

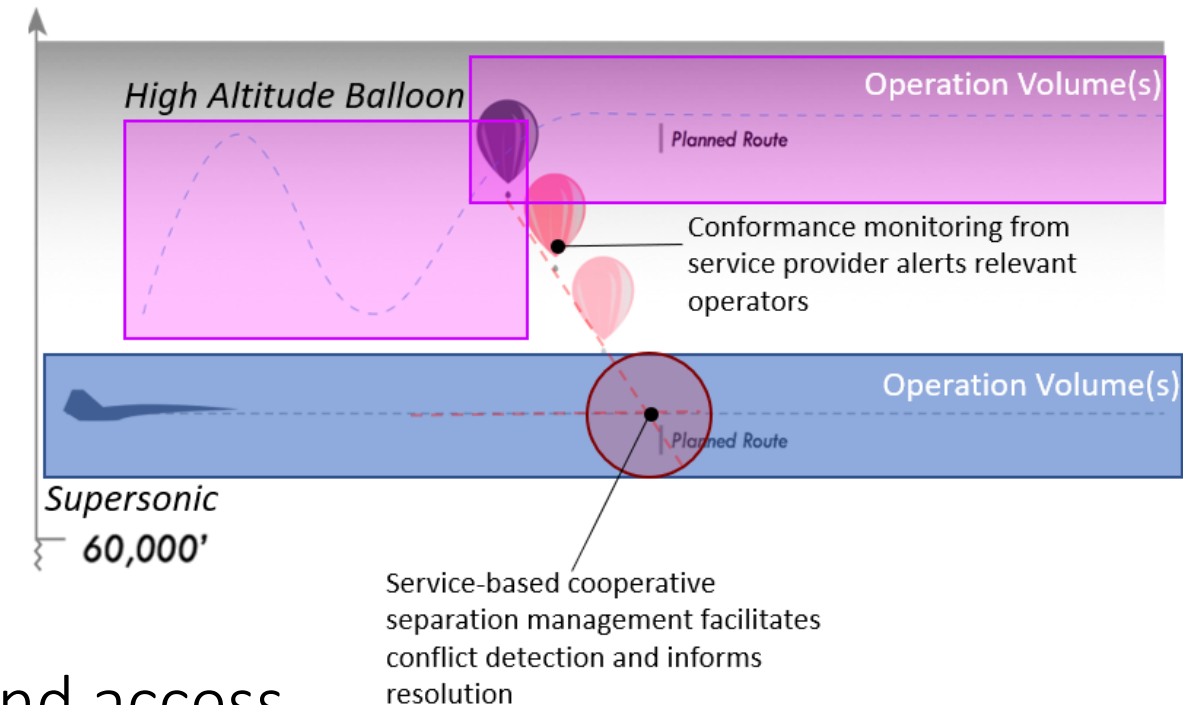


Upper Class E Traffic Management (ETM) and ATM-X

Jeffrey Homola
NASA Ames Research Center
4th Federal UAS Workshop
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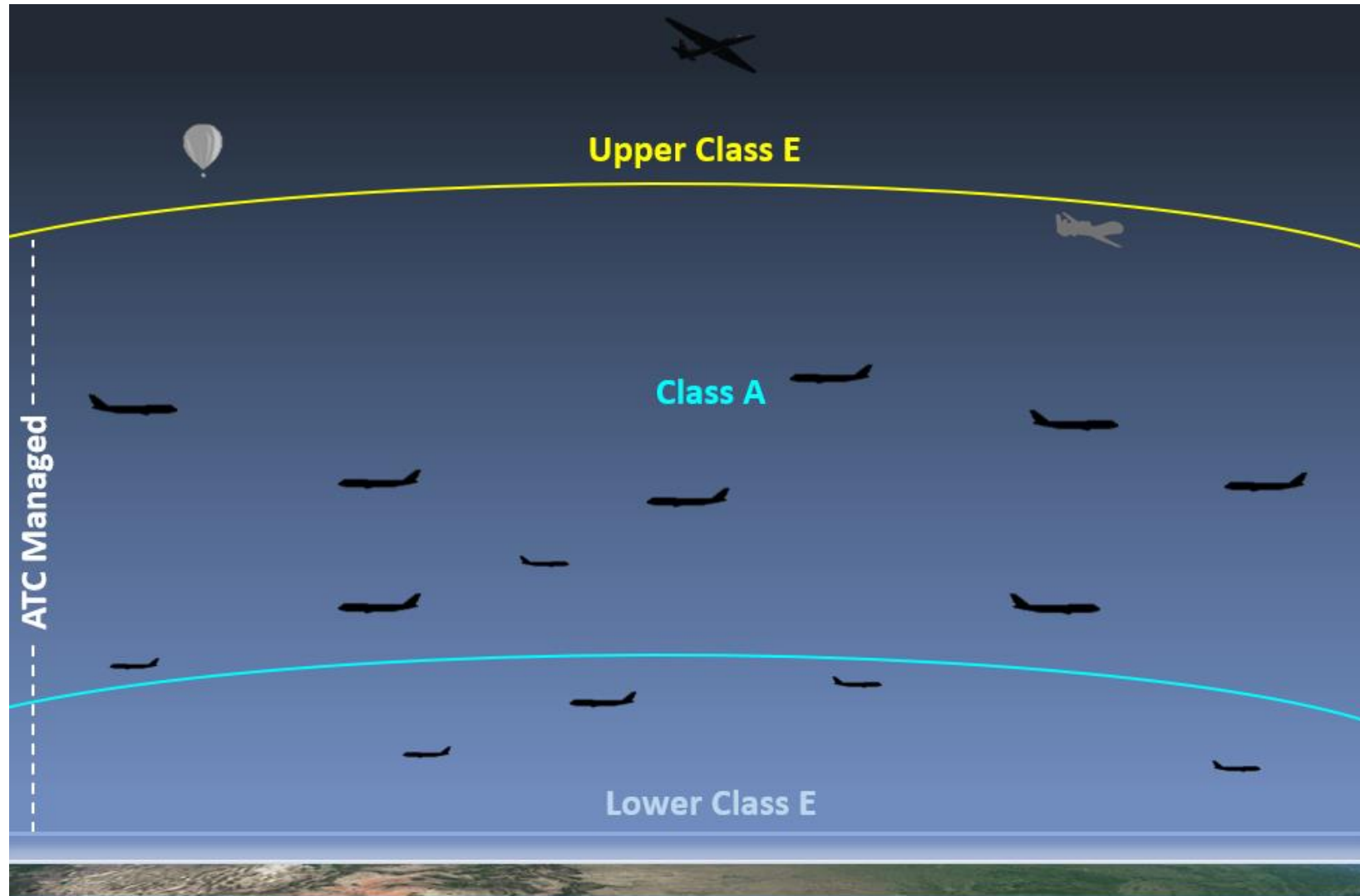
Upper Class E Traffic Management (ETM)

- What is ETM?
 - A cooperative approach to stratospheric airspace integration and management that is safe, scalable, efficient, and fair that accommodates all missions and use cases
- Why is ETM needed?
 - New entrants are emerging
 - Existing users need continued safety and access
 - Demand for Upper Class E airspace use is projected to increase
 - A diverse set of vehicle and operation types are expected
 - In the US, ATC services are limited or not provided in Upper E, which will impact the ability for industry to scale



Background

- Operations in Upper Class E airspace have traditionally been relatively few in number
- Security and science missions have contributed to much of the presence at high altitudes
- Managed services in Upper Class E have historically not been provisioned for civil aircraft operations





Growth in Upper Class E Opportunities



Security & Science

Communications

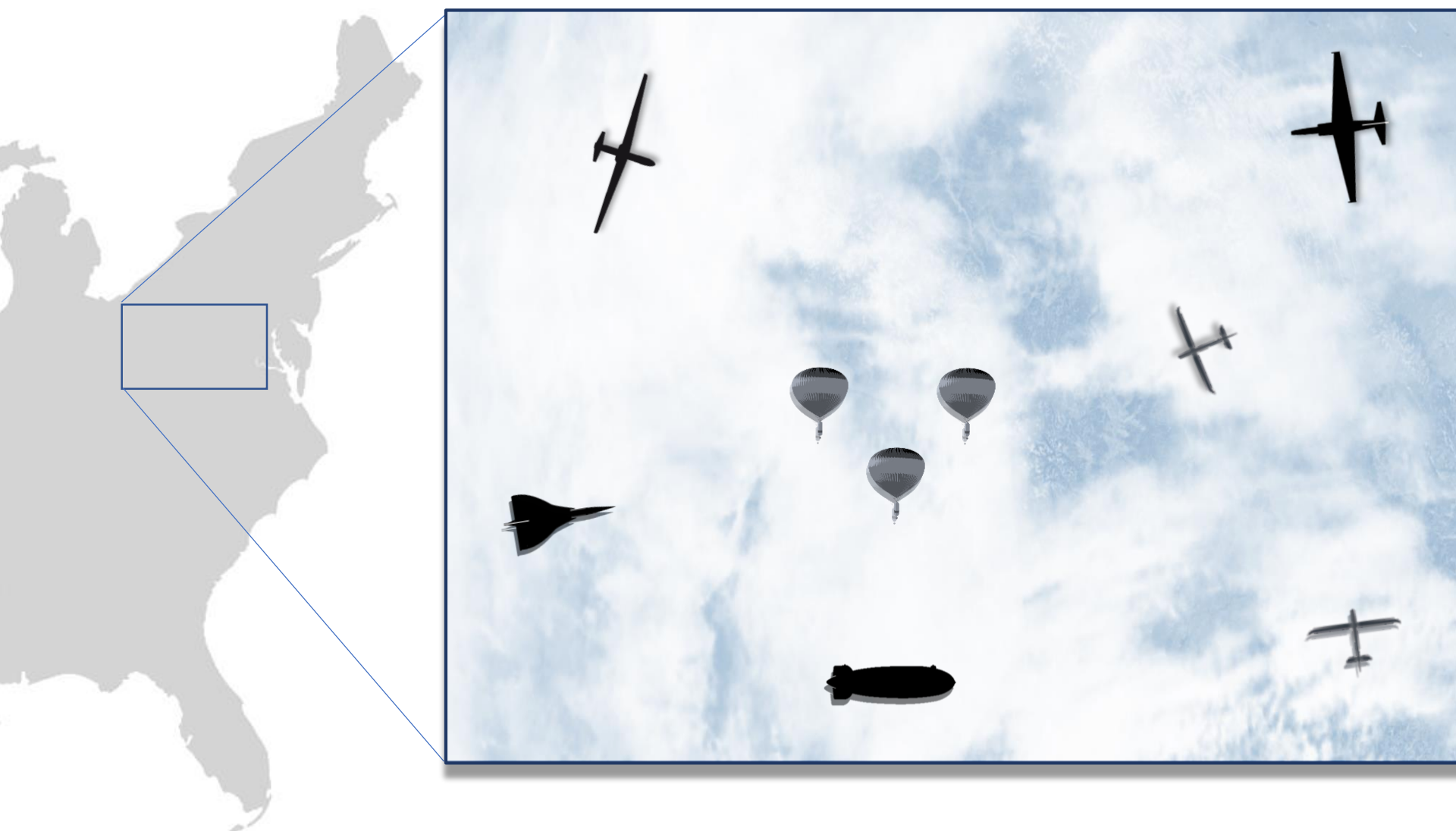
Persistent Monitoring

Supersonic
Transport

Commercial
Space Launch

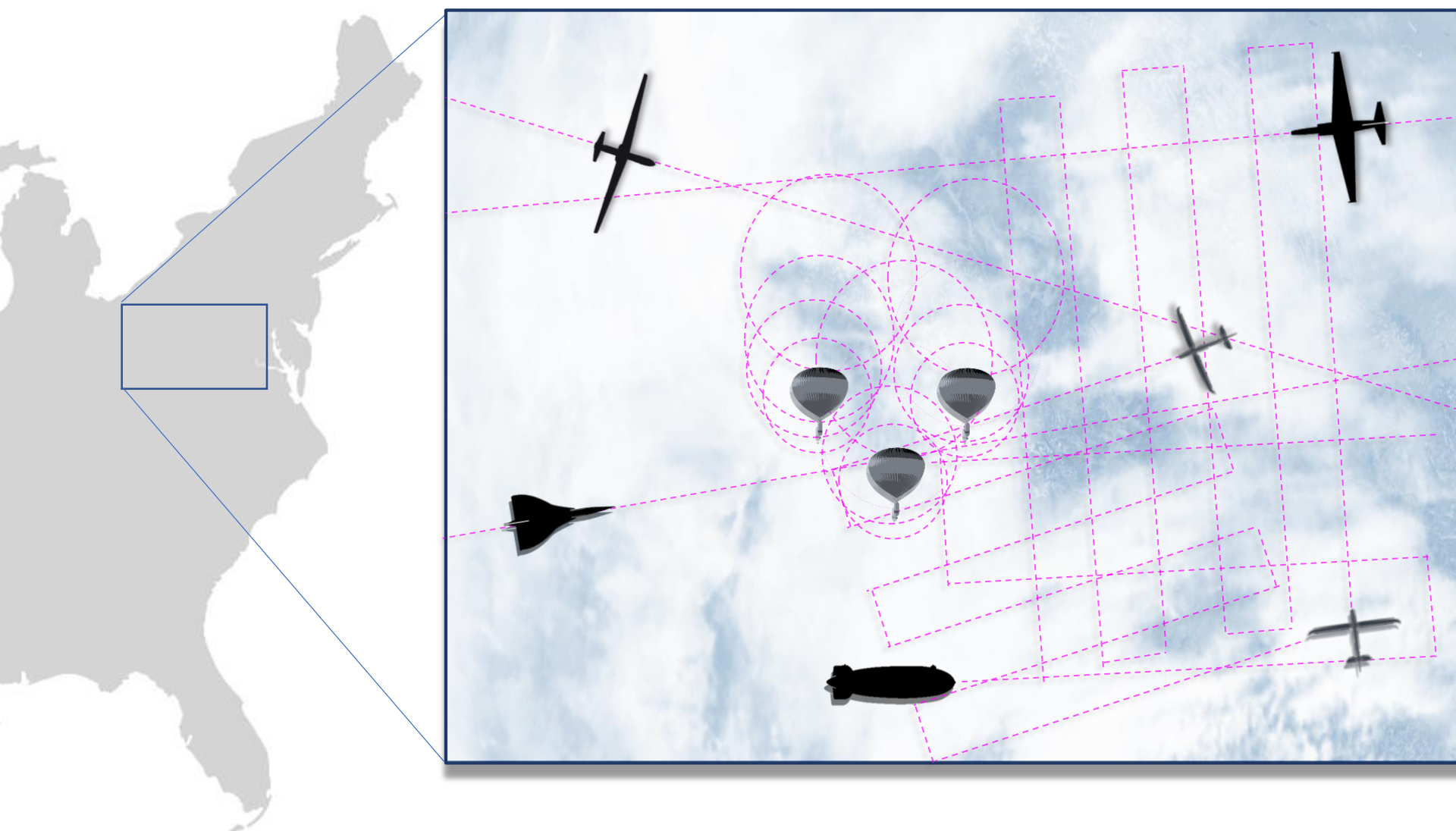
Hypersonics

Challenges in Upper Class E Growth



- Introduction of new entrants will create an increasingly diverse operating environment
- These operations and associated vehicles will vary by:
 - Speed
 - Duration of flight
 - Configuration
 - Trajectory uncertainty
 - Constraints and maneuverability
 - Mission
 - ...

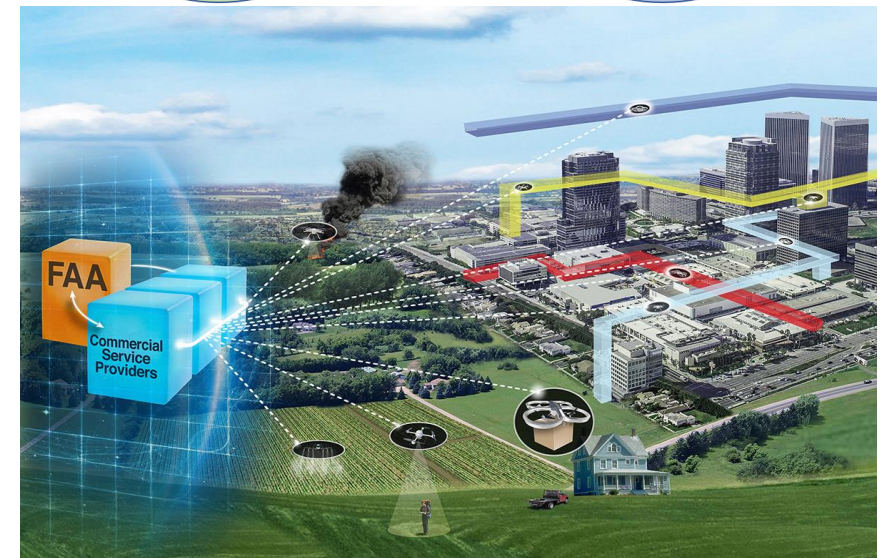
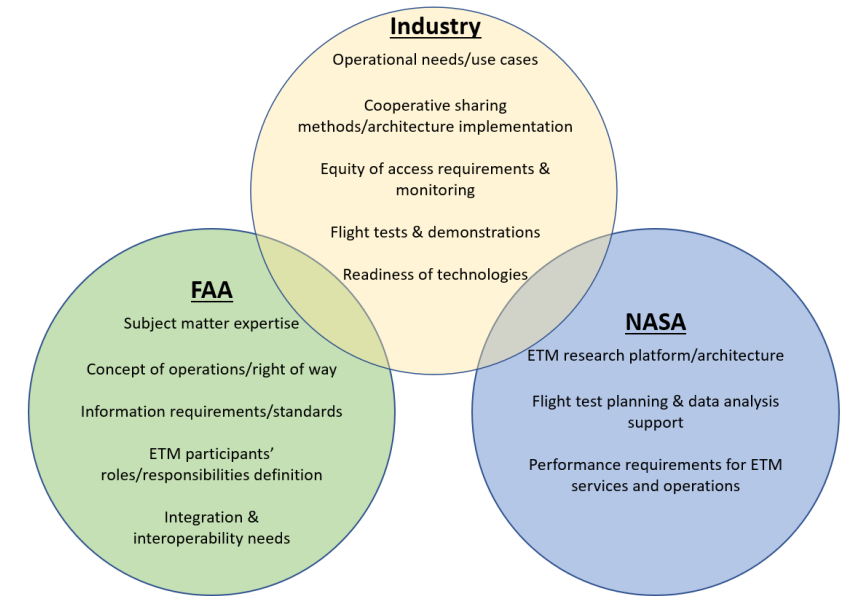
Challenges in Upper Class E Growth



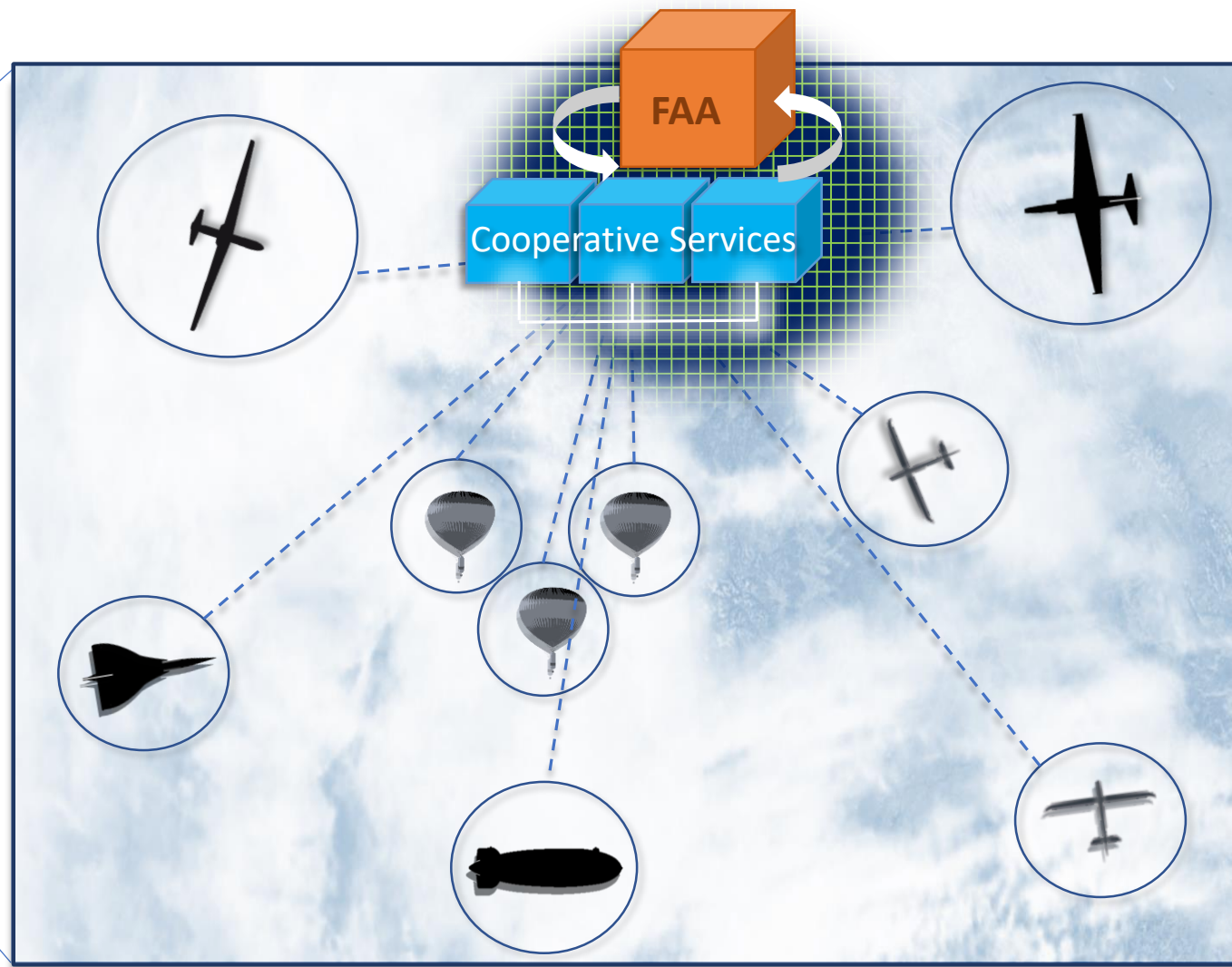
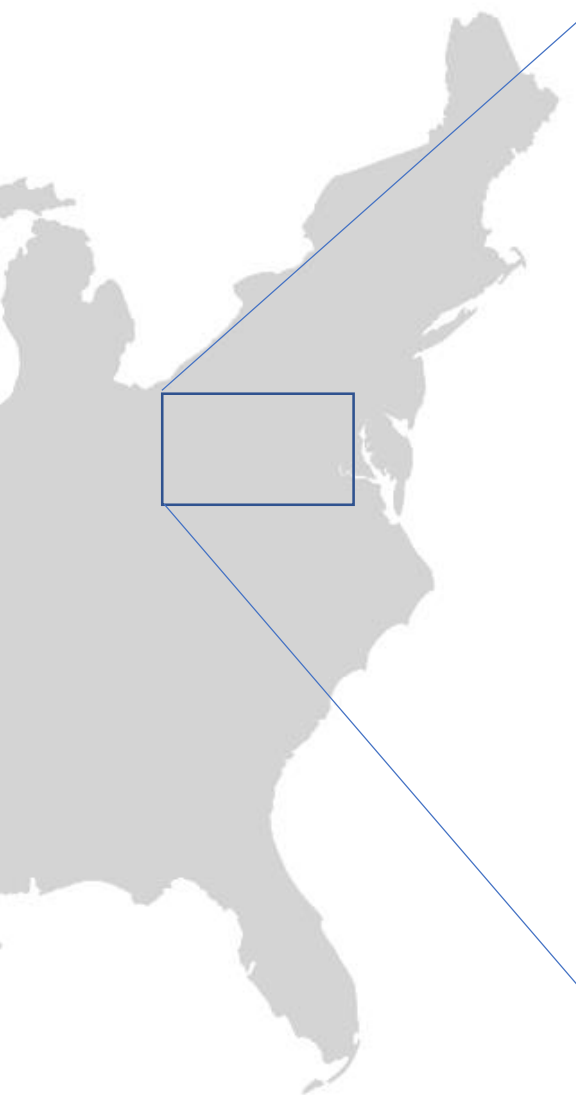
- Resulting environment will pose significant challenges given the diversity of operations
- To enable routine, flexible, and scalable operations, there is a need for a cooperative approach that provides stakeholders with situation awareness and information exchange capabilities to support planning and informed execution of missions

ETM Development

- Development of ETM requires close collaboration with multiple stakeholders
 - Industry
 - FAA
 - Other regulatory agencies and organizations
 - DoD and other federal agencies
- In developing ETM, leverage and build upon the foundations laid in NASA's UAS Traffic Management (UTM) research



Service-Based Cooperative Approach in ETM



- Work in UTM produced an architecture and information exchange method that provided a viable means of digital coordination and cooperation
- Pathway to achieve a cooperative environment that does not burden the current ATM infrastructure
- It is clear, however, that the ETM environment poses unique challenges and needs that were not addressed in UTM

Tabletop Meetings with Industry & Government Stakeholders: Tabletop 1



NASA Ames Research Center

Participants

Standards

Int'l. Civil Aviation Org.



Defense & Security

Dept. of Defense (DOD)
Dept. of Homeland Security (DHS)



Industry



NASA

Ames Research Center



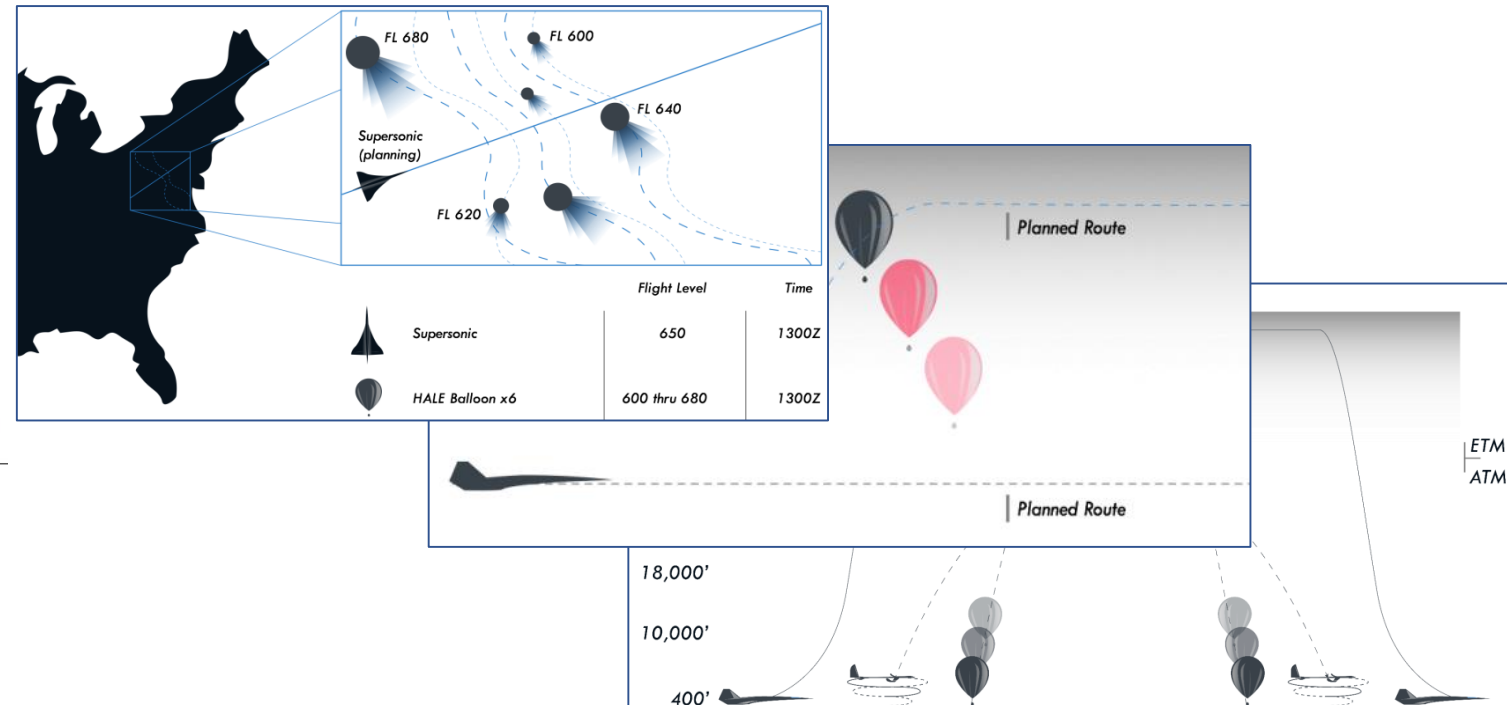
FAA

NextGen (ANG)
Aviation Safety (AVS)
Air Traffic Organization (ATO)
UAS Integration Office (AUS)
National Air Traffic Controllers Association (NATCA)



Scenarios

- 1) Transition into ETM
- 2) Strategic Deconfliction between Operations (Pre-Flight)
- 3) Deconfliction between Pre-Flight and Active Operations
- 4) Planned Overlapping Areas of Supersonic & HALE Operations
- 5) Tactical Deconfliction
- 6) Off-Nominal Event



Tabletop Meetings with Industry & Government Stakeholders: Tabletop 2



NASA Ames Research Center

Participants

NASA
Ames Research Center



FAA
NextGen (ANG)
Aviation Safety (AVS)
Air Traffic Organization (ATO)
National Air Traffic Controllers Association (NATCA)
UAS Integration Office (AUS)



Defense & Security
Dept. of Defense (DOD)



Industry

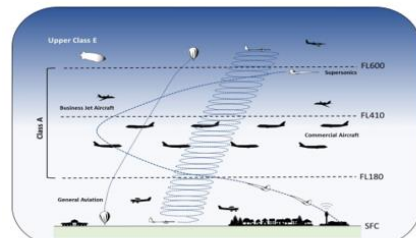


Ascent to Operating Altitude Airspace Management and Procedures

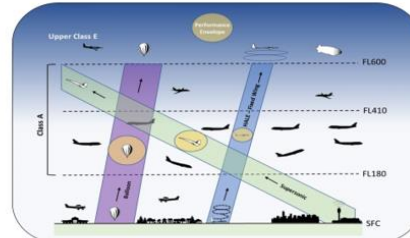
| Aerion AS2 (Super/Subsonic) | |
|--|---|
| Ascent | Manned Fixed Wing |
| Ascent Pattern | |
| Speed | 270-280 accelerating to 380 knots |
| Rate of Ascent | 6200 FT/min initially |
| Time to reach altitude | Approximately 10 minutes |
| Ability to move laterally and horizontally | Yes |
| Ability to maintain position (hold altitude) | Able to level off at any portion of the flight |
| Equipment | Manned Fixed Wing |
| Surveillance | Planned Secondary Surveillance Radar (SSR) and ADS-B |
| Communications | Controller Pilot Data Link Communication (CPDLC) and traditional Push-to-Talk (PPT) |
| Navigation | Global Navigation Satellite System (GNSS), GPS, Inertial Reference System (IRS) |



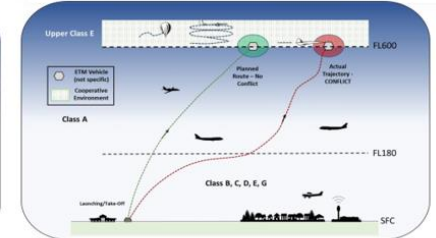
- Ascent procedures
 - ATC services/coordination
- Operating altitude procedures
 - ATC services/coordination
- Operational Issues
 - FAA identified
 - Industry identified



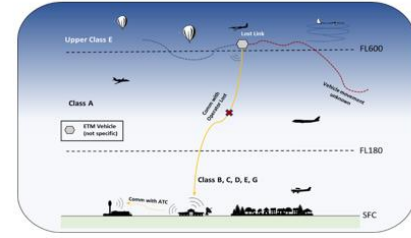
Take-off/launch and transit to Upper Class E airspace



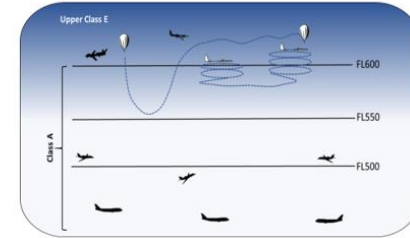
Ascent/Descent to/from operating altitude



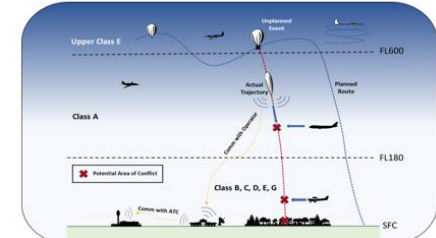
Class E entry point change



Lost link



Operations straddling ETM and provided separation



Uncontrolled descent



Engagement

- Regular meeting schedule developed with Industry, FAA, and other stakeholders
- Interim AIA-mediated meetings for Industry consensus

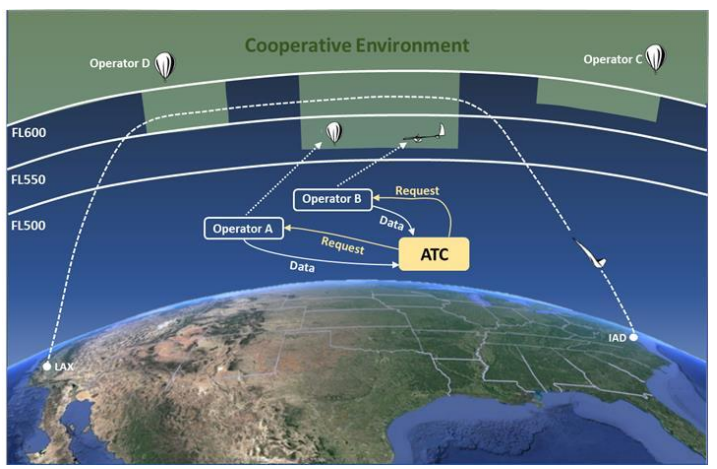


NextGen ETM ConOps

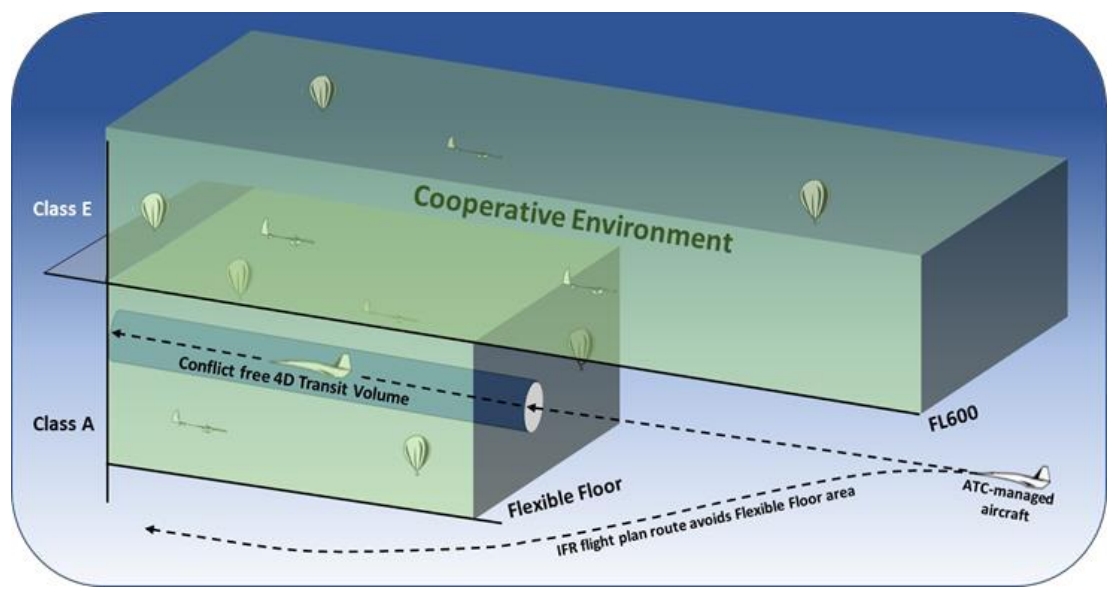
Concept of Operations
v1.0

Foundational Principles
Roles and Responsibilities
Scenarios and Operational Threads

Upper Class E Traffic Management (ETM)

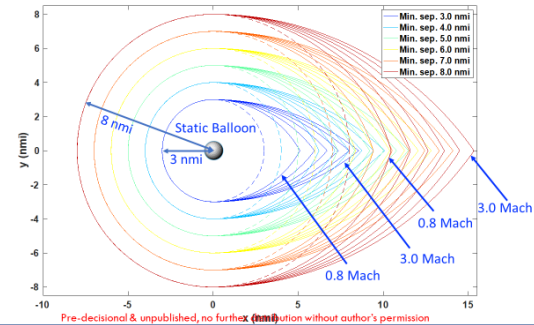


- Operations
 - Pre-Flight and Transition to Upper Class E Airspace
 - Operating Altitude WITHIN Upper Class E Airspace
 - Operating Altitude BELOW Upper Class E Airspace: Flexible Floor of Cooperative Environment
 - Descent from Upper Class E Airspace to Landing (into/through Class A airspace)
 - Contingency Management
- Equity of Airspace Usage
- Security
- ETM Implementation

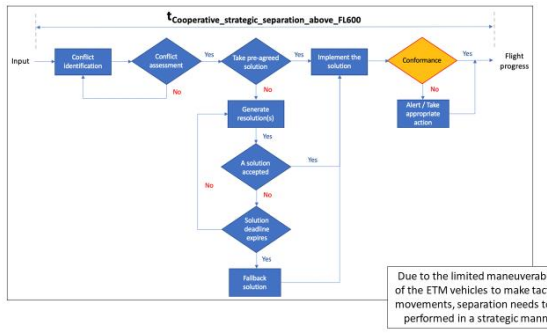


Path Forward

Minimum safety zone for different minimum separations & speeds



Notional cooperative separation management service processes within Upper Class E Airspace (Above FL 600)

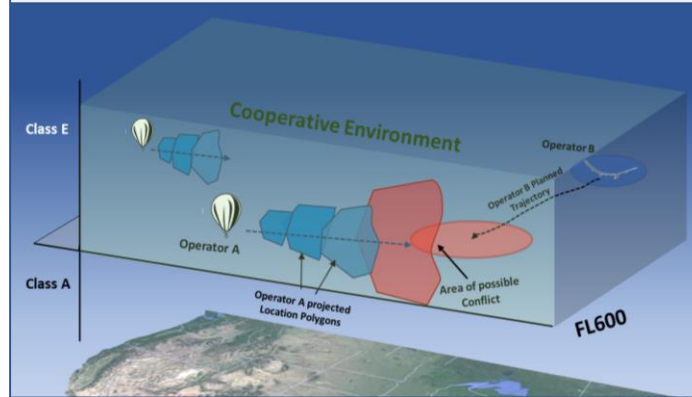
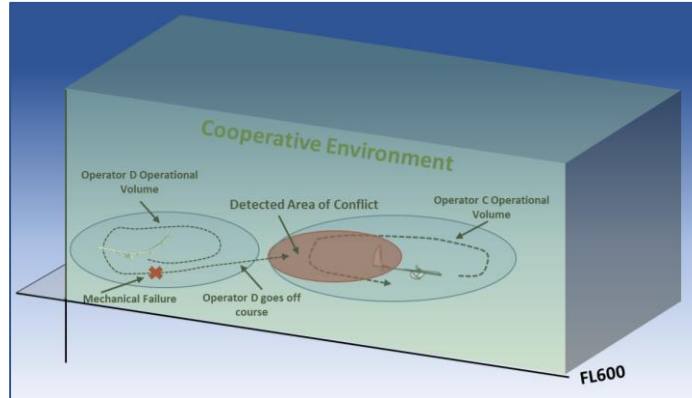
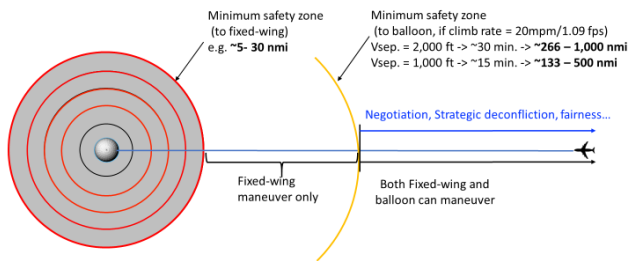


32

Conflict Resolution Phases for Balloon and Fixed wing



Pre-decisional



Modeling and Simulation of High-Altitude Balloons for ETM

A. Ishihara, J. Silva, and M. Xue

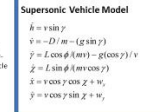
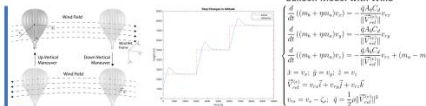
Objective: Develop a 3D balloon model for upper E and integrate into Fe3 simulation environment

Challenge: Balloon dynamics are fundamentally different from conventional aviation vehicles (e.g. fixed-wing type)

- Highly dependent on upper-E atmospheric properties
- Highly susceptible to wind
- Vertical control only

Status

- Initial 3D model of Balloon developed
- Implemented initial PI (proportional-integral) controller
- Performed initial tuning of drag coefficient and controller gains based on realistic balloon flight data
- Initial kinematic model of supersonic vehicle

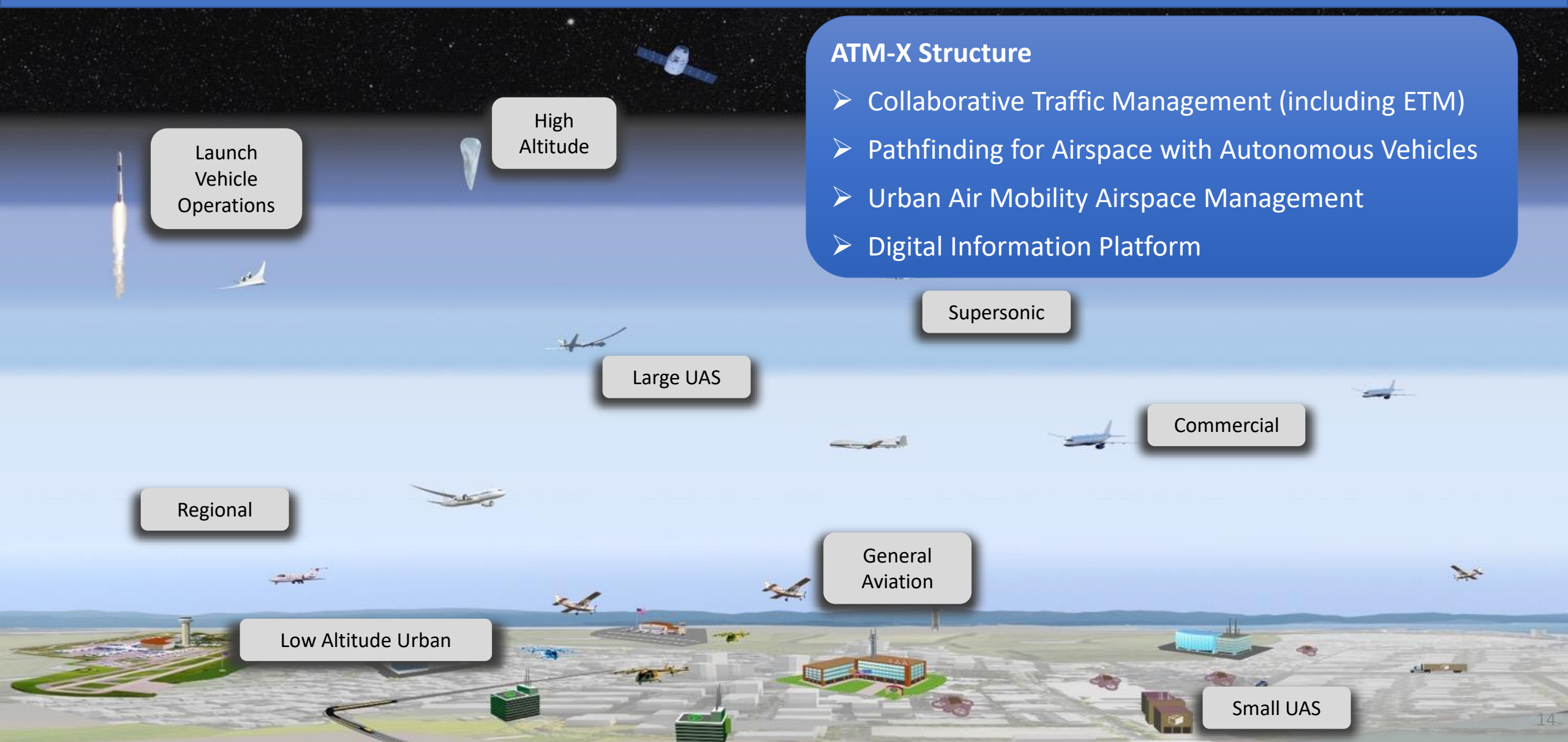


Initial take-off in urban environment

- Continued stakeholder engagement and outreach
- Use case development
- ConOps update
- Simulation research
- Flight demonstration coordination/observation
- Architecture development
- Services analysis and reference development/engagement
- Standards engagement



ETM as Part of ATM-X



- ### ATM-X Structure
- Collaborative Traffic Management (including ETM)
 - Pathfinding for Airspace with Autonomous Vehicles
 - Urban Air Mobility Airspace Management
 - Digital Information Platform



Questions?

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