



EXPLORE FLIGHT

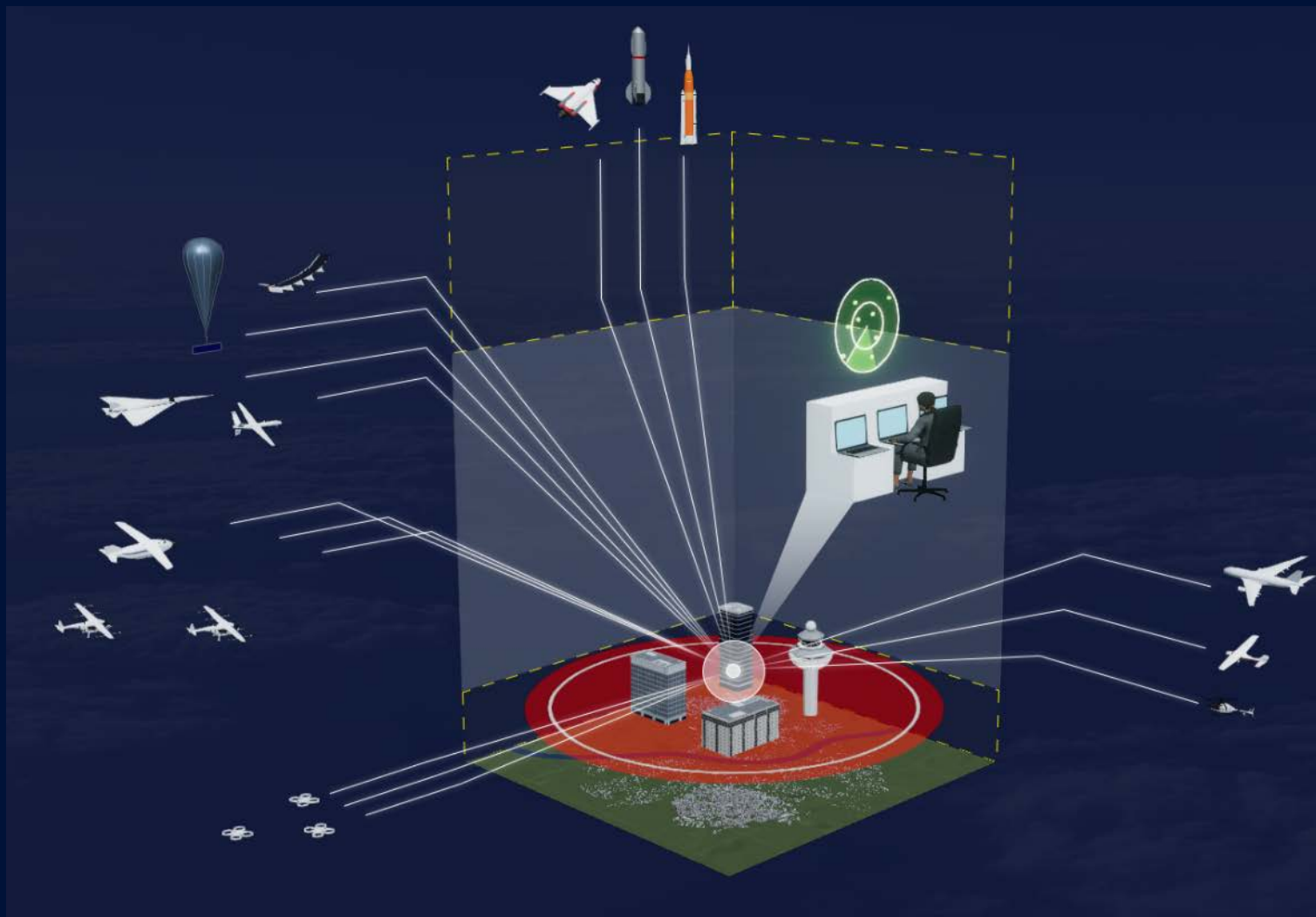
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NAS Exploratory Concepts & Technologies (NExCT) Overview
February 2024

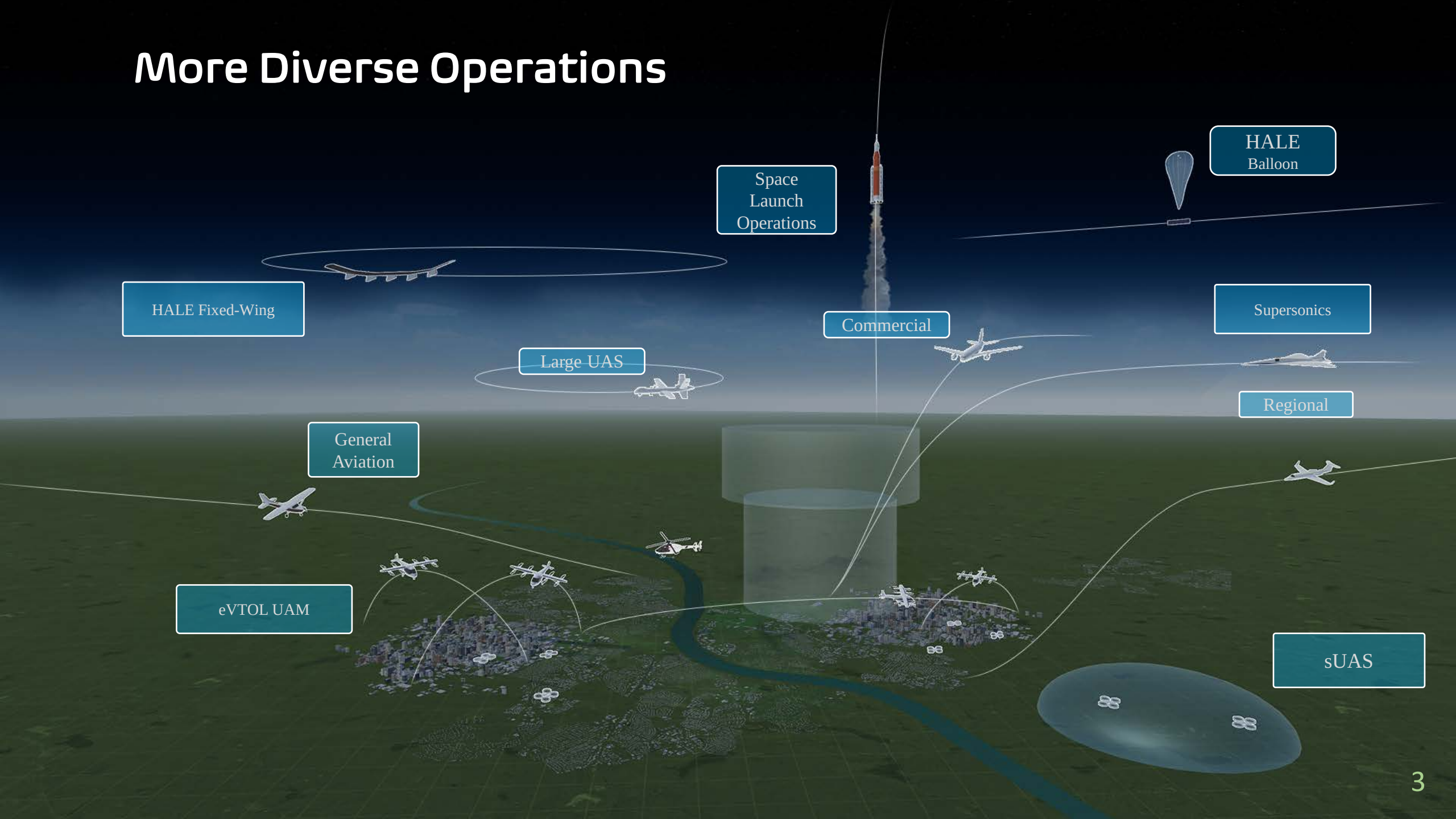


NExCT Goals

- Develop scalable traffic management system for seamless introduction of new entrants while minimizing impact on current operations
- Enable autonomous xTM operations where human-centric operations is not scalable
- Develop xTM airspace management technologies while minimizing the impact to current ATM



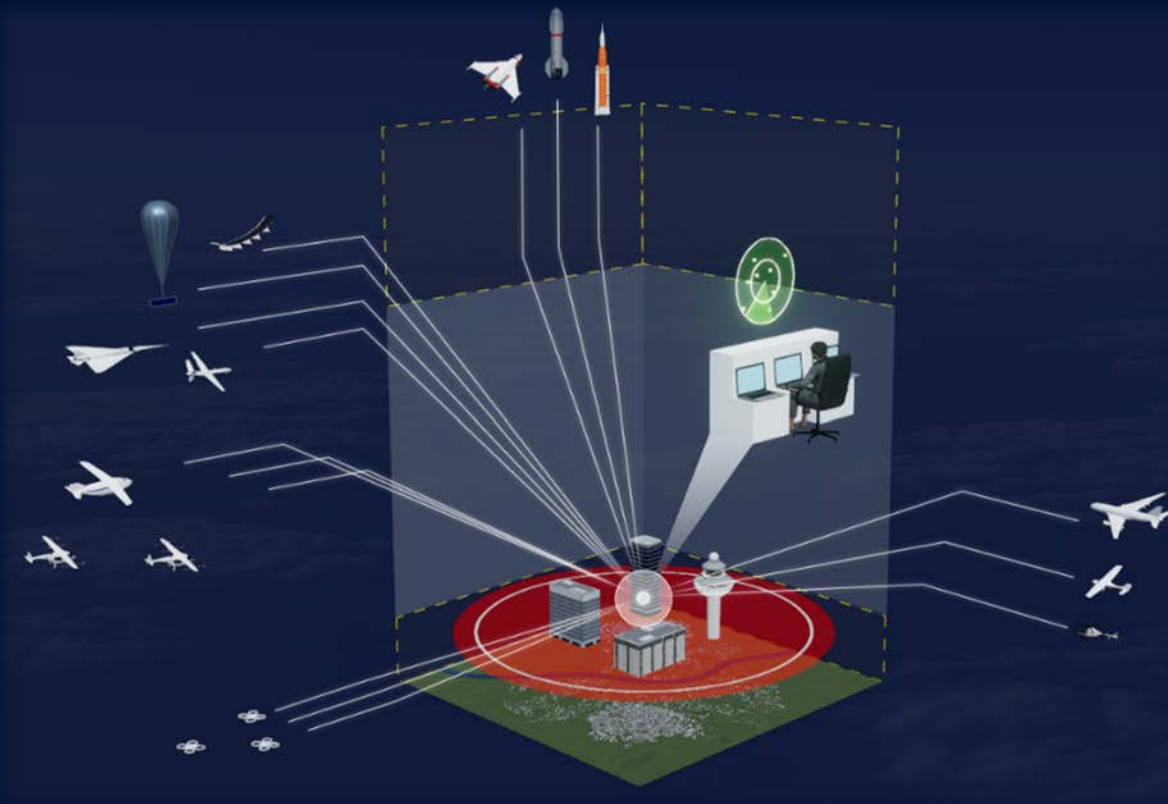
More Diverse Operations





NAS Exploration Concepts and Technologies (NExCT)

Catalyze airspace integration of diverse and scalable cooperative xTM operations



Upper Class-E Traffic Management (ETM) Cooperative Operating Practices

Develop functional requirements to support ETM operations of vehicles with unique performance characteristics and mission needs



Cooperative Operating Practices

Develop and test cooperative operating practices and automated methods of strategic and tactical conflict and flow management for diverse aircraft and operations



Integrated Operations Picture

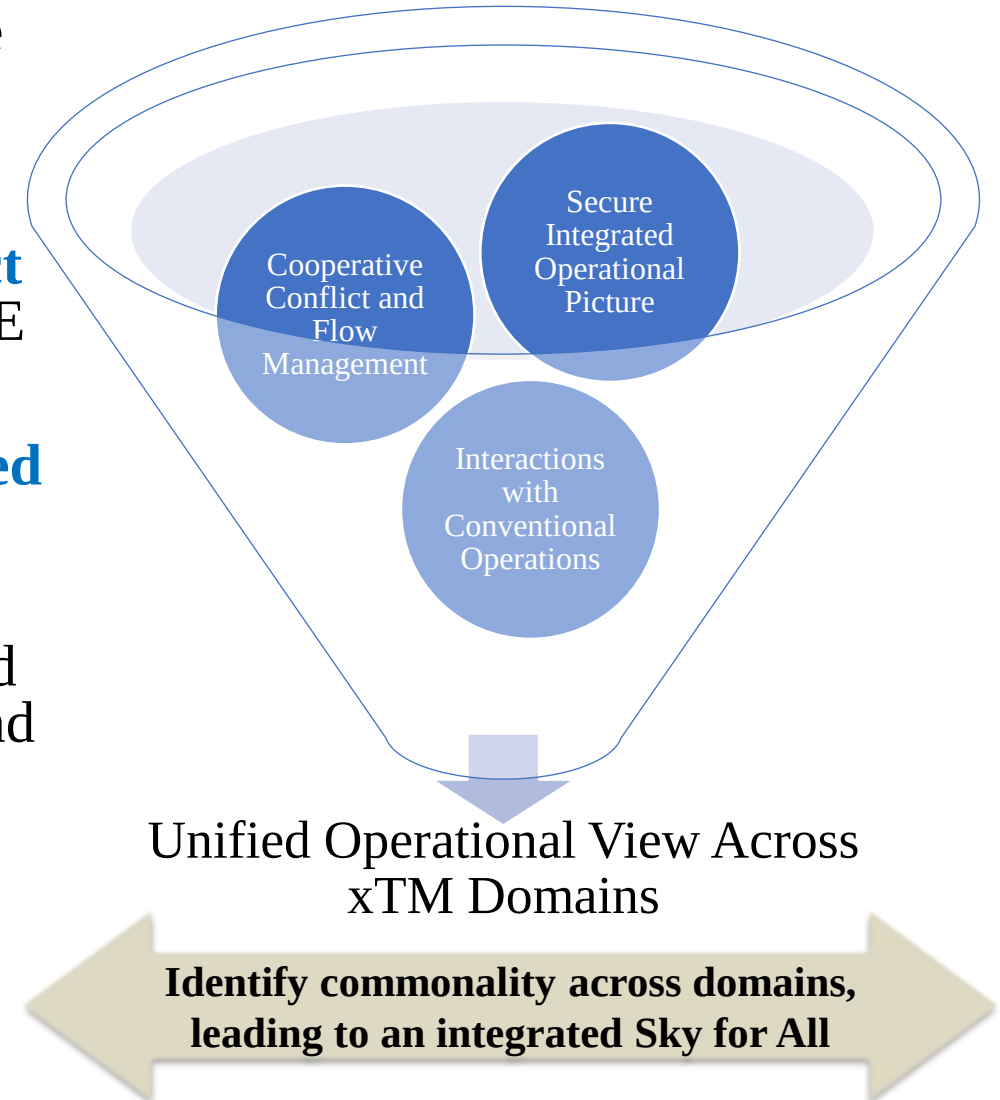
Identify the requirements for a secure digital integrated operational picture that supports diverse and increasingly autonomous operations



NAS Exploratory Concepts & Technologies (NExCT)

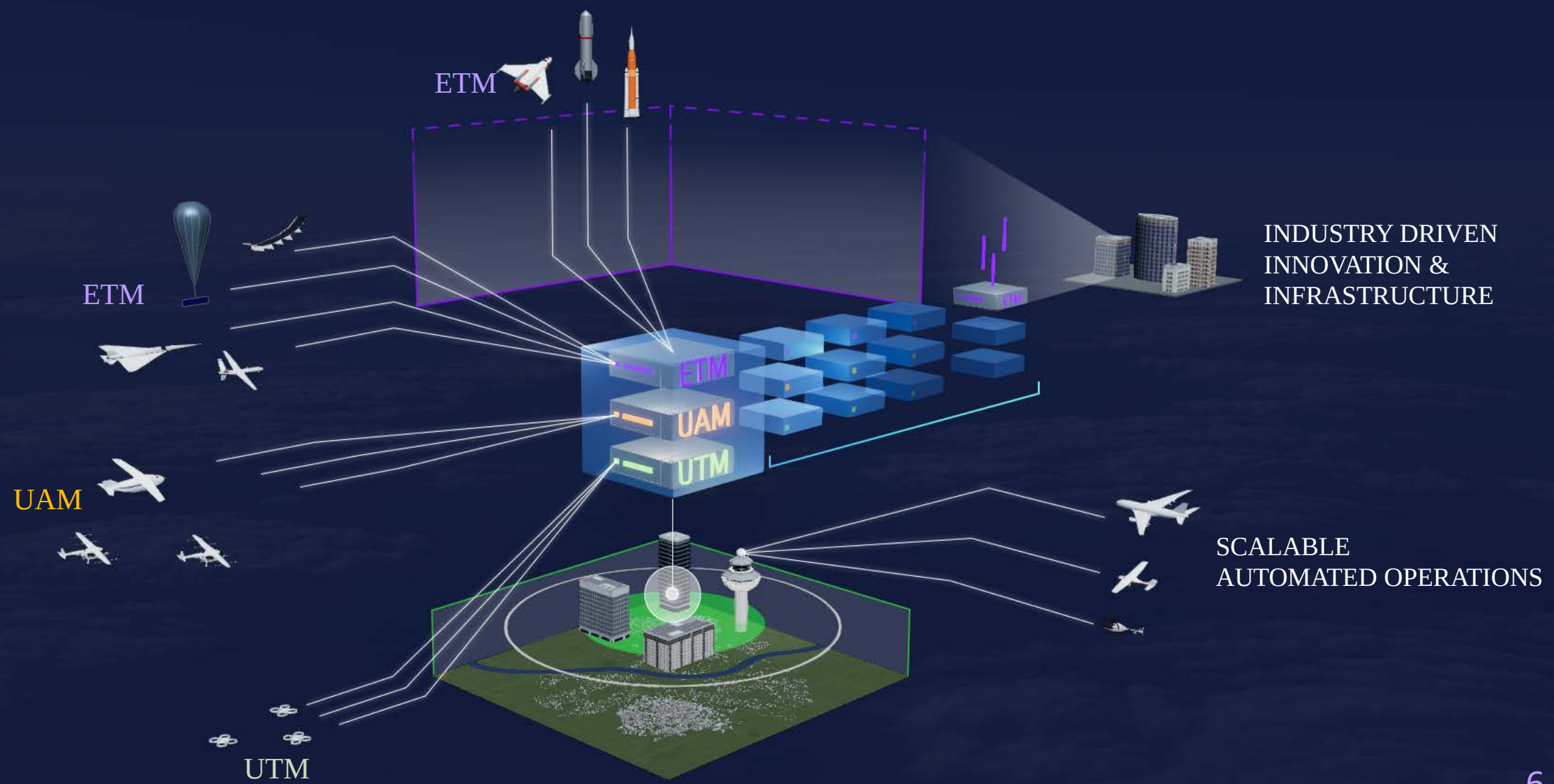
A Unified Operational View Across xTM Domains

- Goal: Catalyze airspace integration of diverse and scalable cooperative xTM operations
- Objectives:
 - o Demonstrate the use of **ETM for cooperative conflict management** between diverse aircraft in upper Class E airspace
 - o Identify the requirements for a secure digital **integrated operational picture** that supports diverse and increasingly autonomous operations
 - o Develop and test **cooperative operating practices** and automated methods of strategic and tactical conflict and flow management for diverse aircraft and operations
 - o Identify guidelines and procedures for the interoperability of **cooperative xTM operations with air traffic services (ATS)**





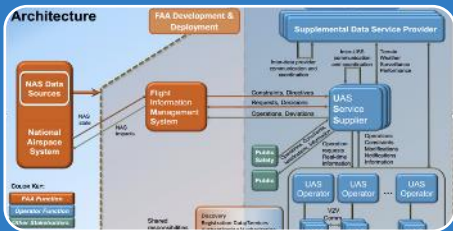
Extensible Traffic Management (xTM)





Extensible Traffic Management (xTM)

xTM: The overarching term for traffic management approaches and/or associated services that address the operation of select new entrants within flexibly allocated, designated airspace.



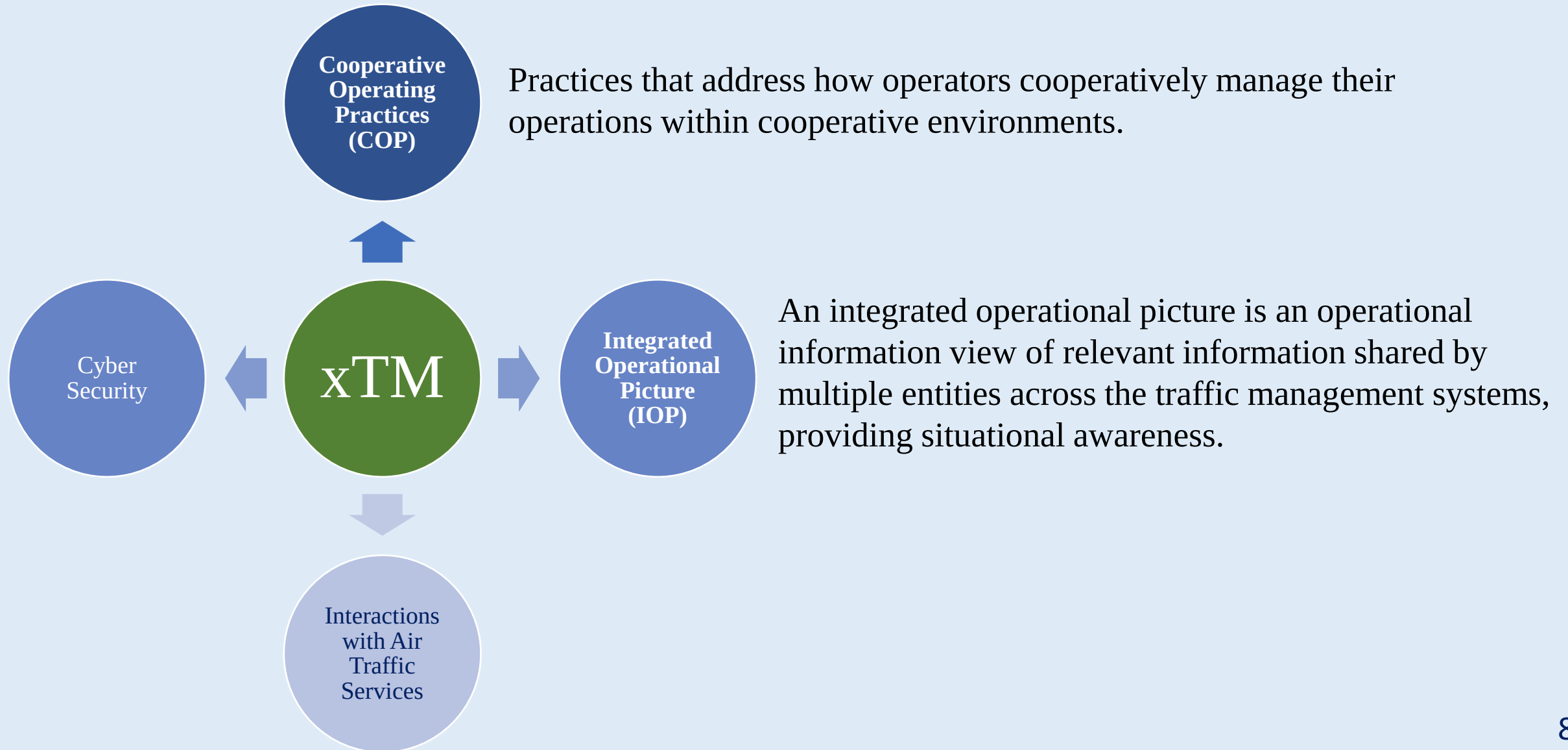
Unmanned Aircraft System Traffic Management (UTM)



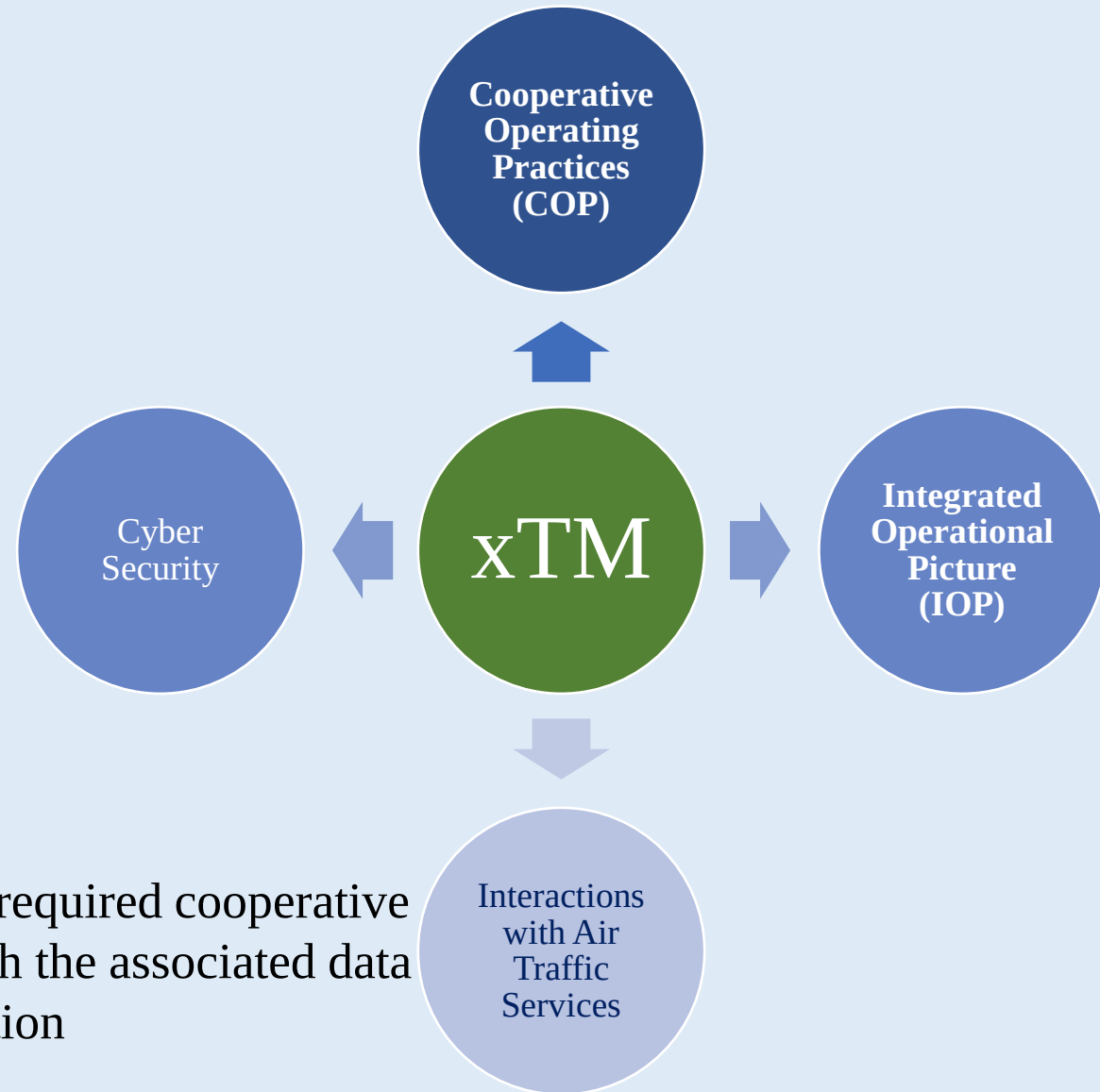
Urban Air Mobility (UAM)



Upper Class E Traffic Management (ETM)



Cybersecurity mechanisms will be researched that ensure the confidentiality, integrity and availability of xTM systems and data exchanges

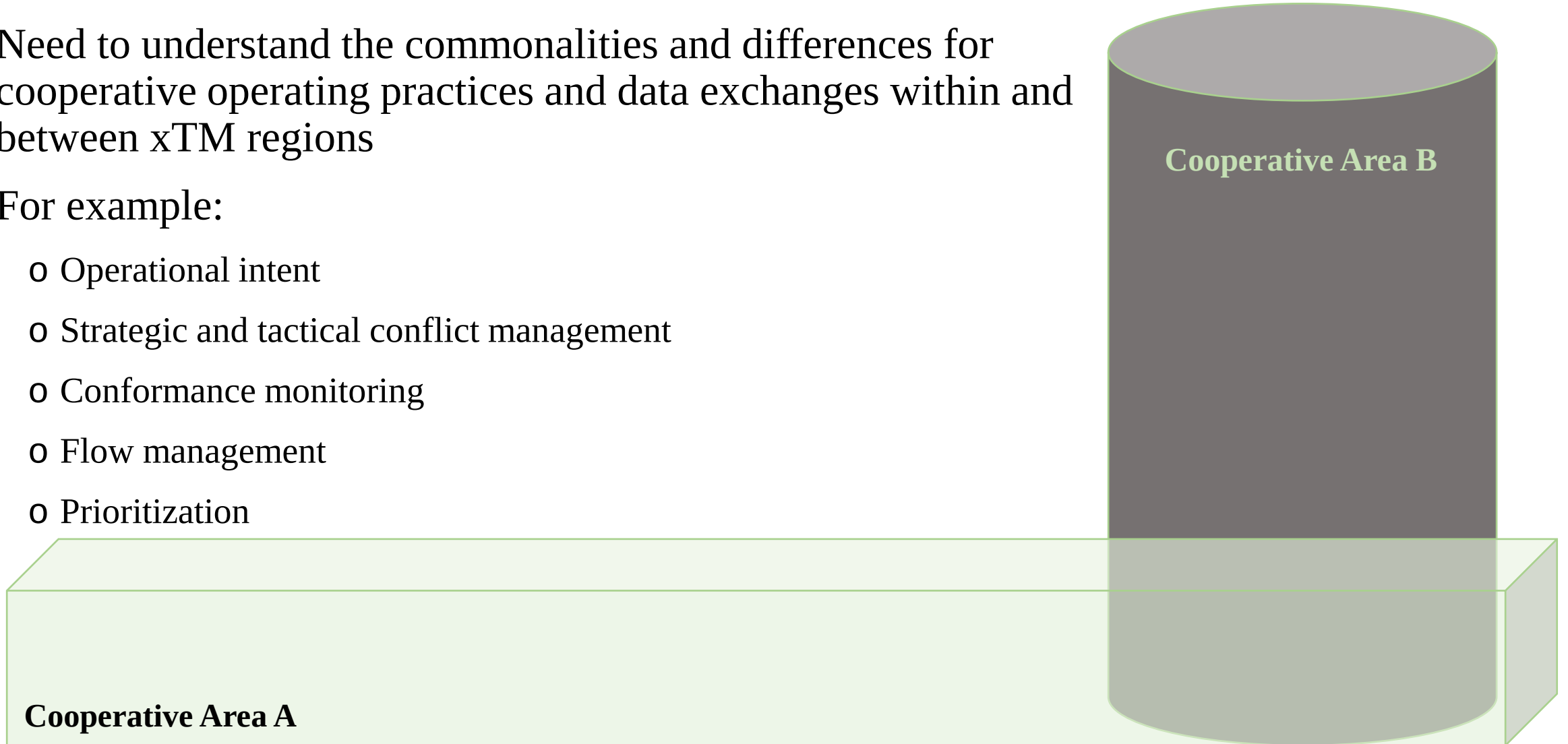


As xTM vehicles interact with ATS, the required cooperative operating practices will be identified with the associated data products required to support this interaction



Approach

- Need to understand the commonalities and differences for cooperative operating practices and data exchanges within and between xTM regions
- For example:
 - o Operational intent
 - o Strategic and tactical conflict management
 - o Conformance monitoring
 - o Flow management
 - o Prioritization





Upper Class-E Traffic Management (ETM)

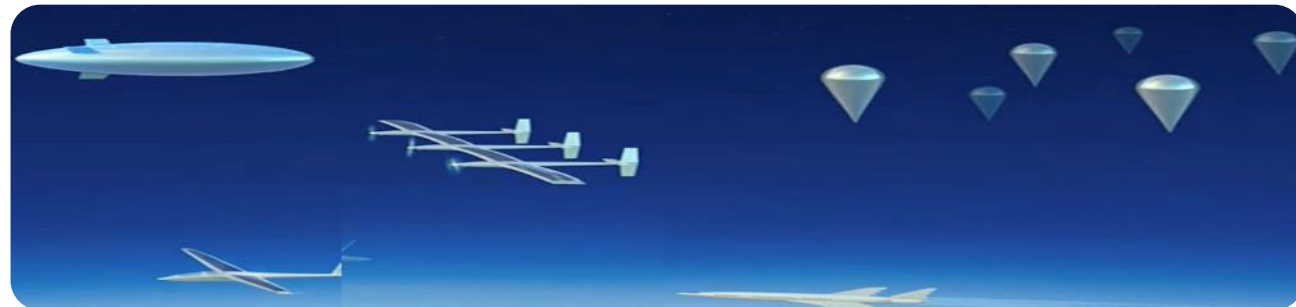
- New generation of high-altitude aircraft are expected to efficiently satisfy research objectives, demands for broad coverage services, and supersonic passenger flight, and an increase in upper Class E operations is predicted
- However, there are limited specific provisions for aircraft operations above 60,000 feet for civil aircraft, and most existing applications are limited to military operations
- Also, existing Air Traffic Management Systems is unable to cost-effectively accommodate upper Class E needs
- A strong need, expressed by both FAA and industry, for NASA to conduct research and simulations to help develop, evaluate, and mature the Upper-Class E Traffic Management (ETM) to meet the expected demand



ETM Research Areas

Upper Class E Traffic Management (ETM)

- Objectives
 - o Develop ETM system architectures and services for Upper Class E operations
- Deliverables
 - o Identify ETM services requirements to coordinate cooperative operations and ANSP for the transition to/from Upper Class E airspace.
 - o In Upper Class E airspace, addressing intent sharing and interactions with other cooperative aircraft.
 - o Support Cooperative Operating Environment (COE) Concept Analysis with the FAA
 - o Develop tools to support the creation of Cooperative Operating Environments (COE) utilizing the recommended COPs, assess the interactions between COEs and ATS.

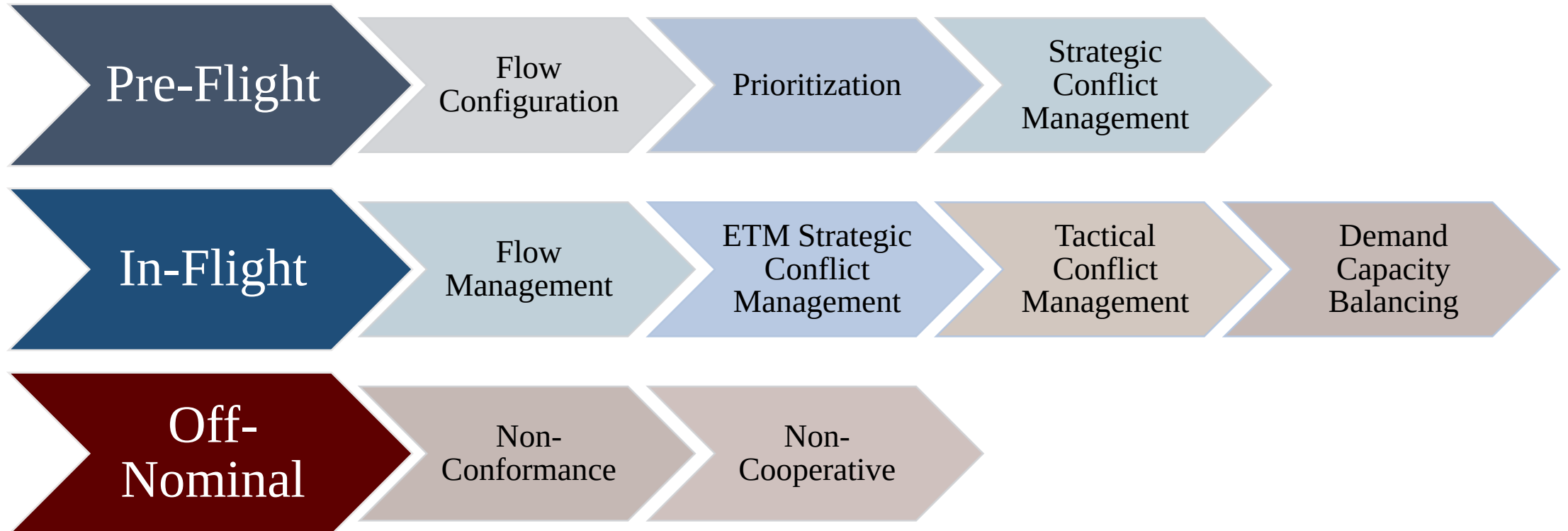




Cooperative Operating Practices

Cooperative Operating Practices

Practices that address how operators cooperatively manage their operations within a cooperative environment.





Cooperative Operating Practices

Intent: Develop cooperative operating practices (COP) and automated methods of strategic and tactical conflict management for diverse aircraft and operations

Deliverables:

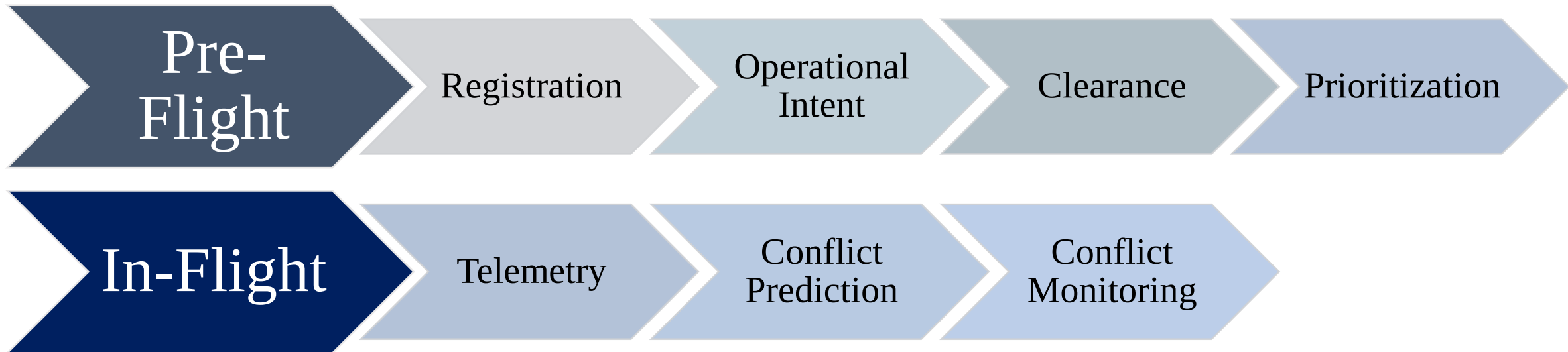
- Rules of the road for strategic conflict management, flow management, and tactical conflict across xTM domains
- xTM pre-flight and in-flight simulations conducted to capturing COP methods and document evaluation results
- A refined set of COPs for the interactions between xTM cooperative environments and air traffic services (ATS)



Integrated Operational Picture

Integrated Operational Picture

An integrated operational picture is a single operational information view of relevant information shared by multiple entities across the traffic management systems, providing situational awareness.



Researching integrated operational pictures across xTM domains that provides requirements for data exchange and situational awareness.



Integrated Operational Picture

Intent: Develop Integrated Operational Pictures to facilitate collaborative planning and combined execution, assisting all traffic management systems to achieve situational awareness across, across xTM domains.

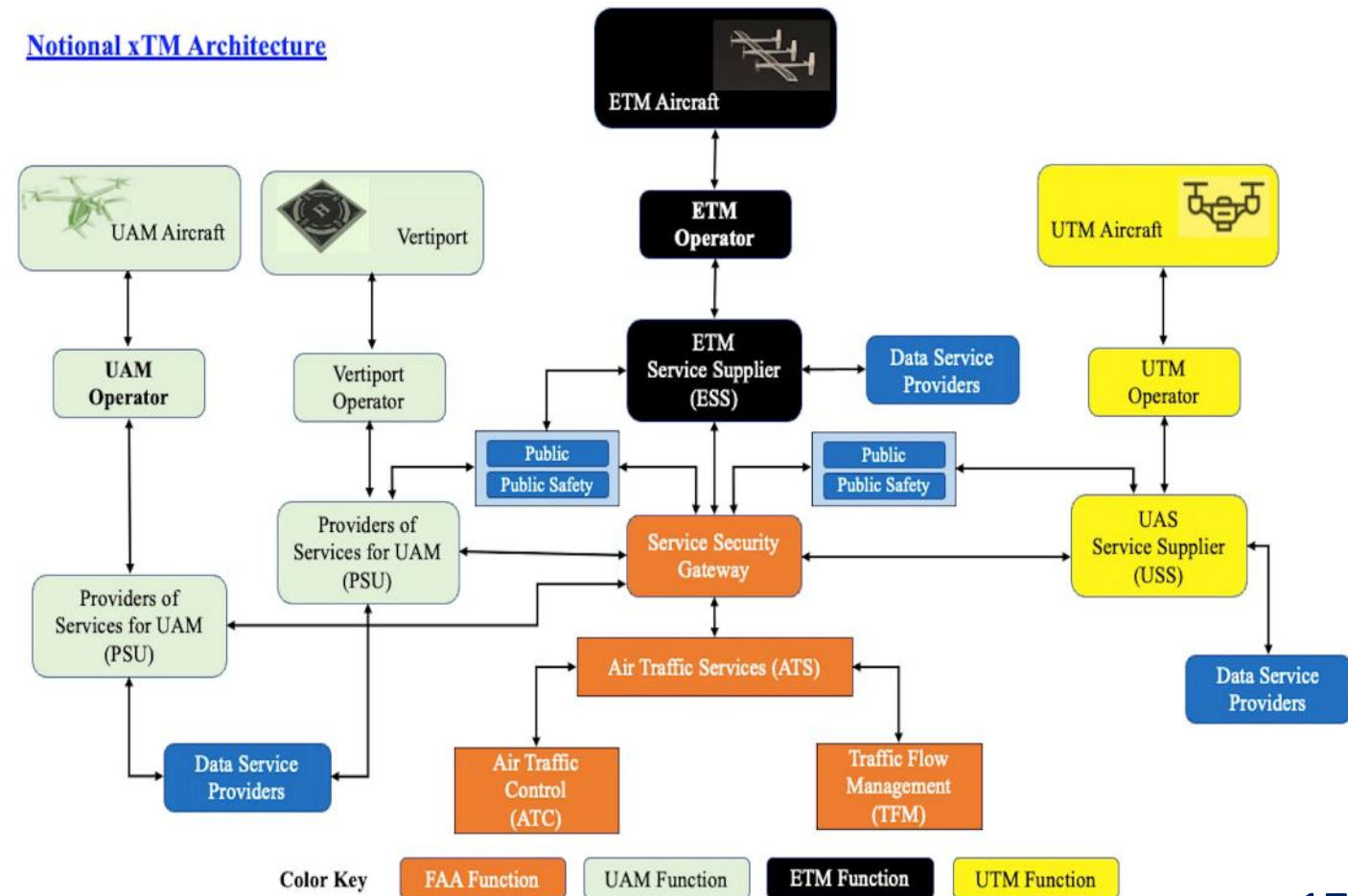
Deliverables:

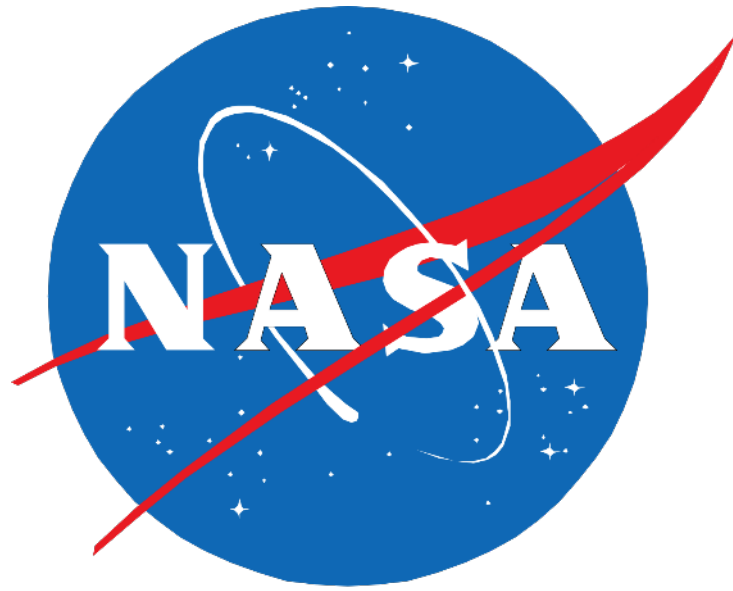
- xTM pre-flight and in-flight simulations conducted to help define the data exchange, and associated performance requirements for diverse operations
- Reference software used to demonstrate common operations pictures for xTM diverse operations
- Simulations to help define the data exchanges, and associated performance requirements for the interactions between xTM cooperative environments and air traffic services (ATS)

Intent: Research cybersecurity mechanisms that ensure the confidentiality, integrity and availability of xTM systems and data exchanges

- Planned Research Areas
 - o xTM Security Architecture
 - o xTM Security Trust Model
 - o Cyber Resilience of Blockchain Technology
- Topics Under Consideration
 - o AI / ML Trustworthiness
 - o UAS vehicle cybersecurity considerations

Notional xTM Architecture







NAS Exploration Concepts and Technologies (NExCT)

	Intent	Deliverables
Upper Class E Traffic Management (ETM)	Develop functional requirements to support Upper Class E operations for vehicles with unique performance characteristics and mission needs	- Identify ETM service requirements to coordinate cooperative operations and ANSP for the transition to/from Upper Class E airspace - Develop tools to support the creation of Cooperative Operating Environments (COE) utilizing the recommended COPs, assess the interactions between COEs and ATS.
Integrated Operational Picture (IOP)	Develop Integrated Operational Pictures to facilitate collaborative planning and combined execution, assisting all traffic management systems to achieve situational awareness across, across xTM domains.	- Pre-flight and in-flight simulations conducted to help define the data exchange and associated performance requirements for xTM operations and the interactions between xTM cooperative environments and Air Traffic Services (ATS) - Reference software used to demonstrate common operations pictures for xTM diverse operations
Common Operational Picture (COP)	Develop cooperative operating practices and automated methods of strategic and tactical conflict management for diverse aircraft and operations	- Rules of the road for strategic conflict management, flow management, and tactical conflict across xTM domains - xTM pre-flight and in-flight simulations conducted to capturing COP methods and document evaluation results - A refined set of COPs for the interactions between xTM cooperative environments and air traffic services (ATS)



NAS Exploration Concepts and Technologies (NExCT)

	Intent	Deliverables
Upper Class E Traffic Management (ETM)	Develop functional requirements to support ETM operations for vehicles with unique performance characteristics and mission needs	• Identify service requirements to coordinate cooperative operations for the transition to/from Upper Class E airspace • Develop tools to support the creation of Cooperative Operating Environments • Assess the interactions between ETM COEs and ATS.
Integrated Operational Picture (IOP)	Develop Integrated Operational Pictures to facilitate collaborative planning and execution to achieve situational awareness across xTM domains.	• Pre-flight and in-flight simulations conducted to help define the data exchange and associated performance requirements for xTM operations. • Reference software used to demonstrate integrated operations pictures for xTM diverse operations
Common Operational Picture (COP)	Develop COPS and automated methods of strategic and tactical conflict management for diverse aircraft and operations	• Simulations conducted to capture the methods for rules of the road for strategic conflict management, flow management, and tactical conflict across xTM domains • A refined set of COPs for the interactions between xTM cooperative environments and air traffic services (ATS)