations
- Datalink, ATM tools
- ADS-B/CDTI
- Runway alerting

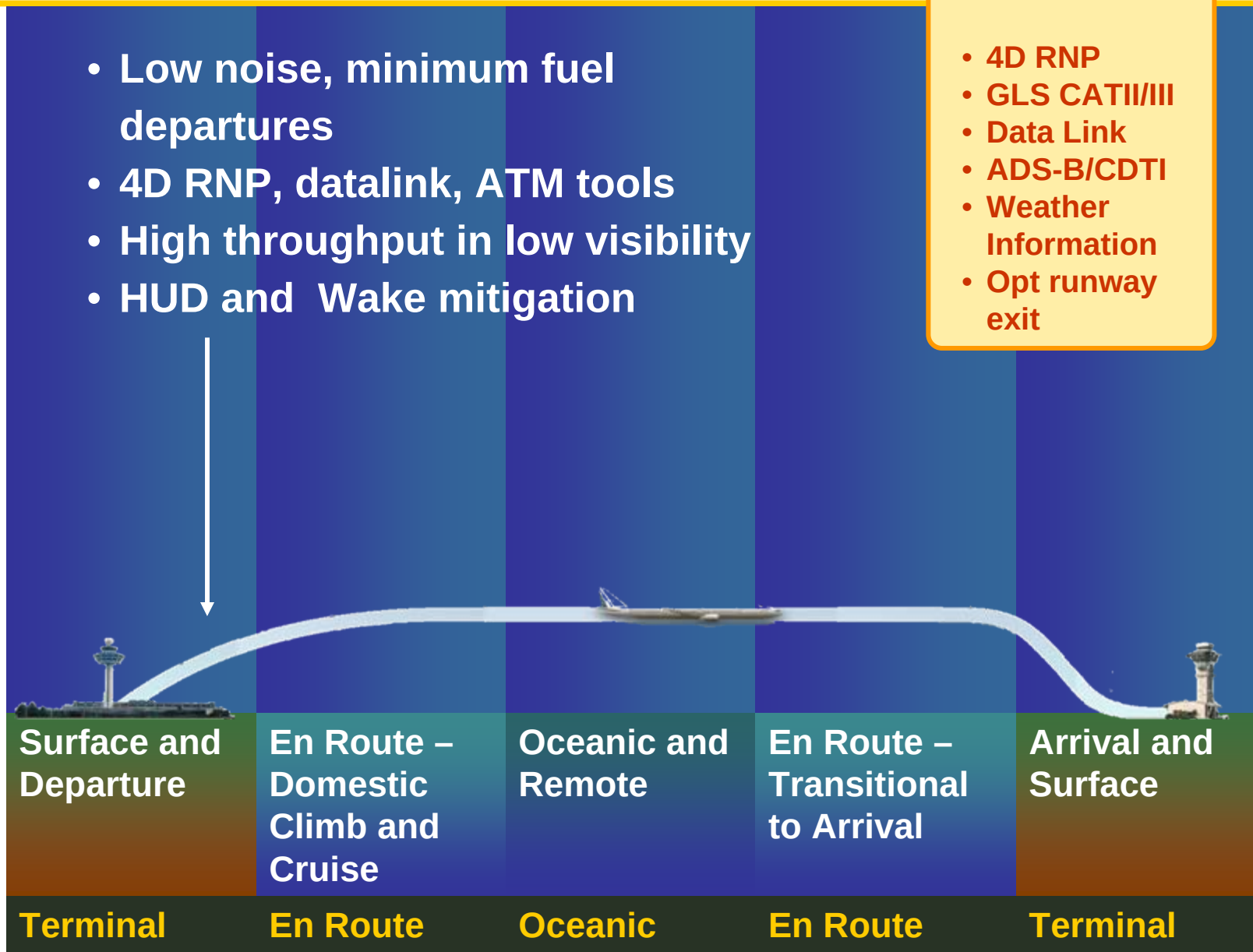
Key aircraft features

- 4D RNP
- GLS CATII/III
- Data Link
- ADS-B/CDTI
- Weather Information
- Opt runway exit



Surface and Departure	En Route – Domestic Climb and Cruise	Oceanic and Remote	En Route – Transitional to Arrival	Arrival and Surface
Terminal	En Route	Oceanic	En Route	Terminal

Operational Concepts for Phases of Flight



Operational Concepts for Phases of Flight

Key aircraft features

- 4D RNP
- GLS CATII/III
- Data Link
- ADS-B/CDTI
- Weather Information
- Opt runway exit

- High throughput and flexible routing
- 4D RNP, datalink, ATM tools
- Dynamic weather re-routing
- Data link, ATM tools
- Weather information in flight deck

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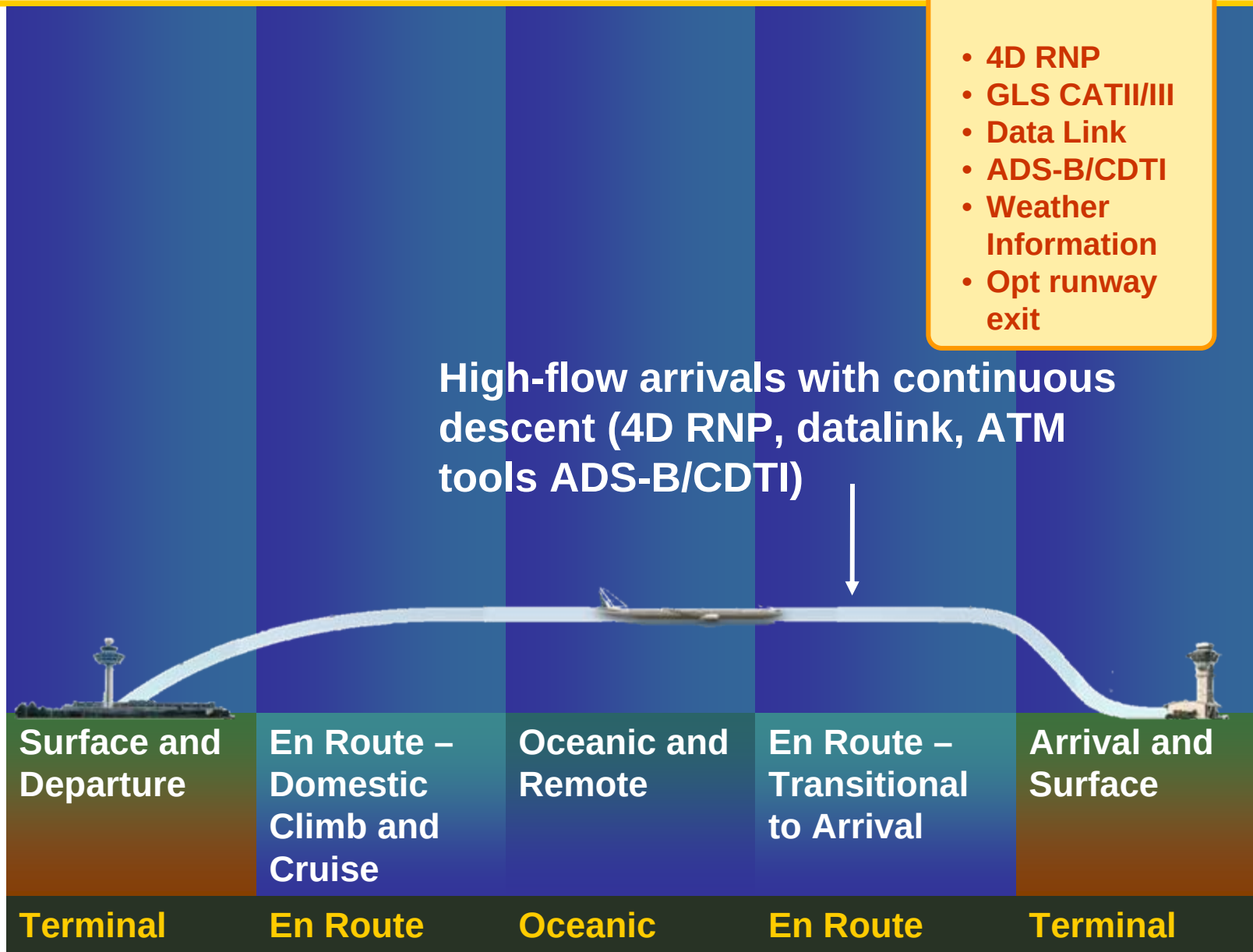

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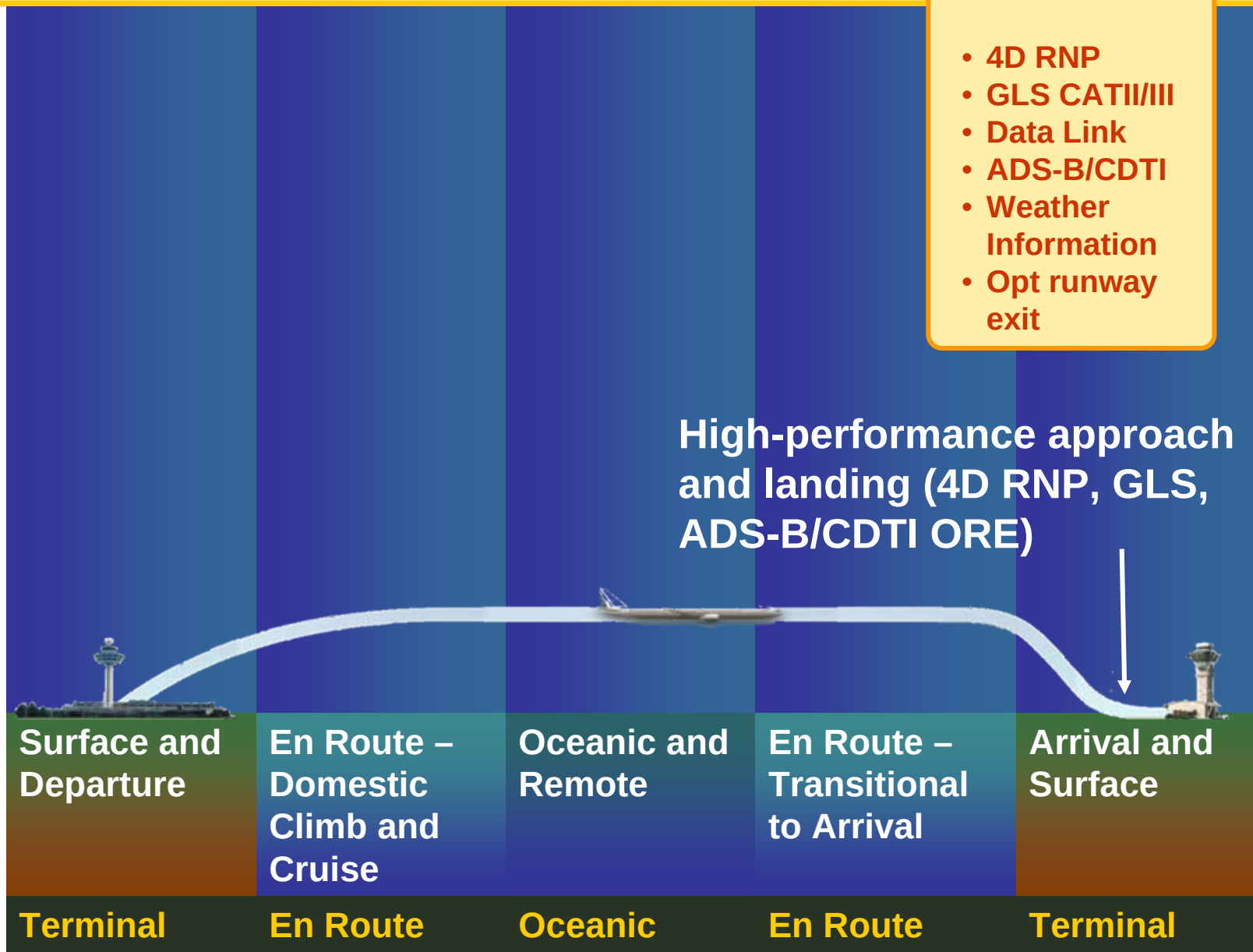

Next Steps To Refine the Mid-Term Plan

- Benefits and cost analysis to support the business case
- Airplane capability definition
- Trade studies to refine operational concept and requirements
- Coordination with avionics suppliers
- Industry collaborations and standards committees on-going and essential (NextGen, SESAR, RTCA, etc.)
- Briefings to BCA airplane programs and marketing
- External briefings to influence mid-term thinking and solicit feedback

Thank You