



# **ADS-B Link Decision Workshop: Session A Objectives, Assumptions, Procedures, Industry Inputs, and ADS-B Configurations**

**June 25, 2001  
(Revised Version)**

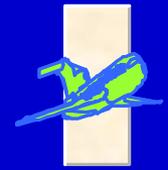
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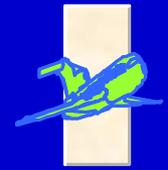
# Overview

- Review session objectives
- Review/revise session assumptions
- Explain procedure
- Review/revise industry inputs
- Review alternative ADS-B link configurations
- Ask manufactures to provide qualitative inputs via completion of worksheets with submission by 11 July 01
  - for alternative ADS-B link configurations and by aircraft category
  - input on factors that will help identify the most viable ADS-B link alternatives (both technically and commercially)



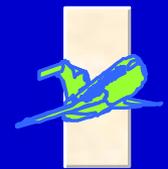
## Session Objectives

- **Collect vendor inputs that will help determine the relative airborne costs, technical risks and market factors associated with the ADS-B link alternatives**
- **Identify areas of industry consensus**
- **Provide qualitative inputs that can be followed up with one-on-one meetings to obtain quantitative information**



## Assumptions: General

- A multiple link solution does not imply that each user must transmit and receive ADS-B using each of the selected link technologies.
- After the link decision and the associated RTCA and/or ICAO standards are approved, only equipment/systems, airborne or ground, conformant to the MOPS/SARPs will be certified for use in the U.S. NAS
- Link systems MOPS will closely reflect TLAT system descriptions
- The Cost Reference Configuration (1090ES Single-Link) is compliant with DO 260A



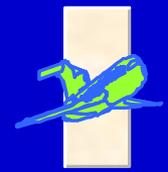
## Assumptions: Certification

- **Certification of ADS-B hardware and software would be based upon application requirements and further assessment of operational hazards and mitigation strategies.**
- **ADS-B system use in the cockpit decision-making process equates to condition where 'failure constitutes a major hazard'**
  - **hazardous/misleading data only**
  - **as defined by AC 23-1309 & AC 25-1309**



# Procedures

- **Brief each configuration**
- **Address/resolve vendor questions and adjust assumptions where necessary**
- **Vendors may use the worksheets provided to indicate responses**
  - **all responses will be treated as proprietary/competition sensitive information**
  - **comment sheets support the worksheet responses and are keyed to the appropriate worksheet number and response cell**
- **Collect/collate responses**
- **Brief results of the session as follows (expected Sep 01):**
  - **only the range of responses for each configuration & class of aircraft will be briefed (subject to receipt of at least three responses)**
  - **will not brief any information thought to be proprietary or competition-sensitive without vendor release**



## Industry Inputs (1)

- **Overall assessment: Is the configuration viable from a technical, cost, and market point of view? (Yes, No)**
- **Avionics Technical Risk (Low, Med, High)**
  - new-start product (e.g., new avionics development effort)
  - integration with or revision of existing product (e.g., addition of second link to existing single-link ADS-B system)
- **Delta Cost - Link (Much GT, GT, Equal, LT, Much LT)**
  - percent change in link cost from CRC
  - link includes: data input interface, message generation, message transmission, message reception, and report generation (includes harmonization for multi-link applications)
- **Delta Cost - System (Much GT, GT, Equal, LT, Much LT)**
  - percentage change of ADS-B system cost as compared to CRC
  - system includes applications, application processor, display, link, and any unique input and display requirements



## Industry Inputs (2)

- **Certification Cost (Much GT, GT, Equal, LT, Much LT)**
  - change in system certification costs reference the CRC, exclusive of aircraft integration/certification costs
- **Installation Cost (Much GT, GT, Equal, LT, Much LT)**
  - change in cost to install and certify the installation in representative user aircraft referenced to the CRC
- **Installation Complexity (Much GT, GT, Equal, LT, Much LT)**
  - change in complexity of aircraft installation and integration referenced to the CRC
- **U.S. Availability Date (Near = 2003 or earlier; Mid = 2004-2007; Far = 2008 and beyond)**
- **International Availability Date (Near, Mid, Far)**
- **User Acceptance & Market Demand (Minimal, Moderate, Strong)**
  - subjective assessment of conformance of the configuration to user desires and market demands
  - indicate in notes which applications are considered key for target market/user



## Industry Inputs (3)

### – Worksheet Notes

- notes, comments, and other information may be provided via the Worksheet Notes pages
- each note, comment, etc. is keyed to a worksheet and cell number
- notes, comments, etc. not specifically related to a worksheet or cell may be provided on notes pages
- notes are subject to the same concern for proprietary information as the other vendor assessment worksheets
- vendors may offer actual cost estimates (versus relative costs)



# Configuration Data:

## Aircraft Configuration Prior to ADS-B Installation

### ■ GA (Low/Mid):

- four-place, single-engine, fixed-gear, non-pressurized IFR aircraft
- Mode A/C, VFR GPS w/ text-only display\*, 760 channel Nav/Comm & ADF
- FAR 23

### ■ GA(High/Corp):

- pressurized light jet
- non-EFIS, FMS (nav only), C129 GPS, Mode A/C, weather radar, radalt, VOR/ILS/DME/ADF
- FAR 25

### ■ Transport (Non-PFD):

- Turbojet
- TCAS, weather radar, TAWS-A, VOR/ILS/DME/ADF, radalt, FMS (nav only)
- FAR 25

### ■ Transport (Integrated PFD):

- turbojet;
- FMS/EICAS/429 data bus; TCAS, weather radar, TAWS-A, MMR, radalt
- FAR 25

\* See WAAS MOPS for GPS requirements



## Applications:

- From Session B User Breakout



# ADS-B Configurations (1)

- **Single-Link Configurations**
  - 1090ES (CRC)
  - UAT
  - VDLM4
- **Multi-Link Configurations**
  - 1090ES/UAT
    - Full Tx/Rx
    - Tx-Only and Rx-Only Configurations
  - 1090ES/VDLM4
    - Full Tx/Rx
    - Tx-Only (1090ES) and Rx-Only (1090ES/VDLM4) Configurations
  - Triple-Link (1090ES, UAT, VDLM4)



# ADS-B Configurations: Single-Link

W/S Number	Config	GA Low/Mid	GA High/Corp	Transport (Non-PFD)	Transport (Integ PFD)
1 (CRC)	Single Link: 1090ES	Mode S* 1090ES	Mode S 1090ES	Mode S TCAS 1090ES	Mode S TCAS 1090ES
2	Single Link: UAT	Mode A/C UAT	Mode A/C UAT	Mode S TCAS UAT	Mode S TCAS UAT
3	Single Link: VDLM4	Mode A/C VDLM4	Mode A/C VDLM4	Mode S TCAS VDLM4	Mode S TCAS VDLM4

**\*Manufacturers are requested to cost both A0 (Mode A/C, 1090ES) and A1 configurations**



# ADS-B Configurations: Multi-Link (1090ES/UAT)

W/S Number	Config	GA Low/Mid	GA High/Corp	Transport (Non-PFD)	Transport (Integ PFD)
4	Multi-Link: 1090/UAT	Mode S* 1090ES UAT	Mode S 1090ES UAT	Mode S TCAS 1090ES UAT	Mode S TCAS 1090ES UAT
5	Multi-Link: 1090 with UAT Tx-Only	Mode S* 1090ES UAT Tx	Mode S 1090ES UAT Tx	Mode S TCAS 1090ES UAT Tx	Mode S TCAS 1090ES UAT Tx
6	Multi-Link: 1090 with UAT Rx-Only	Mode S* 1090ES UAT Rx	Mode S 1090ES UAT Rx	Mode S TCAS 1090ES UAT Rx	Mode S TCAS 1090ES UAT Rx
7	Multi-Link: UAT with 1090 Tx-Only	Mode A/C 1090ES Tx UAT	Mode A/C 1090ES Tx UAT	Mode S TCAS 1090ES Tx UAT	Mode S TCAS 1090ES Tx UAT
8	Multi-Link: UAT with 1090 Rx-Only	Mode A/C Xpdr 1090ES Rx UAT	Mode A/C 1090ES Rx UAT	Mode S TCAS Rx 1090ES UAT	Mode S TCAS Rx 1090ES UAT

**\*Manufacturers are requested to cost both A0 (Mode A/C, 1090ES) and A1 configurations**



# ADS-B Configurations: Multi-Link (1090ES/VDLM4)

W/S Number	Config	GA Low/Mid	GA High/Corp	Transport (Non-PFD)	Transport (Integ PFD)
9	Multi-Link: 1090/VDLM4	Mode S* 1090ES VDLM4	Mode S 1090ES VDLM4	Mode S TCAS 1090ES VDLM4	Mode S TCAS 1090ES VDLM4
10	Multi-Link: 1090 with VDLM4 Rx- Only	Mode S* 1090ES VDLM4 Rx	Mode S 1090ES VDLM4 Rx	Mode S TCAS 1090ES VDLM4 Rx	Mode S TCAS 1090ES VDLM4 Rx
11	Multi-Link: VDLM4 with 1090 Tx-Only	Mode A/C 1090ES Tx VDLM4	Mode A/C 1090ES Tx VDLM4	Mode S TCAS 1090ES Tx VDLM4	Mode S TCAS 1090ES Tx VDLM4
12	Multi-Link: VDLM4 with 1090 Rx-Only	Mode A/C 1090ES Rx VDLM4	Mode A/C 1090ES Rx VDLM4	Mode S TCAS Rx 1090ES VDLM4	Mode S TCAS Rx 1090ES VDLM4

**\*Manufacturers are requested to cost both A0 (Mode A/C, 1090ES) and A1 configurations**



## ADS-B Configurations: Multi-Link (Triple-Link)

W/S Number	Config	GA Low/Mid	GA High/Corp	Transport (Non-PFD)	Transport (Integ PFD)
13	Multi-Link: Triple-Link	Mode S* 1090ES UAT VDLM4	Mode S 1090ES UAT VDLM4	Mode S TCAS 1090ES UAT VDLM4	Mode S TCAS 1090ES UAT VDLM4

\*Manufacturers are requested to cost both A0 (Mode A/C, 1090ES) and A1 configurations