Boeing Air Traffic Management
Overview and Status

ENRI International Workshop on ATM/CNS – EIWAC 2010
November 10-15, 2010
Tokyo, Japan

Matt Harris
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.
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

Airspace Operational Goals

Strategic Objectives
- Current Market Outlook

ATM System Performance
- Capacity, Safety, Efficiency, Environment

Concept of Operations (AOD Document)

System Requirements and Objectives
- Airplanes In-Production
- Airplanes Retrofit
- Ground Systems

Cost/Benefits Analysis and Requirements Trades

Potential Capabilities
- 4D RNP, GLS II/III, ADS-B Out/In
- DataComm, Weather Display, ORE
- AMAN, TFM, CD&R, ...

Implementation Roadmaps
- RNP AR, GLS Cat I, ADS-B Out

Mid-Term AOD Status

Near-Term AOD Status

From Concept of Operations to Implementation
What Success Looks Like

Success occurs only here

Air Traffic Service and Infrastructure

Airplane Capabilities

Aircraft and Aircrew Standards, Regulation and Procedures

- RNP
- 3D Paths
- GLS
- ADS-B Out
Near Term
2008-2012
Technology Core
Requirements
Near-Term Transition Step

Foundation for Trajectory – and Performance – Based Airspace Operations

RNP

xLS

GLS

Near-Term 2008-2012: Technology Core Requirements
Near-Term Transition Step: RNP

RNP is a highly accurate navigation method that includes guaranteed path containment and can take advantage of multiple sources of navigation signals.
Near-Term 2008-2012: Technology Core Requirements

Near-Term Transition Step: 3D-Paths

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.
GLS is the airborne segment of the GPS landing system, which uses the GPS signal as well as a ground-based correction signal to provide instrument landing capability for low visibility operations.
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 2008-2012: Technology Core Requirements

Near-Term Transition Step: Core Requirements

Foundation for Trajectory – and Performance – Based Airspace Operations

- Constant Descent Paths from Top of Descent
- 3D Path Options
- Low RNP Missed Approach Paths
- RNP Provides Full Path Definition
- ADS-B Out
- Air Traffic Planning Tools for 3D Path Management
- GBAS Based GLS Reduces Inter-Arrival Spacing
- GLS Reduces / Eliminates ILS Critical Areas
- Low RNP Departure Paths
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

- Departures using best climb and noise procedures (RNAV, VNAV)
  - Reduced oceanic separation (FANS-1)
  - In-trail climb/descend (FANS-1 ADS-C)
  - Remote transitions to en route (ADS-B Out)

- More altitudes and flexible routing (RVSM, RNAV, RNP)
- Efficient weather re-routing (FAA Airspace Flow Program)

- High-flow arrivals with continuous descent (3D Paths), (Time-Based RNAV/RNP)

- Enhanced runway operations (RNAV/RNP, VNAV, GLS)

- Flow Management coordinates across all domains
# Near-Term 2008-2012: Operational Concepts and Benefits for Phases of Flight

## Airlines Around World Realize Value of RNP

<table>
<thead>
<tr>
<th>Airlines Flying RNP Procedures</th>
<th>RNP Level</th>
<th>Value Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alaska Airlines</td>
<td>737NG 0.11</td>
<td>“Palm Springs…27 avoided diverts in three months, 1,890 miles saved”</td>
</tr>
<tr>
<td>WEST JET</td>
<td>737NG 0.10</td>
<td>“Two RNP procedures, one airport, $2.5 - $3.5 M annual savings…embarking on 90 procedures for 24 destinations”</td>
</tr>
</tbody>
</table>
| 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” |
# Near-Term 2008-2012: Operational Concepts and Benefits for Phases of Flight

## Airline Customers are Incorporating AOD Elements

<table>
<thead>
<tr>
<th>Constant Descent Arrivals</th>
<th>Boeing is not pursuing MLS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>RNP (Remote)</strong></td>
<td></td>
</tr>
<tr>
<td><strong>RNP (Congested)</strong></td>
<td></td>
</tr>
<tr>
<td><strong>GLS</strong></td>
<td></td>
</tr>
<tr>
<td><strong>MLS</strong></td>
<td></td>
</tr>
<tr>
<td>*<em>3-D Path with Path Options</em></td>
<td><em>3-D Path Arrival Management trials at DEN in 2009</em></td>
</tr>
<tr>
<td><strong>ADS-B Out</strong></td>
<td></td>
</tr>
</tbody>
</table>
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
Operational Concepts for Phases of Flight

- Low noise, minimum fuel departures
- 4D RNP, datalink, ATM tools
- High throughput in low visibility
- HUD and Wake mitigation

Key aircraft features:
- 4D RNP
- GLS CATII/III
- Data Link
- ADS-B/CDTI
- Weather Information
- Opt runway exit
Operational Concepts for Phases of Flight

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

Key aircraft features

- 4D RNP
- GLS CATII/III
- Data Link
- ADS-B/CDTI
- Weather Information
- Opt runway exit
Operational Concepts for Phases of Flight

High-flow arrivals with continuous descent (4D RNP, datalink, ATM tools ADS-B/CDTI)

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
Operational Concepts for Phases of Flight

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

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

High-performance approach and landing (4D RNP, GLS, ADS-B/CDTI ORE)
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