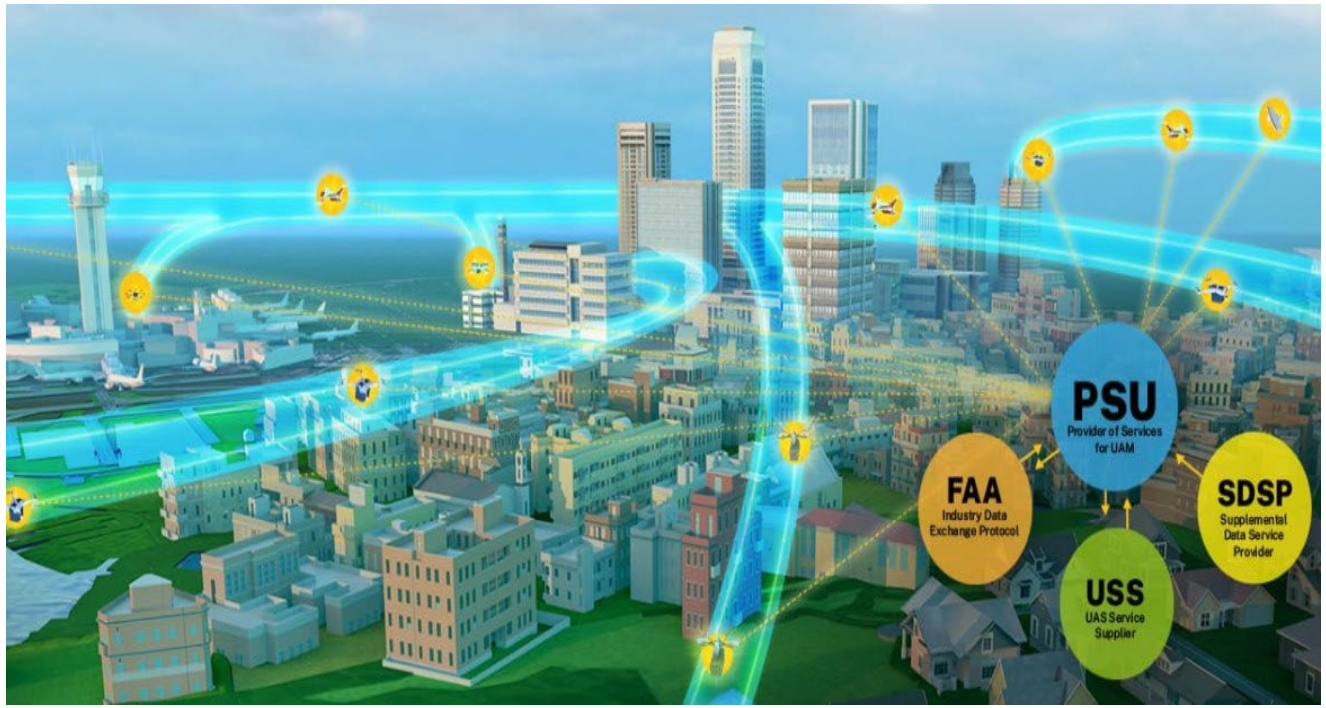
Urban Air Mobility Overview

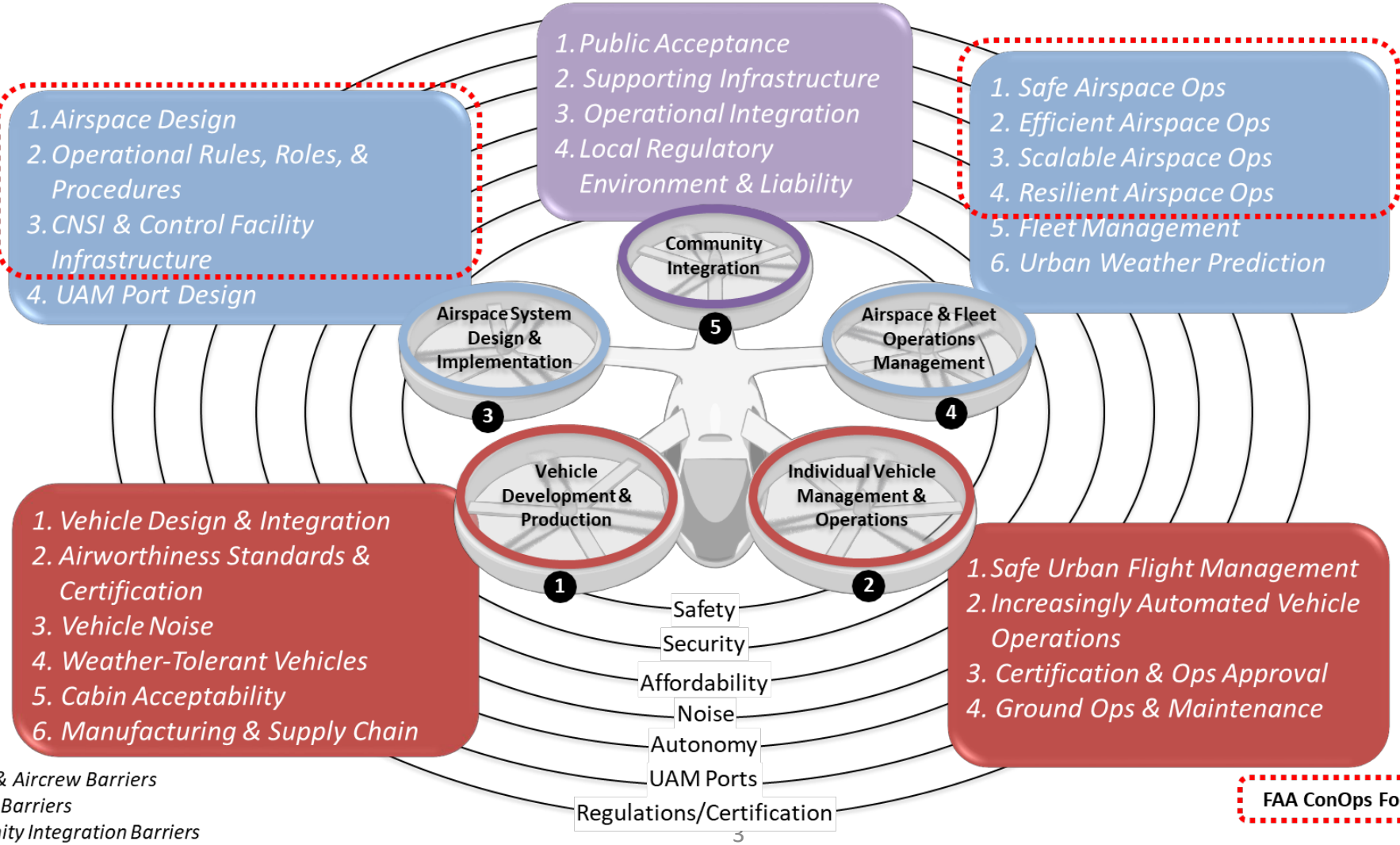
August 31, 2022

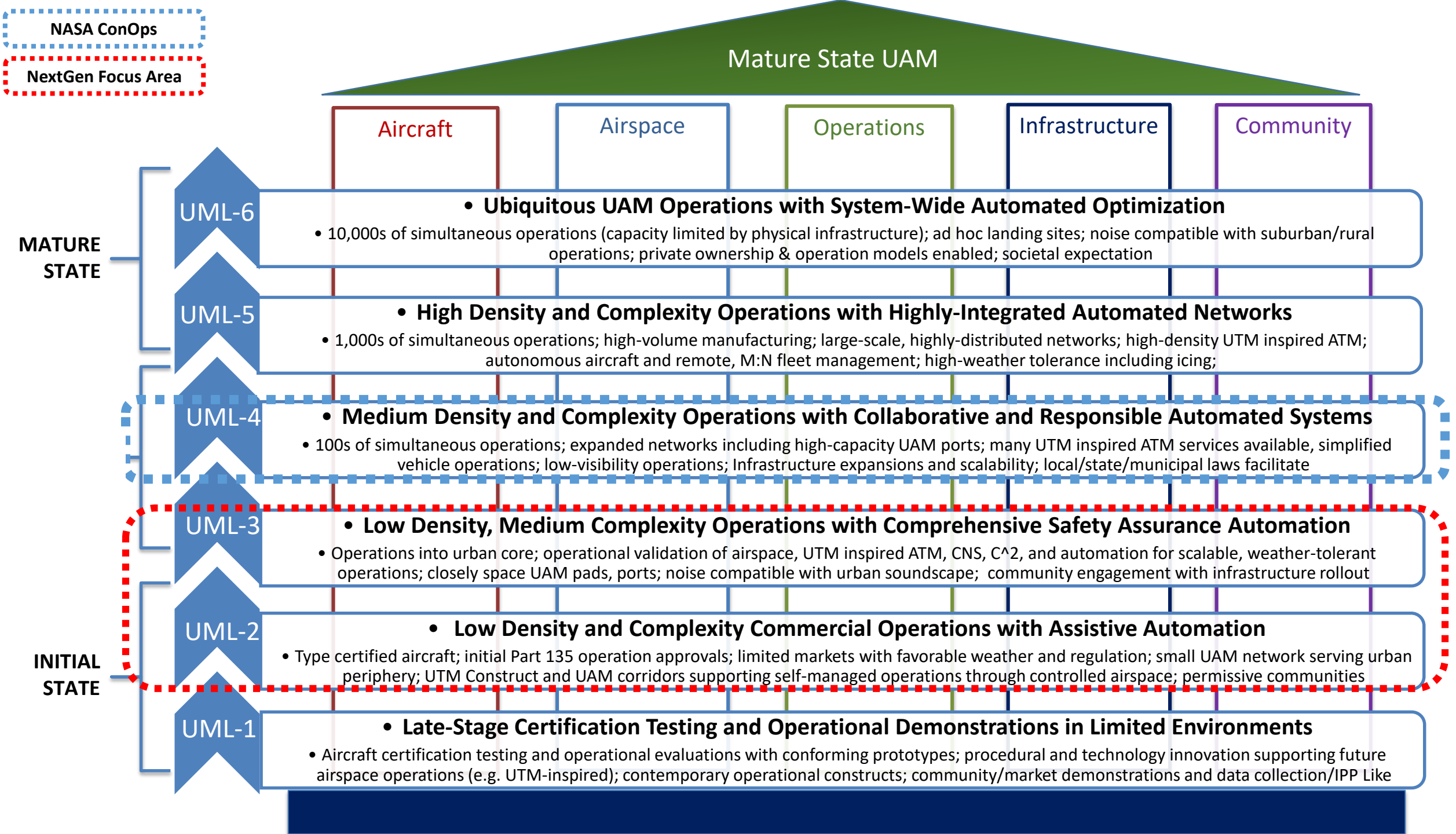
UAM Concept Development Project

- Focus on crewed and un-crewed aircraft operations carrying passengers and cargo at lower altitudes in and around major metropolitan areas
- Address incorporation of UAM operations into the NAS, where traditional ATC and UTM operations exist
- Consider evolution of vehicle technology and increasing levels of automation

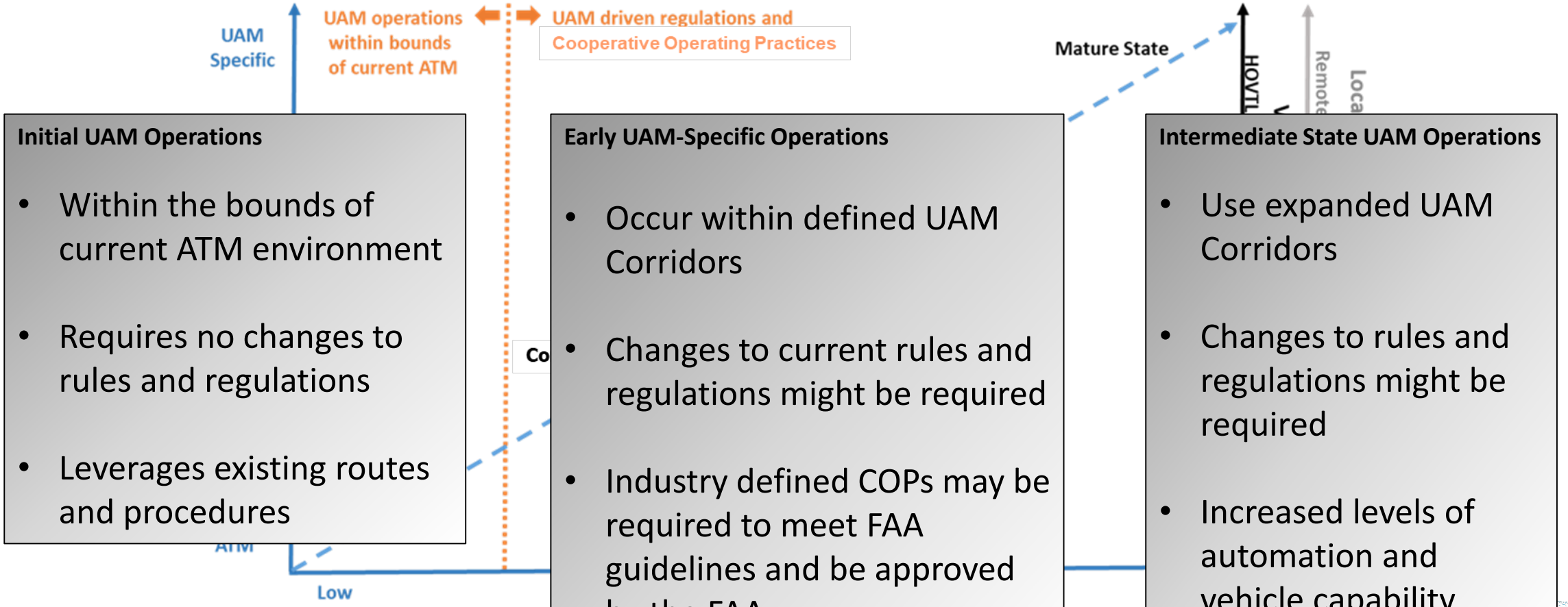


UAM Framework and Barriers




NASA ConOps
NextGen Focus Area
Mature State UAM
Aircraft
Airspace
Operations
Infrastructure
Community
MATURE STATE
INITIAL STATE
UML-6
• Ubiquitous UAM Operations with System-Wide Automated Optimization
• 10,000s of simultaneous operations (capacity limited by physical infrastructure); ad hoc landing sites; noise compatible with suburban/rural operations; private ownership & operation models enabled; societal expectation
UML-5
• High Density and Complexity Operations with Highly-Integrated Automated Networks
• 1,000s of simultaneous operations; high-volume manufacturing; large-scale, highly-distributed networks; high-density UTM inspired ATM; autonomous aircraft and remote, M:N fleet management; high-weather tolerance including icing;
UML-4
• Medium Density and Complexity Operations with Collaborative and Responsible Automated Systems
• 100s of simultaneous operations; expanded networks including high-capacity UAM ports; many UTM inspired ATM services available, simplified vehicle operations; low-visibility operations; Infrastructure expansions and scalability; local/state/municipal laws facilitate
UML-3
• Low Density, Medium Complexity Operations with Comprehensive Safety Assurance Automation
• Operations into urban core; operational validation of airspace, UTM inspired ATM, CNS, C^2, and automation for scalable, weather-tolerant operations; closely space UAM pads, ports; noise compatible with urban soundscape; community engagement with infrastructure rollout
UML-2
• Low Density and Complexity Commercial Operations with Assistive Automation
• Type certified aircraft; initial Part 135 operation approvals; limited markets with favorable weather and regulation; small UAM network serving urban periphery; UTM Construct and UAM corridors supporting self-managed operations through controlled airspace; permissive communities
UML-1
• Late-Stage Certification Testing and Operational Demonstrations in Limited Environments
• Aircraft certification testing and operational evaluations with conforming prototypes; procedural and technology innovation supporting future airspace operations (e.g. UTM-inspired); contemporary operational constructs; community/market demonstrations and data collection/IPP Like

UAM Evolution



Initial UAM Operations

- Within the bounds of current ATM environment
- Requires no changes to rules and regulations
- Leverages existing routes and procedures

Early UAM-Specific Operations

- Occur within defined UAM Corridors
- Changes to current rules and regulations might be required
- Industry defined COPs may be required to meet FAA guidelines and be approved by the FAA

Intermediate State UAM Operations

- Use expanded UAM Corridors
- Changes to rules and regulations might be required
- Increased levels of automation and vehicle capability

UAM Responsibilities

Operator

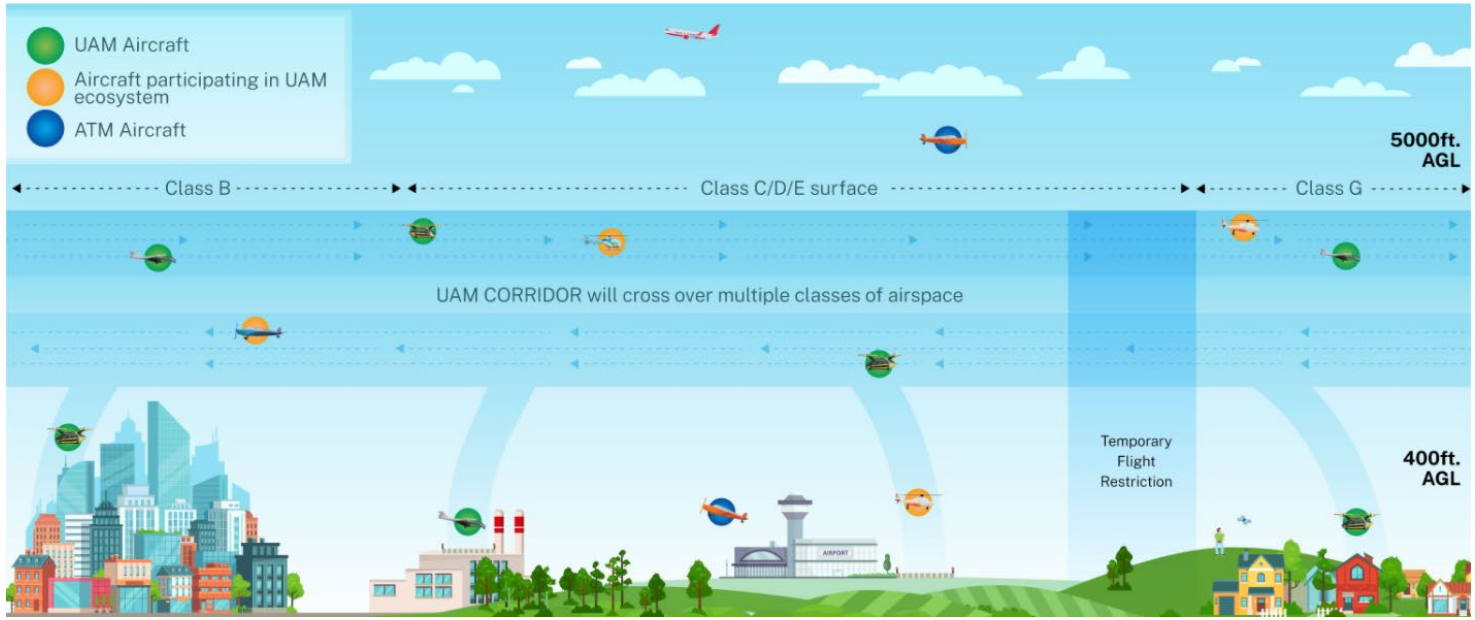
- Coordinate, execute, and manage operations
- Comply with a set of stakeholder-developed Cooperative Operating Practices (COPs)
- Comply with applicable performance and regulatory requirements for the airspace within which they are operating
- Use airspace as efficiently as practical and do not knowingly impede other operators' use of airspace
- Share intent information with other relevant stakeholders as required
- Maintain conformance to the intent communicated to other stakeholders

Regulatory/ANSP

- Maintain regulatory authority over airspace and operations
- Provide guidelines and approves or acknowledges COPs in accordance with agency statutory responsibilities for equity, safety, and security
- Qualify third-party suppliers of services for use by UAM operators to meet regulatory requirements
- Establish performance requirements frameworks for cooperative airspace and confirm the operator meets the standardized level of performance

UAM Concept of Operations

- UAM Operations were defined as the transport of people or goods from one vertiport or airport to another using UAM Corridors
- Any aircraft using or crossing a UAM Corridor participates in the UAM Ecosystem by obtaining a confirmed Operational Intent from a PSU
- Aircraft operating within a UAM Corridor must meet the performance and participation requirements of the UAM environment



While a good starting point, UAM Corridors in all airspace classes with a requirement to fully participate becomes restrictive

FAA Airspace Analysis

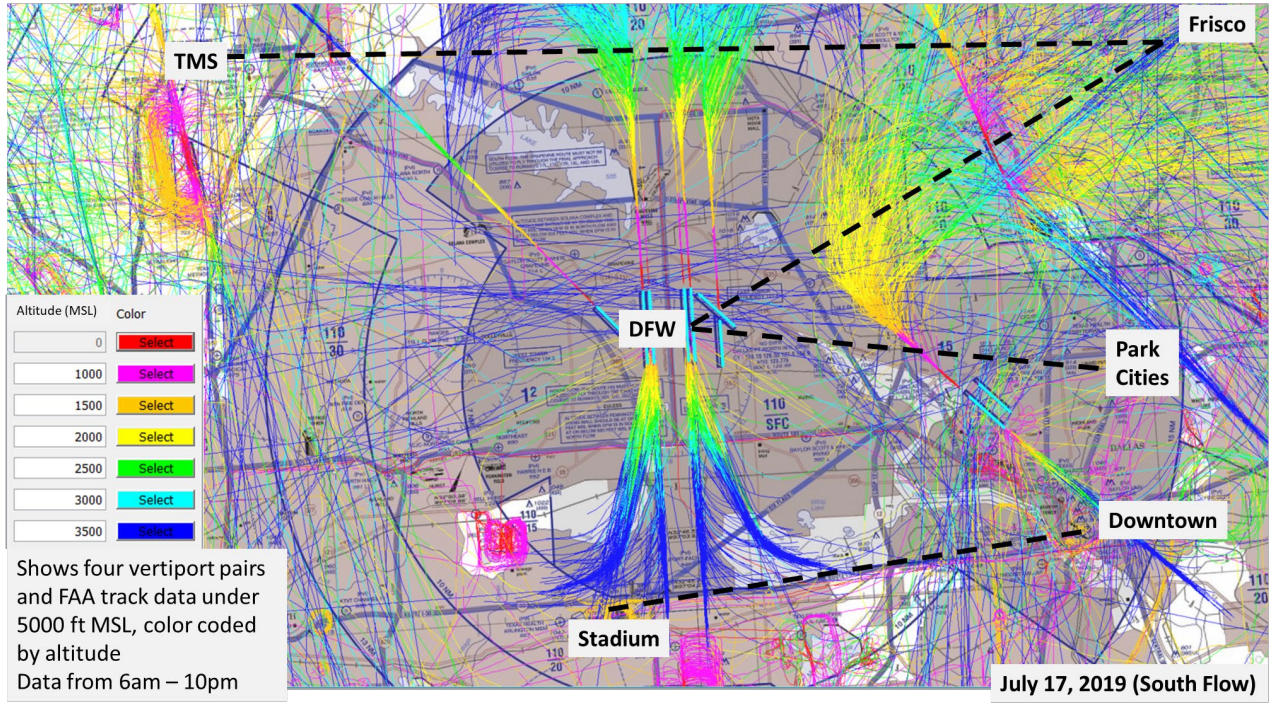
1. UAM Corridor characteristics

- **Impacted ATM Operations**: Some impact to ATM operations (average of 15 GA or helicopter impacted operations)
- **Altitude**: Challenging – often lower than the target and led to inclusion of varying altitudes within a single UAM Corridors
- **Distance**: Conformant to target, but not straight lines
- **Height/Width Sensitivity:** Significant sensitivity to corridor height, less sensitivity to width

2. Airport Flow Impact

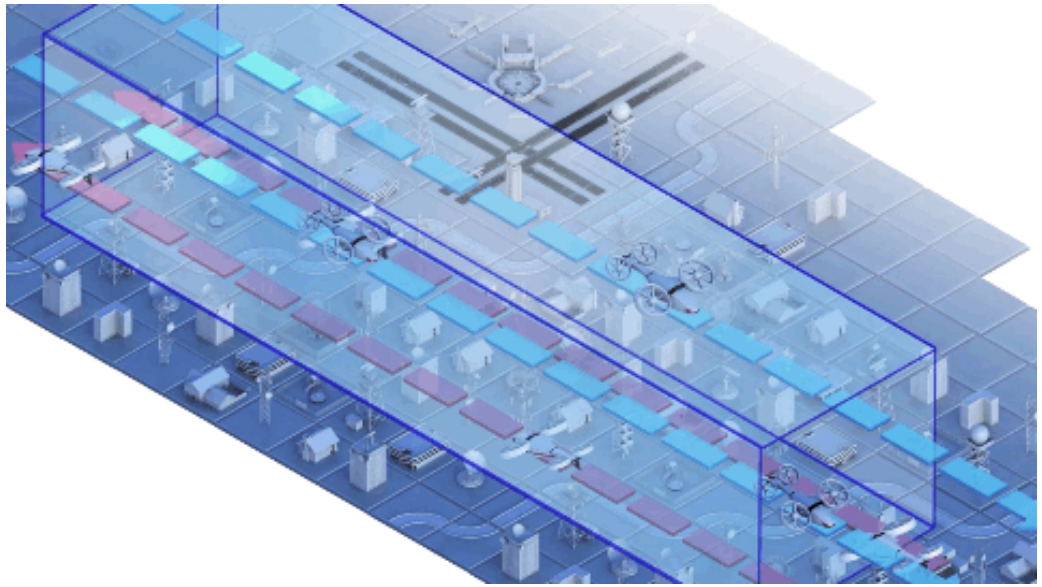
- Locations available for UAM Corridors near airports is dependent upon the airport flow

3. NAS Trade-offs - No Green Space, there is a trade space of stakeholder needs



UAM Corridor Considerations

- Revisit three foundational assumptions from UAM ConOps 1.0
  - UAM Corridors would be required in all classes of airspace
  - Non-UAM aircraft would be required to share operational intent to cross UAM Corridors
  - UAM Corridors going all the way to the vertiport*
- Explore Concepts that:
  - Minimize impact to non-UAM crossings
  - Maximize flexibility/access for UAM
  - Mitigate impacts of UAM/non-UAM interactions
  - Provide scalable solutions for ATC interactions
  - Optimize overall integration objectives



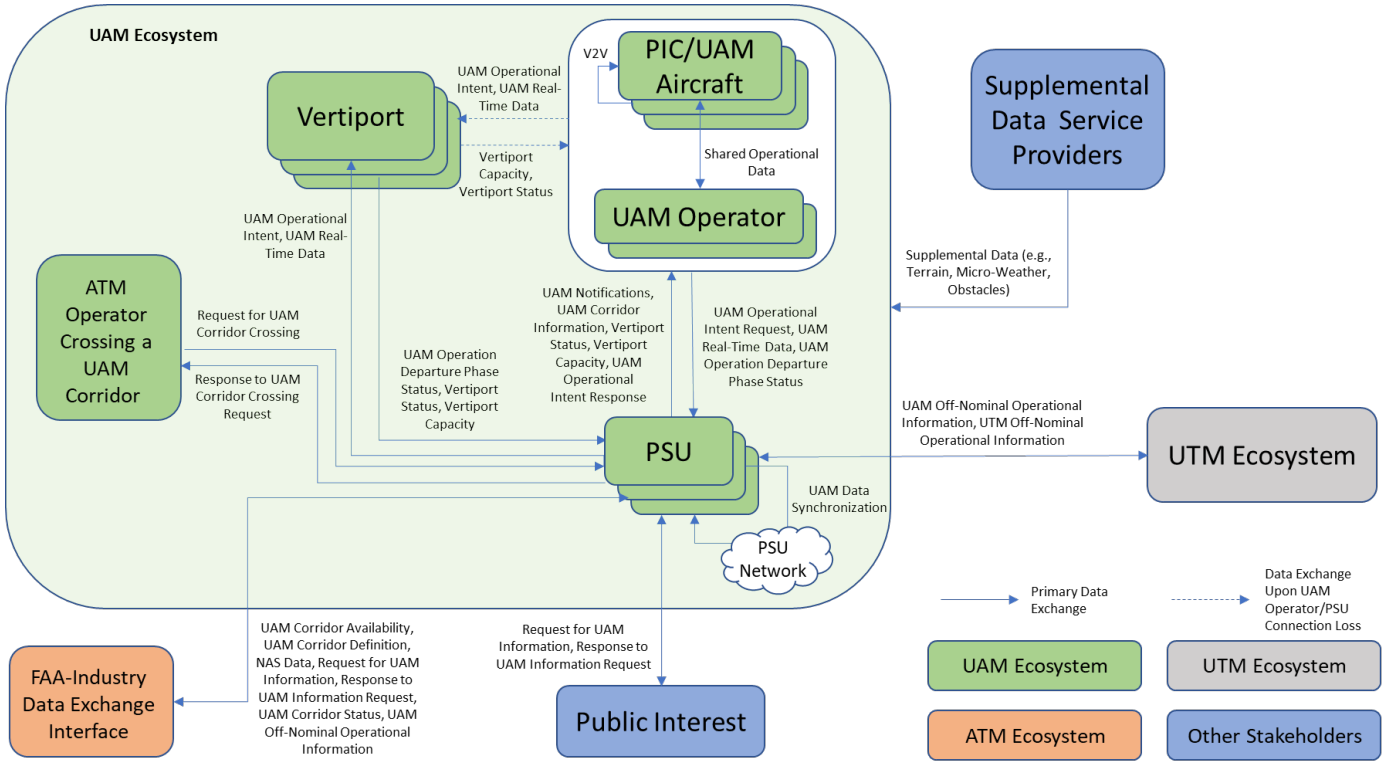
*Research Ongoing

UAM Corridor Expectations

Airspace Class	B	C	D	E
Corridors Required?	Yes	Yes	As-required	IMC- yes VMC - eventually
Participation Requirements for Non-UAM Aircraft Crossing a UAM Corridor	Required Confirmed UAM Operational Intent	Prescribed (e.g., ADS-B Out, cross at designated points, predictable crossing trajectory (level flight, constant speed, no turns))	Moderate (e.g., ADS-B Out, cross at designated points, predictable crossing trajectory (level flight, constant speed, no turns))	Minimal (e.g., ADS-B Out)
UAM Tactical Capabilities within UAM Corridor	UAM Ecosystem baseline capability	UAM Ecosystem increased capability	UAM Ecosystem increased capability	UAM Ecosystem increased capability

UAM Architecture

- UAM Operations are organized, coordinated, and managed by a federated set of actors through a distributed network that leverages interoperable information systems
- The PSU Network lies at the center of the UAM notional architecture and exchanges data with UAM Operators, USSs, SDSPs, the FAA, and Public Interest entities
- Introducing UAM Vertiport and ATM Operator Crossing Class B as new actors
- De-coupling from UTM Architecture



UAM Activities

2019

- One-on-One Listening Sessions I with Industry at NASA
- One-on-One Listening Sessions II Industry at NASA

2020

- Initial set of Guiding Principles and Assumptions
- UAM Scenario Driven Guided Discussion
- FAA NextGen UAM ConOps v1.0 Released

2021

- Conducted Series of Engineering Analysis and research Analyses:
- UAM Concept Maturation Plan
- UAM Corridor Impact Assessment
- Initial UAM Navigation performance Assessment Report

2022

- UAM Guided Discussion March 15, 2022
- Establishment of UAM Airspace Management Demonstration project August 3, 2022

FAA ConOps Development Next Steps

- Continue cross Collaboration with NASA and Industry to refine ConOps v2.0
- Foundational work to support UAM Concept Maturation
  - Candidate research activities (e.g., UAM COPs Assessment, UAM Roadmap, Capability Analysis)
  - Mature and modify UAM ConOps through ongoing Government and industry stakeholder engagement
  - Develop common "use cases" that can be utilized across efforts in both Agencies

Thank you!