



NASA AAM Mission Update

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AAM Maturity Levels (AML)

- AML-4 Medium Density/Complexity, Collaborative and responsible, automated systems
- AML-3 Low Density, Medium Complexity, Comprehensive safety assurance automation
- AML-2 Low Density/Complexity, Assistive automation
- AML-1 Mature Certification Projects

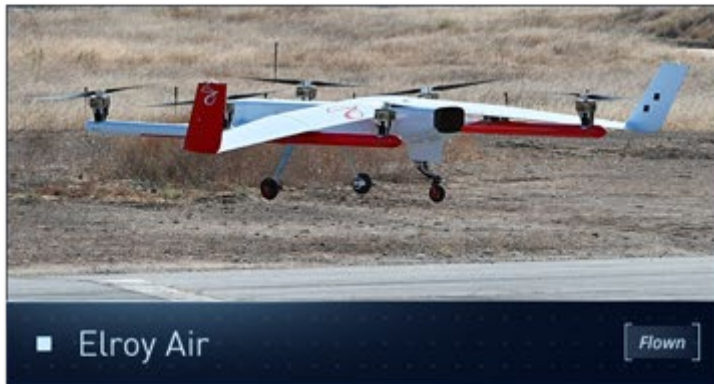
Advanced Air Mobility (AAM) Mission



Safe, sustainable, affordable, and accessible aviation for transformational local and intraregional missions



Strong Domestic AAM Industry Base





AAM Definitions and Scope

How is AAM being defined?

- NASA - Safe, sustainable, affordable, and accessible aviation for transformational local and intraregional missions
- National Academies (not formally defined) – not traditionally served by current modes of air transportation ... urban and rural.. UAM as a subset of AAM...electric motors and simplified electric controls
- AAM from FAA - builds upon the UAM concept by incorporating use cases not specific to operations in urban environments, such as: Commercial Inter-city (Longer Range/Thin Haul), Cargo Delivery, Public Services, Private / Recreational Vehicles
- AAM C&LA – a transportation system that transports people and property by air between two points in the United States using aircraft with advanced technologies, including electric aircraft or electric vertical take-off and landing aircraft, in both controlled and uncontrolled airspace.

What's in and what's out?

In	Grey Area	Out
Transformative use cases leveraging electrification and novel automation • Urban Ops (including eVTOL, eSTOL, and drones) • Smaller UAS cargo BVLOS • Regional Air Mobility (including eVTOL, eSTOL, and eCTOL)	Use case segregation or integration driven by commercial transport safety; often human centric; minimal near-term electrification. • Part 107 drones and aerial services • medium/large UAS • HALE • Traditional General Aviation revitalization	Not a transformative use case; not electrified near-term; traditional pilot responsibilities expected • Traditional large aircraft commercial transport • High speed – Supersonic and Hypersonic • Traditional GA applications

NASA's AAM Constellation

Automation

Airspace

Safety

Noise





NASA Role to Address AAM Challenges



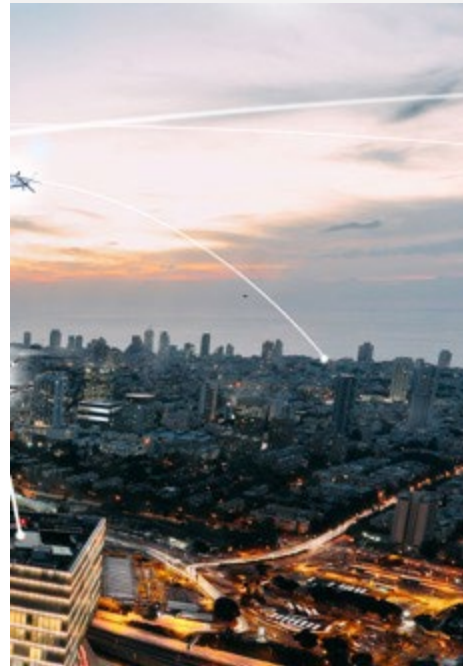
Vehicle Development and Operations



Airspace Design and Operations



Community Integration



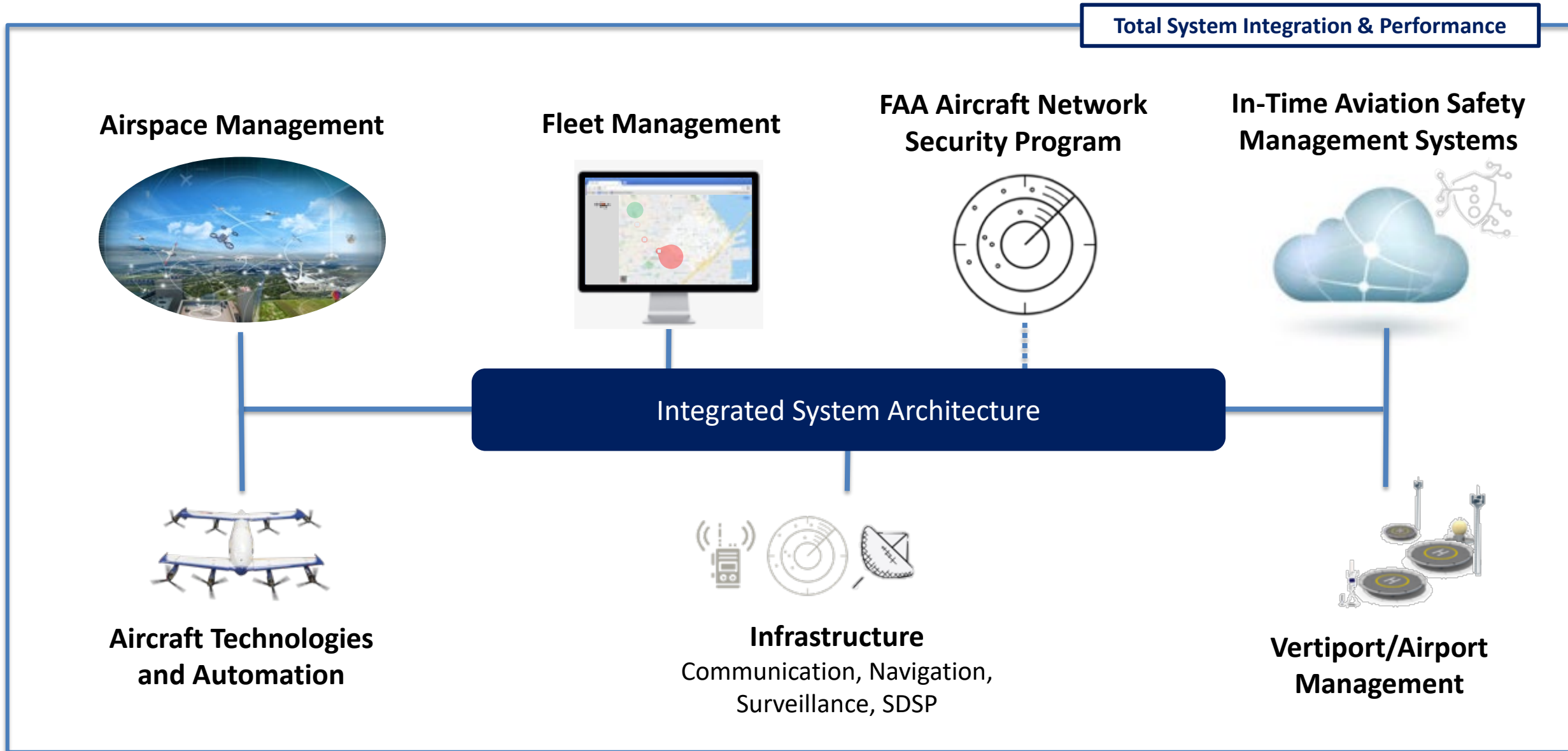
NASA and key partners are collectively taking on the most difficult mission challenges to enable industry to flourish by 2030

- **Research and Development Portfolio**
- **Robust Ecosystem Partnerships**
- **AAM National Campaign Series**

NASA will deliver long term technical solutions through concept, requirement and architecture development for industry and the regulatory community



Framework for Integrated System Level Architecture



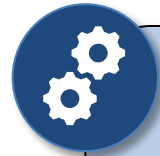
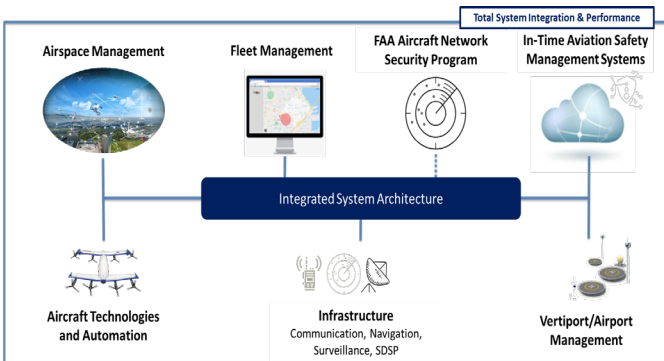
NASA's role emphasizes an integrated system level approach to deliver requirements for total system performance



Autonomy to ensure AAM Industry Emergence, Global Leadership and U.S. Economic Benefit (Why?)

NASA's Value Proposition

Framework for Integrated System Level Architecture



Industry Technology Acceleration

- Community vetted and adopted total system functional and performance architecture and requirements
- Prototype reference airspace, vertiport and vehicle operations and safety automation technologies
- Extensible to high density and variety of AAM use-cases



Accelerate Policy and Guidance

- Inform Standards and certification for Industry and Regulators
- Enable Regulators, service providers, and industry to take lead of establishing standards



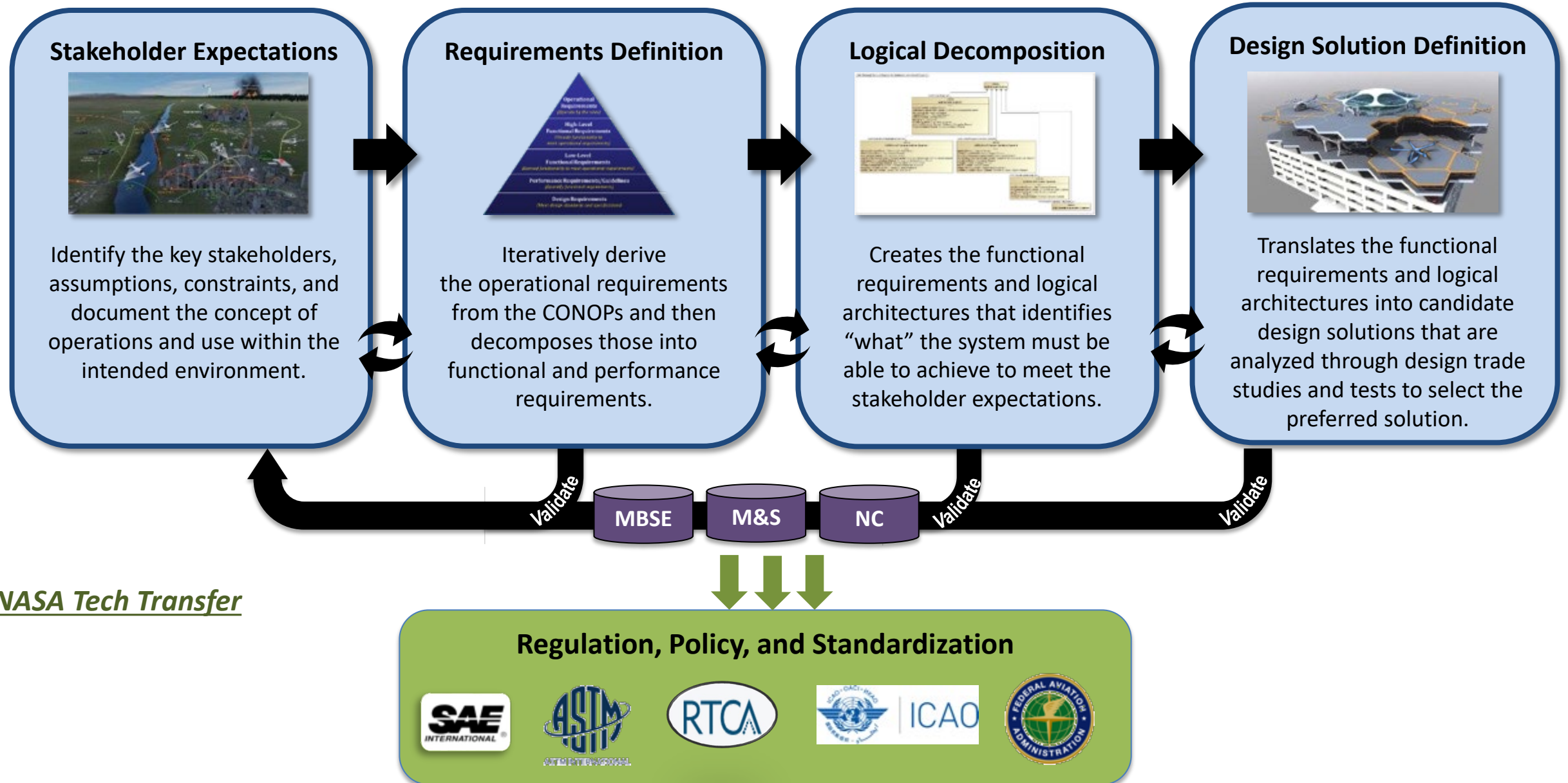
Aviation Leadership

- Influence globally concepts and total system architecture functional and performance requirements
- Springboard AAM and future federated, service oriented, automated NAS Transformation
- Enable domestic industry business models



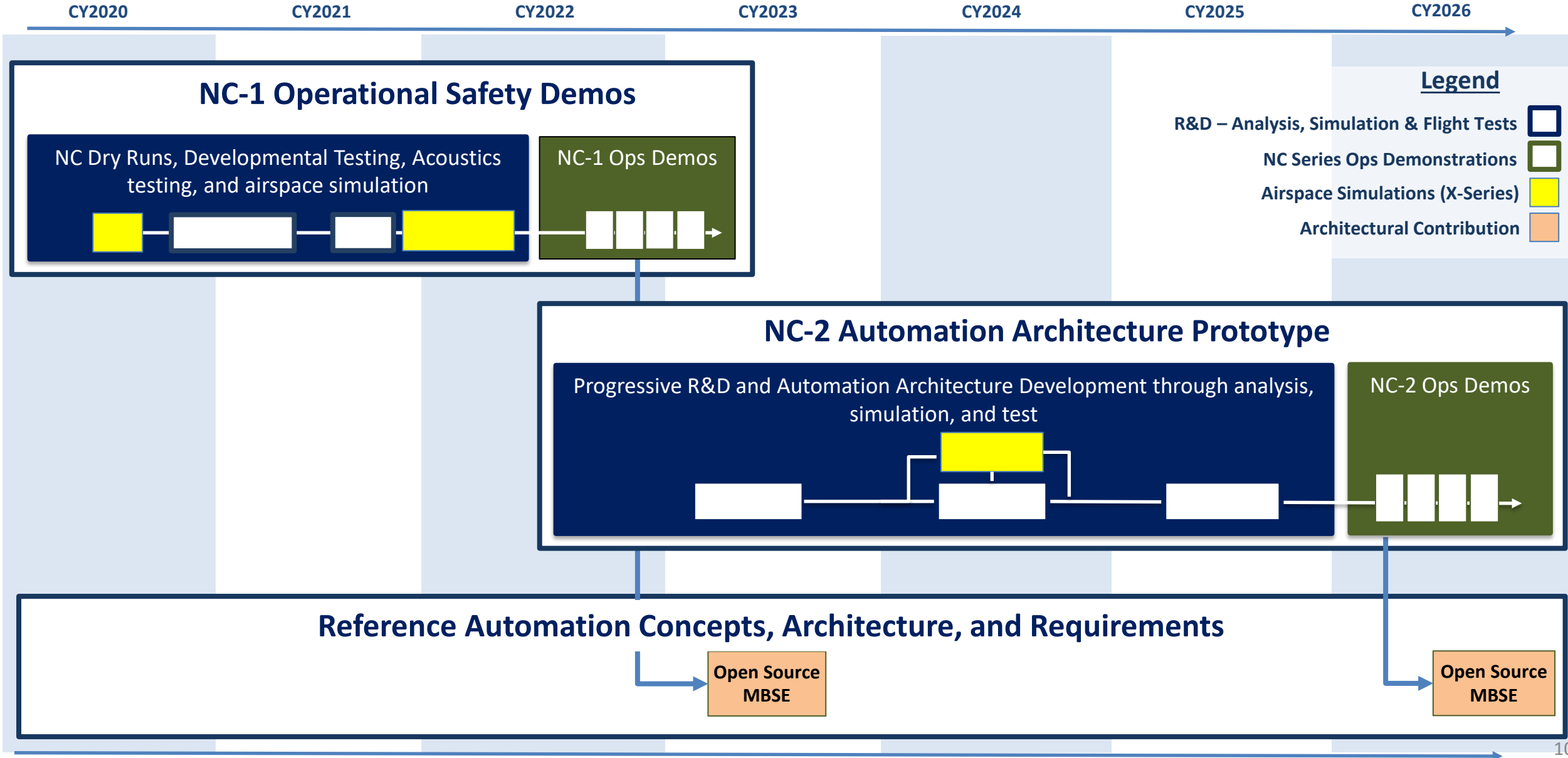
NASA Commitments to AAM System Design

NASA AAM System Design Process



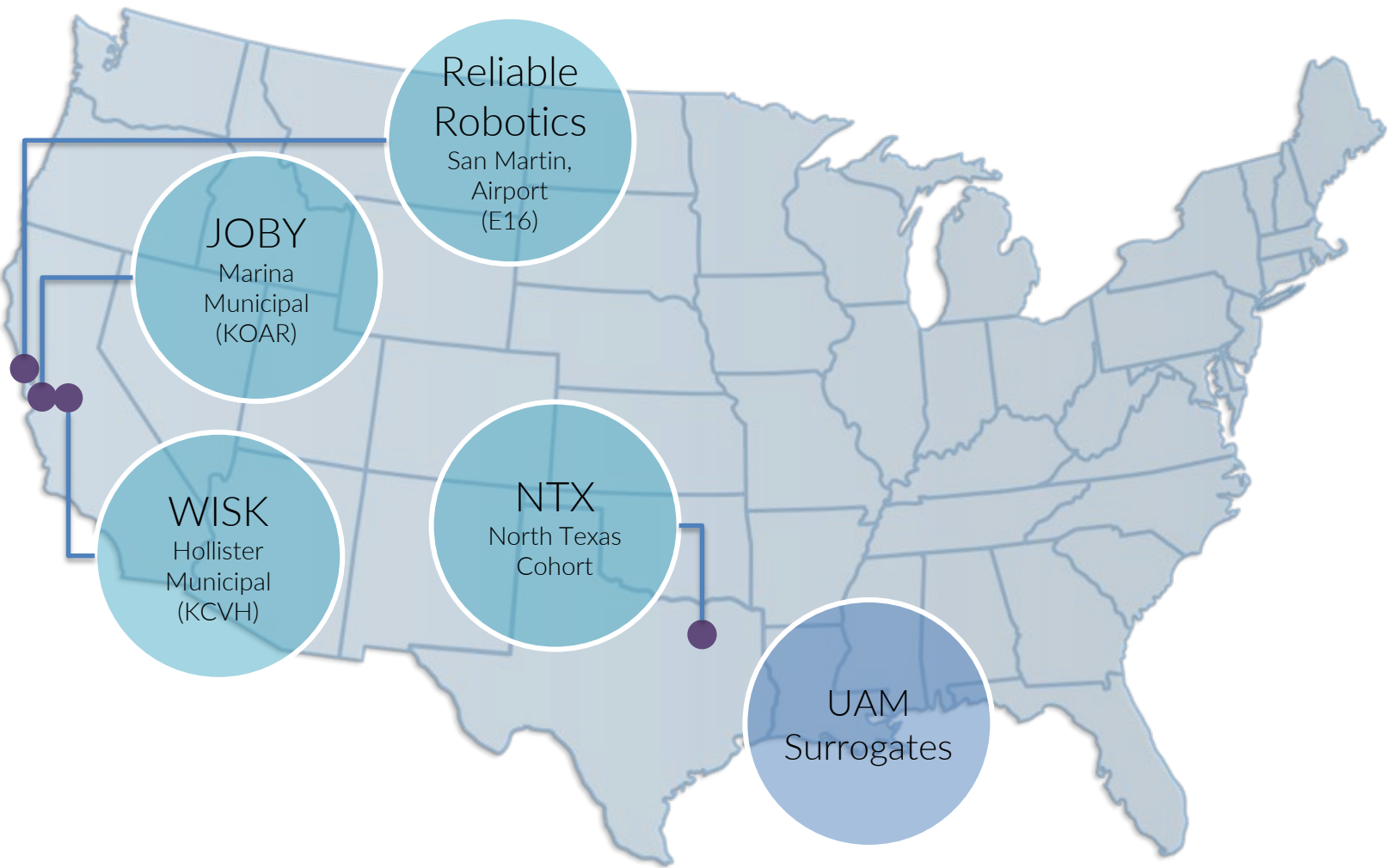


National Campaign (NC) AAM Automation Architecture Development





National Campaign 1 (NC-1) Objectives and Partnerships



- 1 Accelerate Certification and Approval**
 - UAM Surrogate
 - All
- 2 Develop Flight Procedure Guidelines**
 - UAM Surrogate
 - Joby Piloted - Urban Ops
- 3 Assess Infrastructure & CNS Trade Space**
 - Wisk Cohort - Automated Urban Ops
 - NTX Cohort - Urban Ops
 - Reliable Robotics - Regional Ops
- 4 Demonstrate an Airspace Management Architecture**
 - UAM Surrogate
 - Wisk Cohort - Automated Urban Ops
 - NTX Cohort - Urban Ops
- 5 Identify Community Considerations**
 - Wisk Acoustics Test



NASA AAM Airspace Research Overview



Enable digital flight environments



Develop safe and secure third party services



Develop New Airspace Constructs and Procedures



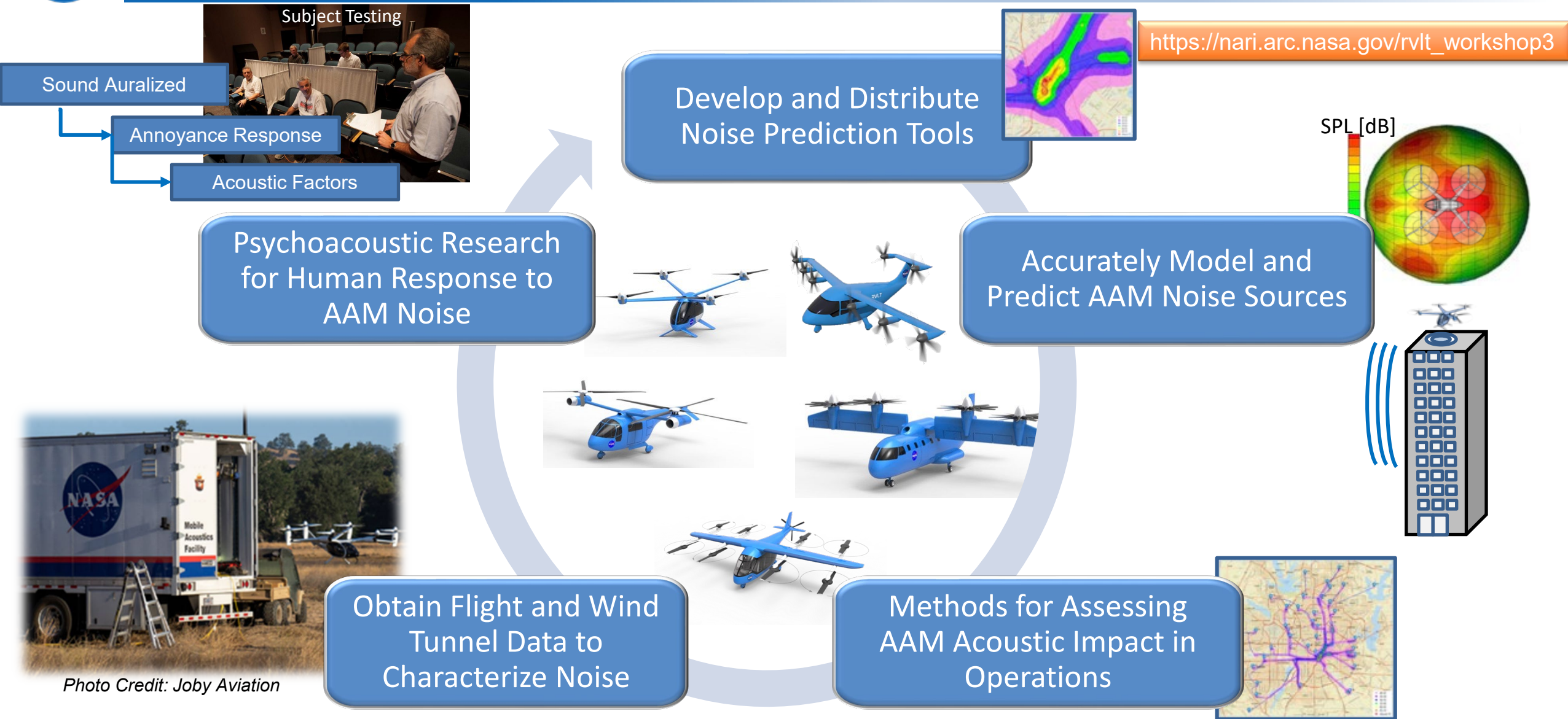
Perform Collaborative simulations (X-Series)



Enabling Advanced Air Mobility Airspace Management Concepts & Technologies



NASA AAM Noise Research Approach

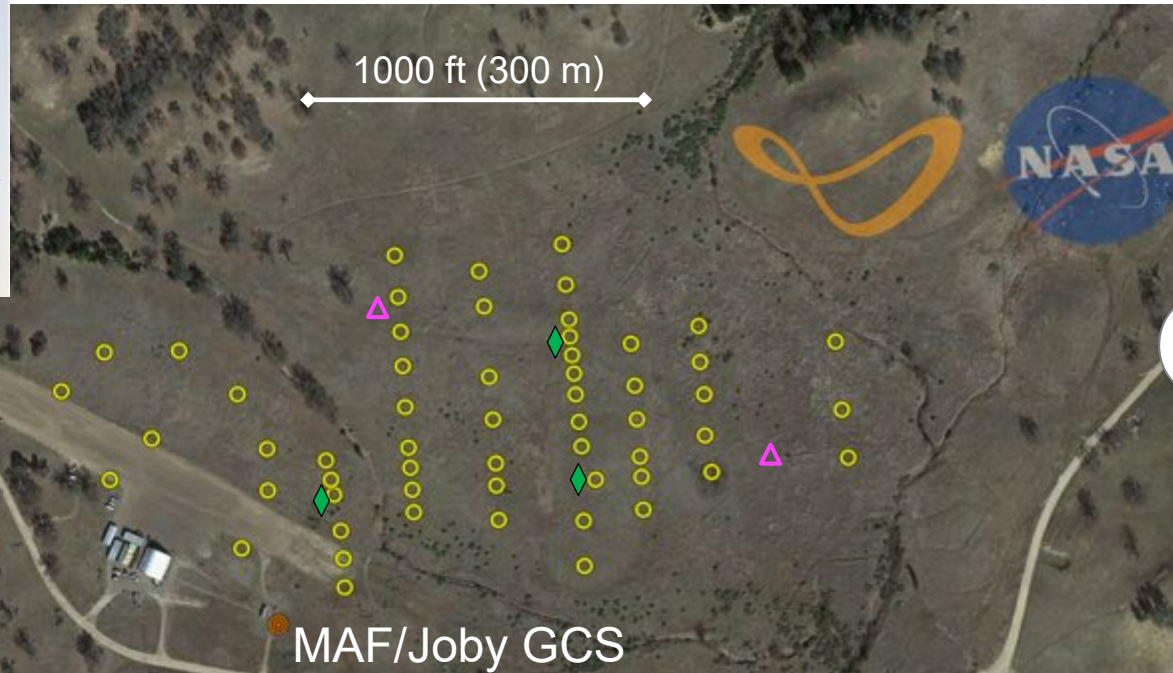


Provide Design Tools and Guidelines for Low Noise Design and Operations



Joby Acoustic Test Overview

<https://www.jobyaviation.com/>



- Microphone
- △ LiDAR Wind Profiler
- Ground Weather Station



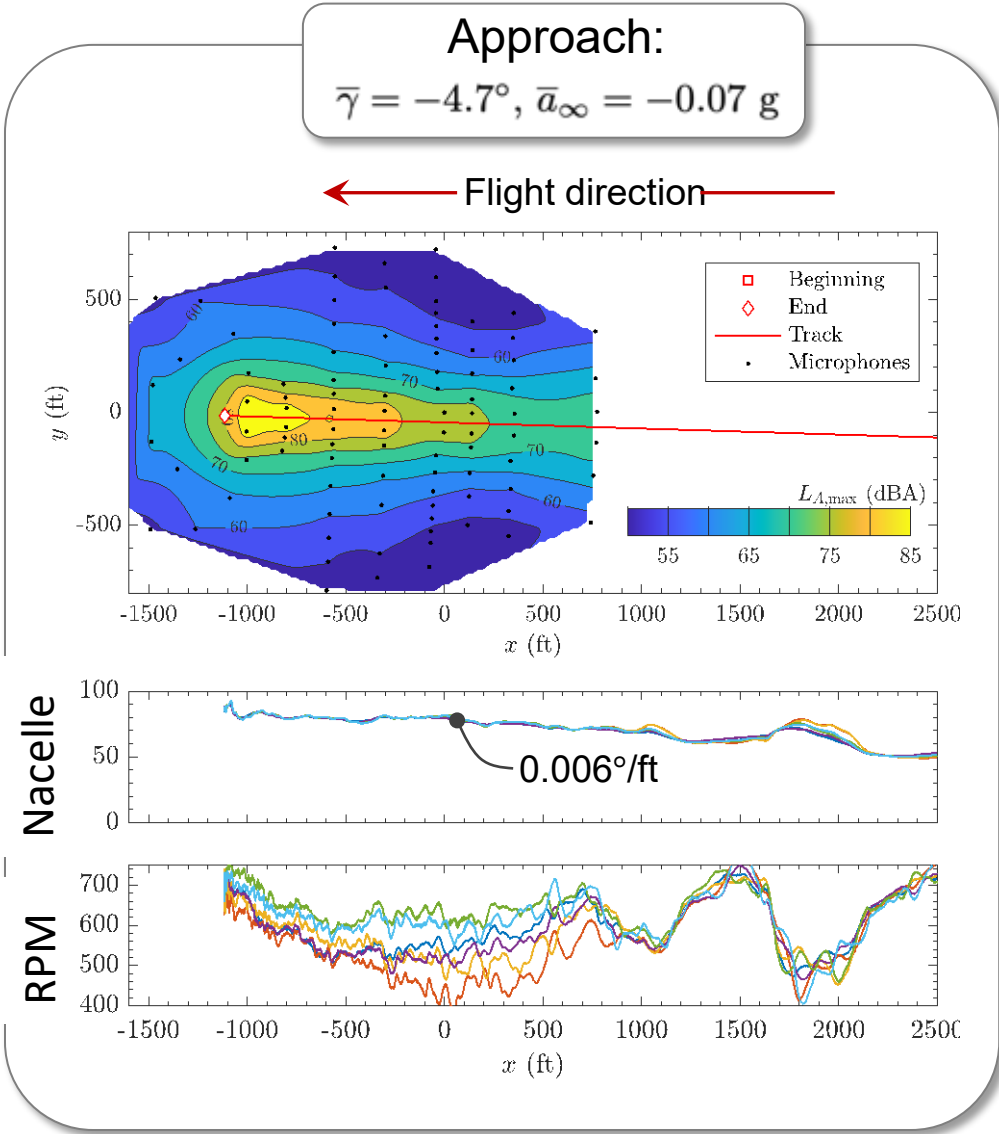
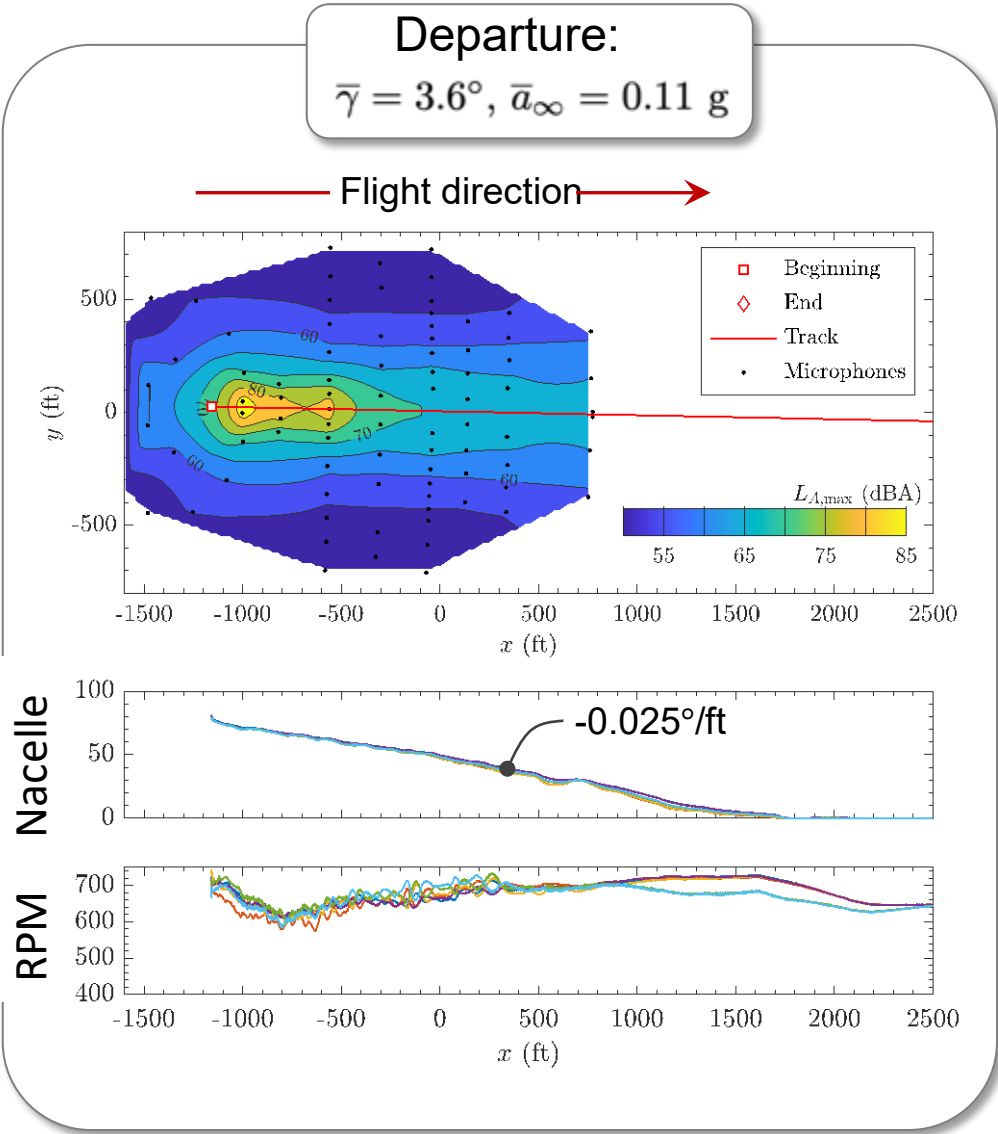
- Microphones
 - 58 Wireless Acoustic Measurement System (WAMS2) channels
 - One phased array station (OptiNav)
- 2 LiDAR vertical wind profilers
 - Direction, horizontal, vertical wind speed up to 1k ft
- 3 ground-based weather stations
- Data acquisition/monitoring @ MAF

AIAA 2022-3036: "Acoustic Flight Test of the Joby Aviation Advanced Air Mobility Prototype Vehicle," Pascioni, et al.
Published Online: 13 Jun 2022 <https://ntrs.nasa.gov/citations/20220006729>



Departures and approaches – ground noise contours

- Transition occurs faster during departure
- Propellers closer to VTOL mode during full approach duration
- Higher RPM variability during approach
- Flight control strategy during approach subject to change





NASA's Advanced Air Mobility (AAM) Ecosystem Partnership and Collaboration Approach

NASA Research and NC Partnerships



AAM Ecosystem Working Groups (AEWG)



NASA's AAM Ecosystem Partnership and Collaboration Approach

NASA and FAA AAM Working Groups

UAM Aircraft Design and Development	Concepts & Transversal Activities (Conops, Community, NC)
Vehicle Automation Concepts and Technologies	Airspace Design and Operations

International Forum for Aviation Research (IFAR)



Eco-system wide partnership base designed to accelerate technology development and operationalization



Community Partnerships

Community partners have assembled multi-organization, diverse teams forming the foundations for detailed planning

Partnerships are providing:

- Education and cross pollination across the multiple organizations – each partner approx. 20 team members and study and analysis results publicly available
- Unified considerations across aviation and ground transportation sectors – over 450 considerations identified for vertiport siting, design and operations
- Identification of AAM use cases able to achieve community sustainability, equity and diversity goals
- Building relationships and identifying best practices that will benefit every congressional district





BACK-UP



AAM Sustainability

Sustainable Operations

High Demand, multi-modal, low noise, no-emissions, with automated networked vehicle operations that provide public good services (fire, medical, emergency) and time savings for regular travelers (regional and local)

Clean Technology and Infrastructure

As aircraft become more electrified, the importance of achieving zero emissions becomes a power grid infrastructure challenge



Production Resiliency

Production certifications and supply chain for aviation must transform to accommodate sustainable technology and energy at high volumes for aviation

AAM Sustainability is based on creating opportunities for public good, logistics and convenience use-cases that leverage clean technologies through the supply chain and operations