Extensible Traffic Management (xTM)

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The Future NAS
Extensible Traffic Management (xTM) in the Context of Air Traffic Management (ATM)

- Traffic management approaches, operations, and/or associated services that address the operation of select new entrants within airspace that is flexibly allocated
- Based on cooperative operating practices (COPs) among operators rather than Air Traffic Services (ATS)
- Includes UAS Traffic Management (UTM), Urban Air Mobility (UAM), and Upper Class E Traffic Management (ETM)
xTM Concepts of Operations
xTM Framework Analysis Project

Purpose

• Analyze xTM concepts and associated services that enable new entrant operations and technologies to co-exist with conventional Air Traffic Services (ATS)

Key Activities

• Identify common principles across xTM domains
• Identify unique attributes of the elements that comprise the xTM domains and the key drivers for the difference
• Examine Air Traffic Control (ATC)-xTM Interactions focused on roles and responsibilities, and information exchange needs among stakeholders
• Establish xTM lexicon
• Establish initial framework to describe xTM
xTM Framework Analysis Approach
xTM Framework Analysis Approach (cont’d)

- Examine currently published concept of operations documents
- Include additional insights sourced from FAA experts where topics have advanced and are generally agreed
xTM Common Principles
Operator Responsibilities

• Coordinate, execute, and manage operations
• Comply with a set of stakeholder-developed Cooperative Operating Practices (COPs)
• 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
• Comply with applicable performance and regulatory requirements for the airspace within which they are operating
• Maintain conformance to the intent communicated to other stakeholders
• Share contingency information with other potentially impacted operators, supporting entities, and ATC (as needed) in a timely manner to support planning of safe, conflict-free operational responses
Regulator Responsibilities

• 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 that are used by xTM operators to meet applicable regulatory requirements
• Establish performance requirements framework for airspace where cooperative operations occur
• Approve operator-defined performance requirements
• Issue operational approvals to the operator that confirm the operator meets the standardized level of performance in a given airspace
Airspace Organization

• The FAA designates airspace where cooperative operations can occur*

• Structure may be utilized for coordination between operators and is informed by the use and needs of the operator community

• Structure of cooperative operations designated airspace informed by the use and needs of the operator community

• Cooperative operations designated airspace may cross or span airspace classes, air traffic facilities, and Flight Information Regions (FIRs) as approved

• Performance requirements for cooperative operations designated airspace may vary over time

*This designation does not make the airspace exclusive use for cooperative operations
Fully Integrated Information Environment

- xTM operations are conducted in a highly automated, information-centric environment
- Operators are expected to be continuously connected to this information environment to facilitate timely information transfer among stakeholders
- Qualified third-party service suppliers may support operators in meeting part of their regulatory requirements
- Information is shared using common standards and messaging protocols to ensure interoperability
- Information management is consistent with established performance and security requirements as appropriate
- Stakeholders have on-demand access to information sufficient to support their roles and responsibilities (e.g., operators, ATC)
- ATC has the capability to issue advisories and constraints as the need arises
Scalability

- xTM environment is flexible and scalable to support the types of operations envisioned and their anticipated growth.

- FAA may intervene to address demand and capacity issues when COPs are not supporting the requirements for equity of airspace access and use.
Unique Features of xTM Concepts
Accommodating Unique Features

• While cooperative traffic management concepts share a common set of principles, unique elements do exist.

• Operating characteristics can vary based on such things as:
  ▪ Aircraft type
  ▪ Vehicle performance
  ▪ Operational profiles
  ▪ Location
  ▪ Altitude

• Performance requirements, supporting infrastructure, information services are designed to support the operation within the domain.
xTM-ATC Interactions
xTM-ATC Interactions

• Each xTM domain may have some operations transitioning between cooperative traffic management and ATC-managed service environments
  • An air taxi, for instance, may transit out of a defined corridor where cooperative operations occur into controlled airspace (e.g. class E) where the rules for that airspace would apply

• The exact nature of required interactions with ATC, and any updates to flight rules are under development

• All stakeholders need access to real time information about cooperative operations and this information may be used to facilitate these interactions
xTM Lexicon
Lexicon Purpose

- Document and sharpen terminology across xTM concepts
- Ensure consistency in xTM ConOps messaging for FAA, NASA, & Industry stakeholders
xTM Initial Framework
## Conflict Management

<table>
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<th><strong>Airspace Organization</strong></th>
<th>The organization and design of xTM cooperative airspace that provides a strategic layer of separation.</th>
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<td><strong>Cooperative Operating Practices</strong></td>
<td>Industry-defined, FAA-approved practices that address how Operators cooperatively manage their operations within an xTM domain.</td>
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<td><strong>Information Centric Environment</strong></td>
<td>The capabilities and services that support the exchange of digital information between operators and other stakeholders throughout the lifecycle of an xTM operation.</td>
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<td><strong>Intent Sharing</strong></td>
<td>The exchange of operational position information (consisting of spatial and temporal elements) between xTM Operators to support cooperative traffic management.</td>
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### References
- *Global Air Traffic Management Operational Concept (GATMOC)*
Airspace Organization

• The FAA, through their statutory responsibility, designates airspace where cooperative operations may occur. Such designation does not change the underlying airspace classification.

• Airspace organization techniques can be used to manage interactions between cooperatively managed operations and those receiving air traffic services.

• These areas may be exclusive to cooperative operations.

• Within these areas, operators may cooperate with one another to realize the benefits of operational flexibility. ATS are generally not available to aircraft operating in these areas.

• Operators meet any specified performance requirements to operate within these designated areas.

• Designation of these areas should be scalable as necessary to ensure safety and equitable access is maintained while allowing for maximum operational flexibility.
Cooperative Operating Practices

• Defined by the operator community, COPs define how airspace users will conduct their operations in concert with all stakeholders.

• COPs define all manner of interactions among operators when operating in airspace designated for cooperative operations. Additionally, COPs address operator responsibilities and procedures for any required interactions with ATC as operations transition in/out of cooperative areas.

• COPs can address the following:
  • How operational intent is defined and communicated to other stakeholders
  • Strategic planning processes (e.g., establishing operational intent volume)
  • Balancing of demand with capacity of applicable resources (e.g., airspace, vertiports)
  • Identification and resolution of conflicts
  • Procedures for off nominal and contingency operations

• Cooperatively managed xTM operations use established and FAA-approved/acknowledged COPs, which are applied in accordance with tailored flight rules (TaFR) and applicable performance-based standards
Information-Centric Environment

• For COPs to be effective, all stakeholders must be able to effectively exchange digital information throughout the life cycle of a flight (planning, execution, landing)

• This requires access to suitable data communications capabilities and to the proper services (third-party or self-provisioned) to be able to fully meet the required information exchange requirements

• The digital nature of this environment is key to scalability. Traditional ATS, based on voice communications, are not scalable to meet the expected demand. Furthermore, limitations in existing Communication, Navigation, and Surveillance (CNS) systems may preclude delivery of services at certain locations

• The operator community, using COPs, can capitalize on new technologies to deliver services necessary to conduct their operations

• Operators are supported in this environment through a federated network of xTM Service Suppliers (xSSs), or third-party entities who provide services to operators to assist them in cooperatively managing their operations
Intent Sharing

• A foundational principle of cooperative traffic management is the sharing of intent information among operators and relevant stakeholders.

• Sharing of intent is necessary to ensure safe operation, and equitable access and efficient use of airspace. This interaction enables operators to deconflict their operations, and manage demand for access to resources (e.g., airspace, vertiports).

• Intent is a four-dimensional (4D) description of the planned operational volume for a vehicle. For e.g.:
  • One or more polygons depicting a volume of airspace where operations will occur
  • Altitude or altitude ranges
  • Entry/exit points of the area where cooperative operations will be conducted
  • Time associated with these elements

• This intent information is shared with other operators to identify and resolve conflicts. This can occur before and during the flight in accordance with the COPs. Additionally, intent may be updated by the operator during the flight as required.
xTM Operational Intent
Next Steps

• Continue to expand and mature xTM framework analysis
• Continue collaboration with Industry and other stakeholders to mature individual and collective xTM concepts
• Develop an integrated xTM strategy
• Continue to test and advance technologies and standards
• Support development of tailored flight rules
• Continue incremental implementation of applicable FAA capabilities
Thank You!