Stratospheric Operations Market

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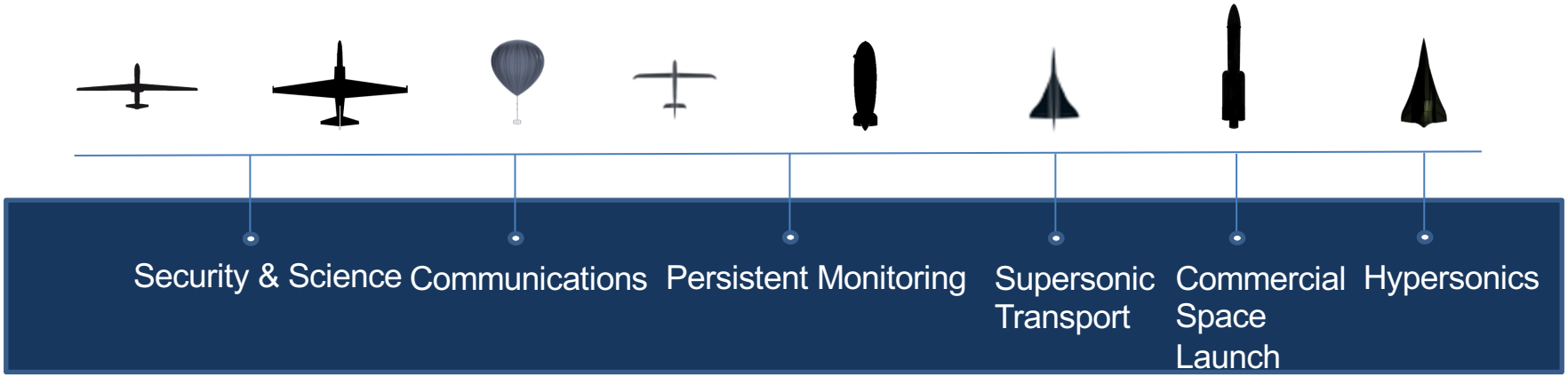
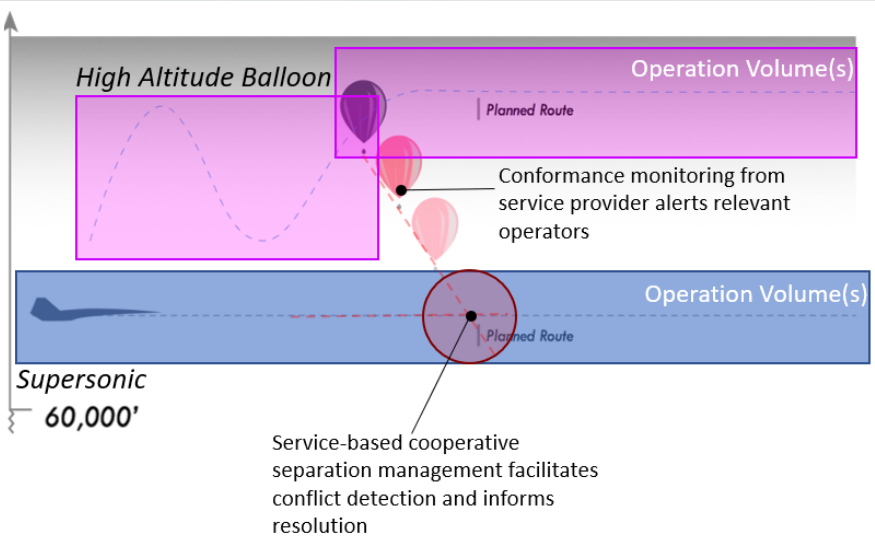
Expected vehicles in the Stratosphere



Upper Class E Traffic Management (ETM)

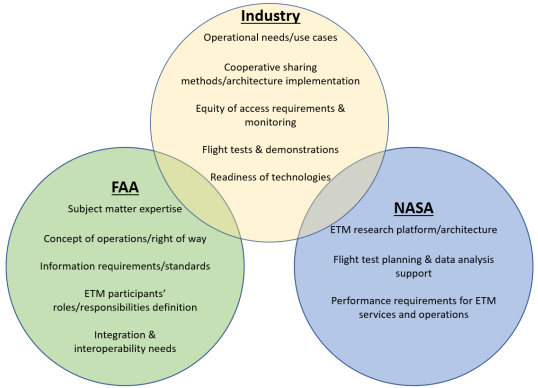
- What is ETM?
  - A cooperative approach to airspace integration and management that is safe, scalable, efficient, and fair that accommodates all missions and use cases

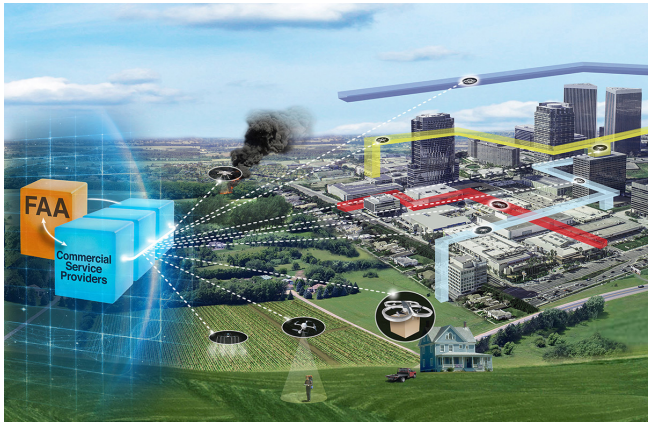


- Why is ETM needed?
  - New entrants are emerging
  - Existing users need continued safety and access
  - Demand for Upper Class E airspace use is projected to increase
  - A diverse set of vehicle and operation types are expected
  - In the US, Air Navigation Services are limited in Upper Class E airspace, which will impact the ability for industry to scale

ETM Development

- Development of ETM was understood to require close collaboration with multiple stakeholders
  - Industry
  - FAA
  - Other regulatory agencies and organizations
  - DoD and other federal agencies
- In developing ETM, the early approach was to build upon the foundations established in NASA's and FAA's UAS Traffic Management (UTM) research





ETM Market Study – Key findings

High Altitude Platform Stations (HAPS) are the key indicator of difference in high-altitude operations market size with and without ETM

- Market potential – growth in demand for services
- Upper airspace is underutilized resource that can be a critical element in meeting this demand
- Airspace demand is tied to geographic demand for services
- ETM is necessary to allow operations at scale
- ETM allows mixed use of airspace
- Regulatory changes are needed to enable the dynamic operation of HAPS
- ETM can enable services that are in the public interest

The study considered:

Current High Altitude Operations (Without ETM)	Envisioned High Altitude Operations (With ETM)
Vehicles	Vehicles
Performance of ATM	Performance of ATM
Uncrewed operations in segregated airspace	Telecom use case
Risks and Barrieres	Earth obersveration use case
	Risks and Barriers

Market Potential and projected growth

Telecommunications

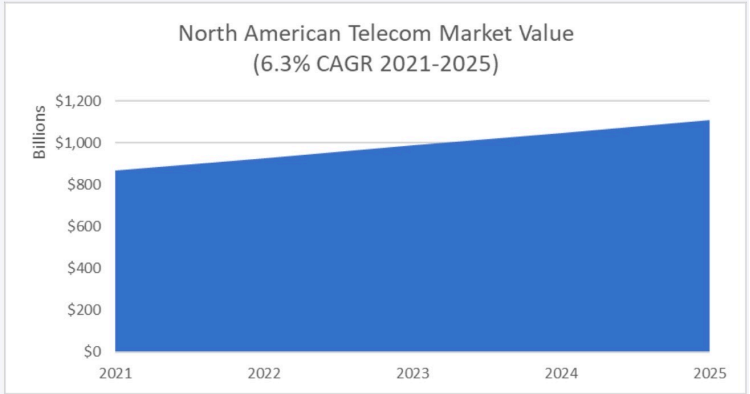
- Commercial: Rapid Growth in the US and abroad
- Public Safety: Restoration of services in disaster zones
- Fixed and mobile services are very large mature markets

Earth Observation

- Commercial: Considerably smaller market than telecom (ex. Business intelligence as new market)
- Public Safety: Threat detection (ex. Improved data for fire suppression activities)

Emerging markets (IoT)

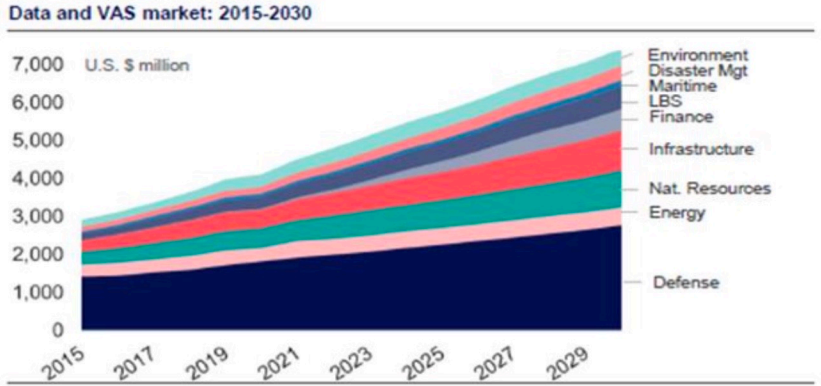
North American Market: $870billion (2020) – 1.1 trillion (2026)



Source: Derived from ResearchAndMarkets.com, "Telecom Global Market Report 2021: COVID-19 Impact and Recovery to 2030"

More opportunities in emerging areas

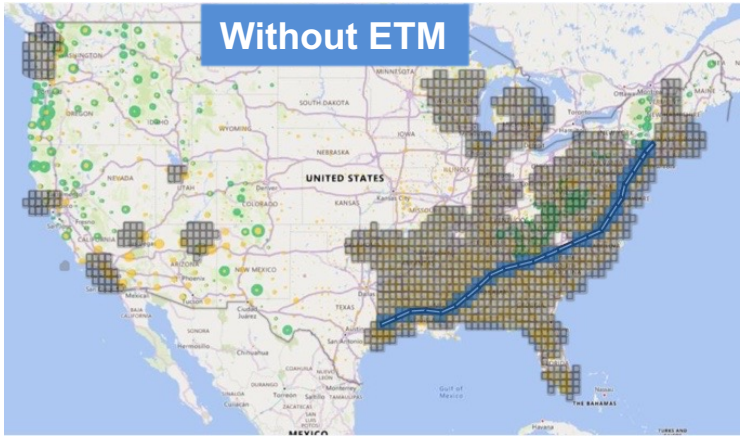
US Market Size: $1.2 billion (2020) – 1.7 billion (2030)



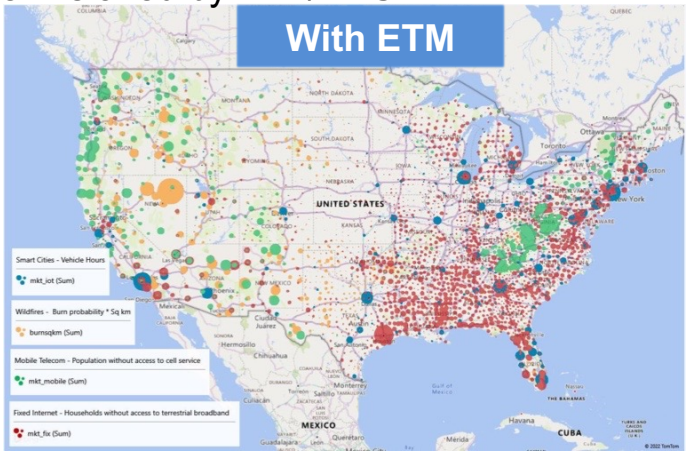
Euroconsult EARTH OBSERVATION DATA & SERVICES MARKET 14TH EDITION // AN EXTRACT

Airspace Capacity with and without ETM

Segregated airspace precludes the market access and competition envisioned by FAA/NASA ETM



- Segregated airspace
- Market access constrained
- Competing services precluded
- No transit through occupied airspace
- Use cases compete for resources



- Cooperative Separation
- Unconstrained Access
- Allows Markets to develop
- Aircraft can transit
- Multiple use cases

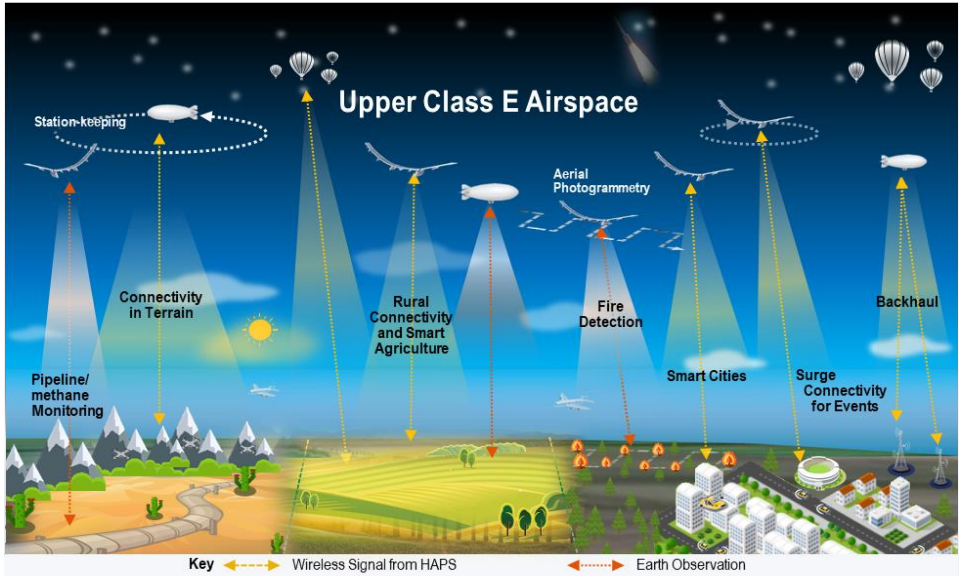
The determining factor in the difference in the market potential is the way uncrewed High Altitude Platform Stations are accommodated in Upper Class E airspace.

Operations at Scale

For High Altitude operations to achieve commercial viability to serve the large and growing telecom, connectivity, and Earth observation markets, Upper Class E airspace needs to provide:

- Unsegregated airspace
- Regulatory certainty
  - Operate under a consistent set of rules, not individual approvals
- Flexibility/competition
  - Move away from “first-come” ALTRV excluding later users
- Scalability
  - Provide fixed wing and LTA airships with the regulatory flexibility of balloons
  - Add the safety layer of a deconfliction requirement (cooperative separation)

ETM meets this goal

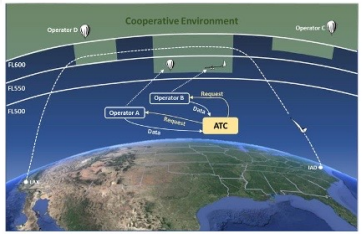


SUMMARY—WHAT WE FOUND

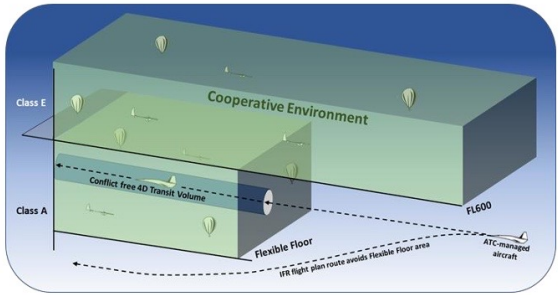
While the existing structure (without ETM) meets the needs of commercial space launch/reentry vehicles and high-altitude balloons operating under FAR 101, it does not accommodate unmanned operations of fixed wing and lighter-than-air airships outside segregated airspace.

The envisioned structure (with ETM) will enable cost-effective HAPS and other uncrewed operations that have the potential to deliver high value services to people on the ground through telecom, connectivity, environmental sensing, and imagery, complementing existing terrestrial and space-based services and creating opportunities for new industries to emerge.

Concept of Operations

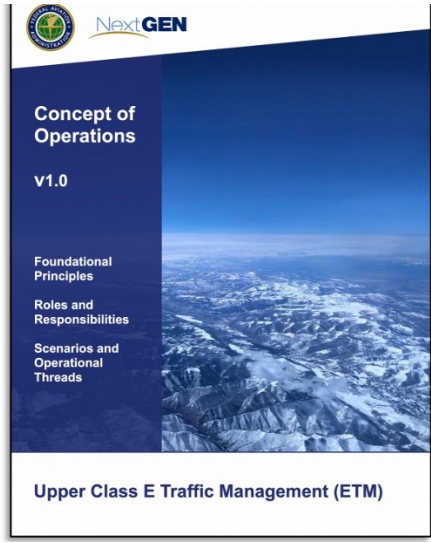


- Operations
  - Pre-Flight and Transition to Upper Class E Airspace
  - Operating Altitude WITHIN Upper Class E Airspace
  - Operating Altitude BELOW Upper Class E Airspace: Flexible Floor of Cooperative Environment
  - Descent from Upper Class E Airspace to Landing (into/through Class A airspace)
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



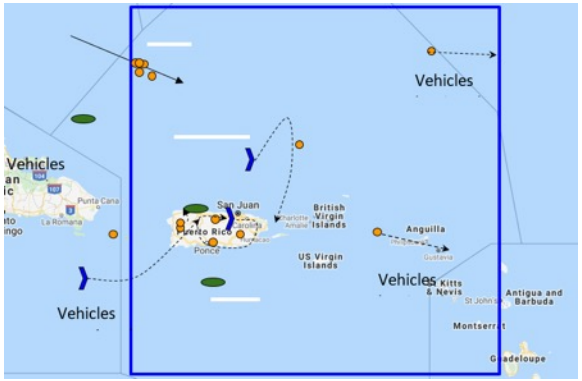
The FAA ETM ConOps v1. states the following:

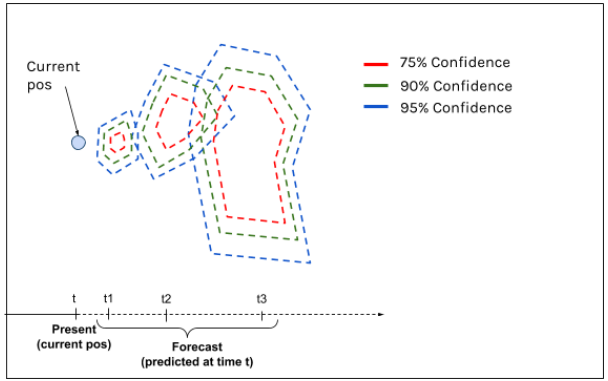
- "The future of upper Class E airspace operations presents opportunities for an alternative traffic management approach. To ensure safe and efficient service provision for current, and expanded operations, the Federal Aviation Administration (FAA) is exploring an upper Class E Traffic Management (ETM) concept." (p.2)
- "An ETM construct must:
  - Scale beyond current NAS infrastructure and manpower resources to meet the needs of market forces
  - Support the management of operations where no air navigation service provider (ANSP) separation services are desired, appropriate, or available
  - Promote shared situation awareness among Operators" (p.3)

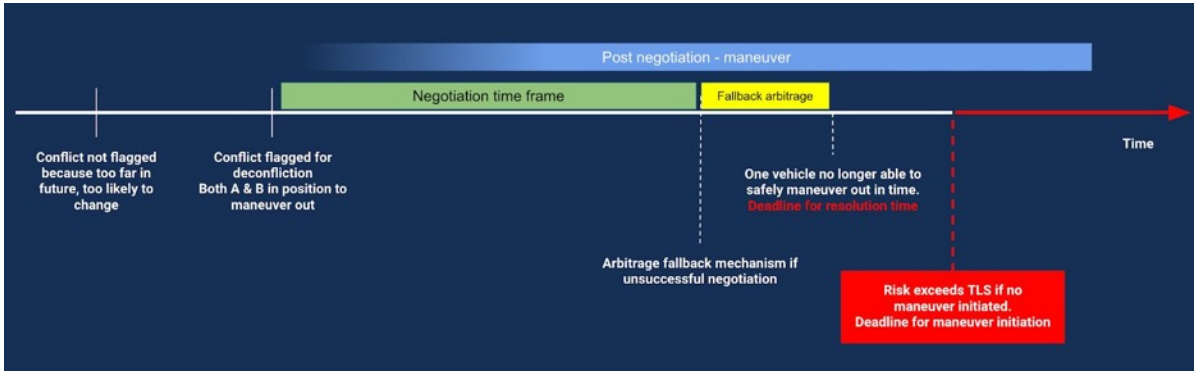


Cooperative operation through information exchange is a critical enabler of ETM

Early Collaborative Discussions



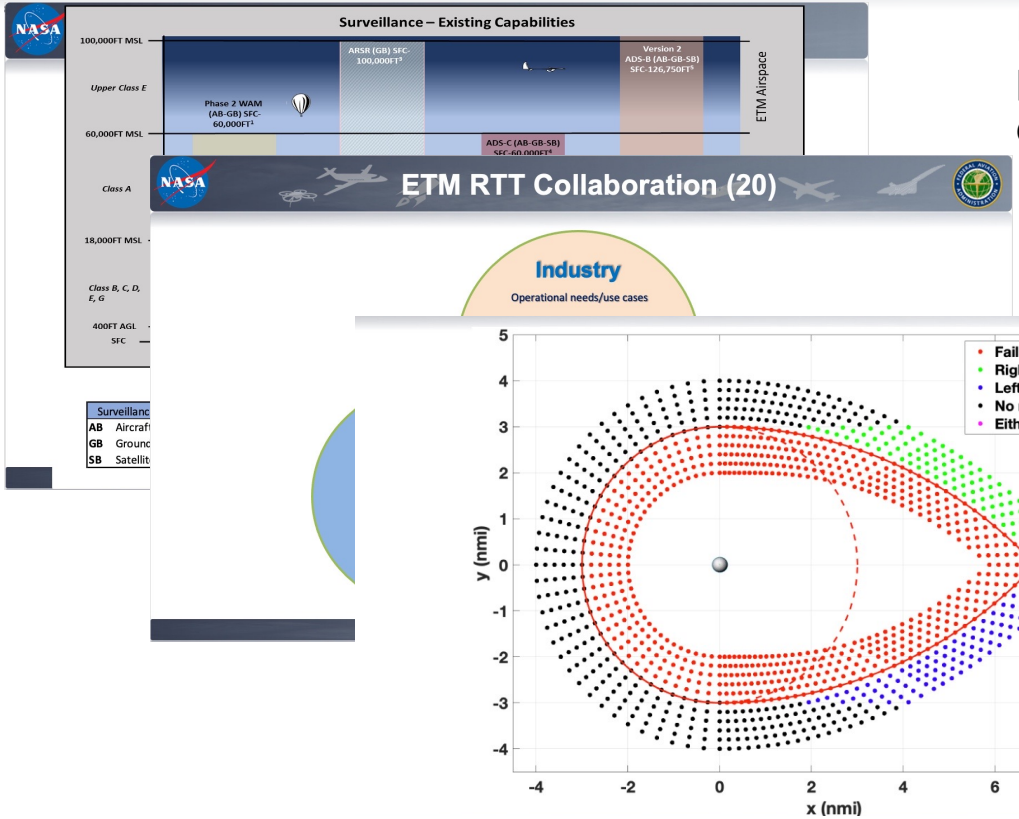




Multiple topics presented and discussed as part of regular engagement between stakeholders:

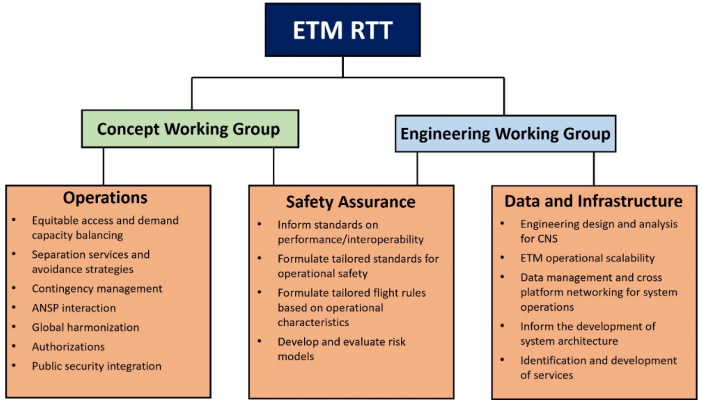
- Proposed use cases
- Concept of intent sharing
- Conflict identification
- Cooperative conflict resolution process and negotiation
- Rules of the road for operators
- Characterization of ETM environments
- *many more…*

Workshop July 2021

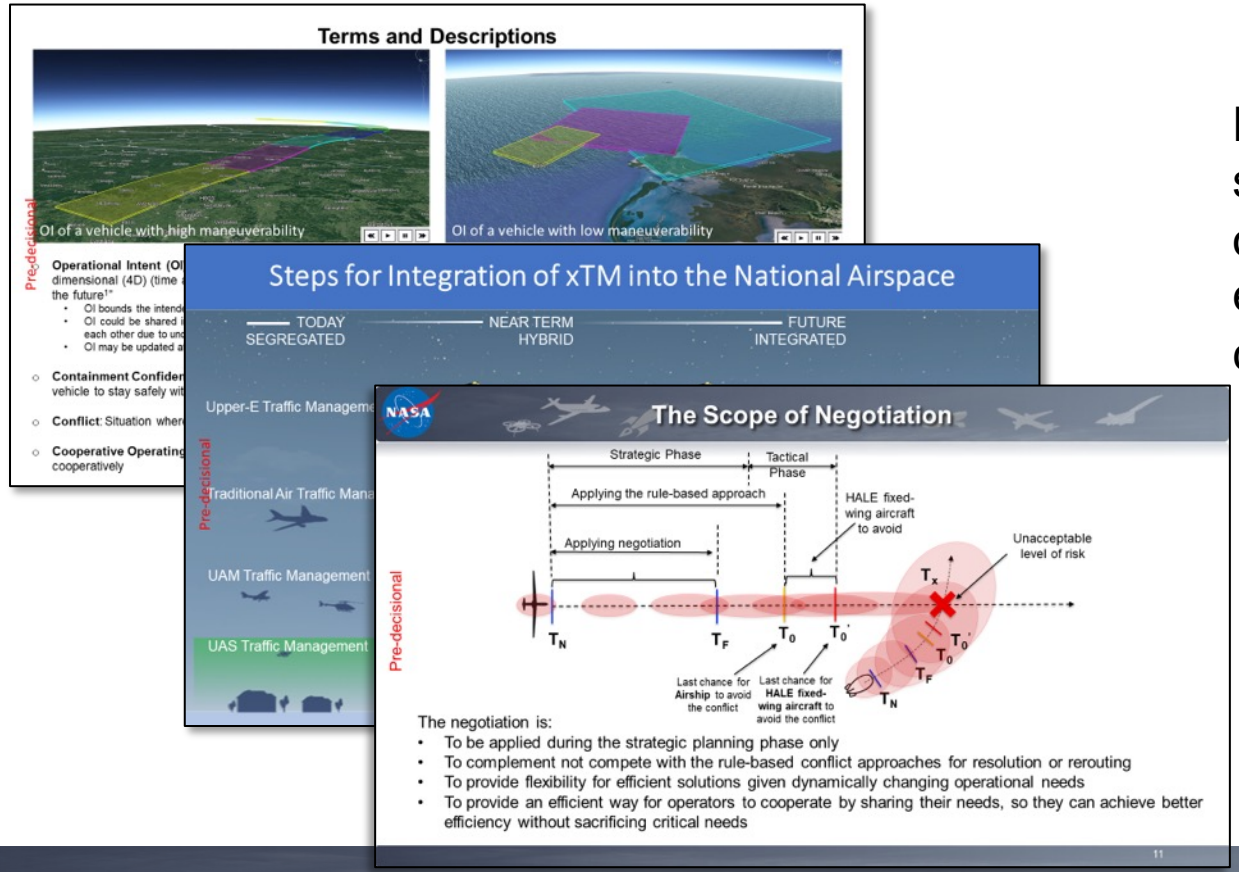


Early collaboration between ETM participants provided foundation for formal research and development structure.

NASA and FAA:
Established Research Transition Team in 2021:



Ongoing Collaborative Discussions



Discussions between stakeholders continue in order to maintain engagement and drive concept forward:

- COPs development
- CNS technical discussions
- Cooperative Areas
- …

Questions?

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