Agenda

Meeting Topic	Name	Time (PDT)
Opening Remarks	NASA: Parimal Kopardekar	10:00 – 10:15
UTM Concept Update	FAA: Sherri Magyarits	10:15 – 10:45
UTM Test Infrastructure	NASA: Joseph Rios	10:45 – 11:00
Break		11:00 – 11:15
Overview of UFT Project	FAA: Praveen Raju	11:15 – 11:30
Scenarios Part I	FAA: Praveen Raju	11:30 – 12:00
Break (LUNCH)		12:00 – 1:30
Scenarios Part II	FAA: Praveen Raju	1:30 – 2:00
Next Steps	FAA: Praveen Raju	2:00 – 2:15
Questions and Answers	All	2:15 – 2:45
Wrap Up	FAA: Praveen Raju	2:45 – 2:50

Opening Remarks

UTM Concept Development Update
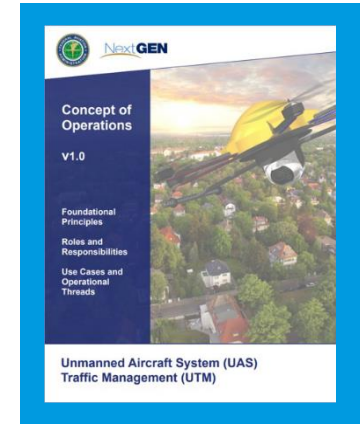
UTM Development Milestones

2015

- NASA UTM Technical Capability Level (TCL) 1 Activities

2016

- 14 CFR Part 107 Established
- NASA UTM ConOps Released
- NASA UTM TCL 2 Activities
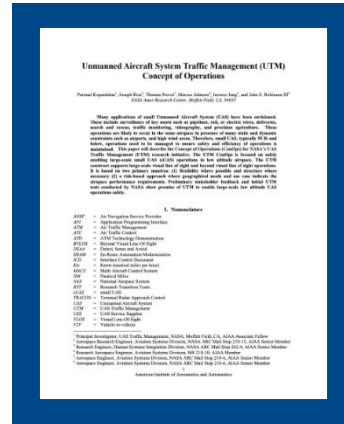
2017

- FAA/NASA UTM Research Transition Team (RTT) established
- UTM RTT TCL 3 Activities

2018

- LAANC Airspace Authorization Services Available
- UTM RTT Technology Transfers Begin
- FAA UTM ConOps v1.0 Released

UTM Development Milestones

2019
- FAA UPP Phase 1 Activities
- UTM RTT TCL 4 activities

UTM PILOT PROGRAM

2020

Concept of Operations v2.0
Foundational Principles
Roles and Responsibilities
Scenarios and Operational Threads
Unmanned Aircraft System (UAS) Traffic Management (UTM)
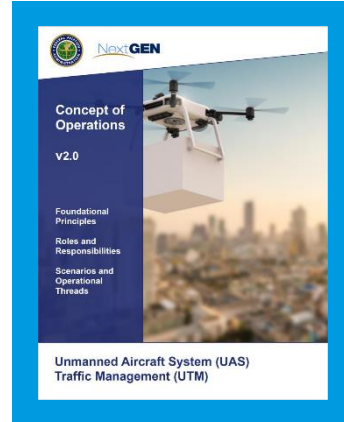
- UTM RTT Technology Transfers Complete
- FAA UTM ConOps v2.0 Released
- FAA UPP Phase 2 Activities
- FAA-NASA-Industry Engagement Session 1 (ConOps v2.0)

2021
- Final Remote ID Rule
- Final Rule for Ops Over People
- FAA-NASA -Industry Engagement Session 2 (ConOps v2.0)
- UPP Closeout (Final Report)

2022

- UTM Field Tests Initiated
- FAA UTM ConOps v3.0

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UAS Traffic Management FIELD TEST

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Concept Development Timeline
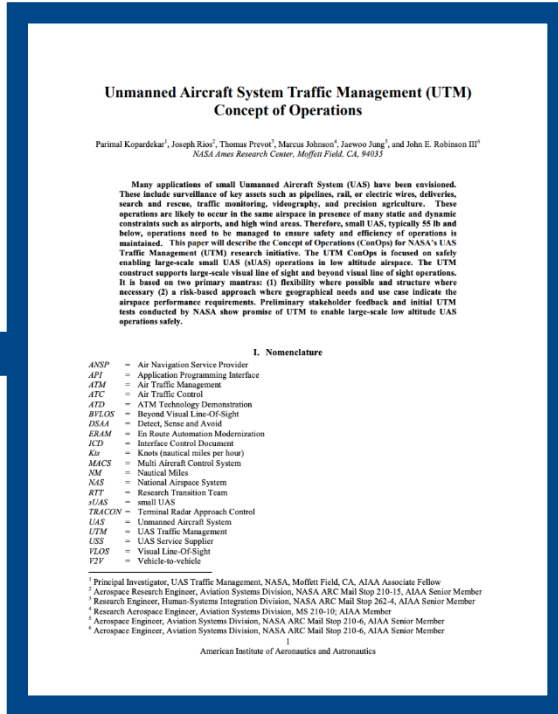
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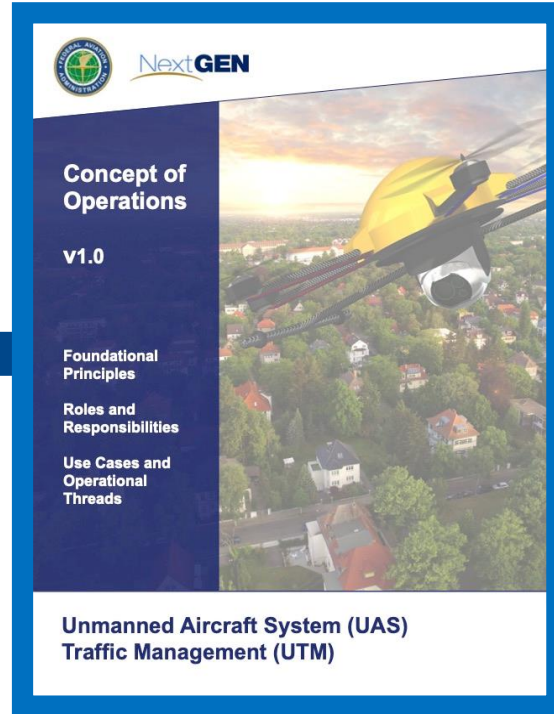
May 2018
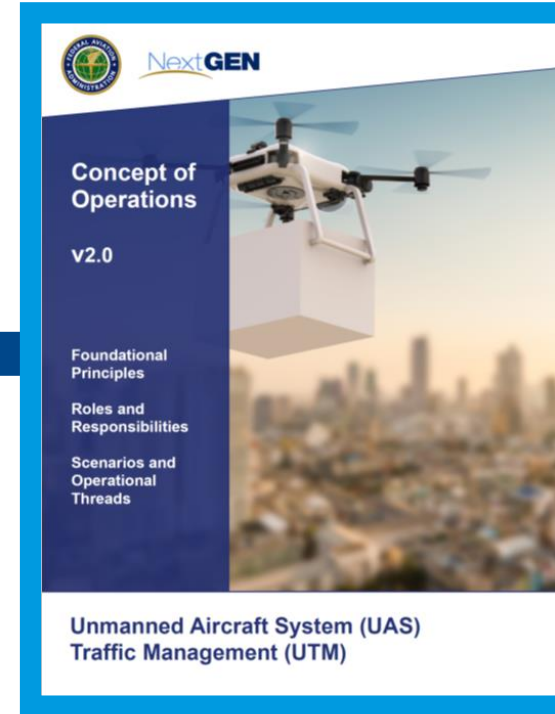
March 2020
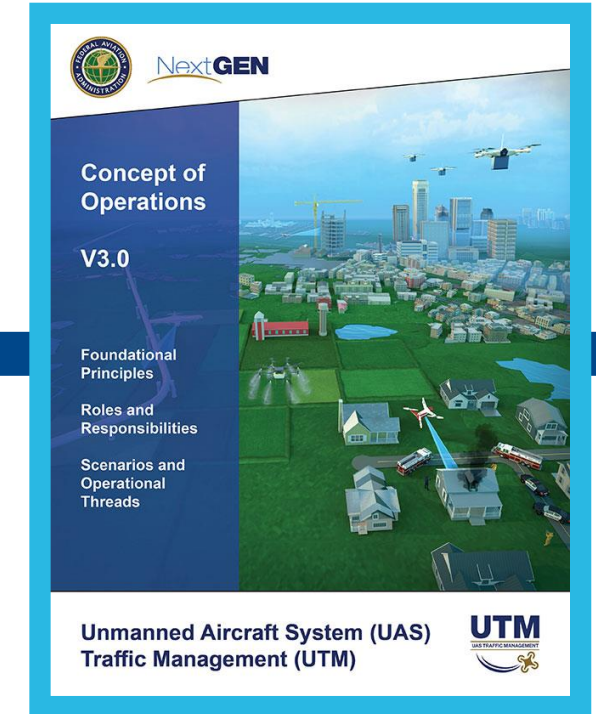
2022

FAA-NASA-Industry Engagement Sessions

- **The NASA Aeronautics Research Institute (NARI) hosted two sessions with FAA, NASA, and Industry stakeholders on the topic of UTM ConOps v2.0**
  - Session #1 - December 4, 2020
  - Session #2 - February 19, 2021

- **Meeting Objectives**
  - Address feedback/comments from the Advanced Aviation Advisory Committee (AAAC)* on FAA UTM ConOps v2.0 and provide clarifications
  - Address additional Industry questions
  - Document inputs/takeaways for consideration in v3.0

Formerly known as the Drone Advisory Committee (DAC)

AAAC-Identified Topics for Further Clarification

1

Session Topics

UAS Participation in UTM

Manned Aircraft Participation in UTM

Roles & Responsibilities of Operator and USS

2

Session Topics

Volume-Based vs. Trajectory-Based Strategic Deconfliction

Data Protection

Scenario Accuracy

Additional Topics

Role of UVRs

Networked RID

Role of Performance Authorizations

Technology taking place of certain UTM Services

Role of FIMS

Benefits of UTM

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ConOps v3.0 Development Highlights

❑ **UTM Architecture**
- Update based on based on continued FAA, government, and industry developments

❑ **Information Security**
- Update security topics (e.g., authentication/authorization) based on continued FAA, government, and industry developments

SDSP: Supplemental Data Service Provider
FIMS: Flight Information Management System
USS: UAS Service Supplier
DSS: Discovery and Synchronization Service
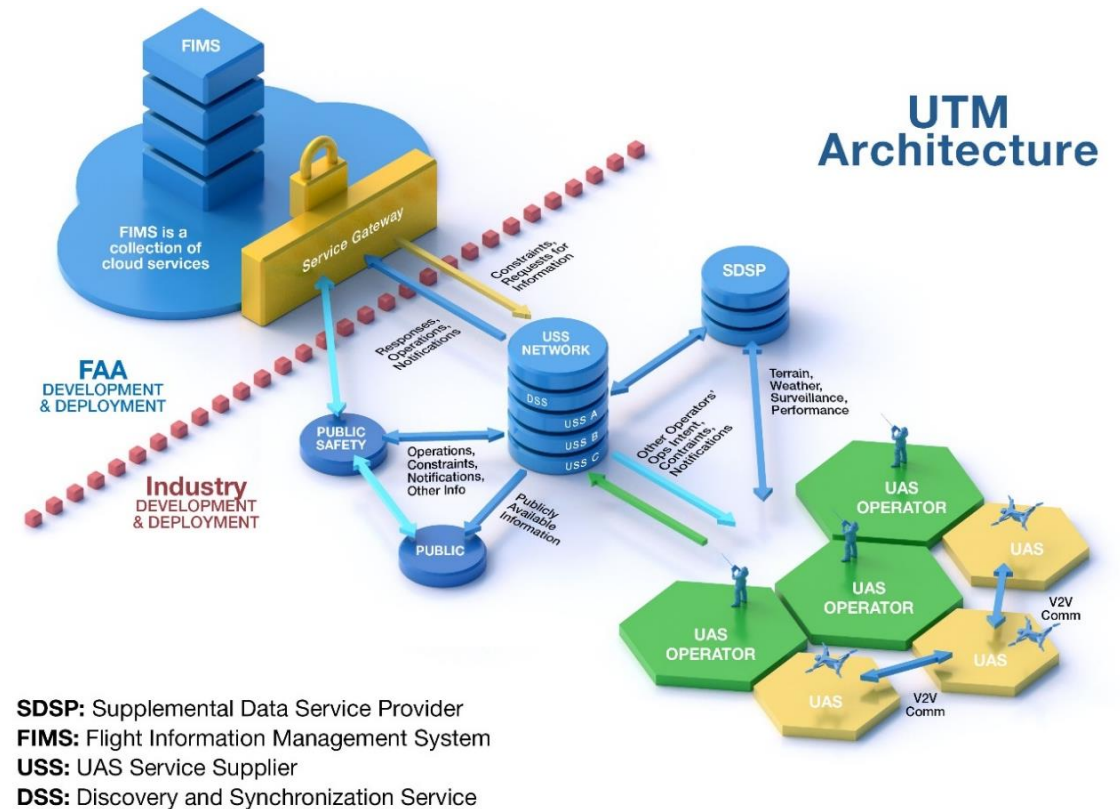
ConOps v3.0 Development Highlights (cont'd)

❑ **Public Safety Operations & Security Stakeholder Needs**
- Update public safety Remote ID narrative and scenarios to address operational priority

❑ **Remote ID**
- Update based on Final Remote ID Rule requirements (e.g., broadcast)
- Update to Data Correlation Service using Remote ID information (e.g., data sources, FAA role)

ConOps v3.0 Development Highlights (cont'd)

❑ **UTM Participation**
- Clarify definition of participation

❑ **Roles & Responsibilities**
- Update/refine roles & responsibilities of UAS operator, USSs, and FAA as required

❑ **Cooperative Operating Practices (COPs)**
- Replace Community Based Rules (CBRs)
- Expound principles relating to COPs

❑ **Constraint Data Management**
- Update based on industry feedback and continued FAA development

Function		UAS Operator	USS	FAA
		✓ = Primary responsibility S = Support		
Separation	UAS from UAS (VLOS and BVLOS)	✓	S	
	VLOS UAS from Low-Altitude Manned Aircraft	✓	S	
	BVLOS UAS from Low-Altitude Manned Aircraft [1]	✓	S	
Hazard/ Terrain Avoidance	Weather Avoidance	✓	S	
	Terrain Avoidance	✓	S	
	Obstacle Avoidance	✓	S	
Status	UTM Operations Status	✓	S	
	Flight Information Archive	✓	S	
	Flight Information Status	✓	S	
Advisories	Weather Information	✓	S	
	Alerts to Affected Airspace Users of UAS Hazard	✓	S	
	Hazard Information (e.g. obstacles, terrain)	✓	S	
	UAS-Specific Hazard Information (e.g., Power-Lines, No- UAS Zones)	✓	S	
Planning, Intent & Authorization	Operation Plan Development	✓	S	
	Operation Intent Sharing (pre-flight)	✓	S	
	Operation Intent Sharing (in-flight)	✓	S	
	Operation Intent Negotiation	✓	S	
	Control of Flight	✓		
	Controlled Airspace Authorization		S	✓
	Airspace Allocation & Constraints Definition		S	✓

ConOps v3.0 Development Highlights (cont'd)

❑ **Scenarios**

• Update/Revise

– Routine VLOS & BVLOS UTM operations

– Remote ID for alignment with final rule

– Manned aircraft interactions

• Add

– Recreational operation

– Priority UTM operations

– Off-nominal notifications

❑ **Recreation / VLOS Operations**

• Clarify use of services and participation

❑ **Operations over People / Night Ops**

• Assess need for updates to ensure alignment with final rule

ConOps v3.0 Development Highlights (cont'd)
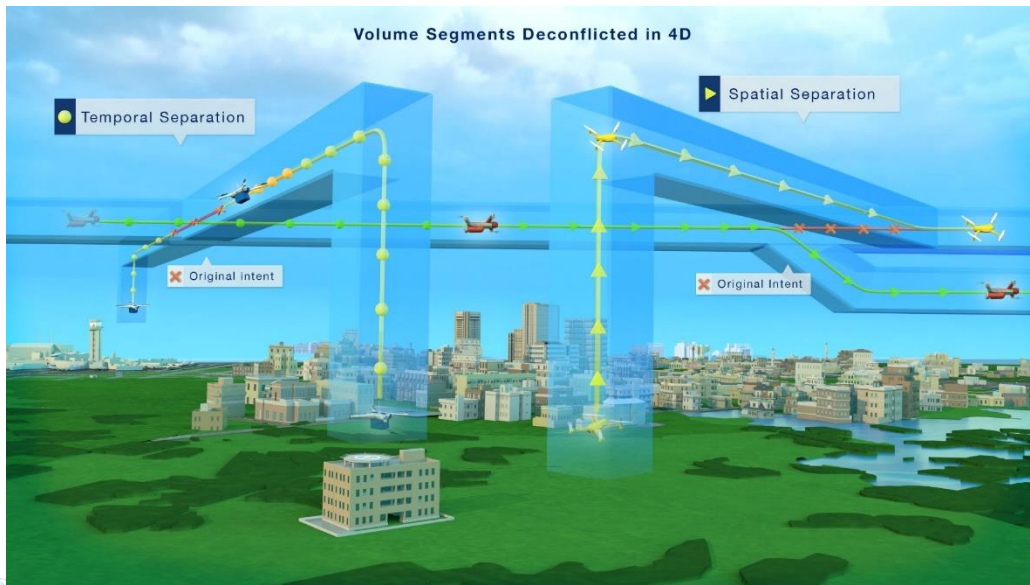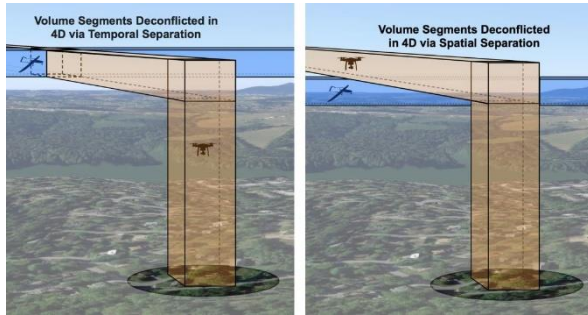
☐ **Updated Graphics**

☐ **UTM Pilot Program Results & Outcomes**

- Incorporate relevant findings and recommendations

❖ **BVLOS ARC Rulemaking outcomes?**

Moving Forward…

- **Review BVLOS ARC report**
  - Assess impacts to UTM
  - Determine UTM ConOps v3.0 content coverage and additional areas to address with Industry
  - Incorporate relevant content into ConOps v3.0

- **Continue FAA coordination on policy-related and other UTM topics**
  - Operational constraints (e.g., UVR)
  - Performance Authorizations
  - Interactions with manned aircraft

- **Complete UTM ConOps v3.0**
  - Current target - end of 2022

Thank You!

UFT Infrastructure

Test Infrastructure

- FAA and NASA will collaboratively provide the necessary test infrastructure to allow for successful testing
    - Authorization Server
    - Certificate Authority and Certificates
    - Reference USS
    - Correlation Server
    - Data Collection
- Stakeholders external to FAA and NASA will provide remaining elements, including, but not limited to:
    - 1 or more USSs
    - Supplementary Data/Service Provider
    - UASs
    - Relevant sensors and other elements
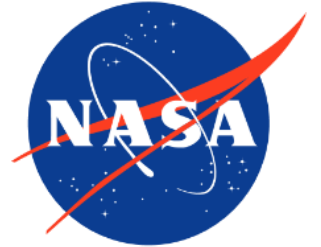
High-level Test Architecture (Data-Focused)

- Two version of this environment:
    - Development
    - Checkout/Operations
- In this data-focused view, other elements such as UAS, sensors, etc. are not highlighted.

FAA

- Certificate Authority
- Authorization Server
- Correlation Service
- Data Collection

Test Site Teams

- SDSP
- USS
- Other elements as proposed

NASA
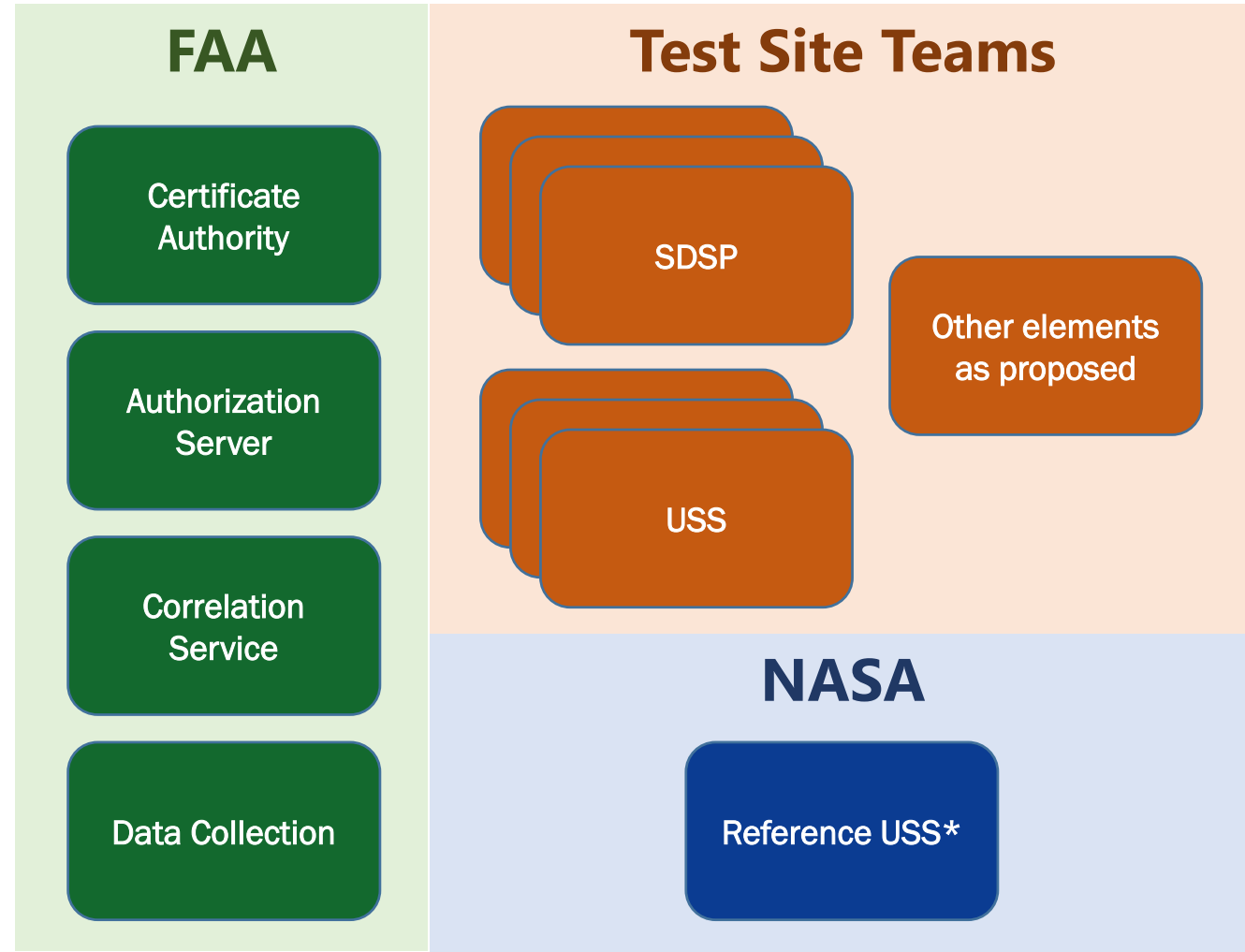
- Reference USS*

*A reference USS is an important part of automatic testing framework to ensure interoperability of test elements, as well as for project risk mitigation purposes. The reference USS is not intended to be an operational USS used outside of researches and test events".

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Project Overview

UTM Field Test (UFT)

- In collaboration with industry, the FAA is establishing the UAS Traffic Management (UTM) Field Test (UFT) project to execute flight test activities, support industry in validating standards, and evaluate maturation of UTM services.

- UFT Stakeholders will:

  - Explore capabilities proposed by standards such as **strategic coordination** in complex environments

  - Test enhancements to **UTM functionalities**

  - Develop and test **updated security management** for information exchanges between the FAA, industry, and authorized entities

  - Explore **future concept elements** such as authorized historical data queries

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Vision for UFT

- Execute a targeted evaluation of the following capabilities and services to continue improving UTM
  - Industry Services Supporting UTM
  - Planning and Coordination in Complex Operating Environments
  - Priority Status of Operational Intent
  - Data Correlation Service Enhancements
  - Identity and Access Management

- Inform policy development and support maturation of standards to enable routine UTM operations

- Support advancement of UTM capabilities and best practices for secure information exchanges

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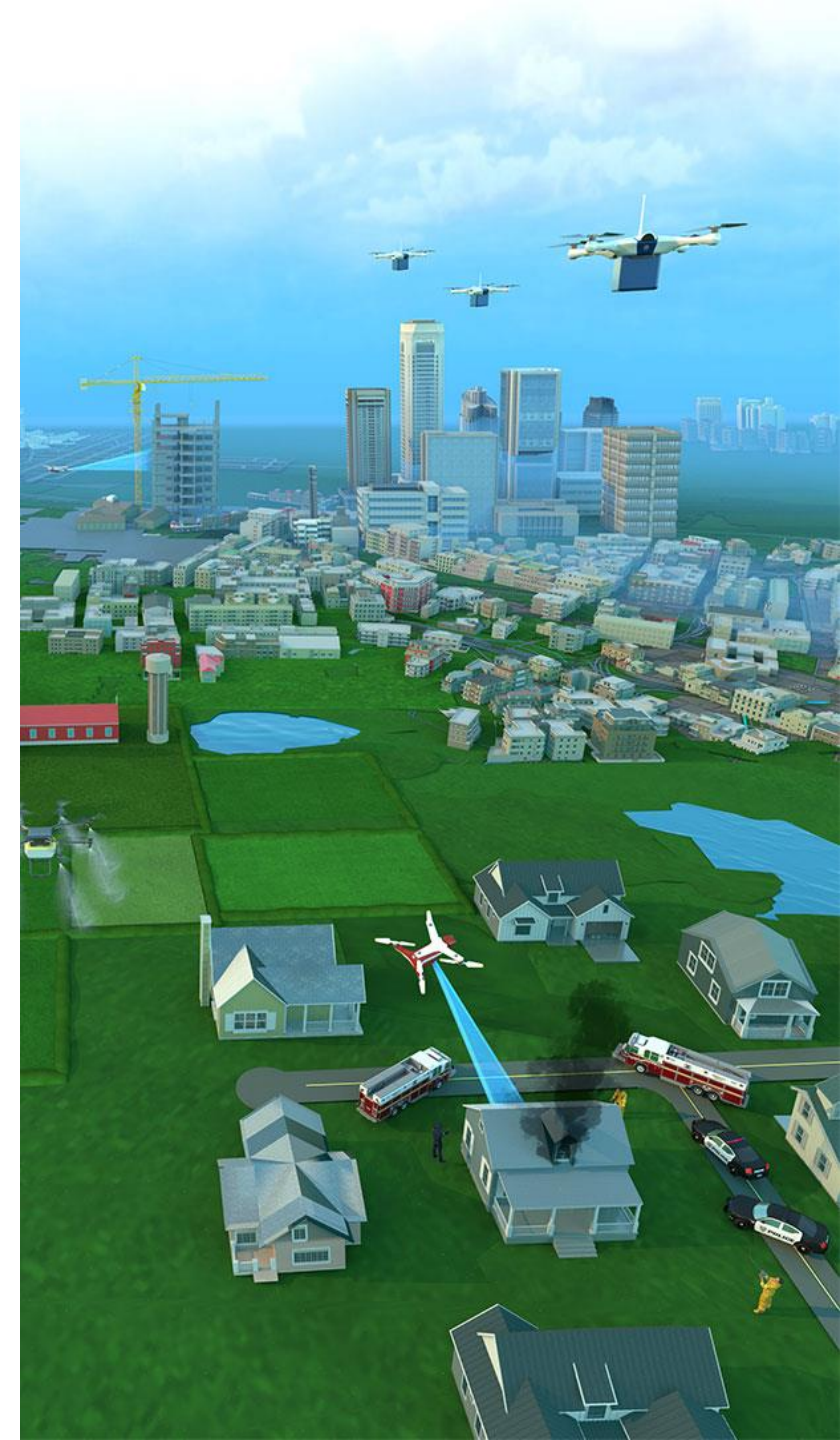
Incremental Standards Validation

- ASTM F3411-19 Standard Specification for Remote ID and Tracking

  - Defines message formats, transmission methods, and minimum performance standards for Remote ID: broadcast

- ASTM WK63418 New Specification for UAS Traffic Management (UTM) UAS Service Supplier (USS) Interoperability

  - Provides requirements and interoperability APIs for USSs operating in a federated UTM environment. The services addressed include:

    - Strategic Conflict Detection

    - Aggregate Operational Intent Conformance Monitoring

    - Conformance Monitoring for Situation Awareness

    - Constraint Management and Processing

- Other industry standards associated with interoperability

  - Industry participants are encouraged to propose additional standards for testing and validation

Stakeholder Validation of Standards

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Advancing Message Security in UFT
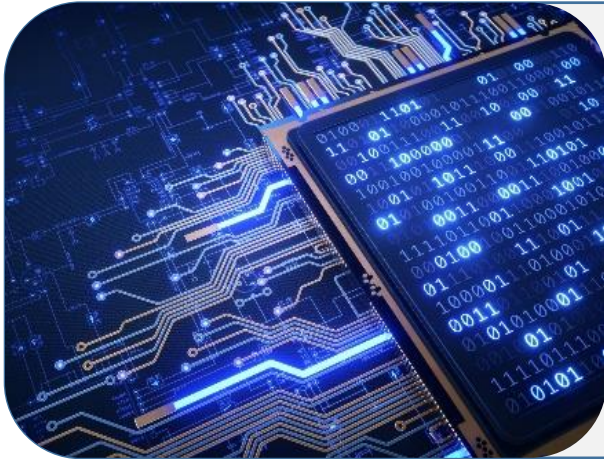
Enhancing Existing Security Framework

- Expanded system roles and scopes for new capabilities
- Expanding message signing to ensure non-repudiation, authentication and integrity of all UTM messages
- Evaluate the interoperability of multiple public key infrastructure (aviation vs. public safety)
- Updates to USS onboarding & checkout processes

Public Safety Data Queries

- Tailor data correlation queries to requestor permissions
- Enable user-initiated queries for data correlation
- User-based Role-Based or Attribute-Based Access Control (RBAC or ABAC)
- User permissions management
- Encryption of sensitive data sent outside FAA

Flight Operations in UFT

UFT Flight Operations

- Adhere to existing operating rules, waivers, and COAs

- May have mixed levels of participation in UTM

- Are flown at or below 400 feet Above Ground Level (AGL)
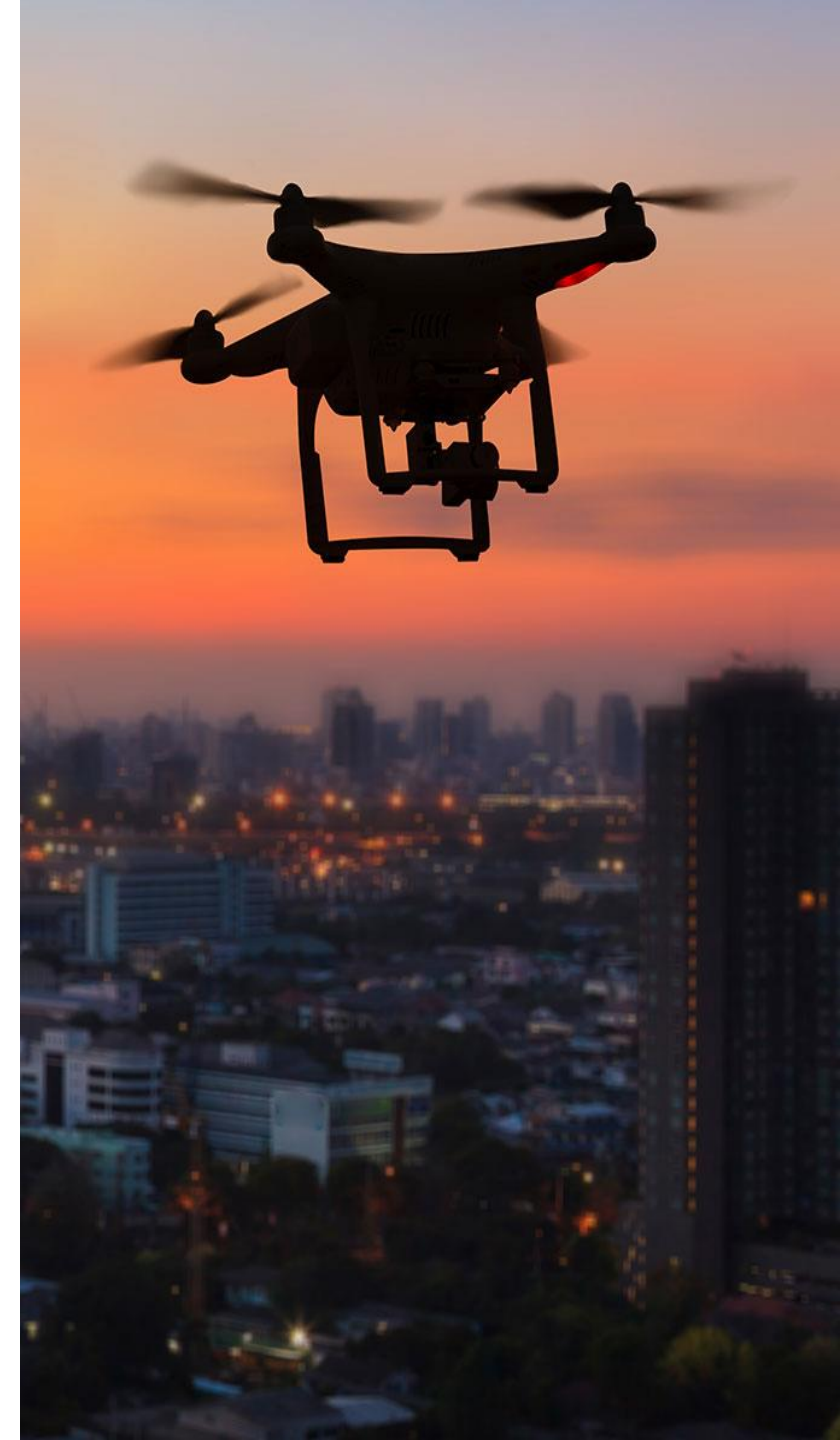
Operational Complexity During UFT

Operational Complexity can be characterized through multiple perspectives:

- Number of interactions, including conflicts between operational intents
- Types of interactions
  - BVLOS to BVLOS
  - BVLOS to VLOS
  - VLOS to VLOS
  - BVLOS to constraint
  - VLOS to constraint
- Operational tempo
- Operating environment and changes to it
  - Considerations that affect planning, equipage, and service needs
  - Variations in flight conditions within the environment

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Scenarios

Notional Scenarios

Scenario 1: UTM Operations in Environments of Varying Complexity

Scenario 2: Public Safety UTM Operations in Environments of Varying Complexity

Scenario 3: Public Safety Queries Due to Concern of UAS Operation

Scenario 4: Future Concept Elements: Post-Incident Investigation Involving UAS

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UFT Example Operations

Inspection

Delivery

Media

Public Safety

BVLOS

Photography

Over People

VLOS

Agricultural

Recreational

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UFT Operating Environment

Urban Environment

Suburban Environment

Remote/Rural Environment

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Scenario 1 - Overview

UTM Operations in Environments of Varying Complexity

- Planning and execution of UTM operations in an operating environment of varying complexity

  o Changes in number/type of operational interactions, operational tempo, and operating environment

- Scenario vignettes provide a framework for planning flight activities that result in variable operational complexity

  o Scenario 1a: Non-peak operations

  o Scenario 1b: Peak operations

Scenario 1 – Objectives
UTM Operations in Environments of Varying Complexity

- Evaluate cooperative traffic management and various means of strategic conflict resolution based on ASTM Standard Specification for USS Interoperability

- Test how standards, technologies, and capabilities support mixed UAS operations in complex environments

- Evaluate UTM services, such as strategic de-confliction, for criticality in supporting BVLOS operations in complex environments to inform evolving regulatory framework and future service qualification

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Scenarios 1a: Non-Peak and 1b: Peak Operations Scenario Narrative

UTM Operations in Environments of Varying Complexity

- Scenarios 1a: Non-Peak and 1b: Peak examine operations where there is a low operational tempo, creating low levels of operational interactions, that may transition to high operational tempo and correspondingly high operational interactions.

Scenario 1a: Non-Peak

- *Low operational tempo*
- *Low operational interactions*
- *Operations generally localized and sparse*

Scenario 1b: Peak

- *High operational tempo*
- *High operational interactions including BVLOS and VLOS*
- *Operations more diverse, dense, and on-demand*

Considerations for Scenario 1

- **Functional Highlights**

  - Interoperability:

    - Operators and USSs resolve detected conflicts in accordance with an agreed-upon set of cooperative operating practices.

  - Constraints Management and Processing:

    - A UAS constraint may restrict access to airspace for some or all operations, or it may be informational, as proposed in the Draft ASTM Standard Specification for UTM USS Interoperability.

    - Operators (and their supporting USS) assess UAS constraints to determine if conflicts exist with their intent.

- **Areas of Interest**

  - Operation Planning

  - Off-Nominal Operations

  - Aggregate Operational Intent Conformance Monitoring

  - USS Availability Arbitration

  - Data Provisioning and Interoperability

  - Airspace Constraints

  - Message Security

Scenario 2 - Overview

Public Safety UTM Operations in Environments of Varying Complexity

- Planning and execution of public safety operations

- Public safety operations conducted within and transiting across non-peak and peak operating environments

- Certain public safety operations within the scenario may be assigned operational priority

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Scenario 2 – Objectives
Public Safety UTM Operations in Environments of Varying Complexity

- Test cooperative operating practices for resolving conflicts
- Evaluate interoperability among operations with different priority
- Inform approaches for service qualification

Scenario 2 – Narrative

Scenario includes a range of operating environments – one area is experiencing peak operations, while an adjacent area has non-peak operations.

- *Hospital requiring critical medical materials is in peak operating area.*
- *Hospital in the non-peak operating area has needed materials.*
- *A transport flight is planned as a higher priority UTM operation.*
- *The planned transport flight is shared with other USSs via the network and designated with higher priority.*
- *Operators subscribing to relevant USS services receive notification of the higher priority operation if they are in conflict.*
- *Affected operations may include those not yet in flight, as well as those in flight.*

Considerations for Scenario 2

- Functional Highlights

  - Priority Operations:

    - Certain operations conducted as part of UFT activities may be considered to have higher priority than other UTM operations

    - Affected participants adjust their intent upon notification of a conflict with a higher priority operation intent

- Areas of Interest

  - Operation Planning

    - Elevated priority operations
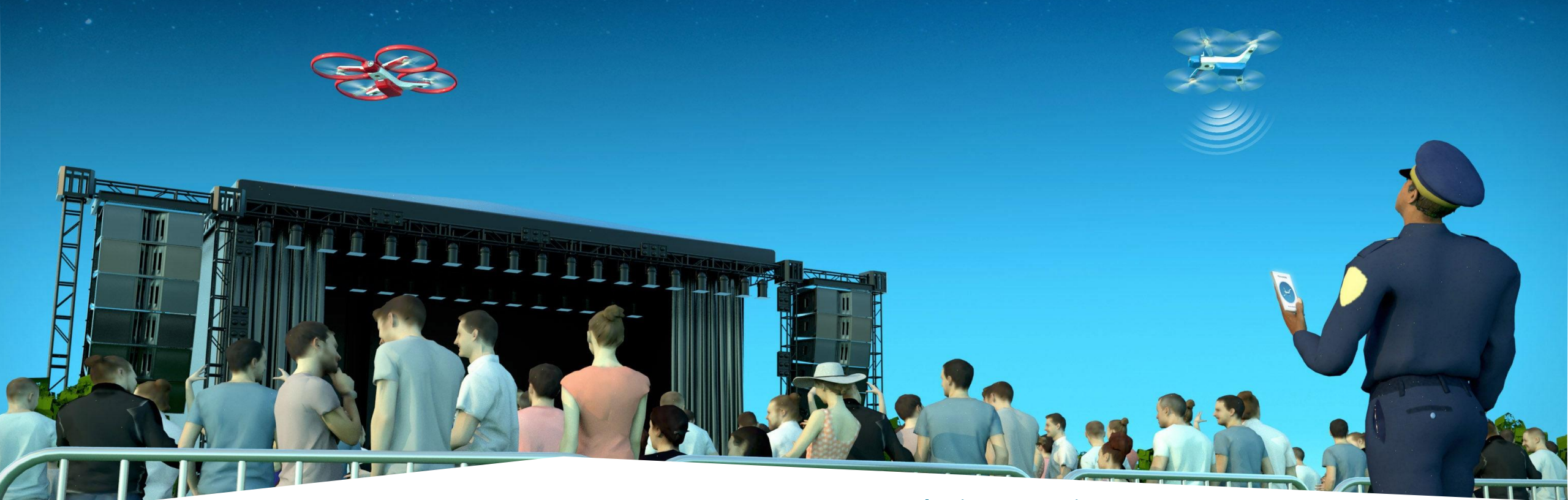
  - Message Security

Scenario 3 - Overview

Public Safety Queries Due to Concern of UAS Operation

- Reception of Remote ID broadcast messages

- Use of FAA Data Correlation service*, via an API, with a serial number received via Remote ID broadcast

- Authorized use of the FAA's Data Correlation service, with varying levels of access

*An FAA Data Correlation service will be built by the FAA for test purposes within the UFT environment. For authorized entities it will respond to query inputs such as data obtained via Remote ID broadcast (e.g., UA serial number).

Scenario 3 – Objectives
Public Safety Queries Due to Concern of UAS

- Test FAA Data Correlation service
- Evaluate functionalities associated with:
  - Identity and access management
  - Data and service access per user or entity permissions
  - Message security
- Obtain feedback from stakeholders on tested data correlation capabilities

Scenario 3 – Narrative

Scenario examines use of UFT FAA data correlation query capabilities* by authorized stakeholders in support of Remote ID of UA.

- *A public safety entity monitoring UA activity in an area advised of a UA of concern. The public safety entity captures Remote ID broadcast messages from the UA using a Remote ID Display Mobile App on a mobile device.*

- *The public safety entity initiates a data correlation query with the UA serial ID.*

- *Correlation service will tailor the query results based on the requesting entity's permissions, and if permitted, provide the correlated results.*

- *The registration and airspace authorizations are returned to the public safety entity. The public safety entity uses the information to perform their duties.*

*These capabilities include a service built by the FAA for test purposes within the UFT environment. For authorized entities, it will respond to query inputs such as data obtained via Remote ID broadcast (e.g., UA serial number).

Considerations for Scenario 3

- Functional Highlight

  - Data Correlation:

    - UFT examines how authorized participants can submit data correlation requests to the FAA

    - UA Serial ID received via Remote ID Broadcast may be used as an input for a data correlation request

- Areas of Interest

  - Remote ID Broadcast

  - Data Correlation Using Remote ID
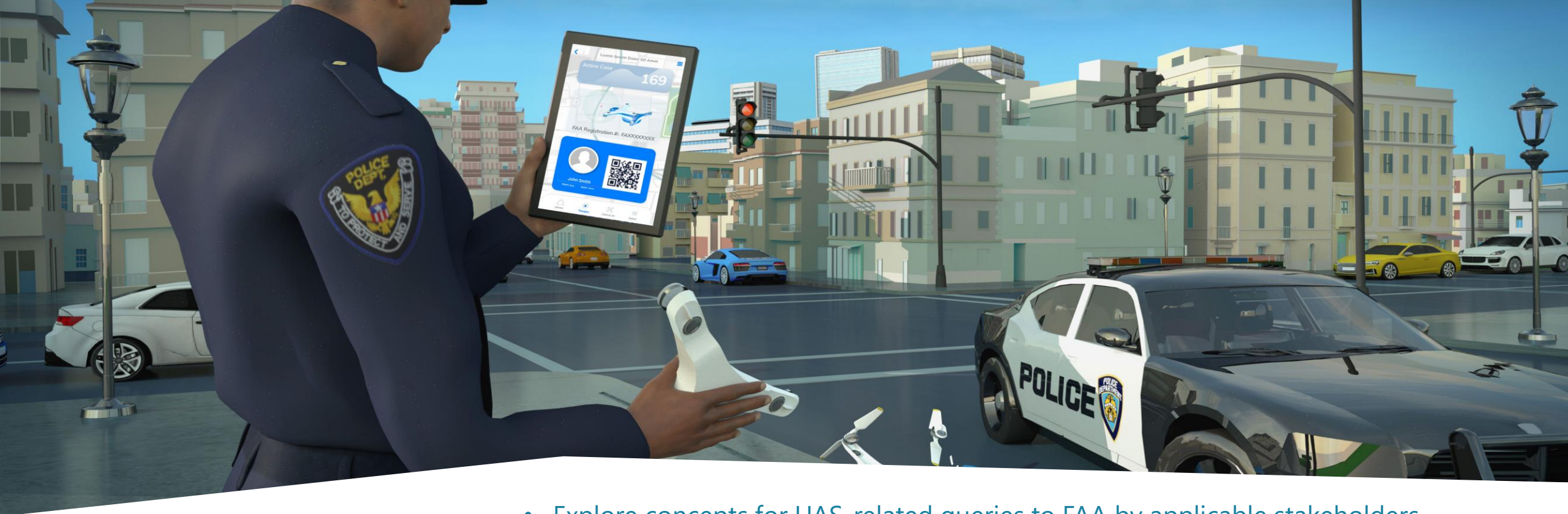
  - Message Security

Scenario 4 – Future Concept Elements

Post-Incident Investigation Involving UAS

- Exploration of concept elements

- Potential future query functionalities

- Advanced message security

Scenario 4 – Objectives

Future Concept Elements for Post-Incident Investigation Involving UAS

- Explore concepts for UAS-related queries to FAA by applicable stakeholders
- Inform development of
  - Geospatial queries for information such as airspace authorizations
  - Queries for other historical information
  - Identity and access management (including non-repudiation)
  - Data and service access per user or entity permissions
  - Service qualification to support data correlation

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Scenario 4 - Narrative

An Authorized Entity (AE) is conducting a post-incident investigation involving a UAS.

- *The AE knows the location and time range of incident.*

- *The AE is authorized to submit queries.*

- *The AE submits the location and time range in a query to the FAA's data correlation service.*

- *Correlation service tailors the query results based on the AE's permissions, and if permitted, returns requested information.*

- *The AE submits a query for historical information and receives information from a service supplier.*

- *The AE uses the information to perform their duties.*

Considerations for Scenario 4

- Functional Highlight

  - Post-incident Data Retrieval

    - o UFT examines how authorized participants can request information about UTM operations to support post-incident investigation
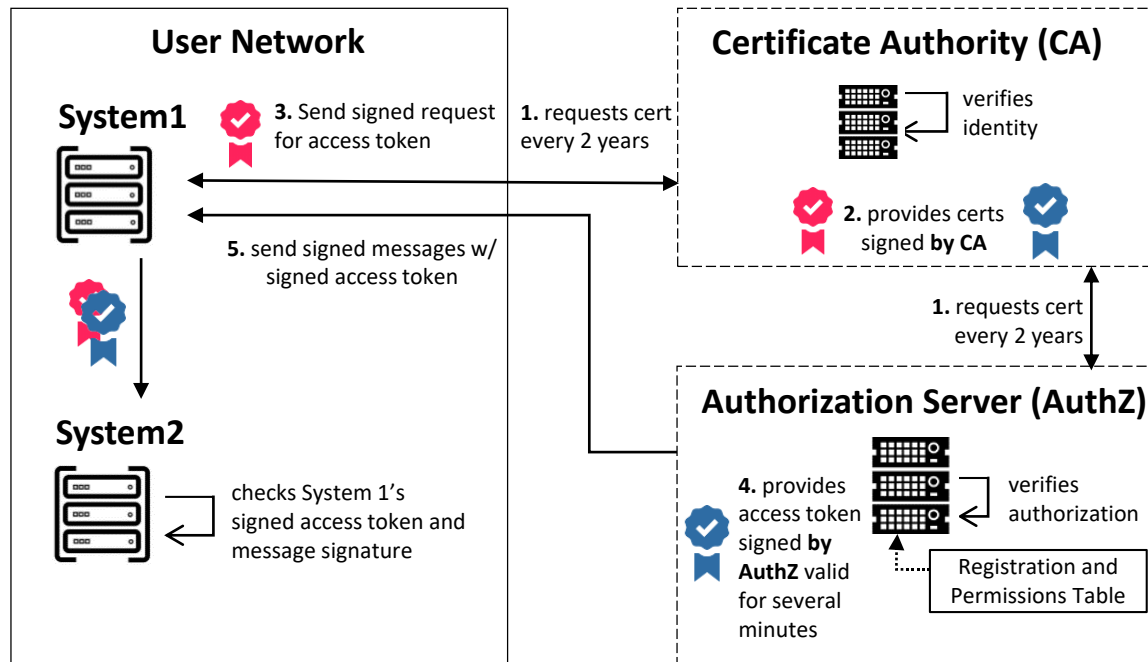
- Areas of Interest

  - Data Correlation using location-based query parameters

  - Historical UTM information queries

  - Message Security

    - o Non-repudiation

    - o Interoperability of multiple PKIs

UTM Message Security Framework

Three security components are used together to satisfy the security objectives for system-to-system information exchanges in UTM

Certificate Authority (CA)
CAs manage digital certificates which enable TLS connections and digital signatures. Certificates utilize cryptographic keys for <u>authentication</u> and <u>encryption</u>.

Authorization Server (AuthZ)
To perform UTM actions, users must receive <u>authorization</u> (e.g., via access tokens) from the AuthZ, a centralized management system for access and permissions based on the OAuth 2.0 framework.

Message Signing
If UTM actors use certificates to produce digital signatures on their messages, these messages then have end-to-end <u>non-repudiation</u> and <u>data integrity</u>.

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Next Steps

- SIR Release scheduled for March 2022

- FAA UAS Test Sites

  - Form partnerships to meet test objectives

- USSs, UAS Operators, and interested parties

  - Work with FAA UAS Test Sites to form proposal teams for UFT