Bird Strike Mitigation for Aviation

Christopher Drummond, Anthony Combs
Undergraduate Studies, School of EECS

Chris Bartone, Ph.D., P.E.,
Professor, School of EECS
bartone@ohio.edu, 740-591-1660 (m)

Russ College of Engineering and Technology
School of Electrical Engineering and Computer Science
Ohio University

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Outline

- **Background**
  - » **Bird Strikes in Aviation**
  - » **Previous FAA efforts**
- **Ohio University Research Items**
  - » **Overall Approach**
  - » **Bird Radar Detections**
  - » **Target Output Requirements**
  - » **Target Classification & Risk Assessment**
  - » **TIS-B/FIS-B Considerations**
  - » **TIS-B Target Report Formatting/Distribution**
  - » **Applicability of Target Report**
  - » **Plans**

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Background: Bird Strikes in Aviation

- Occur when a bird collides with an aircraft; usually cause little damage, but can be devastating (ex. American Airlines Flight 1549 Hudson River incident).

- Roughly 10,000 strikes are reported annually; estimates suggest that as few as half of total strikes are reported.

- Less than 8% of strikes occur above 3,000 feet and 61% occur at less than 100 feet (according to FAA Wildlife Hazard Management Manual).

- FAA estimates $400 million in damages annually are attributed to bird strikes in the United States alone, and over $1.2 billion in damages occur annually worldwide.

Ref: http://www.faa.gov/airports/airport_safety/wildlife/media/wildlife-strike-report-1990-2013-usda-faa.pdf

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Background: Previous FAA efforts

- **Guidance on Wildlife Strike Reports**
  - » Number and kind of strike (among other details) are required to be reported when known. These figures are public, and an estimated 39% of strikes at certified airports from 2004-2008 were reported. However, report percentages have been increasing year-to-year (1990-2013) and currently this data is under review.
- **Airport Cooperative Research Program (ACRP) Reports**
  - » FAA has funded three reports to aid airports with wildlife hazard mitigation.
- **Wildlife Hazard Awareness campaigns**
  - » Awareness is raised by FAA posters, public wildlife strike information (bird strike database)
  - » Advisory Circulars
- **Currently, avian activity is manually delivered from the avian radar to the ATC tower, then to pilots (if appropriate) via voice communications.**

Ref: https://www.faa.gov/news/fact_sheets/news_story.cfm?newsId=14393

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Background: FAA Circular (2010)

- **Provides Guidelines for Implementation On-airport property avian radar systems for:**
  - » **airport authorities**
  - » **radar manufacturers**
- **Gives Overview of Avian Radar fundamentals**
  - » **Object -> radar -> A/D -> broadcast -> processor -> data delivery (screen/radio/etc)**
- **System Selection considerations**
  - » **Radar systems operate in X-Band (8-12 GHz), S-Band (2-4 GHz), or L-Band (≈ 1GHz), each having its own advantages.**
  - » **Physical capabilities of the radar systems**
  - » **Requirements of individual airports (topology, clutter, location, native wildlife, etc)**
- **Provides Guidance for Data Storage and Management (for manufacturers and airport authorities)**
  - » **Must be capable of recording at least one hour of raw digital data (in a B-scan and/or scan-converted format) to support reprocessing.**
  - » **Avian radar systems must be capable of recording at least 24 hours of plot and track data, or regenerating plot and track data from the raw digital data. The ability to store and view any screen captures of plot and track displays is also required.**

Ref: http://www.faa.gov/documentLibrary/media/Advisory_Circular/150_5220_25.pdf
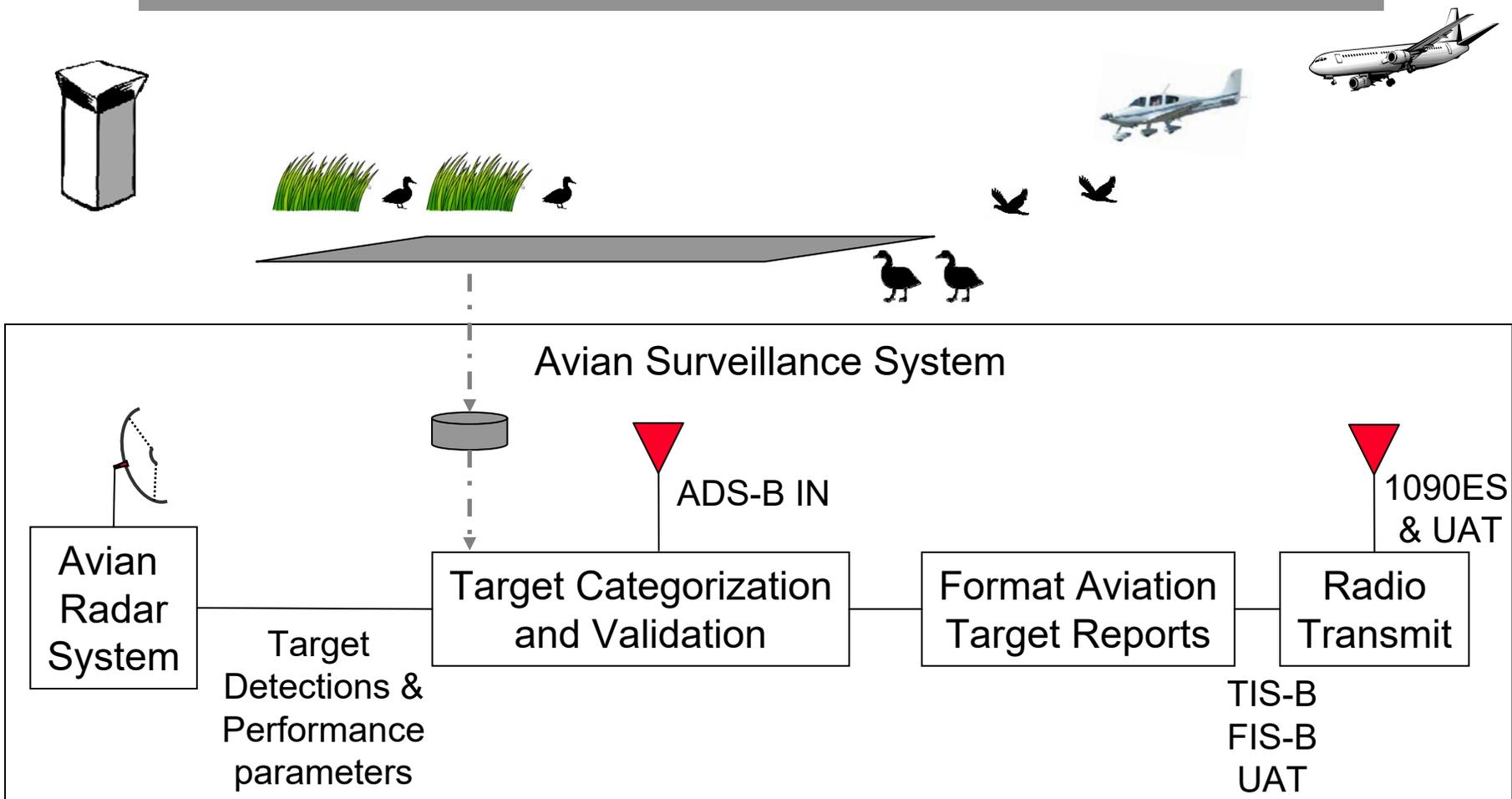
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Background: FAA Circular (cont.)

- **Key minimum performance specifications:**
  - » **Standard Avian Target (SAT) = 0.5kg (1.1 lb) with Radar-Cross-Section (RCS) of -16dBm2 @ 300 ft in moderate clutter environments (flat airport, no rain)**
  - » **Be able to detect a 1 SAT object from 0.3-1 nmi up to an elevation of 1,000 feet**
  - » **Be able to detect a 2 SAT object up to 3 nmi up to an elevation of 3,000 ft**
  - » **Have the capability to simultaneously detect and track a minimum of 1,000 individual targets**
  - » **Have a resolution which allows differentiation between two 1 SAT objects with a 165-ft distance between them in range or azimuth**
  - » **Provide coverage of the airspace defined by the flight path of the primary runway of the airport up to 3 nmi from the sensor location and elevated up to 3,000 feet, beyond which bird strike occurrences significantly drop**
  - » **Have the capability of detecting 1 SAT up to 1 nmi with a confidence level of 90% in moderate clutter environments, and up to 3 nautical miles with a confidence of 75%**
  - » **Time interval between updates and detection time for new targets must not exceed 5 sec apiece**

Ref: http://www.faa.gov/documentLibrary/media/Advisory_Circular/150_5220_25.pdf

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Ohio University Research Plans: Overview

- **Goal: Reduce bird strikes for aviation**
- **Considering a "stand-alone" Avian Surveillance System**
- **Investigate utilizing Ground-based Radar Detection and Information/signal transmission to A/C tower and A/C in/around airport**
  - » **Implement specialized avian ground-based radar on the airport property**
    - • **Produce target detections and performance parameters**
  - » **Target categorize and validation**
  - » **Create target reports**
- **Transmit Interface to NAS via aviation data links**
  - » **Aircraft: ADS-B equipped and non-ADS-B equipped via 1090ES and UAT**
  - » **ATC tower: via ADS-B**

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Ohio University Research Plans: Overview

Avian Surveillance System

ADS-B IN

1090ES & UAT

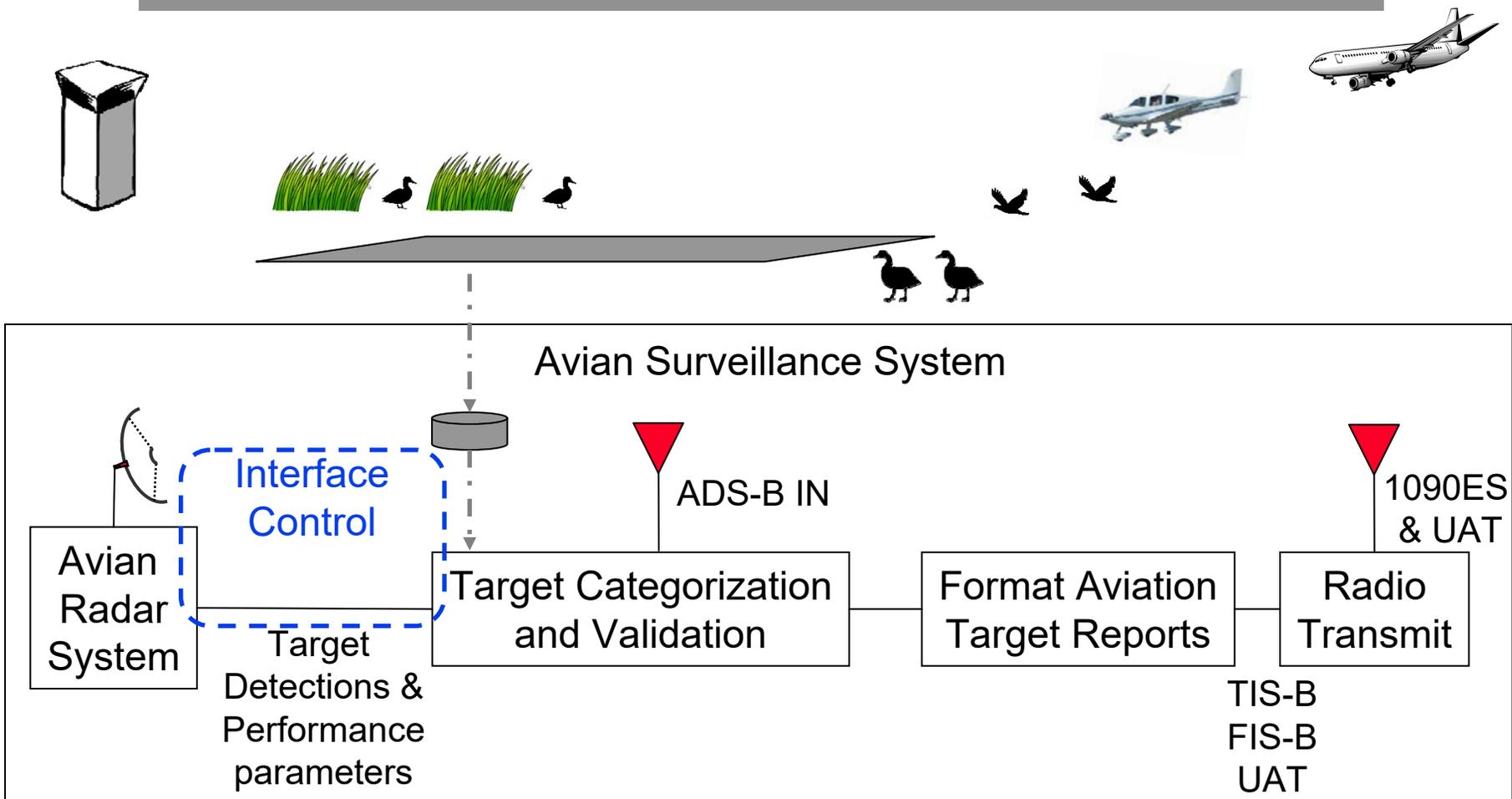| Avian Radar System | Target Detections & Performance parameters | Target Categorization and Validation | Format Aviation Target Reports | Radio Transmit |

TIS-B
FIS-B
UAT

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Related RTCA Documents for Avian Messages

1. **DO-242A Minimum Aviation System Performance Standards for Automatic Dependent Surveillance Broadcast (ADS-B)**
2. **DO-338 Minimum Aviation System Performance Standards (MASPS) for ADS-B Traffic Surveillance Systems and Applications (ATSSA)**
3. **DO-318 Safety, Performance and Interoperability Requirements Document for Enhanced Air Traffic Services in Radar-Controlled Areas Using ADS-B Surveillance (ADS-B-RAD)**
4. **DO-348 Safety, Performance and Interoperability Requirements Document for Traffic Situation Awareness with Alerts (TSAA)**
5. **DO-319 Safety, Performance and Interoperability Requirements Document for Enhanced Traffic Situational Awareness During Flight Operations (ATSA-AIRB)**
6. **DO-286B Minimum Aviation System Performance Standards (MASPS) for Traffic Information Service - Broadcast (TIS-B)**
7. **DO-260B with Corrigendum 1 - Minimum Operational Performance Standards for 1090 MHz Extended Squitter Automatic Dependent Surveillance - Broadcast (ADS-B) and Traffic Information Services - Broadcast (TIS-B)**
8. **DO-282B with Corrigendum 1, Minimum Operational Performance Standards for Universal Access Transceiver (UAT) Automatic Dependent Surveillance – Broadcast**
9. DO-323 Safety, Performance and Interoperability Requirements Document for Enhanced Traffic Situational Awareness on the Airport Surface with Indications and Alerts (SURF IA)
10. DO-323 Supplement - Supplement to DO-323: Safety, Performance and Interoperability Requirements Document for Enhanced Traffic Situational Awareness on the Airport Surface with Indications and Alerts (SURF IA)

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Ref: RTCA, Inc., www.rtca.org

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Ohio University Research Plans: Overview

Avian Surveillance System

Interface Control

Avian Radar System

Target Detections & Performance parameters

ADS-B IN

Target Categorization and Validation

Format Aviation Target Reports

Radio Transmit

1090ES & UAT

TIS-B
FIS-B
UAT

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Avian Target Detection Outputs (Requirements)

- **Identify Avian Radar Output Requirements (based on FAA circular), radar manufacture data outputs, and an ADS-B automated target reporting architecture. For example:**
  - » **RCS**
  - » **Target mass (i.e., bird body mass)**
  - » **Target classification**
    - **Single detection**
    - **Volume detection**
    - **Target type**
    - **Target ID (number)**
  - » **Location similar reporting as ADS-B Target[1]**
    - **Latitude, Longitude (referenced to WGS-84)**
    - **Height (i.e., pressure altitude)**
    - **Position Quality Indicator (both accuracy and integrity)**
  - » **Velocity[1] (i.e., ground referenced to WGS-84)**

Ref 1: DO-318 Safety, Performance and Interoperability Requirements Document for Enhanced Air Traffic Services in Radar-Controlled Areas Using ADS-B Surveillance (ADS-B-RAD), pdf pg. 82-85/582.

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Avian Radar Manufacture Liaison

- **Information gathering on avian radar manufactures;**
  - »**SRC, BSTAR Avian Surveillance and Warning System**
    - **A non-disclosure agreement has been executed between Ohio University and SRC regarding proprietary data, 11/22/2015**
    - **Data output using ASTERIX data format**
    - **Plan to obtain a sample data set to begin processing avian target reports.**
  - »**Accipiter Avian Radars**
    - **Begun discussion on data output formats.**
    - **Range**
    - **Altitude**
    - **Resolution (range, azimuth)**
    - **Detection probability, etc**
  - »**DeTect, Merlin, Avian Radar Systems**
    - **No response.**

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ASTERIX

All-Purpose **ST**ructured **E**urocontrol Su**R**veillance **I**nformation E**x**change

- EUROCONTROL Standard
- Primarily used by Air Traffic Control (ATC) Centers
- ATM Surveillance Data Binary Messaging format (and ASCII)
- Allows transmission of harmonized information between any surveillance and automation system
- Suitable for real-time implementation
- For specific applications, data items are able to be grouped into 256 separate categories
- Defines structure of data to be exchanged over communication medium
- **Support for Presentation (6) and Application (7) layers as defined by the OSI Model**

Ref: ASTERIX Overview http://www.eurocontrol.int/asterix

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ASTERIX within OSI Model

• Interface Control will focus primarily on Application (7) and Presentation (6) levels within the OSI model.

• Application - Specifies minimum requirements at the user interface (ie how the information is displayed to ATC or pilots)

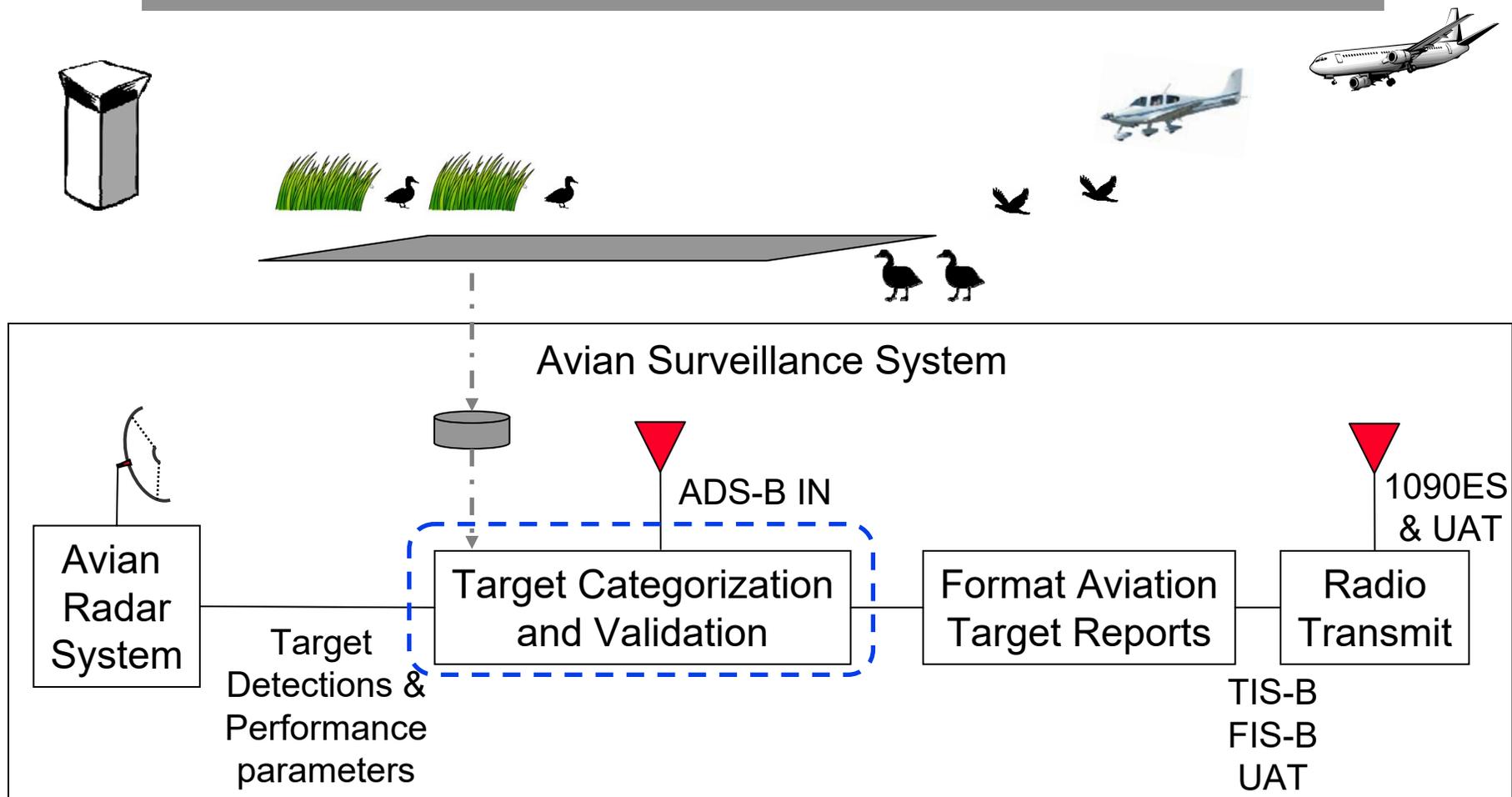• Presentation – Communication facilitated by the known ADS-B format links between the radar, ATC tower, and pilot

OSI (Open Source Interconnection) 7 Layer Model

Layer	Application/Example	Central Device/Protocols	DOD4 Model
Application (7) Serves as the window for users and application processes to access the network services.	**End User layer** Program that opens what was sent or creates what is to be sent Resource sharing • Remote file access • Remote printer access • Directory services • Network management	User Applications SMTP	Process
Presentation (6) Formats the data to be presented to the Application layer. It can be viewed as the "Translator" for the network.	**Syntax layer** encrypt & decrypt (if needed) Character code translation • Data conversion • Data compression • Data encryption • **Character Set Translation**	JPEG/ASCII EBDIC/TIFF/GIF PICT	Process
Session (5) Allows session establishment between processes running on different stations.	**Synch & send to ports** (logical ports) Session establishment, maintenance and termination • Session support - perform security, name recognition, logging, etc.	Logical Ports RPC/SQL/NFS NetBIOS names	
Transport (4) Ensures that messages are delivered error-free, in sequence, and with no losses or duplications.	**TCP** Host to Host, Flow Control Message segmentation • Message acknowledgement • Message traffic control • Session multiplexing	TCP/SPX/UDP	Host to Host
Network (3) Controls the operations of the subnet, deciding which physical path the data takes.	**Packets** ("letter", contains IP address) Routing • Subnet traffic control • Frame fragmentation • Logical-physical address mapping • Subnet usage accounting	Routers IP/IPX/ICMP	Internet
Data Link (2) Provides error-free transfer of data frames from one node to another over the Physical layer.	**Frames** ("envelopes", contains MAC address) [NIC card —— Switch—— NIC card] (end to end) Establishes & terminates the logical link between nodes • Frame traffic control • Frame sequencing • Frame acknowledgment • Frame delimiting • Frame error checking • Media access control	Switch Bridge WAP PPP/SLIP	Network
Physical (1) Concerned with the transmission and reception of the unstructured raw bit stream over the physical medium.	**Physical structure** Cables, hubs, etc. Data Encoding • Physical medium attachment • Transmission technique - Baseband or Broadband • Physical medium transmission Bits & Volts	Hub	

PACKET FILTERING — GATEWAY Can be used on all layers — Land Based Layers

Ref: https://www.itu.int/rec/T-REC-X.200-199407-I/en

Ref: http://www.escotal.com/osilayer.html

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Ohio University Research Plans: Overview

Avian Surveillance System

ADS-B IN

1090ES & UAT

Avian Radar System

Target Detections & Performance parameters

Target Categorization and Validation

Format Aviation Target Reports

Radio Transmit

TIS-B
FIS-B
UAT

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Ohio University Research Plans:
Target Categorization & Risk Assessment

- **Considering:**
  - » Avian target detections requirements
  - » Avian radar output capabilities
- **Investigate best place to do Target Categorization and Risk Assessment:**
  - » Within avian radar systems
  - » Separate processor (external to radar)
  - » Interface and parameter production requirements
- **Implement external parameters:**
  - » Bring in ADS-B-IN to display actual A/C flight path
  - » Airport surface database (i.e., runway locations)
  - » Weather, etc.

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Ohio University Research Plan: Target Report Formatting

- **Take validated target detections and create TIS-B Track Reports**
- **Categorize Track Reports and output Target Reports**
- **Format Target Reports in a standard aviation format, suitable for distribution**
- **Investigate Automatic Dependence Surveillance-Broadcast (ADS-B) integration:**
    - » **Traffic Information Service - Broadcast (TIS-B)**
    - » **Flight Information Service - Broadcast (FIS-B)**
    - » **Universal Access Transceiver (UAT)**
    - » **1090 MHz Extended Squitter (1090ES)**

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To TIS-B or FIS-B Avian Targets?

- ## Typical TIS-B:
  - » Broadcast data collected from ground-based radar
  - » Broadcast to participating users for cockpit display of traffic information
  - » Messages can be sent via 1090ES or UAT
- ## Typical FIS-B:
  - » Broadcast data collected from external sensors
  - » Weather text, weather graphics,
  - » NOTAMS (notice to airmen)
  - » ATIS (Automatic Terminal Information Service)
  - » Periodic broadcast requirements
  - » Transmitted on UAT only

Ref: DO-242A Minimum Aviation System Performance Standards for Automatic Dependent Surveillance Broadcast (ADS-B), pg 124/475.

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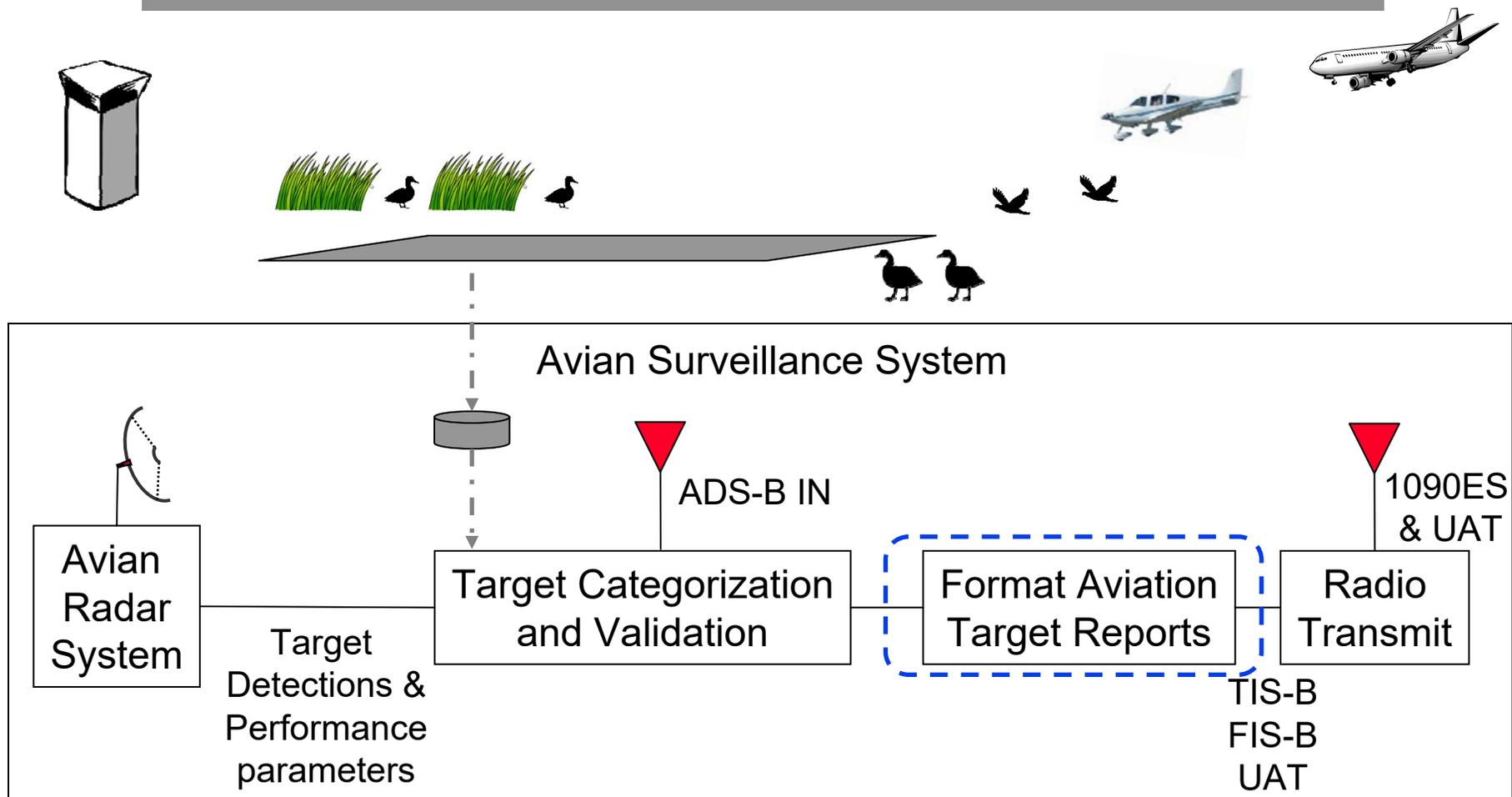
Traffic Information Service-Broadcast (TIS-B)

- **Broadcasts information to the cockpit (TIS client) via Mode S (1090ES) data link or Universal Access Transceiver (UAT)**
- **Similar to VFR radar traffic information normally received over voice radio**
  - » Provides a situational awareness display to the pilot for up to 8 "intruder" aircraft within 7 nmi horizontal distance (time of potential contact <34 s):
    - • estimated position, altitude, altitude trend, and ground track
    - • +3,500 and −3,000 ft vertically of the TIS client
  - » Provides data updates every 5 sec (commensurate with ground radar update rate)
- **Both TIS client, and possible intruder aircraft:**
  - » **Have to be TIS equipped (minimum of transponder (Mode A, C or S)).**
  - » **Within range of the ground TIS, Mode S radar (< 55 nmi)**
- **TIS-Broadcast (TIS-B) provides ADS-B equipped aircraft with data on non-ADS-B equipped aircraft**

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TIS-B Service

- **Provides ADS-B active users with:**
  - » Low-latency stream of position reports of non-ADS-B users.
- **Available to support Service Volumes:**
  - » Non-ADS-B ground sensors
  - » FAA Surveillance and Broadcast Services (SBS) System Ground System radio stations
- **TIS-B Client: receive avian report (i.e., aircraft or ATC tower)**
- **TIS-B Target: avian target**
- **TIS-B messages can contain higher-priority (i.e., time-sensitive/real-time, etc) traffic information than FIS-B service**

Ref: DO-338 Minimum Aviation System Performance Standards (MASPS) for ADS-B Traffic Surveillance Systems and Applications (ATSSA), pdf, pg 80/294.

Ohio University Research Plans: Overview

Avian Surveillance System

| Avian Radar System | | Target Categorization and Validation | Format Aviation Target Reports | Radio Transmit |

ADS-B IN

1090ES & UAT

Target Detections & Performance parameters

TIS-B
FIS-B
UAT

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TIS-B Avian Block Diagram

Avian Radar System

Flight Data Info Processing

•Aircraft Information
•ADS-B in
•Primary/Secondary Radar

•Create and Maintain Tracks
•Assess Track Quality
•Generate TIS-B Track Reports

Ground Surveillance Processing

TIS-B Track Reports

•TIS-B Target Report Filtering
•Target Report Distribution
•Distribute Service Status

Distribution

TIS-B Target Reports

•Extrapolate Target Position
•Assemble TIS-B Message
•Transmit TIS-B Message

Ground-Link-Specific Processing

TIS-B Target Report to Data Link

Ref: RTCA, DO286B Minimum Aviation System Performance Standards (MASPS) for TIS-B, Table 3.3, pg. 5

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TIS-B Track Report Definition

Element	Contents	Bit #	Req. for Airborne Tgts?	Req. for Surface Tgts?	Ref. Section	Info Needed From Radar
ID	Target Address	24	Yes	Yes	3.1.1.3.1.1	**TBD**
	Address Qualifier	1	Yes	Yes	3.1.1.3.1.1	**TBD**
	Call Sign	8(char)	Yes	Yes	3.1.1.3.1.1	**TBD**
	Target Category	5	Yes	Yes	3.1.1.3.1.1	**TBD**
TOM	Time of Measurement		Yes	Yes	3.1.1.3.1.2	**TBD**
SV	State Vector		Yes	Yes	3.1.1.3.2	**TBD**
Target	Nav. Acc. Category for Position	4	Yes	Yes	3.1.1.3.1.3	**TBD**
Quality	Nav. Acc. Category for Velocity	3	Yes	Yes	3.1.1.3.1.3	**TBD**
	Navigation Integrity Category	4	Yes	Yes	3.1.1.3.1.3	**TBD**
	Surveillance Integrity Level	2	Yes	Yes	3.1.1.3.1.3	**TBD**
	Transmit Quality Level	4	Yes	Yes	3.1.1.3.1.3	**TBD**
Status	Emergency/Priority Status	3	Yes	Yes	3.1.1.3.1.4	**TBD**
Operational	IDENT switch active	1	Yes	No	3.1.1.3.1.5	**TBD**
Mode	Receiving ATC service	1	Yes	No	3.1.1.3.1.5	**TBD**
Data	True/Magnetic Heading	1	Yes	Yes	3.1.1.3.1.6	**TBD**
Reference	Vertical Rate Type (Baro/Geo)	1	Yes	No	3.1.1.3.1.6	**TBD**
	Reserved	3	No	No		**TBD**
	Air/Ground State	2	Yes	Yes	3.1.1.3.1.6	**TBD**
Version	TIS-B Version Number	3	Yes	Yes	3.1.1.3.1.7	**TBD**

Ref: RTCA, DO286B Minimum Aviation System Performance Standards (MASPS) for TIS-B, Table 3.3, pg. 30.

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TIS-B Target State Vector Definition

Element	Contents	Bit #	Req. for Airborne Tgts?	Req. for Surface Tgts?	Ref. Section	Info Needed From Radar
Geometric	Latitude (WGS-84)		Yes	Yes	3.1.1.3.2.1	**TBD**
Position	Longitude (WGS-84)		Yes	Yes	3.1.1.3.2.1	**TBD**
	Horizontal Position Valid	1	Yes	Yes	3.1.1.3.2.1	**TBD**
	Geometric Altitude		Yes	No	3.1.1.3.2.1	**TBD**
	Geometric Altitude Valid	1	Yes	No	3.1.1.3.2.1	**TBD**
Estimated	North Velocity While Airborne		Yes	No	3.1.1.3.2.2	**TBD**
Horizontal	East Velocity While Airborne		Yes	No	3.1.1.3.2.2	**TBD**
Velocity	Airborne Horizontal Velocity Va	1	Yes	No	3.1.1.3.2.2	**TBD**
	Ground Speed While on Surface		No	Yes	3.1.1.3.2.2	**TBD**
	Ground Speed Valid	1	No	Yes	3.1.1.3.2.2	**TBD**
Estimated	Heading While on Surface	6 bits (deg)	No	Yes	3.1.1.3.2.3	**TBD**
Heading	Heading Valid	1	No	Yes	3.1.1.3.2.3	**TBD**
Baro	Pressure Altitude		Yes	No	3.1.1.3.2.4	**TBD**
Altitude	Pressure Altitdue Valid	1	Yes	No	3.1.1.3.2.4	**TBD**
Estimated	Vertical Rate Type (Baro/Geo)		Yes	No	3.1.1.3.2.5	**TBD**
Vertical	Vertical Rate Valid	1	Yes	No	3.1.1.3.2.5	**TBD**
Rate						**TBD**

Ref: RTCA, DO286B Minimum Aviation System Performance Standards (MASPS) for TIS-B, Table 3.3, pg. 33.

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Avian Targets as TSAAs

- **Investigating reporting Avian Targets as <u>Traffic Situational Awareness Alerts (TSAA)</u> with ADS-B IN, to provide:**
    - » **Alerts to flight crew to mid-air and near mid-air collisions**
    - » **Voice annunciations to flight to draw attention[2]**
    - » **Adds visual cues to Traffic Displays[2]**
    - » **Aids in visual acquisition and avoidance of traffic in both Visual Meteorological Conditions and Instrumented Meteorological Conditions; applicable under Visual Flight Rules (VFR) and Instrument Flight Rules (IFR)[1]**
    - » **TIS-B information to flight crew with indications of nearby avian activity to support see-and-avoid[2]**
    - » **The alert is intended for airborne conflicts.[1]**
- **Supported at an update 2 sec (requires additional verification)[1]**
    - » **Alerts specified at 2 sec, but max rate is 1 Hz for 1090 and UAT for airport Surface Detection Equipment, Model X (ASDE-X) tracks.**

Ref 1: DO-338 Minimum Aviation System Performance Standards (MASPS) for ADS-B Traffic Surveillance Systems and Applications (ATSSA), pdf pg 28/294, and pg 82/294.

Ref 2: DO-348 Safety, Performance and Interoperability Requirements Document for Traffic Situation Awareness with Alerts (TSAA), pdf pg 67-68/226.

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Table 2-2: Required Information Elements to Support Selected ADS-B Applications

| Information Element ↓	Situational Awareness (EVAcq/AIRB)	Visual Separation on Approach (VSA)	Airport Surface (APT, SURF)	Extended Situational Awareness (ITP)	Traffic Situation Awareness W/Alerts (TSAA)	Spacing (FIM-S)	Delegated Separation (FIM-DS)	Self Separation	ATS Surveillance ADS-B OUT
Identification									
Call Sign (Flight ID)	•[1]	•	•	•	TBD	•	TBD	TBD	•
Address	•	•	•	•	TBD	•	TBD	TBD	•
Emitter Category					TBD		TBD	TBD	•
Mode A Code					TBD		TBD	TBD	•
State Vector									
Horizontal Position	•	•	•	•	TBD	•	TBD	TBD	•
Vertical Position	•	•	•[2]	•	TBD	•	TBD	TBD	•
Horizontal Velocity	•	•		•	TBD	•	TBD	TBD	•
Vertical Velocity					TBD		TBD	TBD	•
Surface Heading			•		TBD		TBD	TBD	•
Ground Speed			•		TBD		TBD	TBD	•
NIC		•		•	TBD	•	TBD	TBD	•
Mode Status									
Emergency/Priority Status					TBD		TBD	TBD	•
Capability Codes	•	•	•		TBD	•	TBD	TBD	•
Operational Modes	•	•	•	•	TBD	•	TBD	TBD	•
NAC$_P$	•	•	•	•	TBD	•	TBD	TBD	•
NAC$_V$	•	•	•	•	TBD	•	TBD	TBD	•
SIL		•		•	TBD	•	TBD	TBD	•
SDA	•	•	•	•	TBD	•	TBD	TBD	•
Length / Width Code									•
ARV							TBD	TBD	
Intent Data [3]							TBD	TBD	

• = Data required for a target to be qualified for the application

Notes:

1. Flight ID is required for AIRB, but not for EVAcq.
2. SURF application also covers airborne targets on approach to and on departure from an airport.
3. Only refers to whether the application requires intent data, not the method in which it is delivered to the aircraft.

Ref: DO-338 Minimum Aviation System Performance Standards (MASPS) for ADS-B Traffic Surveillance Systems and Applications (ATSSA), pdf, pg 35/294.

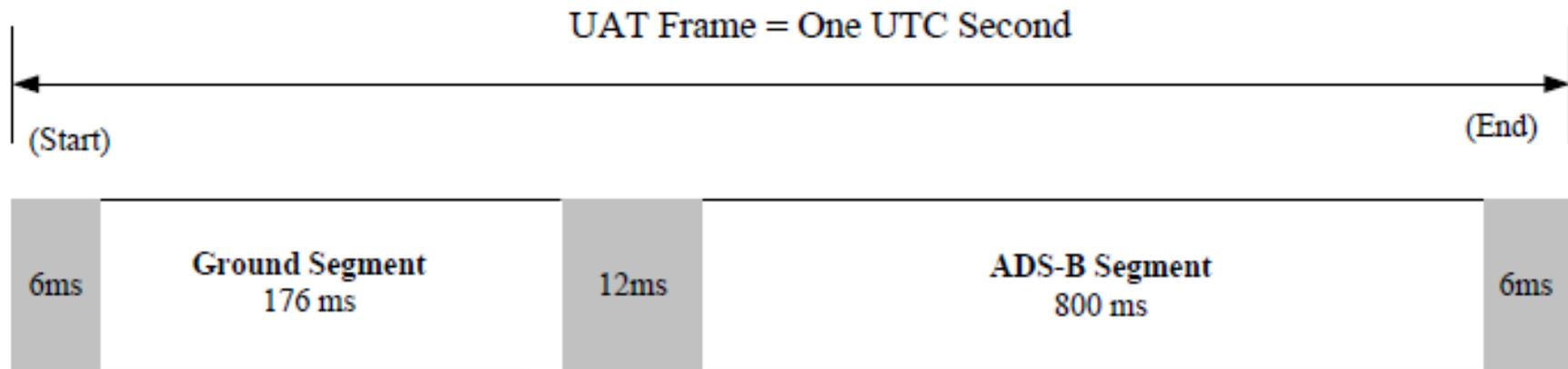OHIO UNIVERSITY

1090ES ADS-B Transmission
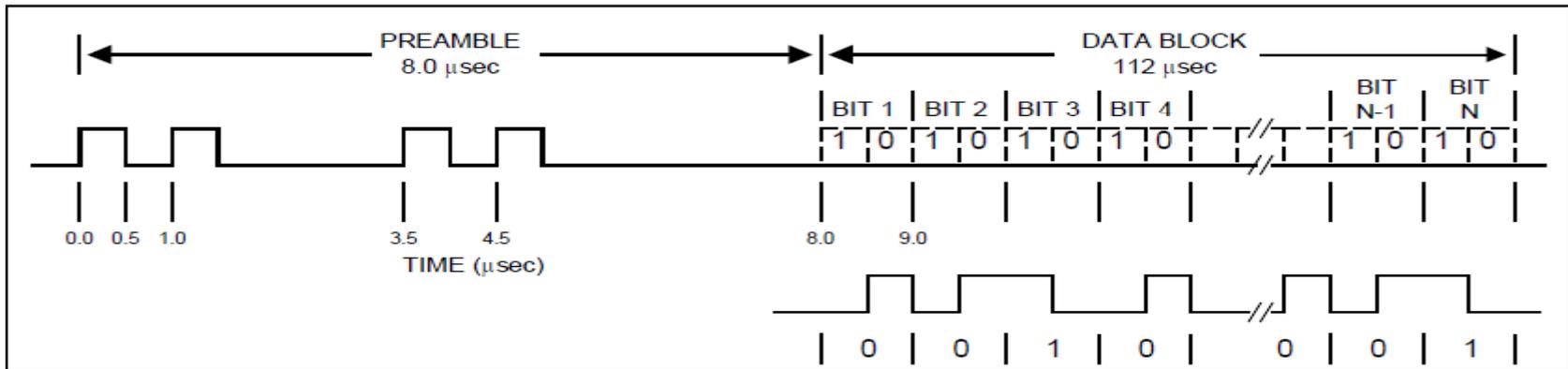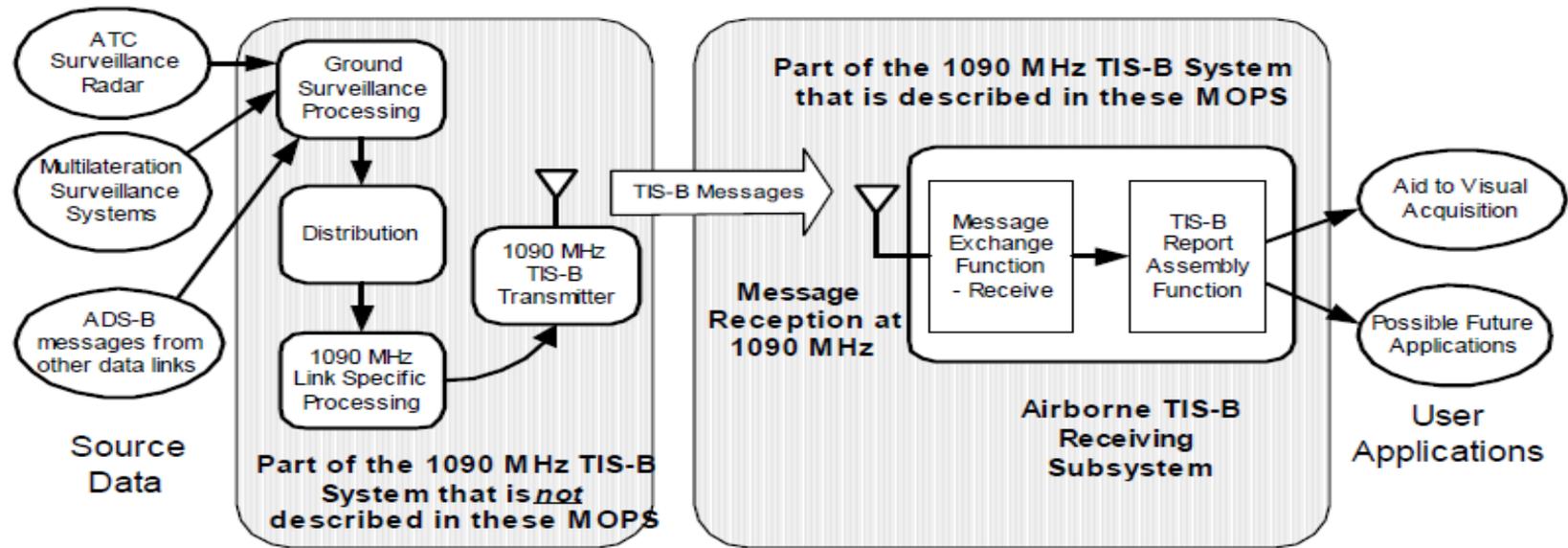
Ref: RTCA D0-260B With Corrigendum 1 pp 95 & 64

Universal Access Transceiver (UAT)

- **Frequency: 978 MHz**
- **Vertical Polarization**
- **Designed to be a multi-purpose data link for surveillance related applications**
  - » **Nominal channeling signal rate: ~1Mbps**
- **Can support:**
  - » **Automatic Dependence Surveillance-Broadcast (ADS-B),**
  - » **Flight Information Service-Broadcast (FIS-B),**
  - » **Traffic Information Service-Broadcast (TIS-B),**
  - » **Potentially other applications**
- **"Uplink" from ground contains:**
  - » **176ms of 1000 ms UAT Frame=1 UTC second**
  - » **weather**
  - » **flight information**
  - » **advisories**
  - » **etc.**
- **"Downlink" from Aircraft:**
  - » **800ms of 1000 ms UAT Frame=1 UTC second**
  - » **ADS-B information**

Ref: RTCA, MOPS for UAT ADS-B, DO-282A, SC-186, July 29, 2004

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UAT Transmission Frame (per second)

UAT Frame = One UTC Second

(Start)   (End)

| 6ms | Ground Segment 176 ms | 12ms | ADS-B Segment 800 ms | 6ms |

- Ground segment transmission consists of 32 messages @ 5.5 ms/message, transmitted at a rate of 100 kbps.
  - FIS-B data transmitted in this Ground Segment
- ADS-B Segment 145 messages @ 5.5 ms/message
  - TIS-B data transmitted in this ADS-B Segment
- Avian radar systems must be able to track 1000 targets and update no less than every 5 seconds
  - Message capacity vs target reports rates under further assessment.

Ref: RTCA D0-282B with Corrigendum 1 page 36

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FIS-B Avian Information

- **Discussions with Wildlife Surveillance Concept (WisC) FAA personnel[1] emphasized:**
  - » **1) Use of TIS-B TSAA will be very valuable.**
 - » **2) FIS-B could be used to collect avian activity for non-critical activities**

1. Phonecon w/ Anton Koros (FAA ANG-C54), Mark Hale (CSSI), Ryan King (FAA ANG-E261), Oct 19, 2015

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FIS-B Avian Information

- **Avian activities could be collected and formatted on a FIS-B for advisory purposes:**
    - » **More specific/detailed avian advisory than is currently broadcast on ADAS (Automated Weather Observing System (AWOS) Data Acquisition System (ADAS)).**
    - » **Could be used to collect historical data on avian activity at a particular airport (some of which is done manually today).**
    - » **FIS-B data could be used to illustrate avian regions of activity (i.e., similar to broadcast weather text and graphics information).**

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Possible Avian Display Symbology

- **FAA investigated three different potential display formats for avian reports:**
    1. **Text**
    2. **Target, for display on the Standard Terminal Automation Replacement System (STARS)**
    3. **Supervisor.**

Speed
Direction
004 07
008 07
Altitude
Avian Symbol
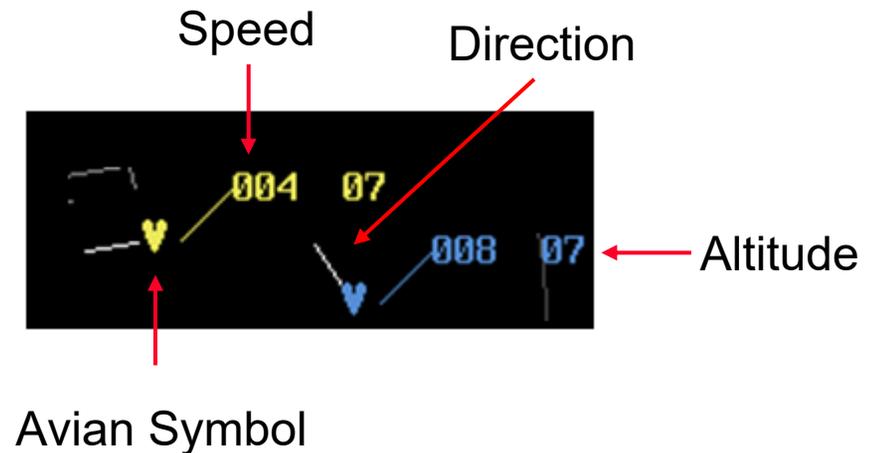
- Yellow: Medium priority (i.e., advisory)
- Blue: Low priority

Ref: Anton Koros, ANG-C43, Wildlife Surveillance Concept (WiSC), Socialization Briefing,ANG-C5 Brief, June 25, 2015

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Ohio University Research Plans: Conclusion/Report to FAA

- **Plan to provide Quarterly Updates to the FAA via the JUP, over the next quarter, with plans to concentrate on:**
  - » **Continuing to evaluate overall approach**
  - » **Avian Radar output requirements and capabilities**
  - » **TIS-B data link formats**
  - » **FIS-B data link formats**

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Bird Strike Mitigation for Aviation

Comments/Questions/Suggestions???

Christopher Drummond, Anthony Combs
Undergraduate Studies, School of EECS

Chris Bartone, Ph.D., P.E.,
Professor, School of EECS
bartone@ohio.edu, 740-591-1660 (m)

Russ College of Engineering and Technology
School of Electrical Engineering and Computer Science
Ohio University

Joint University Program
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