

# *NASA Advanced Air Mobility (AAM) Research Strategy*

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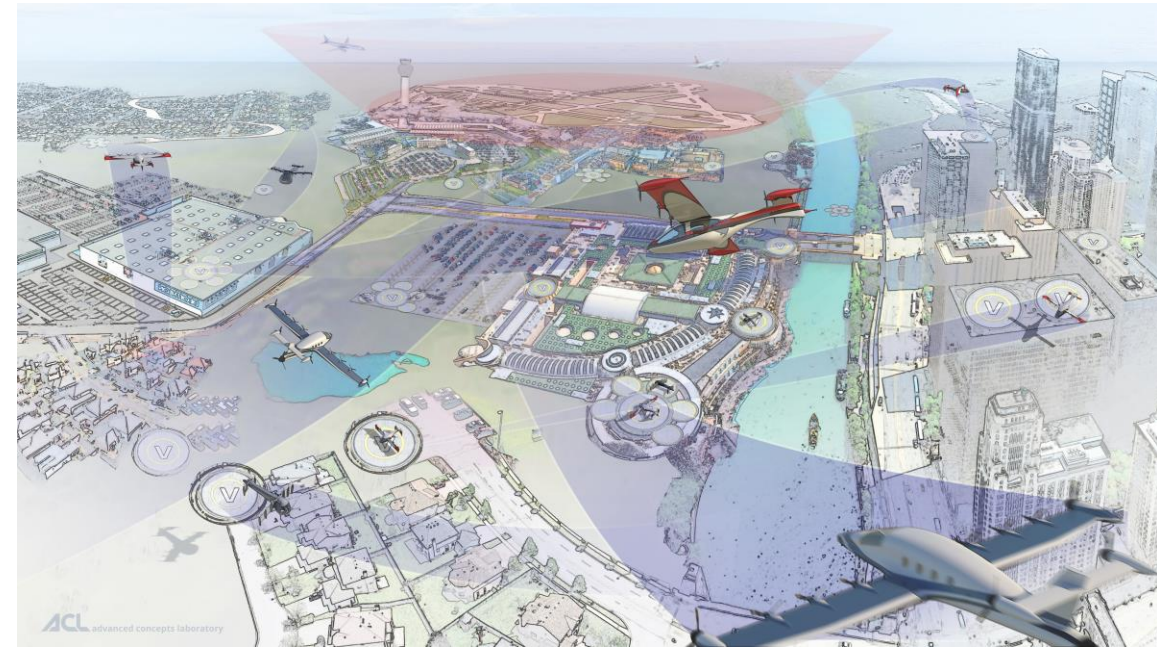
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# Advanced Air Mobility (AAM) Mission

*Safe, sustainable, accessible, and affordable air transportation for passengers and payloads across local and intraregional missions reaching communities that are underserved by aviation today*

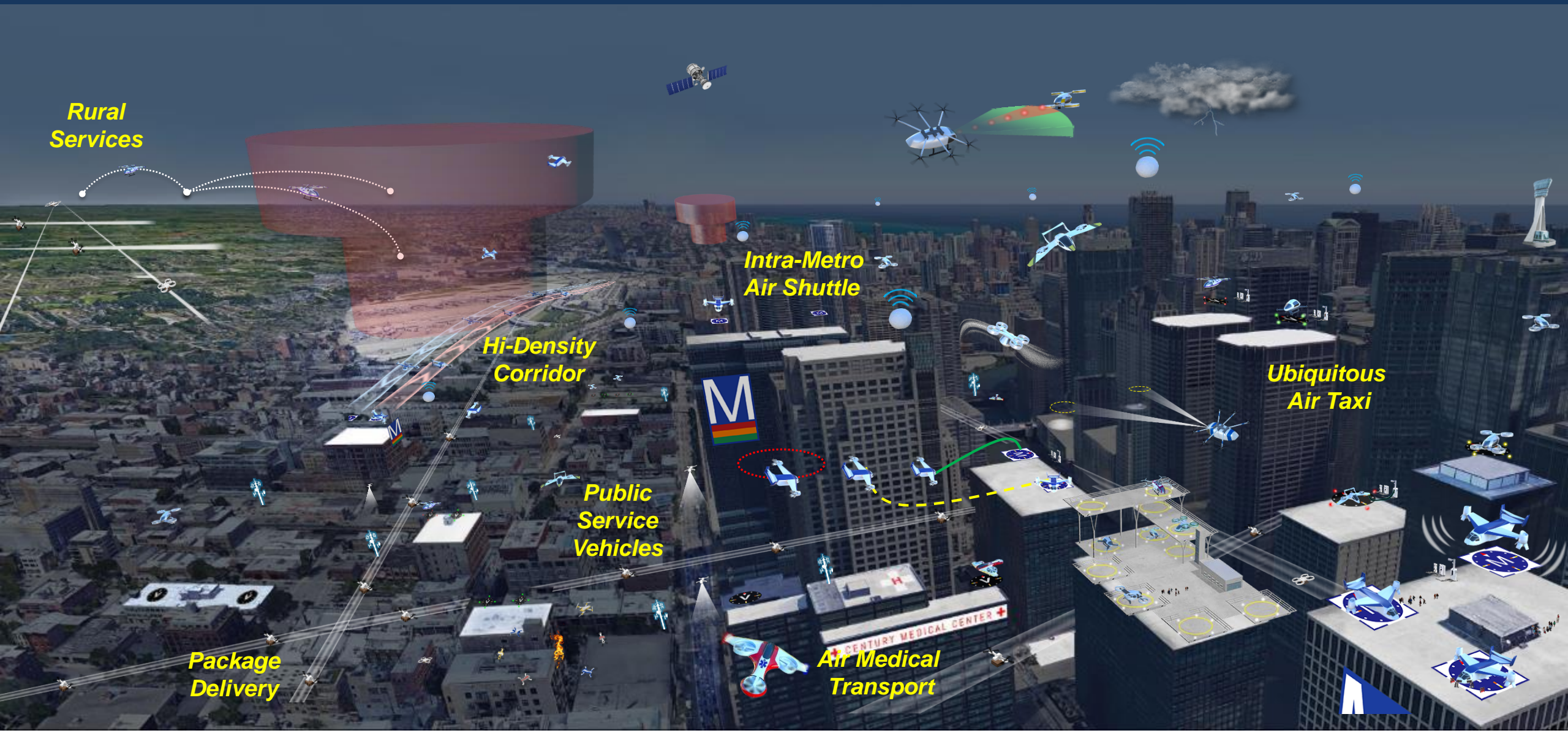
- Includes “rural” and “urban” applications
  - Enabled by electric and automation
  - Aircraft include sUAS, cargo, Pax-carrying, eVTOL, hybrid, etc
  - May be on-demand or scheduled
  - Urban Air Mobility (UAM) as the most challenging mission
- Does not include:
  - Supersonic or hypersonic transport
  - Existing hub-and-spoke air service with large transport aircraft





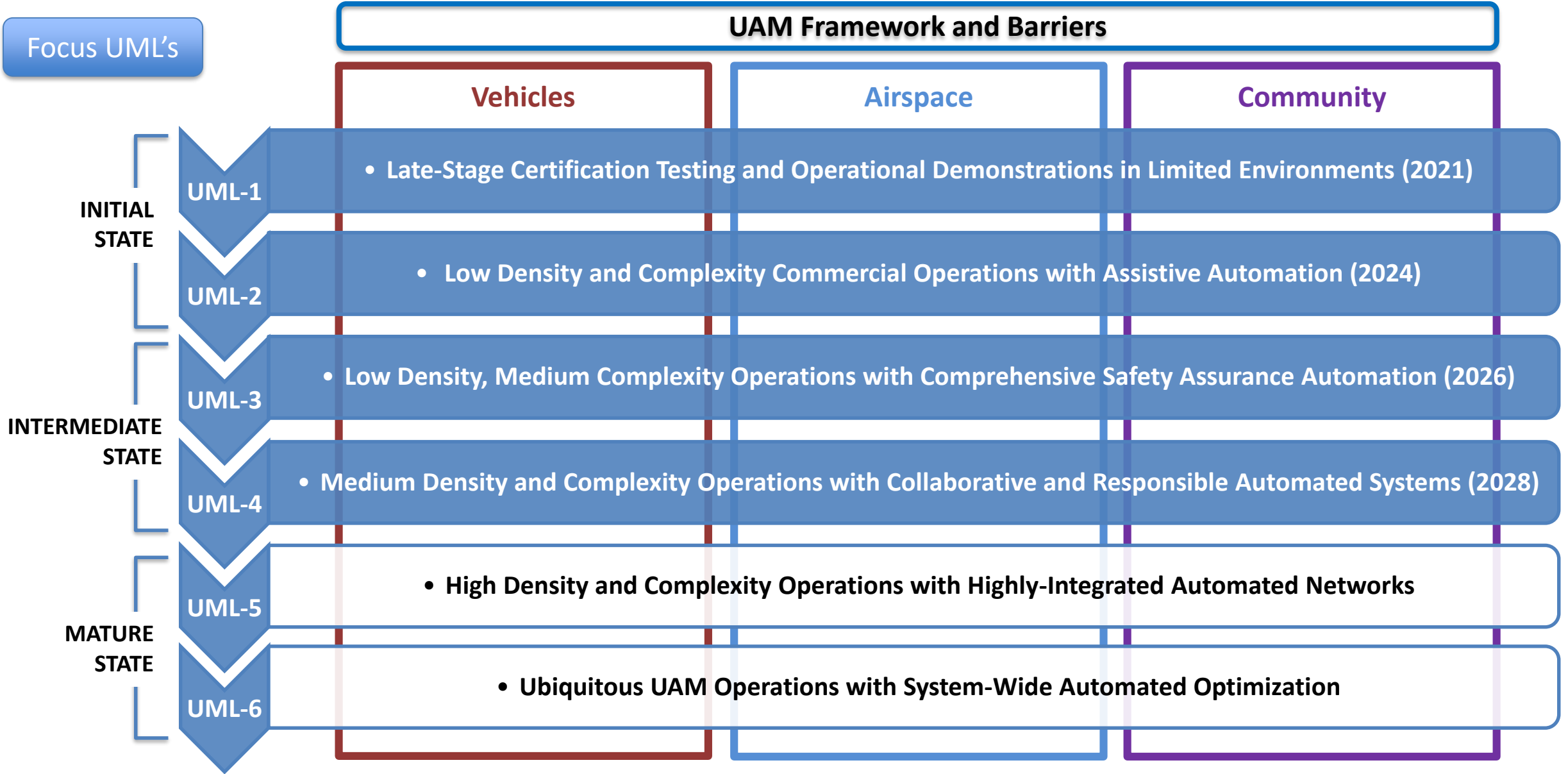
# ARMD AAM Goal

*Develop a validated AAM System Architecture that defines a safe, certifiable, and scalable AAM system*





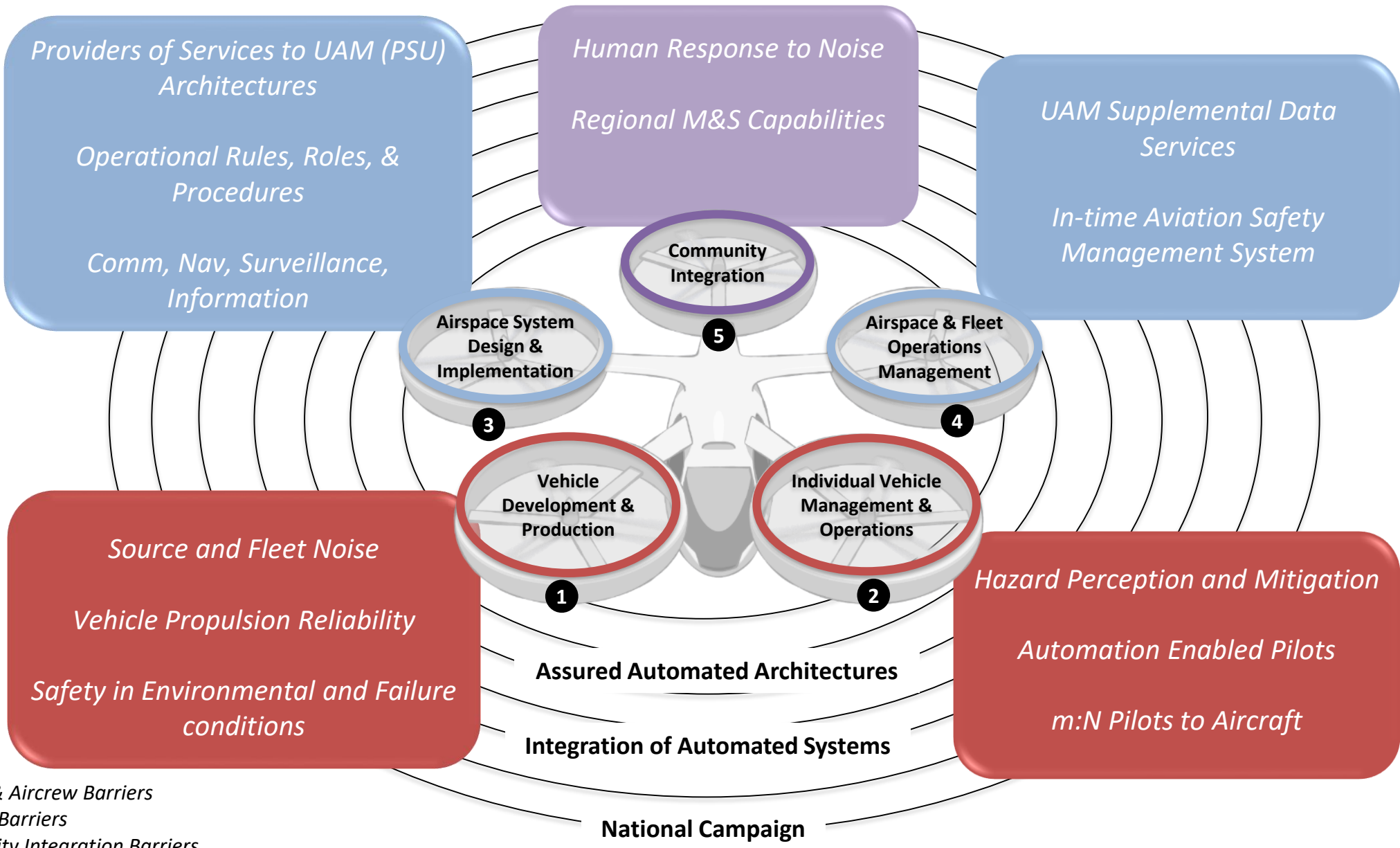
# UAM Maturity Levels (UML) with Representative Timeline\*



\*Dates are representative of industry-proposed timeline



# NASA AAM Priorities



- Aircraft & Aircrew Barriers
- Airspace Barriers
- Community Integration Barriers
- # Pillar number



# AAM Contributions and Outcomes

## NASA Contributions

### ARMD Research Projects

- Advanced Air Mobility (AAM)
- Air Traffic Management – eXploration (ATM-X)
- Flight Demos and Capabilities (FDC)
- Revolutionary Vertical Lift Technology (RVLT)
- System Wide Safety (SWS)
- Transformational Tools & Technologies (TTT)

### Ecosystem Wide Efforts

- AAM Mission Strategy
- AAM System Architecture
  - System Concepts, Architectures & Use Cases
  - Requirements
  - Guidance Material
  - Scorecard
- Model Based Systems Engineering
- Ecosystem Partnership Strategy
- Outreach Strategy

National Campaign Findings & Recommendations



Technology Maturation



Automation Advancements



Best Practices & Lessons Learned



Modeling, Simulation, & Analysis Findings



Test & Evaluation Data

## Community Outcomes



Validated ConOps & Business Cases



AAM Standards



Technical Standard Orders



Airworthiness & Production Certification



Policies & Procedures



Rules & Regulations



State / Local Laws & Ordinances

## Community Contributions



Strategic Partnerships



Previous & Ongoing Research

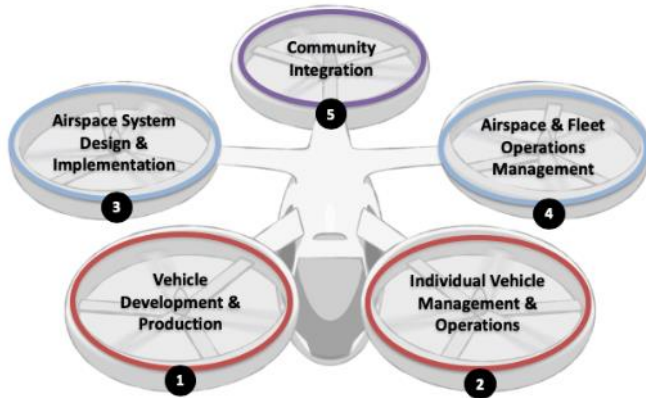


Industry Innovation & Investment

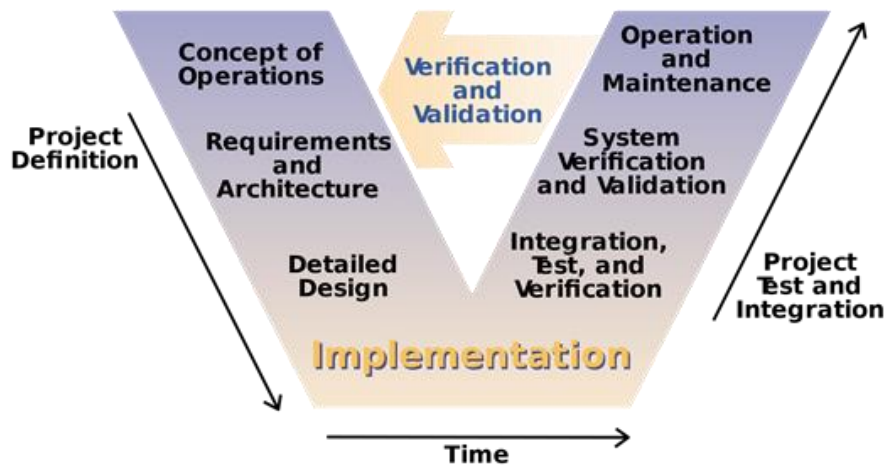




# Validated AAM System Architecture



- Validated system concept and architecture
- “Book of Requirements and Guidelines (BoRG)” developed in concert with FAA and industry standards bodies
- Spans all 5 pillars
- May include standards, regulatory guidance, recommended practices, acceptance metrics, or etc.
- Foundation of detailed design for operationally deployed system





# The National Campaign Series

## Goal

Ensure UAM safety and accelerate scalability through integrated demonstrations of candidate operational concepts and scenarios

## Objectives

1. Accelerate Certification and Approval
2. Develop Flight Procedure Guidelines
3. Evaluate the CNS Trade-Space
4. Demonstrate an Airspace Operations Management (AOM) Architecture
5. Characterize Community Concerns

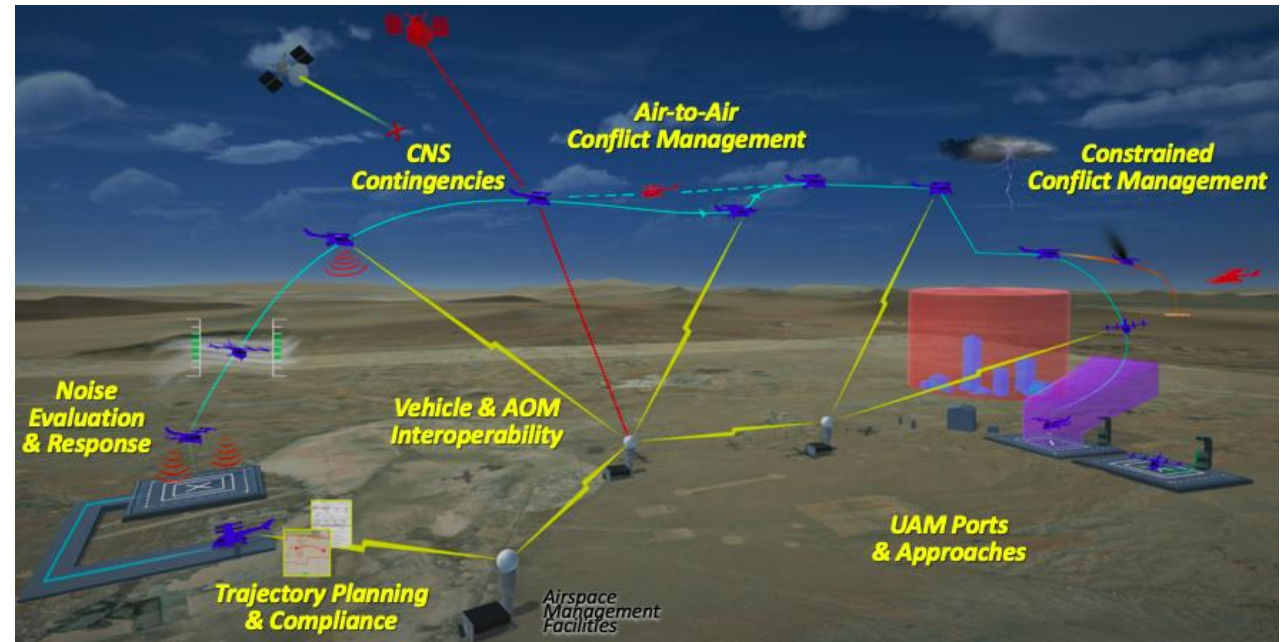






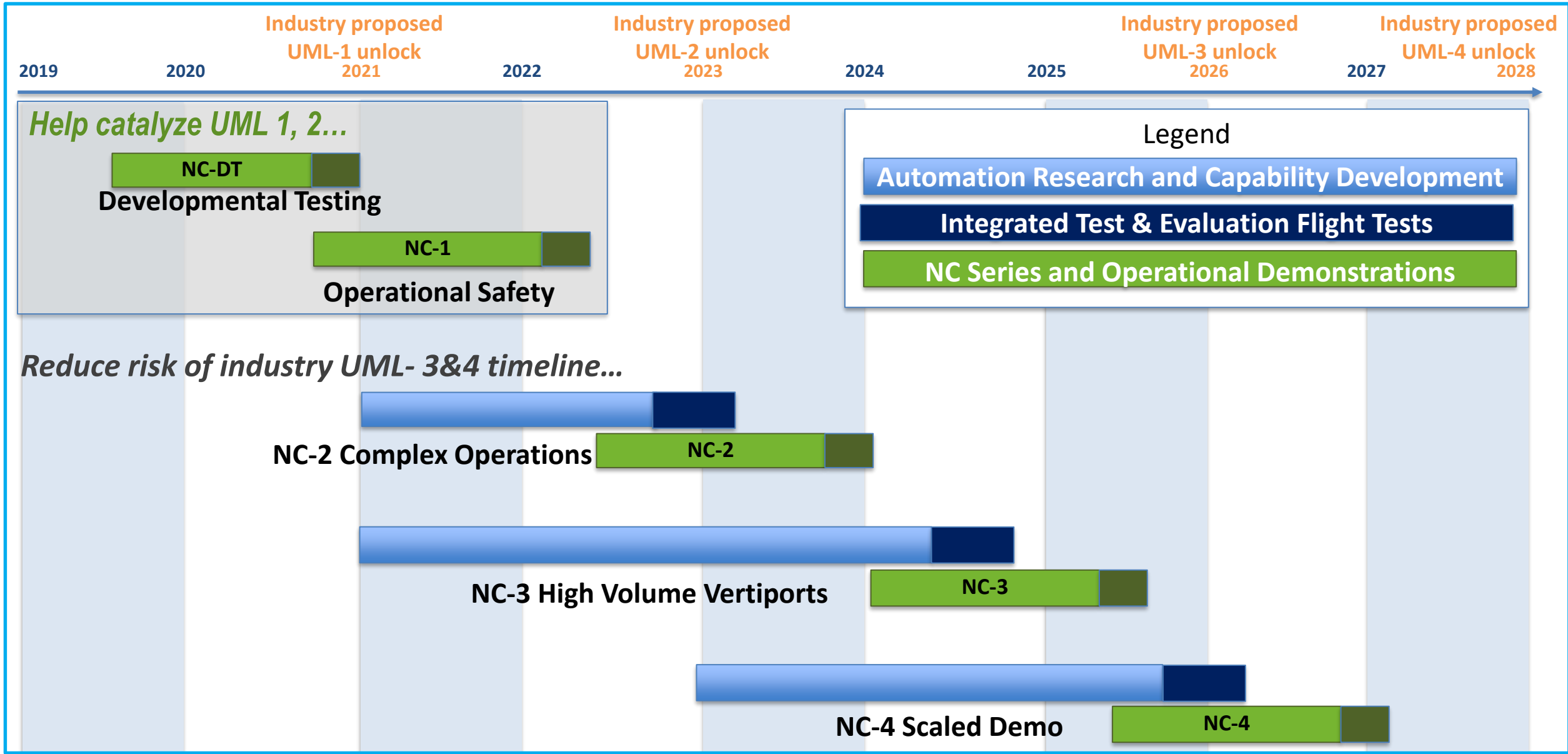
# National Campaign Fundamentals

- Series Emphasis on Operational Scenarios, and remaining flexible to industry needs
  - NC-DT includes flights and simulations to validate scenarios and develop the proving ground in support of NC-1
  - NC-1 scenarios will be used to baseline operational expectations, and as a learning opportunity to identify gaps in AAM
  - NC-1 will get you closer to operations
  - NC Series will progress through more difficult operational environments through targeted demonstrations
- Primary test ranges determined by location that partners plan to fly
- Ecosystem WG's will be the primary means for the entire community to provide inputs





# ARMD Research Approach to Enable NC Series





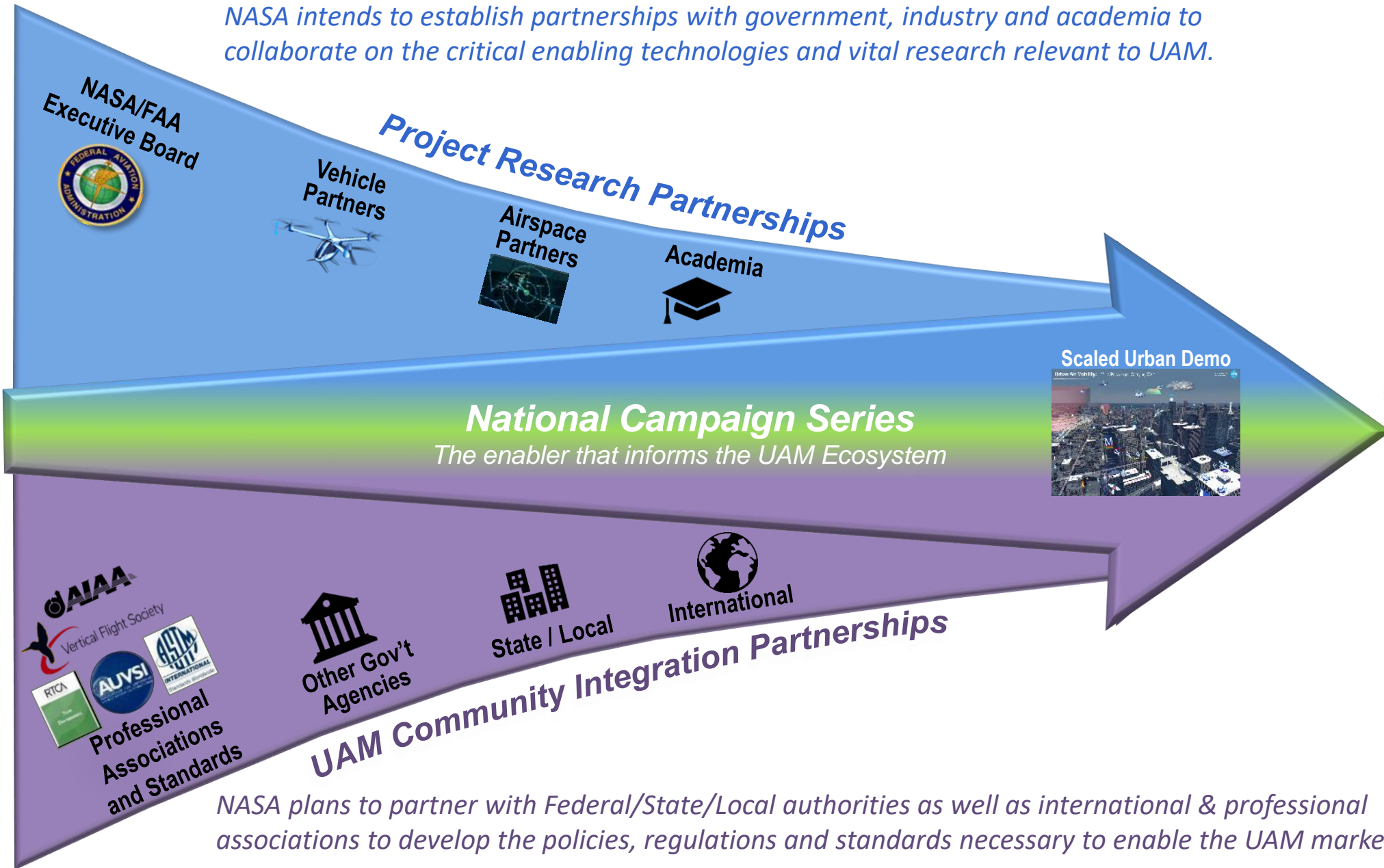
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# BACK-UP



# NASA UAM Ecosystem Partnership Approach

*NASA intends to establish partnerships with government, industry and academia to collaborate on the critical enabling technologies and vital research relevant to UAM.*



*NASA plans to partner with Federal/State/Local authorities as well as international & professional associations to develop the policies, regulations and standards necessary to enable the UAM market.*





# ARMD UAM GOAL



Rural Operations

Urban Operations

Regional Network

Cargo Delivery

Distribution Center/Warehouse

Inter-city eCTOL

Inter-City eCTOL

Cargo Delivery

On Demand Air-Taxi

High Density Corridor

Fleet Operations

Medical Transfer

Air Ambulance

Airport Transfer

Small Package Delivery

Cross-metro Transfer

UML - 4  
UML - 3  
UML - 2



# UNLOCKING UML-4 HELPS ENABLE ‡ OTHER UAM MISSIONS

## "Rural" Missions

## Urban Missions

### UML-4

Wide-scale on-demand, regional air transportation network.



### UML-4

Increasing network of eVTOL operations to smaller vertiports in IMC. Increase in previous missions. (e.g., early on-demand urban air taxi network, wide-scale, distributed small package delivery)



### UML-3

Limited inter-city eCTOL networks. Limited "feeder networks" between rural areas to nearest city. Public service missions.



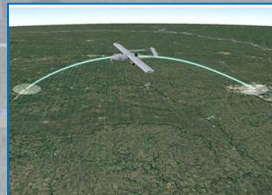
### UML-3

Initial eVTOL fleet operations from urban vertiports. (e.g., airport transfer, cargo delivery, initial urban air metro); Public service missions (e.g., air ambulance, disaster relief)



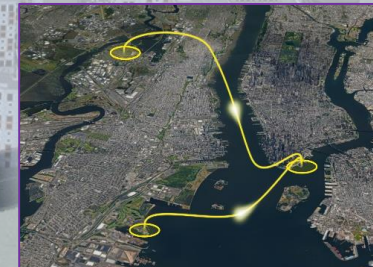
### UML-2

Cargo delivery to/from warehouses & distribution centers in non-urban areas. Increased utility & safety of General Aviation.



### UML-2

Initial, commercial UAM flights using eVTOL, eSTOL, and eCTOL aircraft. (e.g., ex-urban airport transfers, medical transport, cross-metro transfers)



### UML-1

No new commercial rural missions enabled.

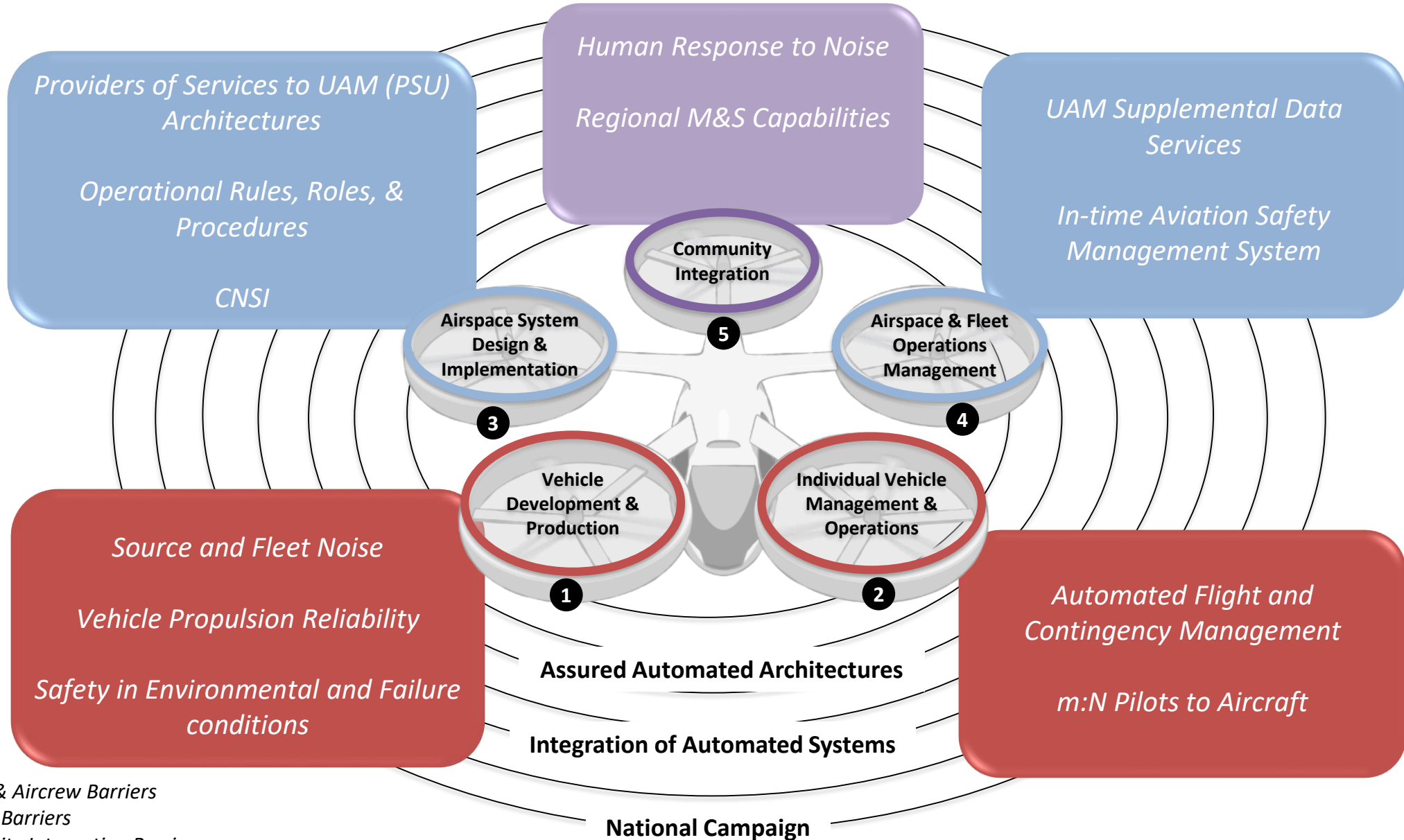
### UML-1

No new commercial urban missions enabled.

‡Enable refers to critical technologies that can be engineered to extend to other missions.



# NASA AAM Priorities



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