FAA UAS SYMPOSIUM

Setting R&D Priorities

Industry Development vs. Regulatory & Operational Responsibility

Moderator: Sabrina Saunders-Hodge

Manager, UAS Research Division, FAA UAS Integration Office

Federal Aviation Administration

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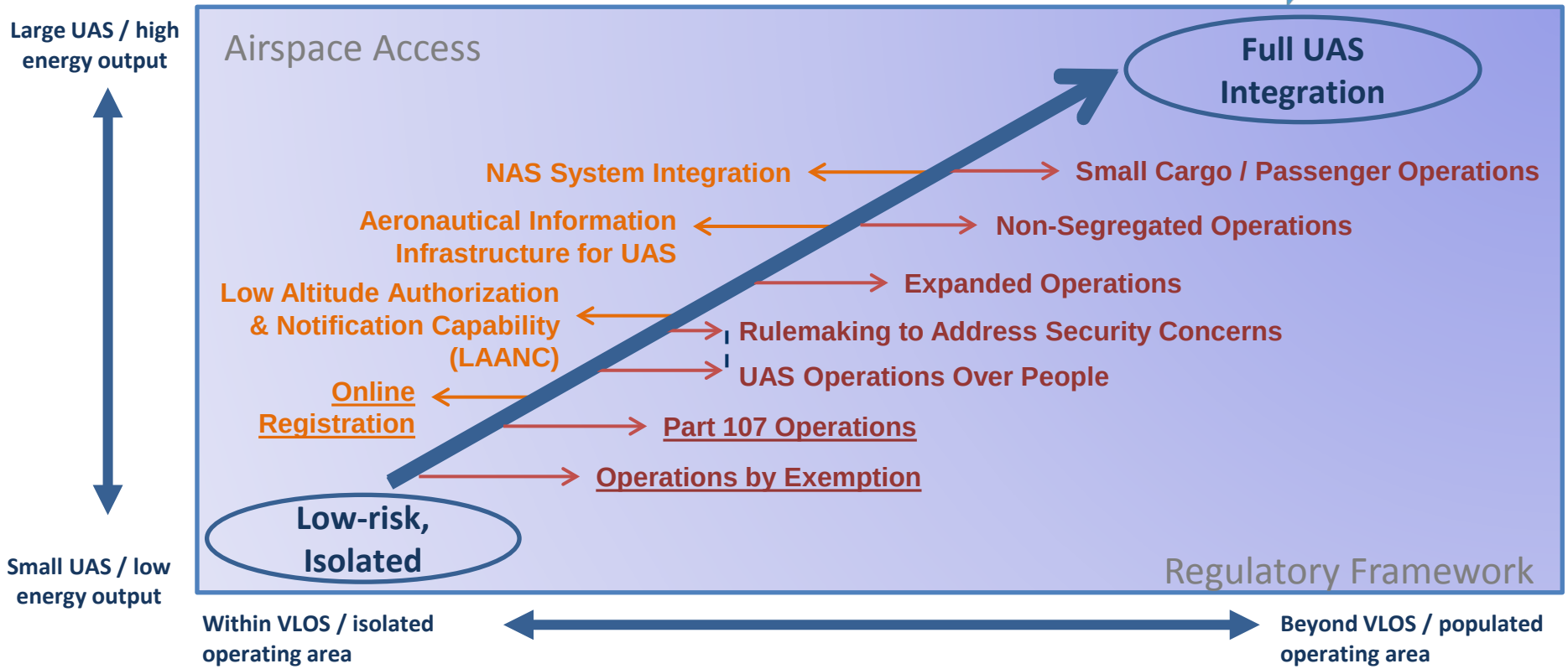
Breakout Session 2A: Setting R&D Priorities

- **Moderator: Sabrina Saunders-Hodge,** Manager, UAS Research Division, FAA UAS Integration Office
- **Paul Fontaine,** Director, Advanced Concepts and Technology Development, FAA NextGen Office
- **Marty Rogers**, Executive Director, ASSURE – FAA's UAS Center of Excellence
- **Mark Blanks**, Director, Mid-Atlantic Aviation Partnership at Institute for Critical Technology and Applied Science, Virginia Tech and UAS Test Site
- **Edgar Waggoner**, Director, Integrated Systems Research Program, NASA
- **Dr. Hassan Shahidi**, Director, Aviation Safety, MITRE Corporation

The Path to Full Integration



FAA Rulemaking Process

Administrative Procedures Act
governs regulatory process for all agencies

Pre-Rulemaking Activities

Optimal Rulemaking Timeline – 36 months

~20 Months | **16 Month Congressional Requirement on FAA**

~3-24 months	*~9-12 months*	*4.5 months*		*~3 months*	*11.5 months*		*4.5 months*	
• Prioritization • International Considerations • Committees (ARC/ARAC)	**NPRM** **Regulatory Impact Assessment (RIA)** **FAA Coordination**	Executive Coordination OST – 45 Days OMB – 90 Days EO 12866	**NPRM Issued**	**Comment Period**	**Comment Disposition**	**Final Rule** **Regulatory Impact Assessment (RIA)**	Executive Coordination OST – 45 Days OMB – 90 Days EO 12866	**Final Rule Issued**

Drivers for Pre-Rulemaking

- EO 13563 - RRR
- Congressional mandates
- EO 13609 – International Cooperation
- NTSB Recommendations
- Petitions for Rulemaking
- Emerging Risk

*LOB/SME Evaluates Options and Scope

Requirements for Consideration for NPRM & Regulatory Evaluation

- TRADE Agreement Act
- Regulatory Flexibility Act
- Unfunded Mandate Reform Act
- OMB Circular A-4
- Paperwork Reduction Act
- National Environmental Policy Act
- Trade Agreements Act
- EO 13132 – Federalism
- EO 13211 – Energy Supply, Distribution or Use
- Small Business Regulatory Enforcement Fairness Act

**Rulemaking team:
LOB/SME (ARM, APO, AGC) Draft Rule (Reg Text) & RIA (Economic Impact)

Responsibility Matrix

* At Pre-Rulemaking stage, the LOB/SME evaluates options and scope of the Rule

** At NPRM stage, the Rulemaking Team drafts the Rule and RIA

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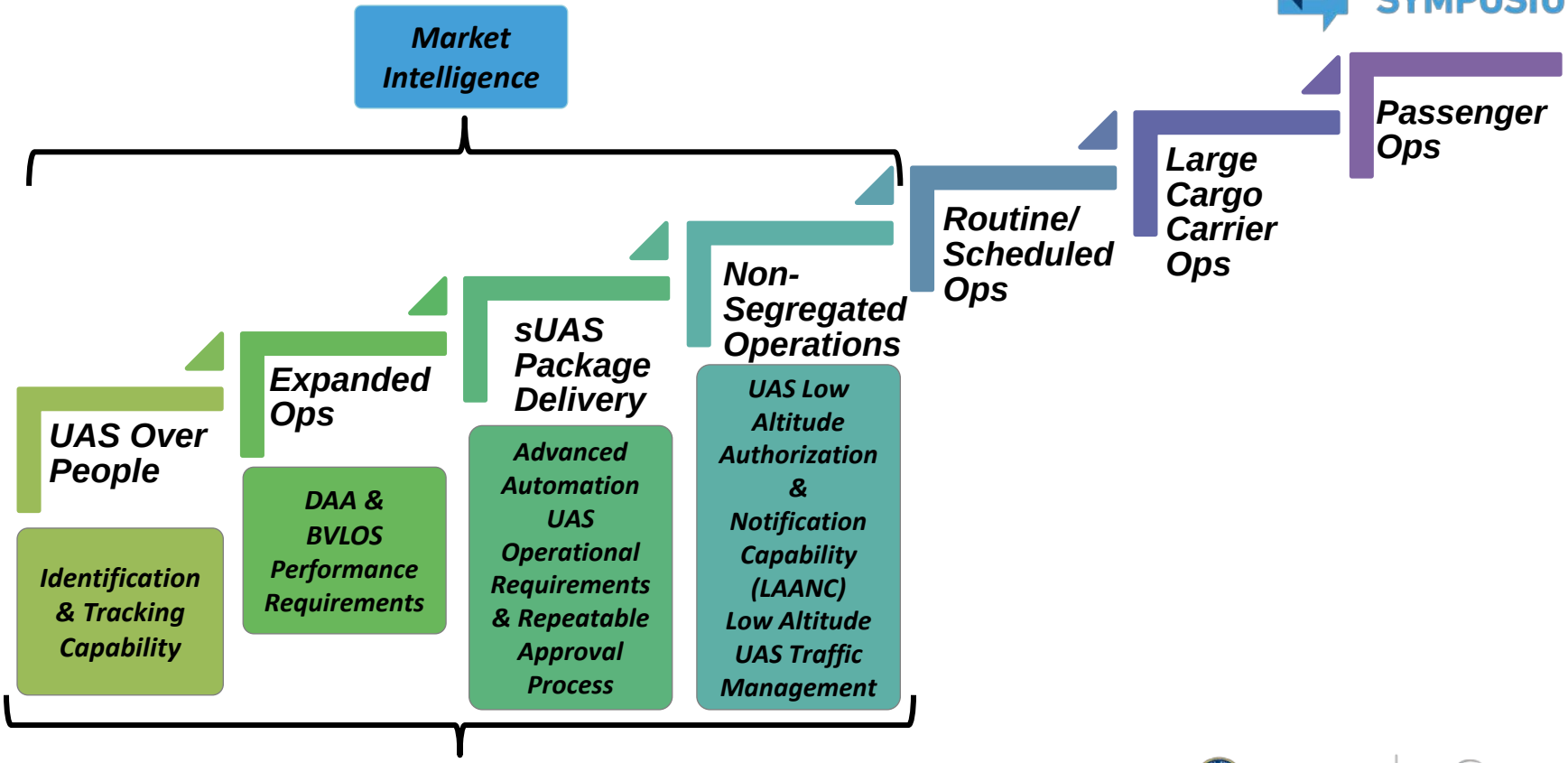
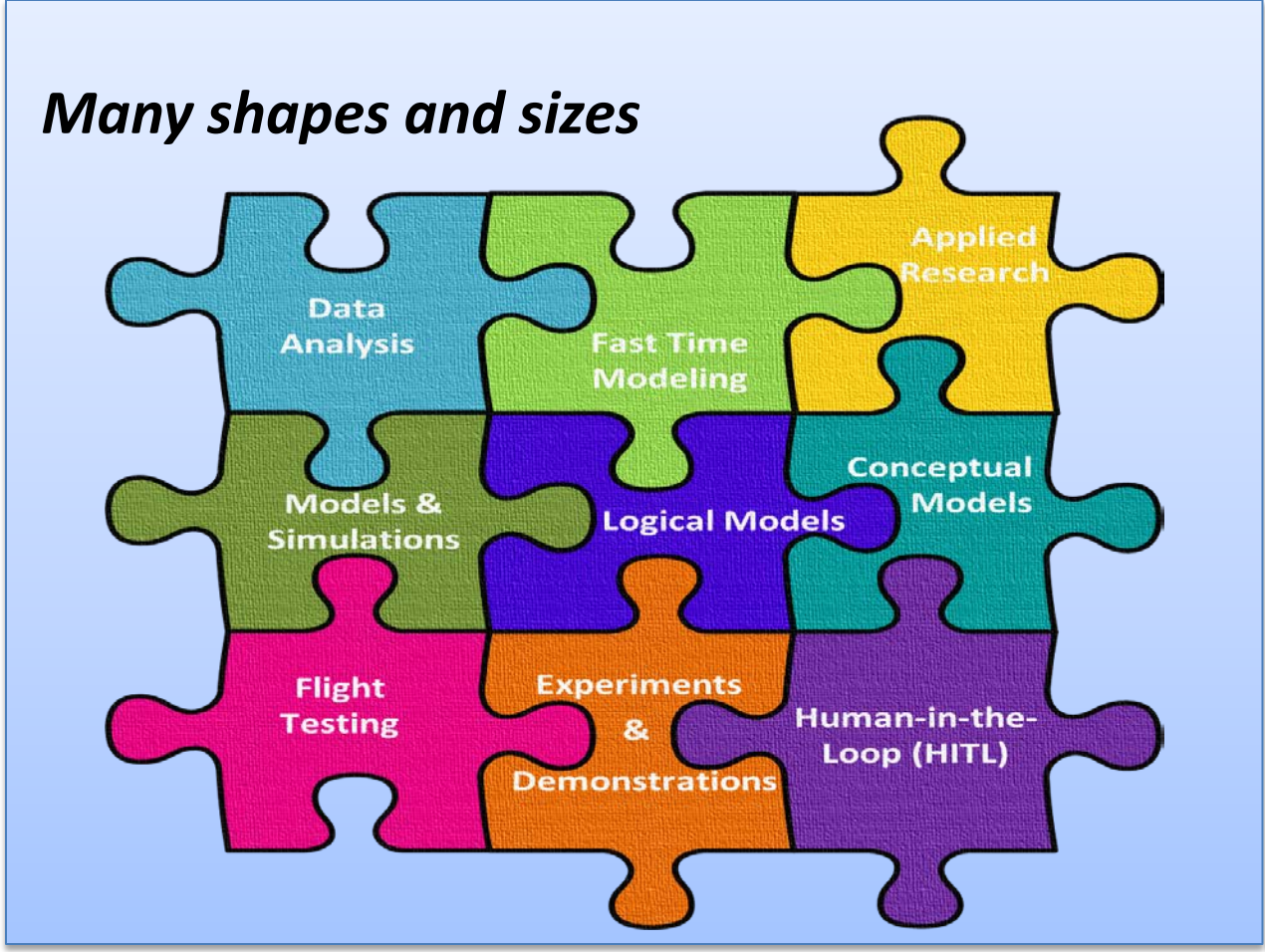
UAS Operational Capabilities Development



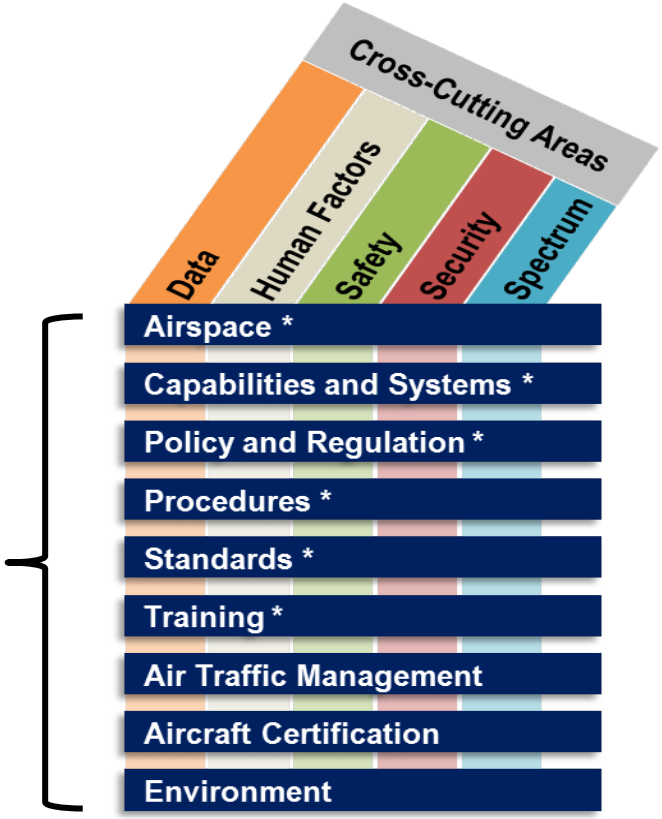
What is *Applied* Research?

”Directed towards a specific practical aim or objective.”



Functional & Cross-Cutting Domains for UAS Integration Research Planning

FAA UAS SYMPOSIUM



Key Functional Domains

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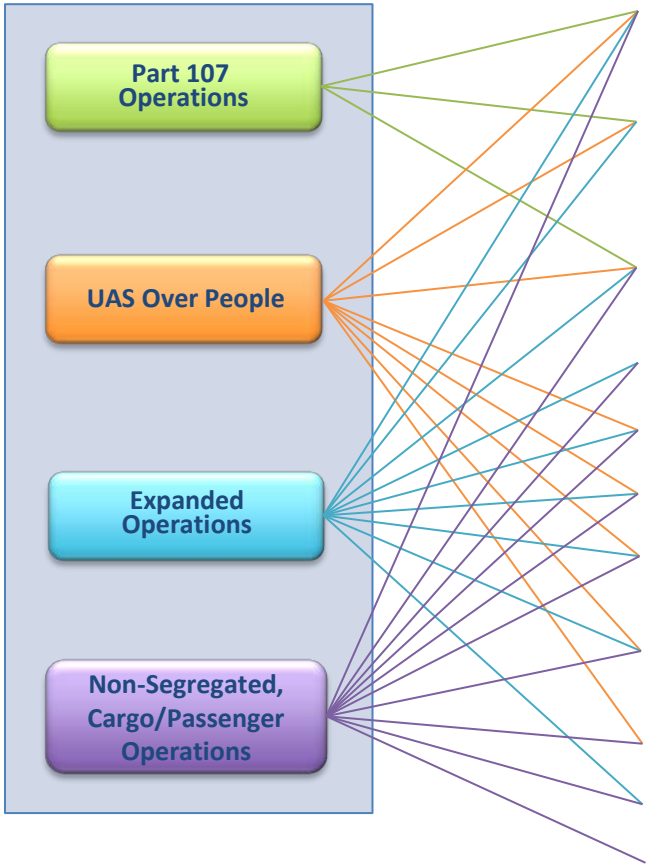
Mapping of Key Research Activities



FAA Integrated Research (AUS, AVS, ASH, ATO, ARP, APO, ANG/Tech Center)

Focus Area Pathfinders
- ConOps
- Operational procedures and risk analysis
- Standards development
- Flight testing

UAS Center of Excellence
- Kinetic energy research
- Ground and airborne collision evaluation
- Impact risk analysis

NASA
- UAS Traffic Management (UTM), UAS in the NAS

UAS ExCom SARP (FAA, DoD, NASA, DHS, DOJ, DOI, DOC, *DOE*)
- Population & airspace density risk assessment, 'Well Clear' definition

UAS Test Sites
- Missions & research lessons learned

International
- Standards and procedures harmonization (ICAO, JARUS, SESAR, CAAs)

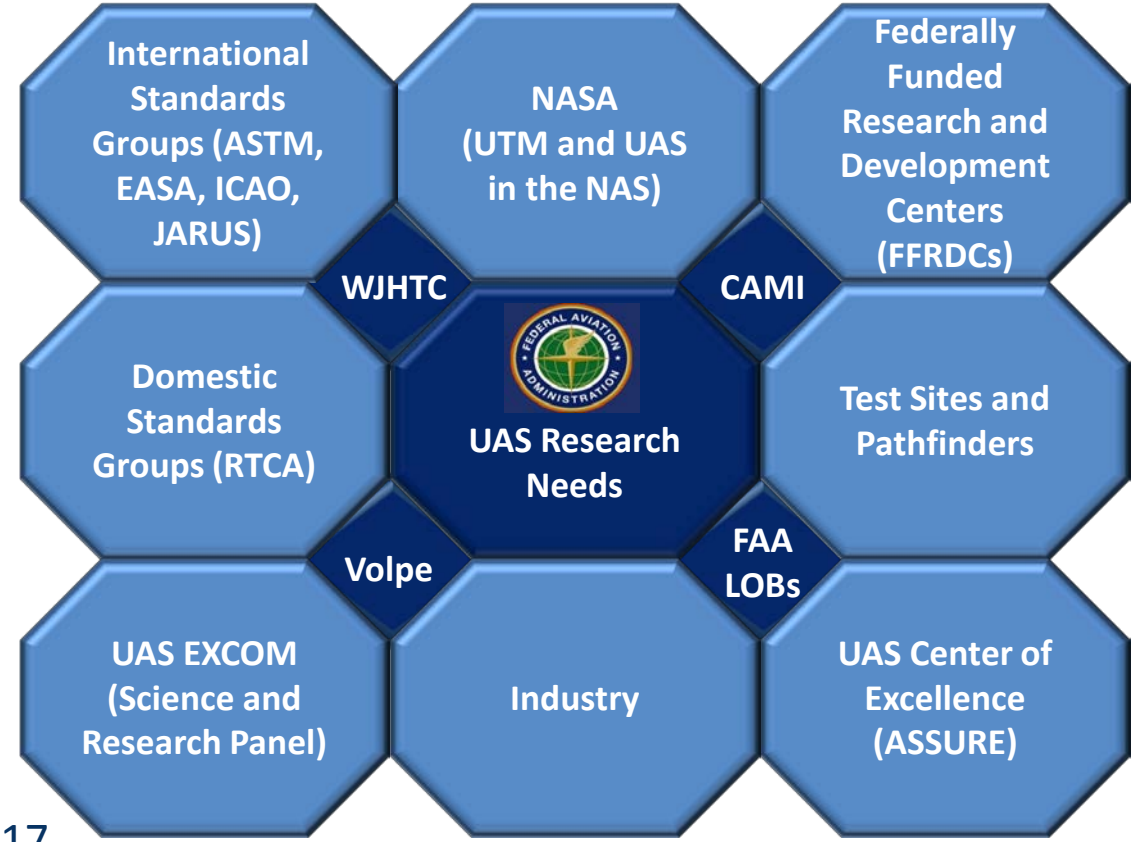
FFRDCs
- Data forecasting, airworthiness standards, risk analysis
- Small cargo delivery analysis
- Technical performance-based standards

ASTM International
- Standards development for ops over people and BVLOS, Operational risk analysis

National Academies
- Probabilistic risk study

RTCA
- DAA and C2 standards development

FAA UAS Research Partnerships



NextGen Overview

Paul Fontaine
Director, Portfolio Management and Technology Development

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Overview

- Collaboration
- NextGen Research Overview
- Scope of NextGen Research

Collaboration

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FEDERAL AVIATION ADMINISTRATION

NASA

DEPARTMENT OF JUSTICE

DEPARTMENT OF DEFENSE UNITED STATES OF AMERICA

The FAA's UAS Center of Excellence for UAS Research

ASSURE

Alliance for System Safety of UAS through Research Excellence

RTCA

THE GOLD STANDARD FOR AVIATION SINCE 1935

CACI

NORTHERN PLAINS UAS TEST SITE

NUAIR ALLIANCE

MAKING FUTURE SKIES SAFER

NM STATE UNIVERSITY

PRECISIONHAWK

TEXAS A&M UNIVERSITY CORPUS CHRISTI

LONE STAR UAS

CENTER OF EXCELLENCE & INNOVATION

NEVADA INSTITUTE FOR AUTONOMOUS SYSTEMS

UNMANNED AIRCRAFT SYSTEMS

BNSF RAILWAY

CNN

MID-ATLANTIC AVIATION PARTNERSHIP

ACUASI

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NextGen Research Overview

- Developed the overarching UAS CONOPs
- Coordinate with FAA research sponsors to select and conduct research to enable the integration of UAS systems into the NAS
  - Currently focused on less than 55 lbs.
  - Primarily supporting development of guidelines and regulations
  - Continue efforts through the spectrum of capabilities
- Leads FAA efforts on Research Transition Teams (RTTs) with NASA
  - UAS Traffic Management (UTM) RTT
  - UAS in the NAS RTT
- Drone Advisory Committee
- Manages the ASSURE Center of Excellence

Scope of NextGen Research

FAA UAS Research Requirements by Domain (FY 2013-FY 2019)		
Research Domain	**Research Requirement Title/Topic**	**Duration**
Detect and Avoid		
	SAA System Certification Obstacles	2013-2016
	▪UAS Operational Assessment: Visual Compliance	
	▪Well Clear	
	SAA Multi Sensor Surveillance Data Fusion Strategies	2013-2017
	Surveillance Criticality	2015-2017
	Integration of Collision Avoidance (ACAS-Xu)	2015-2016
	Small UAS Detect and Avoid Requirements Necessary for Limited Beyond Visual Line of Sight (BVLOS)	2015-2017
	Small UAS Well Clear Definition	2016-2017
	sUAS In and Around Busy Commercial Airspace	2016-2017
Command and Control		
	Ground to Ground Communication Architecture	2015-2017
	Control Non Payload Communication Testing	2014-2016
	UAS Command and Control Link Capability	2016-2018
	Secure Command and Control Link with Interference Mitigation	2016-2018
	UAS Training Device Qualification Criteria	2018-2020

Scope of NextGen Research (cont.)

FAA UAS Research Requirements by Domain (FY 2013-FY 2019)		
Research Domain	**Research Requirement Title/Topic**	**Duration**
Human Factors		
	TRACON UAS Contingency Operations	2014
	En-Route UAS Contingency Operations	2016
	UAS Human Factors Control Station Design	2016-2019
Aircraft Safety / Safety Risk		
	Systems Safety Criteria	2014-2017
	▪Ground Collision Severity Evaluation	
	▪Airbourne Collision Severity Evaluation	
	Enabling Safety Oversight	2015
	UAS Maintenance, Modification, Repair, Inspection, Training and Certification Considerations	2015-2018
	Fuel Cell Energy Supply for UAS	2016-2018
	Lithium Batteries for UAV Systems and Aerospace Applications	2016-2018

Scope of NextGen Research (cont.)

FAA UAS Research Requirements by Domain (FY 2013-FY 2019)		
Research Domain	**Research Requirement Title/Topic**	**Duration**
UAS Test Sites		
	UAS Test Sites (Flight Data Analysis, MLS)	2015-2016
Operational Integration		
	sUAS Airport Detection	2016
	sUAS Part 107 Electronic Accident Reporting Development	2016
	Part 107B Electronic Waiver Processing Development	2016
	Part 107 Waiver Request Case Study	2016
Airworthiness		
	Certification Test Case to Validate UAS Industry Consensus Standards	2015-2016

The FAA's Center of Excellence for UAS Research

ASSURE

Alliance for System Safety of UAS through Research Excellence

"Informing UAS Policy Through Research"

FAA UAS Symposium

Marty Rogers, Executive Director

MISSISSIPPI STATE UNIVERSITY

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What is ASSURE

- Long title: The Alliance for System Safety of UAS Through Research Excellence
- ASSURE is the Federal Aviation Administration's Center of Excellence for Unmanned Aircraft Systems…using research evidence to influence policy
- In May 2017 will be two years old
- 23 Schools & 110+ Partners

ASSURE University Team

Formal Partners

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ASSURE Projects

- A1: Certification Test Case to Validate sUAS Industry Consensus Standards - KSU
- A2: Small UAS Detect-and-Avoid (DAA) Requirements for Beyond-Visual-Line-of-Sight Operations (BVLOS) - NMSU & UND
- A3: UAS Airborne Collision Severity Evaluation - WSU
- A4: UAS Ground Collision Severity Evaluation - UAH
- A5: UAS Maintenance, Modification, Repair, Inspection, Training, and Certification - KSU
- A6: Surveillance Criticality Study - NC State
- A7: Human Factors Station Design Standards - Drexel University
- A8: UAS Noise Certification - MSU
- A9: Secure C2 & Spectrum Management - Ohio State
- A10: Human Factors UAS Control Station Certification and Procedures - ERAU
- A11 Low Altitude Safety: Part 107 Waiver Request Study - UAH
- UAS as a STEM Minority Outreach Learning Platform for K/12 - NMSU
- Total Dollar Amount in UAS Research: $12,194,466

ASSURE Partnership

- Starting in 2017 the ASSURE partnership program changed to reflect ASSURE's evolving needs to support and execute the UAS research projects we are tasked with by the FAA.
- ASSURE creates an opportunity for industry and university partners to "pool" resources together with other contributors as well as Federal funding, significantly compounding investment levels.
- Certified Partners are industry or university partners which are paying members of the ASSURE program, and as such are eligible to receive information related to the research being conducted.

ARDC

- 501c3: A non-profit UAS applied research and development company – started to support the of government and industry sponsors.

- Assure Research and Development Corporation (ARDC)

- Master Service Agreement (MSA) being finalized, with subordinate funded task orders. Value $25M.

Questions?

ASSUREuas

ASSUREuas

ASSURE UAS

www.ASSUREuas.org

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UAS R&D Priorities Panel

Mark Blanks – Director, Mid-Atlantic Aviation Partnership (MAAP)

UAS Test Sites

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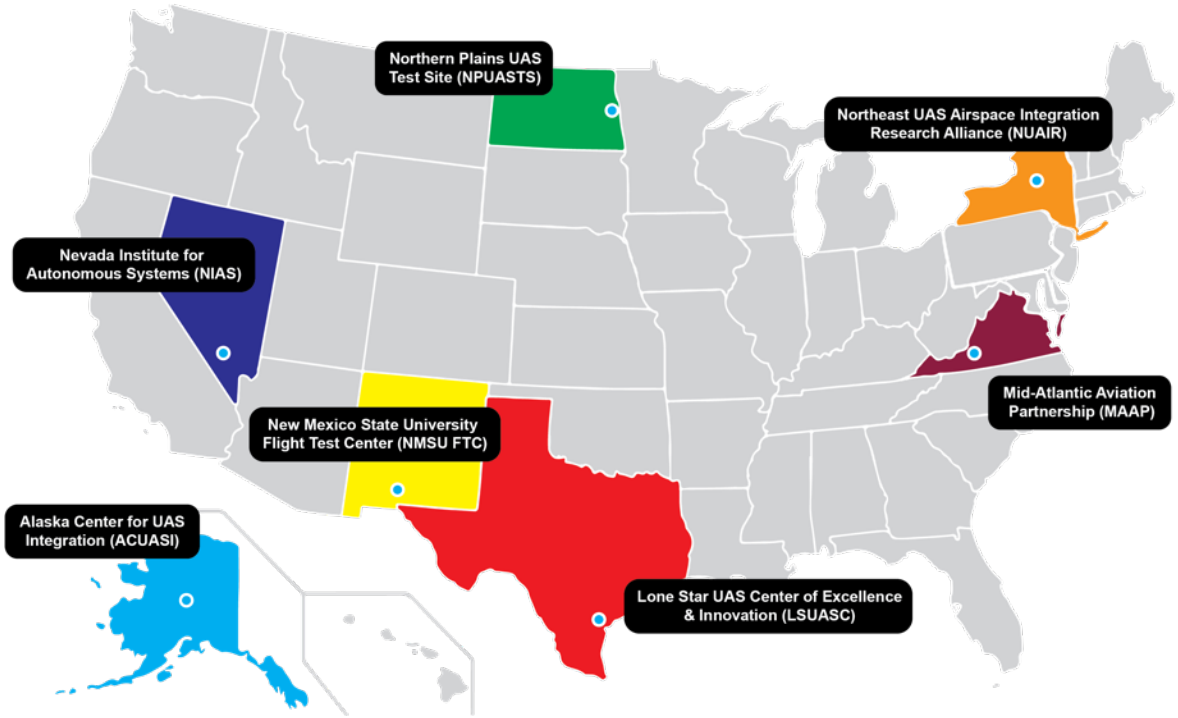
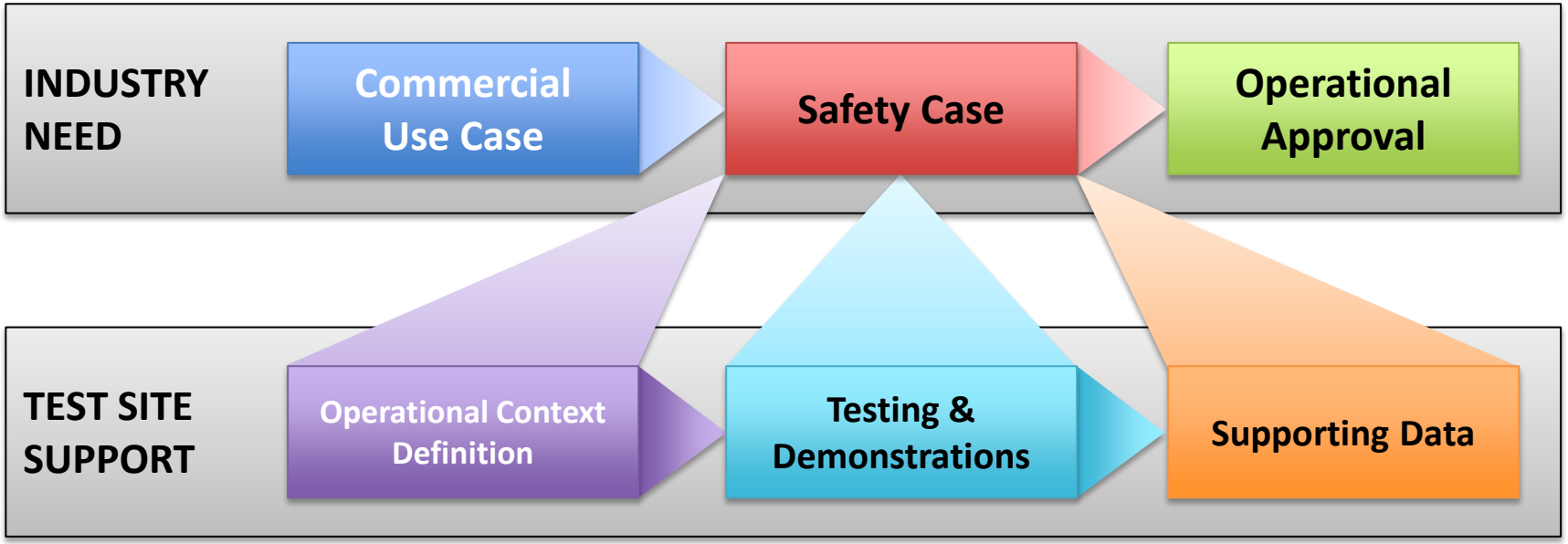
What are the Test Sites?



What do we do?


INDUSTRY NEED
Commercial Use Case
Safety Case
Operational Approval
TEST SITE SUPPORT
Operational Context Definition
Testing & Demonstrations
Supporting Data

How do we support industry?

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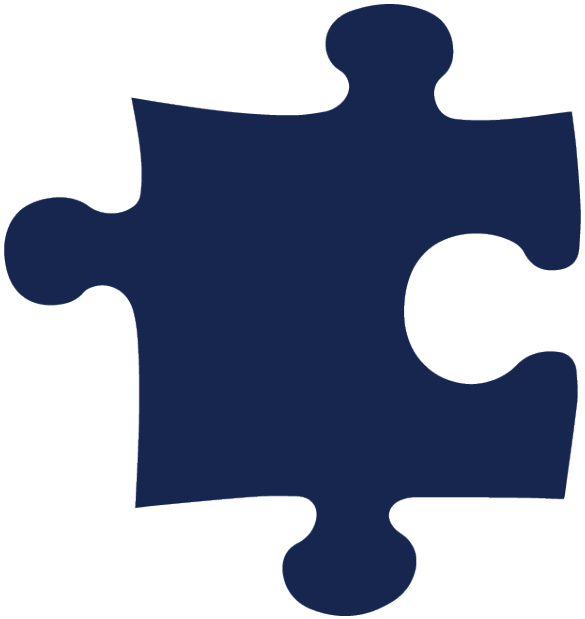
Locations	Facilities	Expertise	Data Collection
• Test new technologies • Validate risk mitigations • Demonstrate safety case	• Equipment (i.e. radars) • Ground infrastructure • Logistical support	• Risk management • Test planning & management • Specific topic areas	• System performance • Demonstrate compliance • Support safety case

How do we fit in the research puzzle?

- Testing of research concepts to provide data and lessons learned
- Test Sites provide “real world” data from industry to the regulator
- Quantifiable data from objective sources to inform decision making



What are we doing with our research?

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Answering Research Questions

Specific

- What kind of injury risk exists?
- Does UTM handle exceptions?

General

- What is the system reliability?
- Are risk mitigations acceptable?

Providing Data

Existing Mechanisms

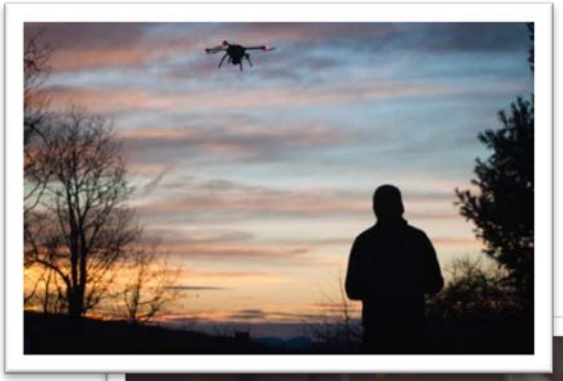
- Supporting Part 107 waivers
- Supporting Type Certification

Targeted Reports

- Providing research reports
- Direct to standards groups

What do we need from industry?

- Willingness to collaborate with other industry partners to address difficult challenges
- New solutions to old problems
- Unique solutions to new problems



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UAS Research Requirements to Support a Full Integration Strategy

Dr. Edgar G. Waggoner

Director, Integrated Aviation Systems Program

NASA, Aeronautics Research Mission Directorate

Federal Aviation Administration

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Introduction

Purpose: Develop a cohesive ARMD Full UAS integration Strategy across NASA Aeronautics Programs

Scope: Focus on what research is needed to enable full integration of UAS for civil / commercial operations within the NAS by ~2025.

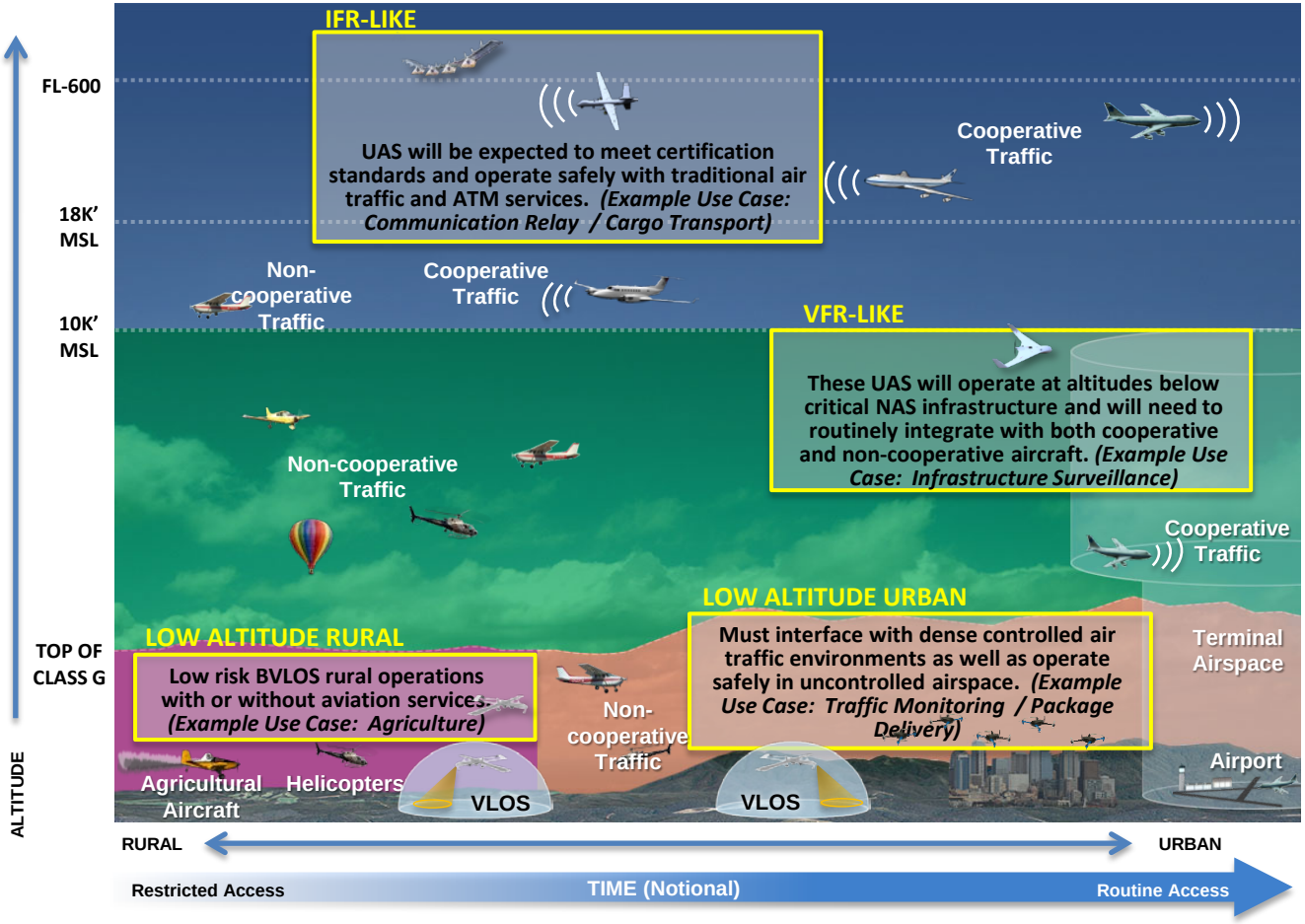
- Top level strategy that assesses stakeholder needs, FAA UAS Integration Strategy, Concept of Operations, Implementation Plans, etc.
- Leverage information from Government-wide R&D Analysis (ExCom) and FAA R&D Roadmap

Outcome: A Vision, Strategic Plan and Communication Strategy for:

- Routine UAS access within the NAS
- Concept for transitioning UAS access advancements towards the integration of highly autonomous systems and on-demand mobility

Enabling Full Integration of UAS for civil / commercial operations within the NAS by ~2025

Future Civil UAS Airspace Environment



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UAS Airspace Access Enablers

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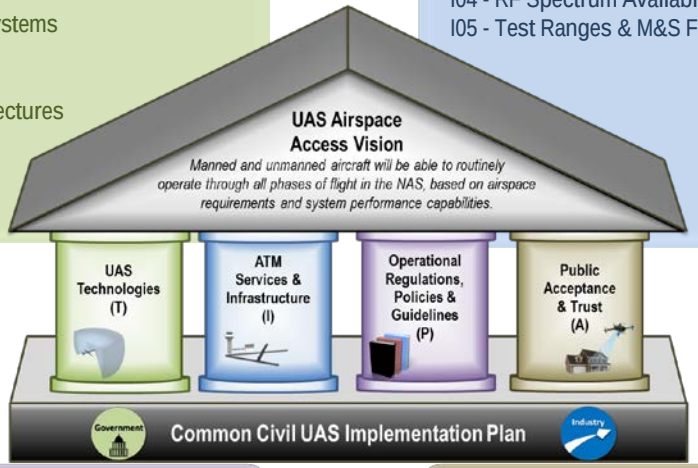
UAS Technologies:

T01 - Airport Operations Technologies
T02 - Airworthiness Standards
T03 – Command, Control, Communications (C3)
T04 - Detect & Avoid (DAA)
T05 - Flight & Health Mngmt Systems
T06 - GCS Technologies
T07 - Hazard Avoidance
T08 - Highly Automated Architectures
T09 – Navigation
T10 - Power & Propulsion
T11 - Weather

ATM Services & Infrastructure:

I01 - Airport Infrastructure
I02 - ATM Infrastructure
I03 - Non-FAA Managed Airspace Infrastructure
I04 - RF Spectrum Availability
I05 - Test Ranges & M&S Facilities



Operational Regulations, Policies & Guidelines:

P01 - ATM Regulations / Policies / Procedures
P02 - Airworthiness Regulations / Policies / Guidelines
P03 - Operating Rules / Regulations / Procedures
P04 - Safety Risk Mngmt & Methods of Compliance

Public Acceptance & Trust:

A01 - Cybersecurity Criteria & Methods of Compliance
A02 - Legal & Privacy Rules / Guidelines
A03 – Noise Reductions
A04 - Physical Security Criteria & Methods of Compliance
A05 - Public Safety Confidence

Summary and Next Steps

- NASA has conducted a comprehensive assessment of research needs/requirements to support full integration of UAS throughout the NAS.
- NASA is ready to begin vetting our parochial findings among the UAS Stakeholder Community
  - Validation of research needs
  - Feedback on:
    - Priorities and Risks
    - Responsibilities
    - Timing

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Research Needs for UAS Integration

Dr. Hassan Shahidi

Portfolio Director for Safety, Training and New Entrants

Center for Advanced Aviation System Development

The MITRE Corporation

Federal Aviation Administration

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UAS Integration Research Landscape

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Airworthiness and Flight Standards

- Collision Avoidance
- Airworthiness Approval
- Operational Approval

Airspace Management

- Low Altitude Traffic Deconfliction
- Fully Automated UAS Operations
- Airspace Design

Security

- Security Requirements

Environment

- Noise Impacts

Access and Equity

- Funding UAS Services
- Incompatible Use of Airspace

Capacity and Efficiency

- ATC Workload and Capacity

MITRE Work Enabling SUAS Ops

FAA UAS SYMPOSIUM

Ops Over People (VLOS)

- Injury Risk Standard
- Risk-Based Airworthiness
- Electronic ID and Tracking

Expanded Ops (BVLOS)

- Test and Evaluate C2 Requirements
- DAA sUAS vs. Manned

Non-Segregated Ops

- Authorized Operations
- Airspace Design

sUAS Package Delivery

- DAA sUAS vs. sUAS
- Full Automated (Pilotless) UAS Ops

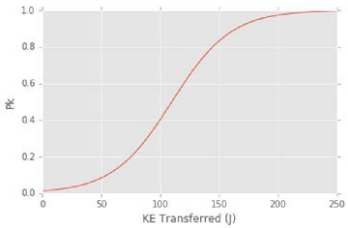
Safety Data and Modeling

Counter UAS

The Way Forward:
Key focus areas

- **Data**
  - Operational data
  - Vehicle performance and reliability
  - Traffic levels, locations and missions

- **Modeling**
  - Probabilistic risk modeling
  - DAA performance models



- **Collaboration**
  - Manufacturers
  - User community
  - Standards bodies

Thank you

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- **Edgar Waggoner**, Director, Integrated Systems Research Program, NASA
- **Dr. Hassan Shahidi**, Director, Aviation Safety, MITRE Corporation

Sabrina Saunders-Hodge,
Manager, Research Division,
FAA UAS Integration Office

Sabrina Saunders-Hodge is the manager of the Unmanned Aircraft Systems (UAS) Research Division within the Federal Aviation Administration's UAS Integration Office. Within this role, Ms. Saunders-Hodge is responsible for coordinating internal and external to the FAA to lead the development of the FAA's UAS research plan to inform the rulemaking framework for safe and efficient integration of unmanned aircraft systems into the National Airspace System. Prior to joining the UAS Integration Office, Ms. Saunders-Hodge was the manager of the FAA's NextGen New Entrants Division with responsibility for executing UAS research as well as standing up the FAA's first UAS Center of Excellence.

Over the past twenty five years Ms. Saunders-Hodge has worked in the field of satellite communications, contributed to the development of ICAO's global plan for transitioning to future communications, navigation, surveillance and air traffic management (CNS/ATM) systems for civil aviation, and co-managed the oversight of FAA/European cooperative research and development initiatives.

Ms. Saunders-Hodge holds a B.S. and M.S. in Computer Science from The University of Maryland and Johns Hopkins University respectively. Additionally, Ms. Saunders-Hodge is a certified Project Management Professional and a graduate of the Federal Executive Institute.

Paul Fontaine, Director, Advanced Concepts and Technology Development, FAA NextGen Office

Paul V. Fontaine is the Federal Aviation Administration's (FAA) Director of the Research and Technology Development in the NextGen Organization. Mr. Fontaine is responsible for the formulation, management, and coordination of the agency's research and advanced technology development program in human factors, communications, navigation, surveillance and air traffic management. Leading the FAA Enterprise Planning effort in collaboration with aviation stakeholders, he identifies strategies, develops integrated solutions, and coordinates investments to evolve and sustain a world class aviation system, and establishes NextGen integration goals, strategies, budgets and priorities. He provides management oversight for integration of NextGen initiatives, activities, and capabilities and ensures National Airspace System (NAS) improvement and sustainment efforts are executed in a comprehensive, integrated environment. His office also provides a conduit between NextGen and the Operations community ensuring NextGen implementation efforts are harmonized with operations and stakeholder priorities and risks are addressed collaboratively to facilitate delivery of NextGen operational capabilities and benefits.

Mr. Fontaine has more than 30 years of FAA and Department of Defense program management experience. He holds a Master of Business Administration in finance from Marymount University and a Bachelor of Science in managerial economics from Rhode Island College.

Marty Rogers, Executive Director, ASSURE – FAA's UAS Center of Excellence

Marty Rogers is the Executive Director of the Mississippi State University lead, FAA UAS Center of Excellence, known as the ASSURE program. The ASSURE program combines the expertise of twenty-three leading UAS university programs and the capabilities of over 110 industry partners to support the UAS R&D needs of the FAA.

Mr. Rogers is a US Air Force veteran, spending the majority of his career with the United States Air Forces in Europe, supporting contingency operations, and completing his Air Force career at HQ Air Mobility Command, Scott AFB, IL. His post-military experience includes a decade of service with a large research and development corporation where he managed an over $300 million-dollar research portfolio. Mr. Rogers also served as the Vice President of international operations, providing R&D expertise to clients in the Americas, Europe and Asia. Prior to leading the ASSURE program Marty was the director of the Alaska Center for Unmanned Aircraft Systems Integration and CEO of the Pan Pacific UAS Test Site.

Mark Blanks, Director, Mid-Atlantic Aviation Partnership at Institute for Critical Technology and Applied Science, Virginia Tech and UAS Test Site

Mark Blanks is the Director of the Mid-Atlantic Aviation Partnership (MAAP) at Virginia Tech.

Mr. Blanks has held a variety of positions in the aviation industry including aircraft maintenance, flight test, and aircraft certification. He accepted the position of UAS Program Manager for Kansas State University in January 2013 where he oversaw the growth and development of the K-State UAS academic and research programs until August 2015 when he transitioned to Virginia Tech to become the Associate Director for MAAP.

Mr. Blanks assumed his current role as Director of MAAP in July 2016 where he is responsible for the oversight of all operations and research at the FAA-designated UAS Test Site. Mr. Blanks is the chairman for the ASTM F38-02 Subcommittee on UAS Flight Operations and serves on the AUVSI Board of Directors. He is a licensed airframe and power plant technician and an instrument rated private pilot.

Edgar Waggoner, Director, Integrated Systems Research Program, NASA

Dr. Edgar Waggoner is responsible for the overall planning, management and evaluation of the directorate's efforts to conduct experimental flight research, and to test the most promising concepts and technologies from across the ARMD portfolio at an integrated system level. He supports the ARMD associate administrator in a broad range of mission directorate activities, including strategic and program planning, budget development, program review and evaluation, and external coordination.

Previously, Dr. Waggoner was director of the Integrated Systems Research Program. He was also was on assignment from NASA to the former Joint Planning and Development Office in Washington, DC, where he served as director of the Interagency Architecture and Engineering Division responsible for technical leadership in the development of the Next Generation Air Transportation System (NextGen) Enterprise Architecture, Concept of Operations, and Integrated Work Plan.

Dr. Waggoner received a bachelor's degree in aerospace engineering from Auburn University, a master's degree in mechanical engineering from Southern Methodist University, and master's and doctoral degrees in engineering management from George Washington University.

Dr. Hassan Shahidi, Director, Aviation Safety, MITRE Corporation

Dr. Hassan Shahidi is the Director of Aviation Safety, Training Technologies and New Entrants at MITRE's Center for Advanced Aviation System Development. He has over 30 years of experience in air traffic control modernization and development of modeling and simulations capabilities. He currently oversees programs in UAS, Commercial Space, safety and training technologies. Dr. Shahidi also directs MITRE's modeling, analysis and data fusion of the Aviation Safety Information Analysis and Sharing (ASIAS) initiative. Prior to his current role, Dr. Shahidi directed MITRE's PBN initiative for nearly a decade. Prior to MITRE, Dr. Shahidi led several ATC modernization and aviation human factors activities at Systems Control Technology and FAL Inc. He holds a private pilot license.

Dr. Shahidi is a recipient of many awards, including RTCA Outstanding Achievement Award. He holds a master's degree in systems engineering from the University of Virginia and a doctorate in systems engineering management from George Washington University.

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