



FAA/NASA UAS Traffic Management Pilot Program (UPP)

Industry Workshop #1

NASA Ames Research Center

March 15, 2018

Agenda

Meeting Topics	Name	Time
Registration	FAA/NASA	8:30 am– 9:00 am
Welcome & Introductions	NASA/FAA	9:15 am – 9:30 am
Overview of UTM Pilot Program (UPP)	NASA/FAA	9:30 am – 9:45 am
UPP Framework	NASA/FAA	9:45 am – 10:30 am
Break		10:30 am – 11:00 am
UPP Use Cases & Scenarios	FAA	11:00 am – 12:00 pm
Lunch		12:00 pm – 1:30 pm
UPP Requirements Discussion	FAA/NASA	1:30 pm – 2:30 pm
Break		2:30 pm – 3:00 pm
Execution & Engagement Timeline Review and Next Steps	FAA	3:00 pm – 3:30 pm
Questions & Answers	All	3:30 pm – 4:00 pm
UPP USS/Operator Collaborative Hour	NASA	4:00 pm – 5:00 pm



Welcome and Introductions

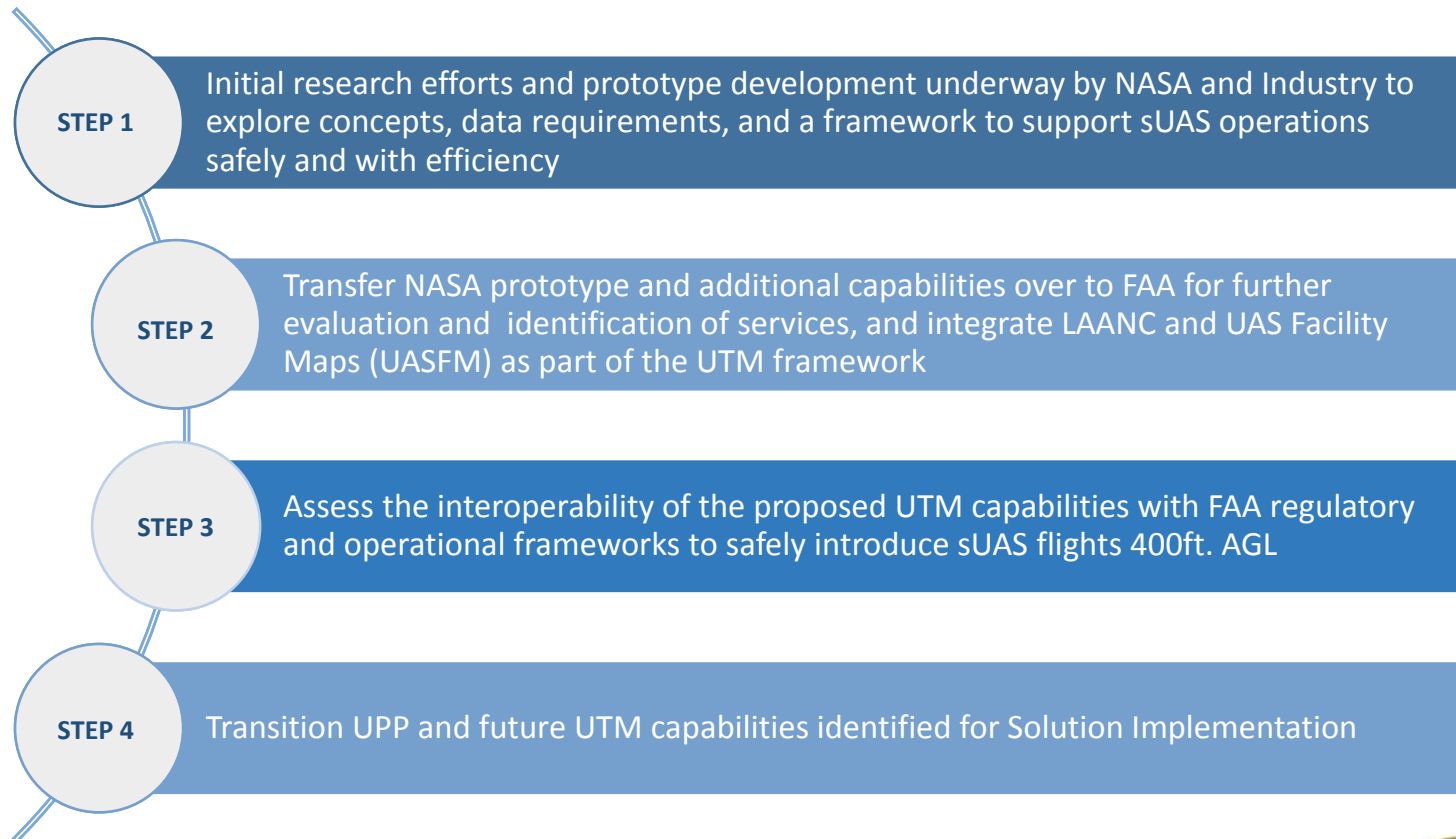


Overview of UTM Pilot Program (UPP)

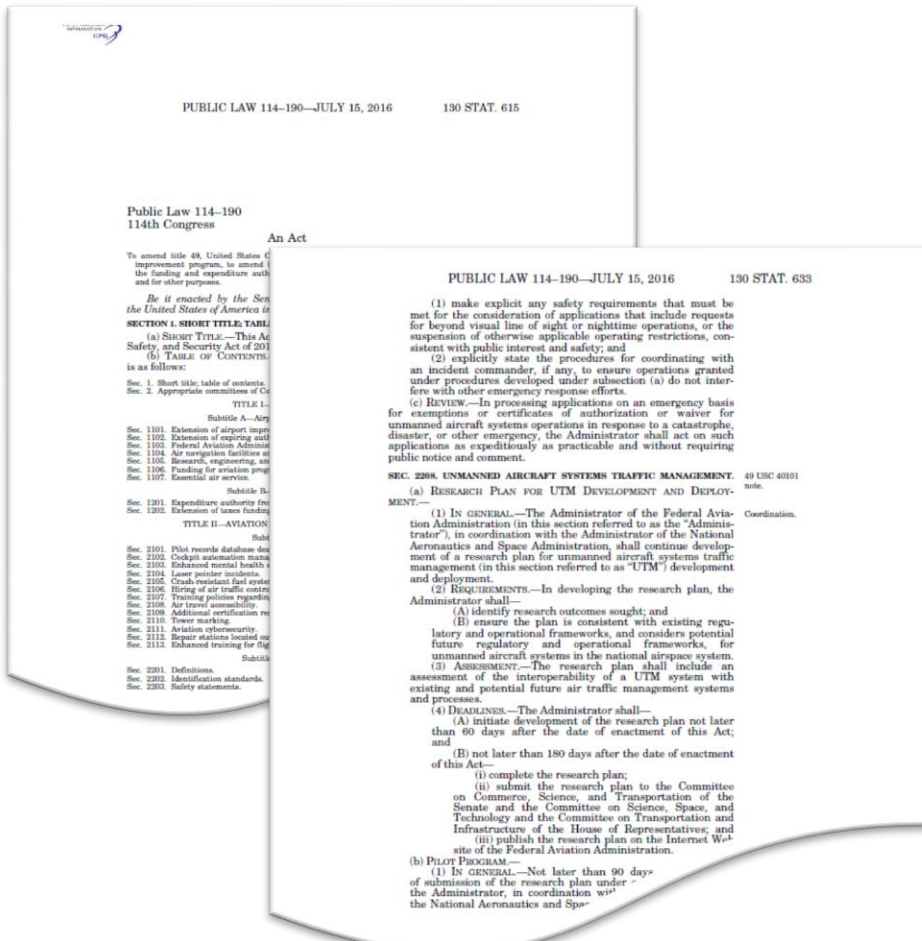


UAS Traffic Management (UTM) Vision

UTM is a traffic management “ecosystem” for UAS operations that is separate, but complementary to FAA’s Air Traffic Management (ATM) system



UTM Pilot Program (UPP) Overview



UTM Pilot Program FAA Extension, Safety & Security Act of 2016 Pub. L. 114-190 § 2208 (July 15, 2016)

Directs FAA and NASA to coordinate/collaborate, develop, and publish an Unmanned Aircraft Systems Traffic Management (UTM) Research Plan and establish an UTM System Pilot Program.

UPP shall be completed not later than two (2) years following its establishment.



UPP Objectives

The UPP, and activities leading up to the demonstration event(s) planned in early 2019, are an important component of identifying the initial set of Industry and FAA capabilities required to support UTM operations



Goals

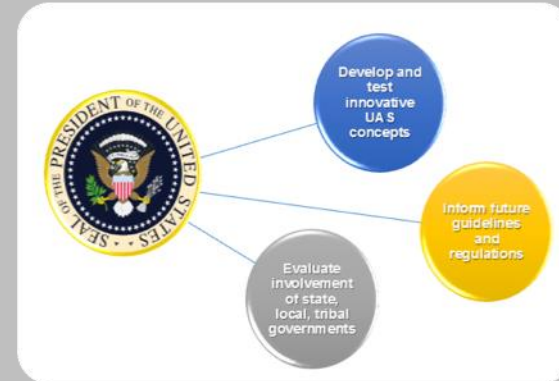
- Demonstrate the initial integrated UTM ecosystem comprised of UTM Services, Low Altitude Authorization & Notification Capability (LAANC) services for USS, and UAS Operators sharing intent and information collaboratively
- Demonstrate Dynamic Restrictions capability and the automation of parts 101(e) and 107 notifications & authorization
- Provide an understanding of the level of investment required for government and Industry stakeholders
- Final Report documenting UTM Pilot Program findings to further mature UTM

How Does UPP Complement IPP?



UAS Traffic Management Pilot Program (UPP)

- Congressional directive for FAA and NASA to partner in order to advance safe sUAS Integration at the lower altitudes through traffic management
- Forum for Industry collaboration with NASA and FAA to evaluate and demonstrate UTM technologies and capabilities
- Development of enterprise capabilities, testing, and evaluation leading up to a successful UPP demonstration



UAS Integration Pilot Program (IPP)

- Presidential directive for the Secretary of Transportation and FAA to create a partnership framework for private sector and state/local/tribal governments to achieve broader national policy
- Advances UAS Industry by informing regulations that permit more complex, demand-driven UAS operations
- Pushes the boundaries of UAS use by expanding what is routinely authorized under the sUAS rule

FAA UTM Activities

Research and Development

- NASA TCL Activities
- Int. Pilot Program

Pre-implementation

- UTM Pilot Program
- FAA / NASA RTT
- Int. Pilot Program

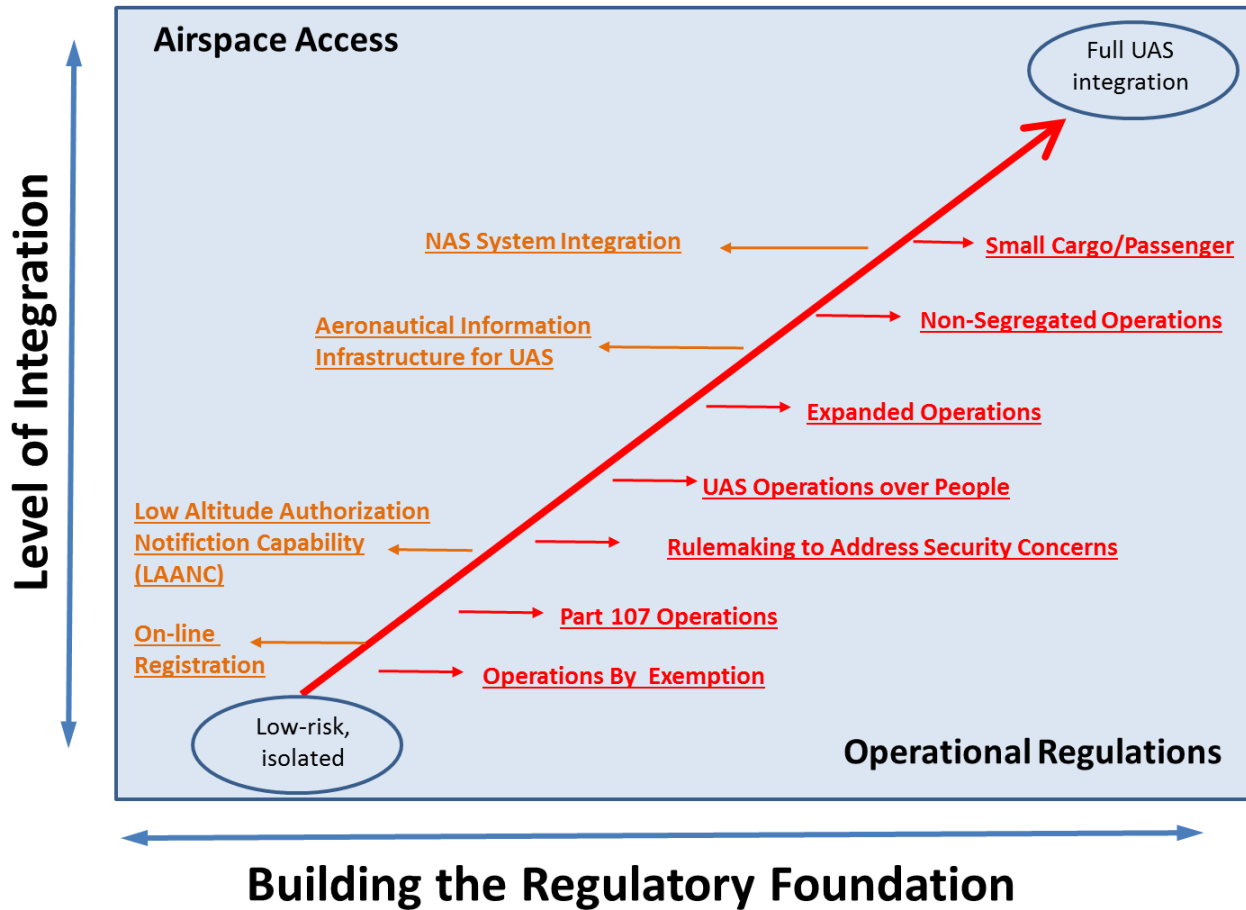
Operational Deployment

- LAANC
- UAS Registration

UTM Pilot Program Bridges the Research Activities and Operational Deployment of Future UTM Capabilities

Path to Full UAS Integration

Path to Full Integration



Types of Operations in UPP

- Visual Line of Sight (VLOS)
 - Operates in accordance with Part 101(e) or Part 107
 - UAS Operator uses a participating USS for 101 notification or 107 authorization if required for a particular operation
 - Operations conducted in controlled or uncontrolled airspace
 - May volunteer to share Operation Intent within UTM, but not required
- Beyond Visual Line of Sight (BVLOS)
 - Assumed to operate under Part 107 waiver
 - Required to share Operation Intent within UTM



UPP Actors

- Government
 - Maintains Federal Authority over operations in the demonstration
 - Provides constraints, information requests, etc. through the Flight Information Management System (FIMS)
 - Provides UAS Facility Maps via applicable LAANC systems
- UAS Operator
 - Responsible for the safe conduct of its UAS operations.
 - Ensure equipment, infrastructure, etc. meet applicable requirements.
 - Responsible for coordination with other UTM participants (when required)
- Remote Pilot in Command
 - Responsible for the safe conduct of a single operation
 - UAS Operator and RPIC roles may be held by the same entity
 - Example: A package delivery company acts as the UAS Operator for all of its package delivery flights, while individual employees act as the RPIC for a single delivery flight



UPP Actors (cont'd)

- UAS Service Supplier (USS)

- Third-party entity that provides various services to assist UAS Operators (and their RPICs) in meeting obligations
 - Planning
 - Conformance Monitoring
 - Information sharing with other UTM stakeholders via the USS Network
- Individual UAS Operators subscribe to an individual USS
- UAS Operators may provide their own services such that they are acting as a USS
- Provides Automatic Notification and Authorization services to Part 101(e) and Part 107 operators, respectively
- Sends information to the FAA via FIMS and applicable LAANC systems, as required

- USS Network*

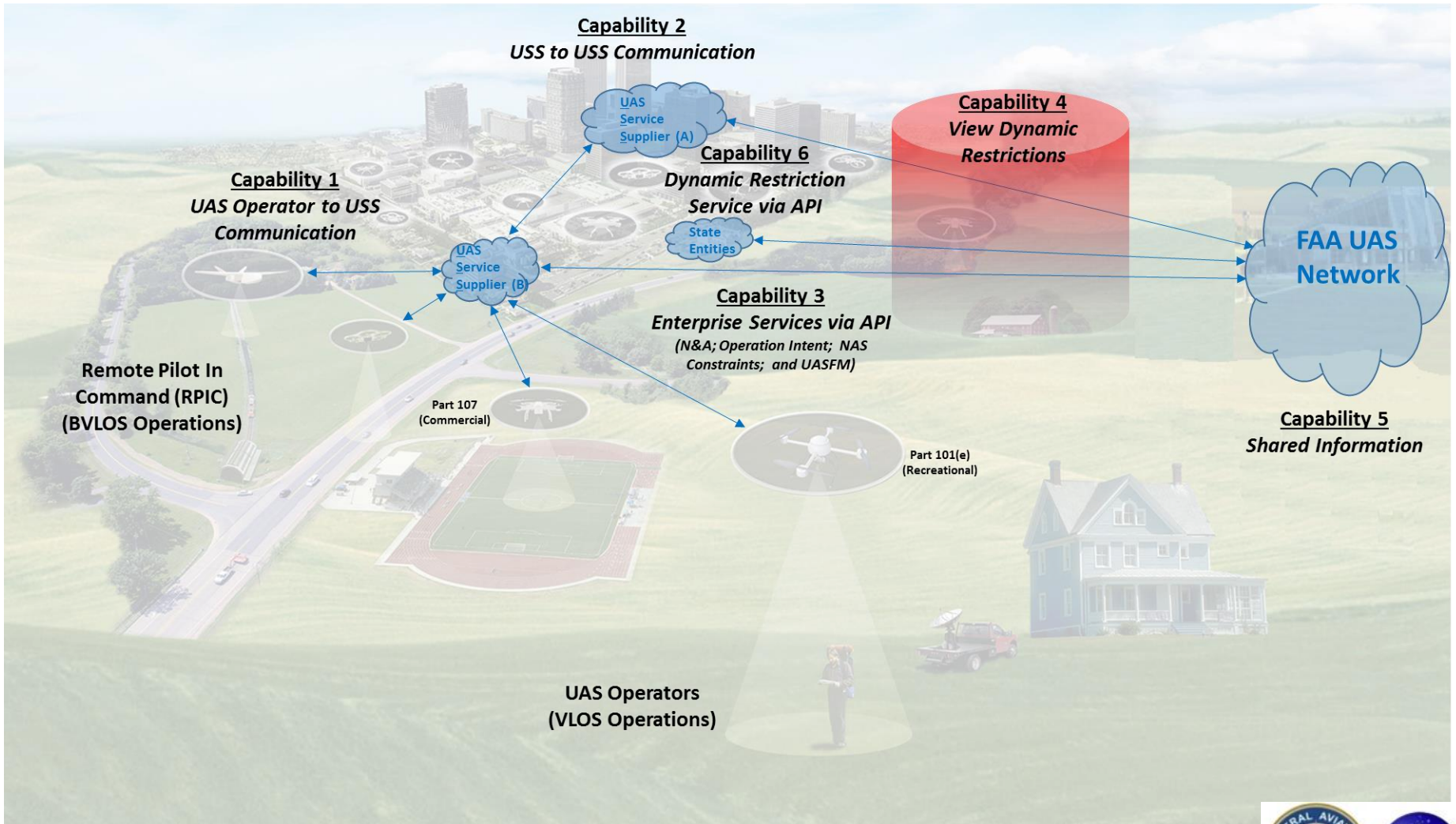
- The conglomeration of all USSs; information is exchanged across the network as required/needed
- A Local USS Network (LUN) includes those USSs that are operating within a limited geographical area
- USSs share applicable information with each other via the Network



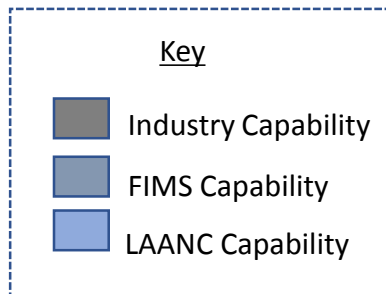
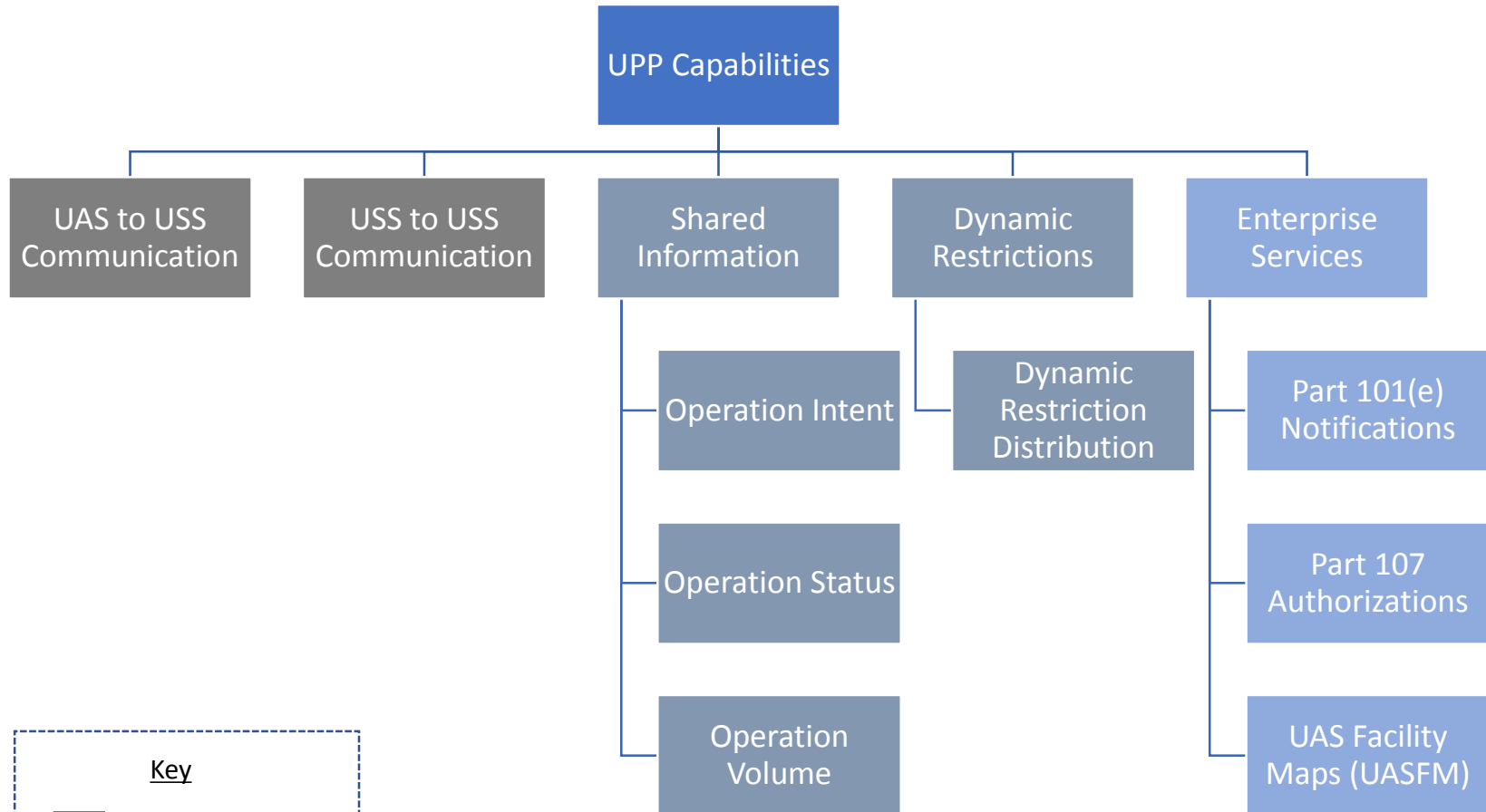
UPP Framework



UPP High-Level Operational Concept

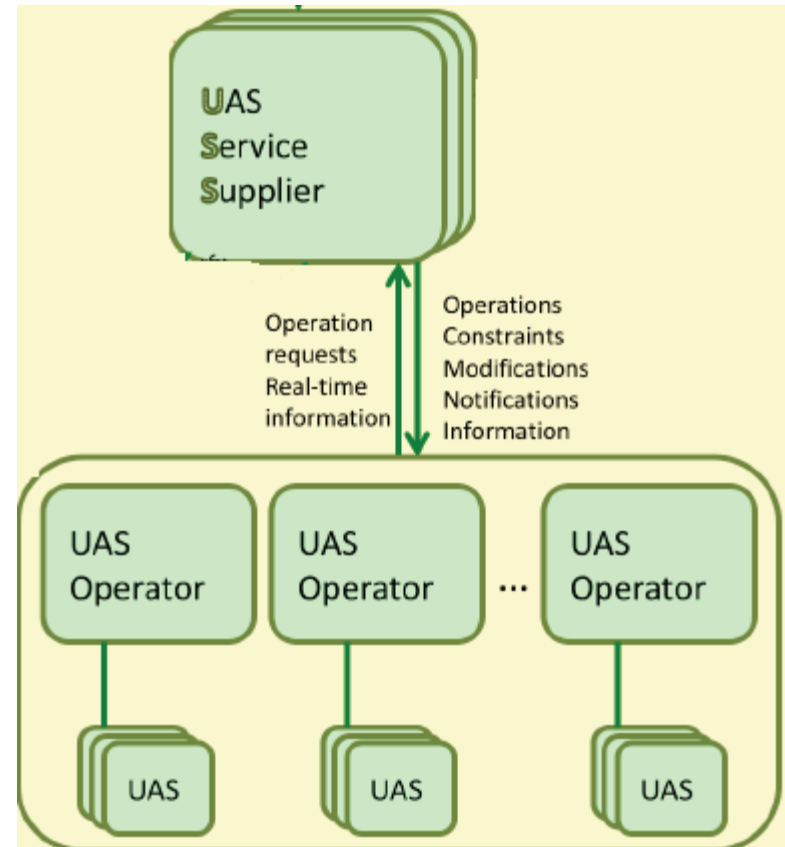


UPP Capabilities Overview



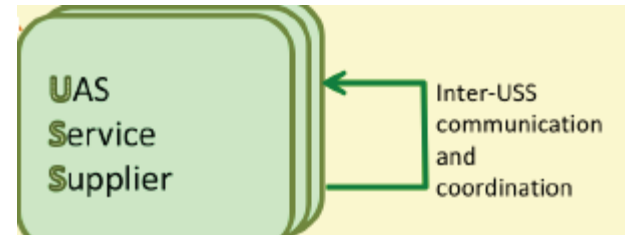
UAS to USS Communication

- UAS operators provide their planned operations to a USS system
- USS is to provide resource mitigation, contingency management, and system information to UAS Operators



USS to USS Communication

- Required interfaces that each USS (or USS Instance) must support to allow interoperability within the USS Network
- Focuses on data exchange between USSs

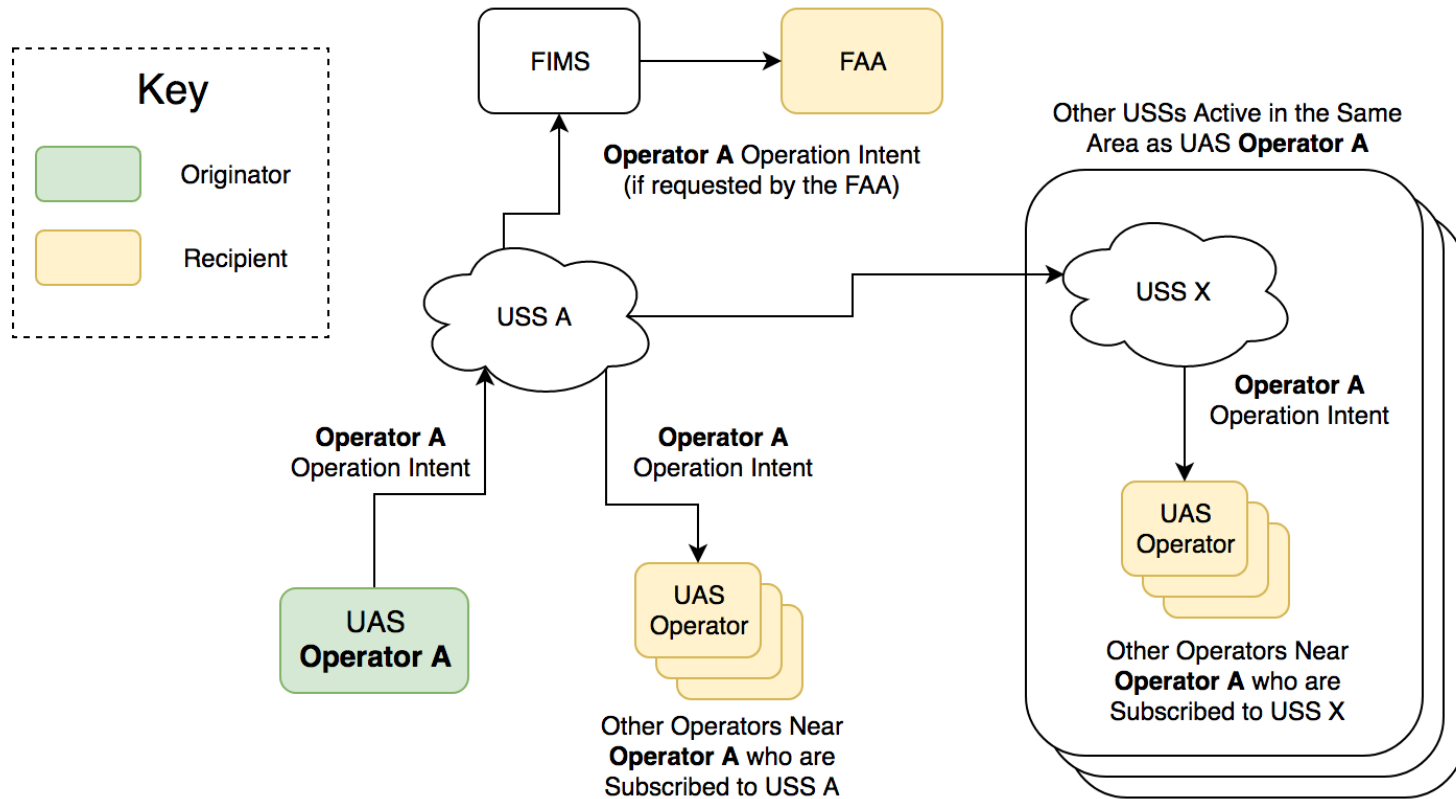


Shared Information: Operation Intent

- Operation Intent is a common data set that is made available by a UAS Operator to applicable UTM participants
 - Other Operators use this shared intent information when planning/conducting their own operations, fostering a shared situational awareness
- Op Intent is developed during the planning stage for a flight, but it can be modified during flight as well
- The USS to which a UAS Operator is subscribed makes the Op Intent available to its own subscriber base, as well as other USSs operating in the same area as the originating Operator
- Included in Operation Intent
 - Type of Operation
 - Operation Status
 - Operation Volume(s)
 - Location, Shape, Floor, and Ceiling
 - Active Times
 - RPIC Information
 - Equipment Information
 - Contingency Information
 - Additional Info



Operation Intent Sharing



NOTE: If an Operation is active, RPICs also transmit updates for their Operation Intent and receive updates regarding nearby operations.

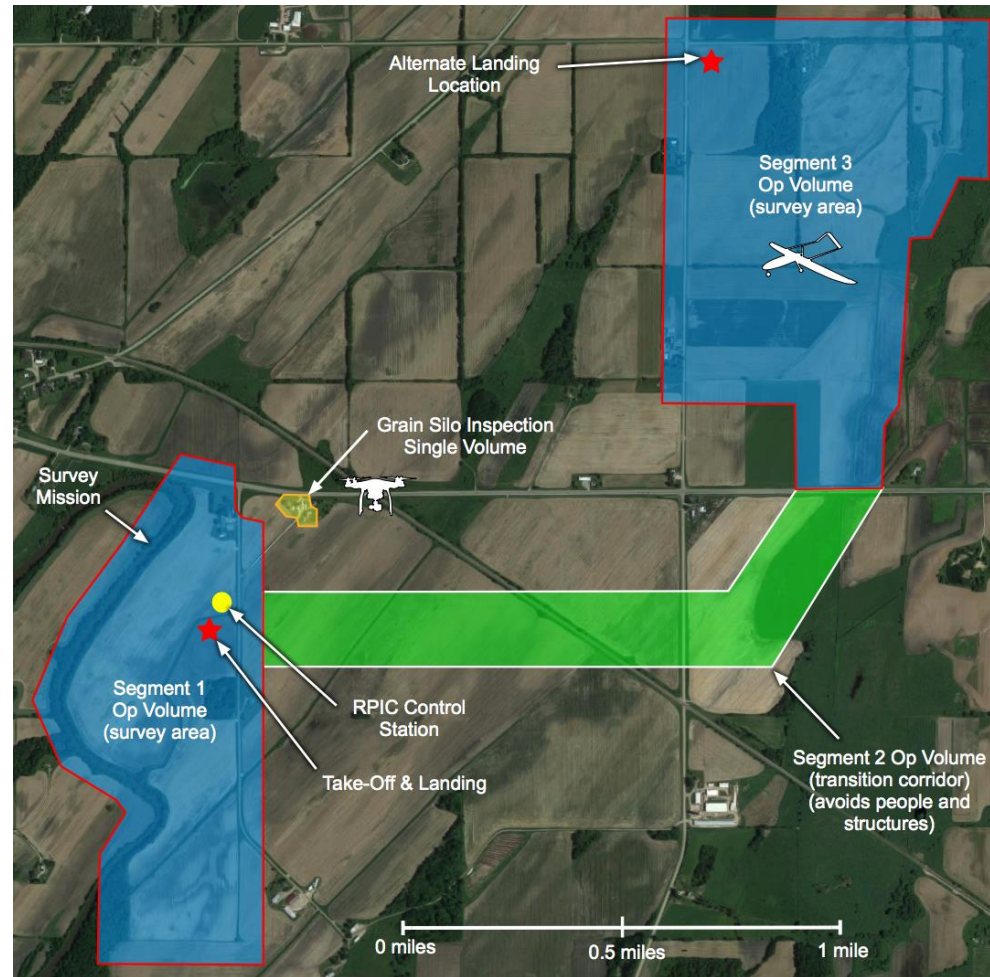
Shared Information: Operation Status

- **Operation Status** – Indicates the state of the overall operation and includes the following possible states:
 - Accepted – Indicates that Operation Intent has been developed and shared with other applicable UTM stakeholders. The UAS is not yet flying in the volume(s)
 - Activated – Indicates that the UAS is flying and is operating in accordance with the Operation Intent
 - Closed – Indicates that the UAS has landed and the operation is concluded
 - Non-Conforming – Indicates that the UAS is not operating in accordance with the Operation Intent
 - Rogue - Indicates that the UAS state is unknown; it may not operating per its Operation Intent, and is also unlikely to return to a conforming state



Shared Information: Operation Volume

- Polygons with ceilings and floors
- Multiple Operation Volumes can be defined for a single operation (segmented)
 - Each volume has its own set of active times determining when they may be considered to have a UAS within the volume
- Other Operators may use this shared information to strategically separate themselves from another operation

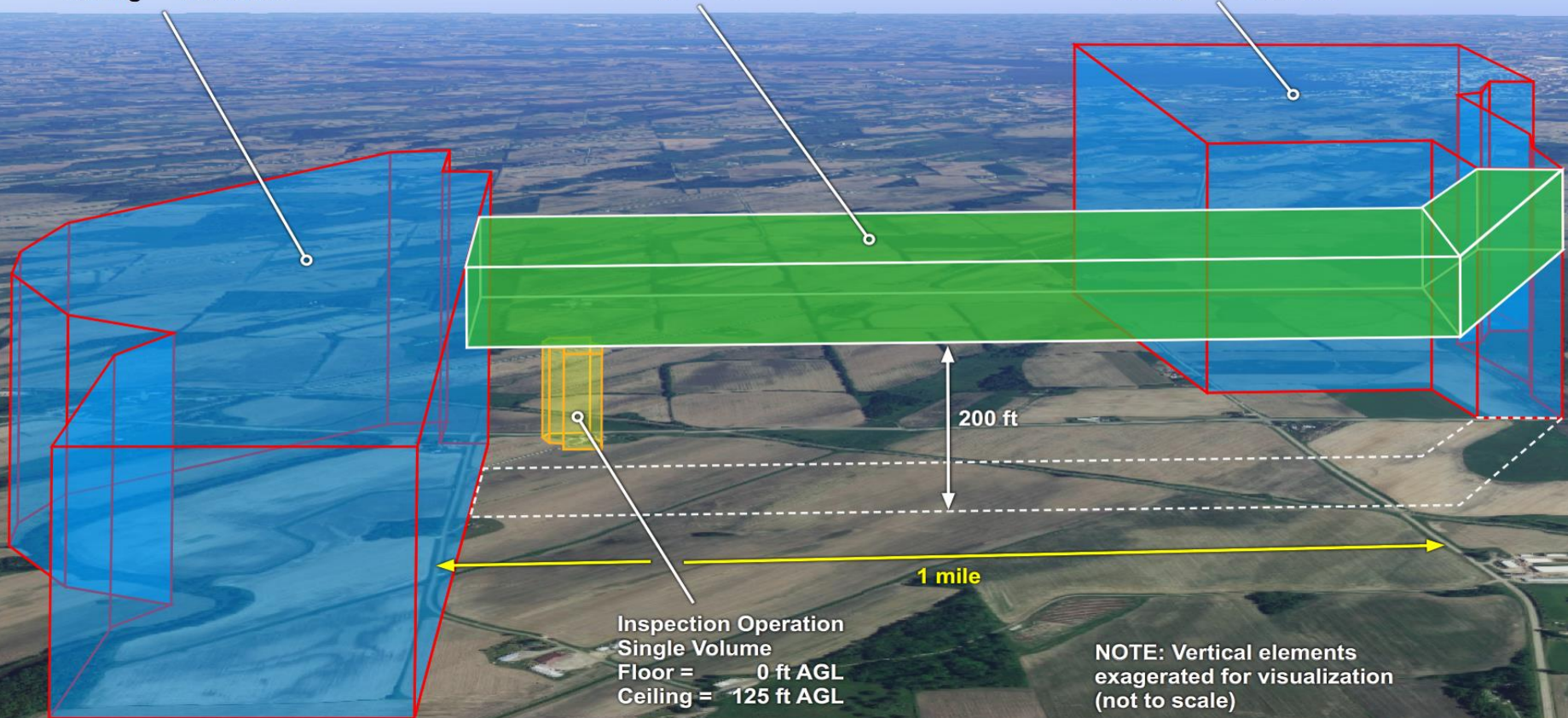


3-D View of Operation Volume

**Survey Operation
Segment 1 Volume**
Floor = 0 ft AGL
Ceiling = 300 ft AGL

**Survey Operation
Segment 2 Volume**
Floor = 200 ft AGL
Ceiling = 300 ft AGL

**Survey Operation
Segment 2 Volume**
Floor = 0 ft AGL
Ceiling = 300 ft AGL

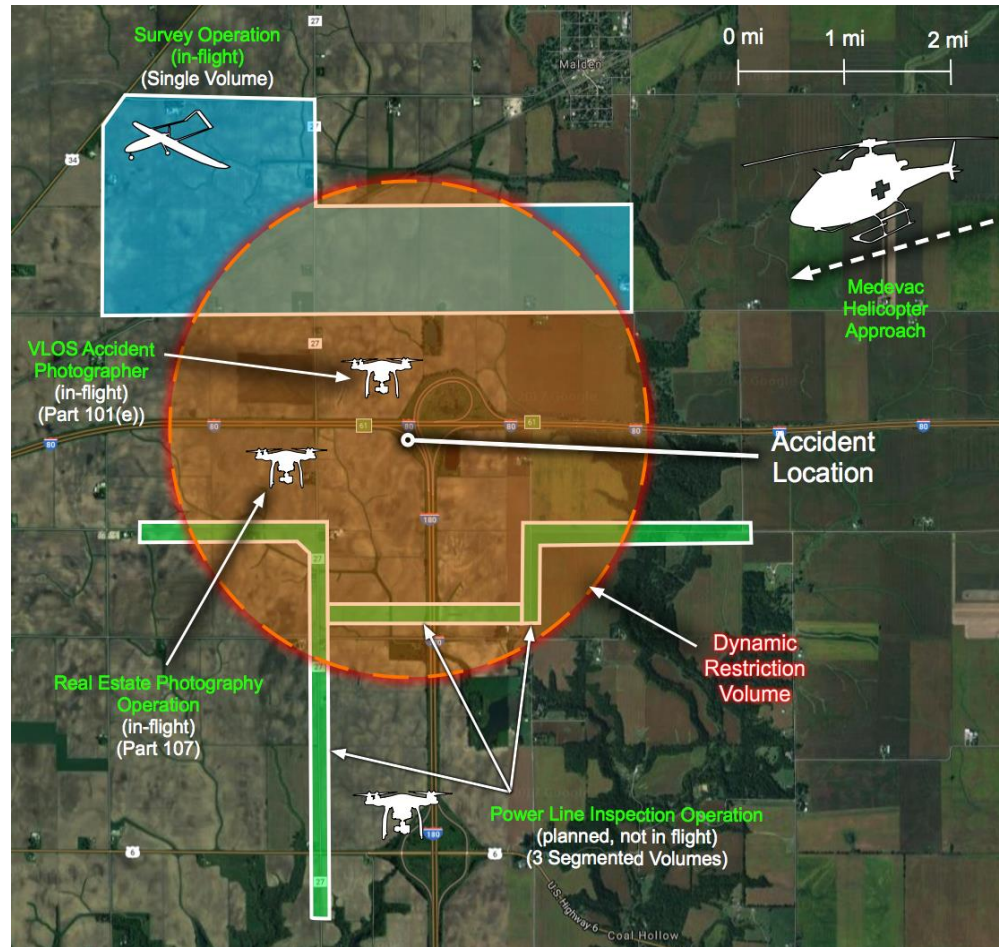


**Inspection Operation
Single Volume**
Floor = 0 ft AGL
Ceiling = 125 ft AGL

**NOTE: Vertical elements
exaggerated for visualization
(not to scale)**

Dynamic Restriction

- Restricts UAS from operating within the bounds of a Dynamic Restriction Volume
 - Permitted UAS may fly within the volume
- Created and Distributed by the FAA during demonstrations
 - Sent to the USS Network via FIMS
 - FAA Public Portal available
 - Sent to other applicable stakeholders (SDSPs, ATM Users, etc.)
- Created/activated on a relatively short times scale (less than an hour), and can be active over short or long periods (hours to days)



3-D View of Dynamic Restriction

**NOTE: Vertical elements
exaggerated for visualization
(not to scale)**

Dynamic Restriction Volume
Floor = 0 ft AGL
Ceiling = 1,000 ft AGL

**Inspection Operation
Single Volume**
Floor = 0 ft AGL
Ceiling = 350 ft AGL

**Inspection Operation
Segment 1 Volume**
Floor = 0 ft AGL
Ceiling = 225 ft AGL

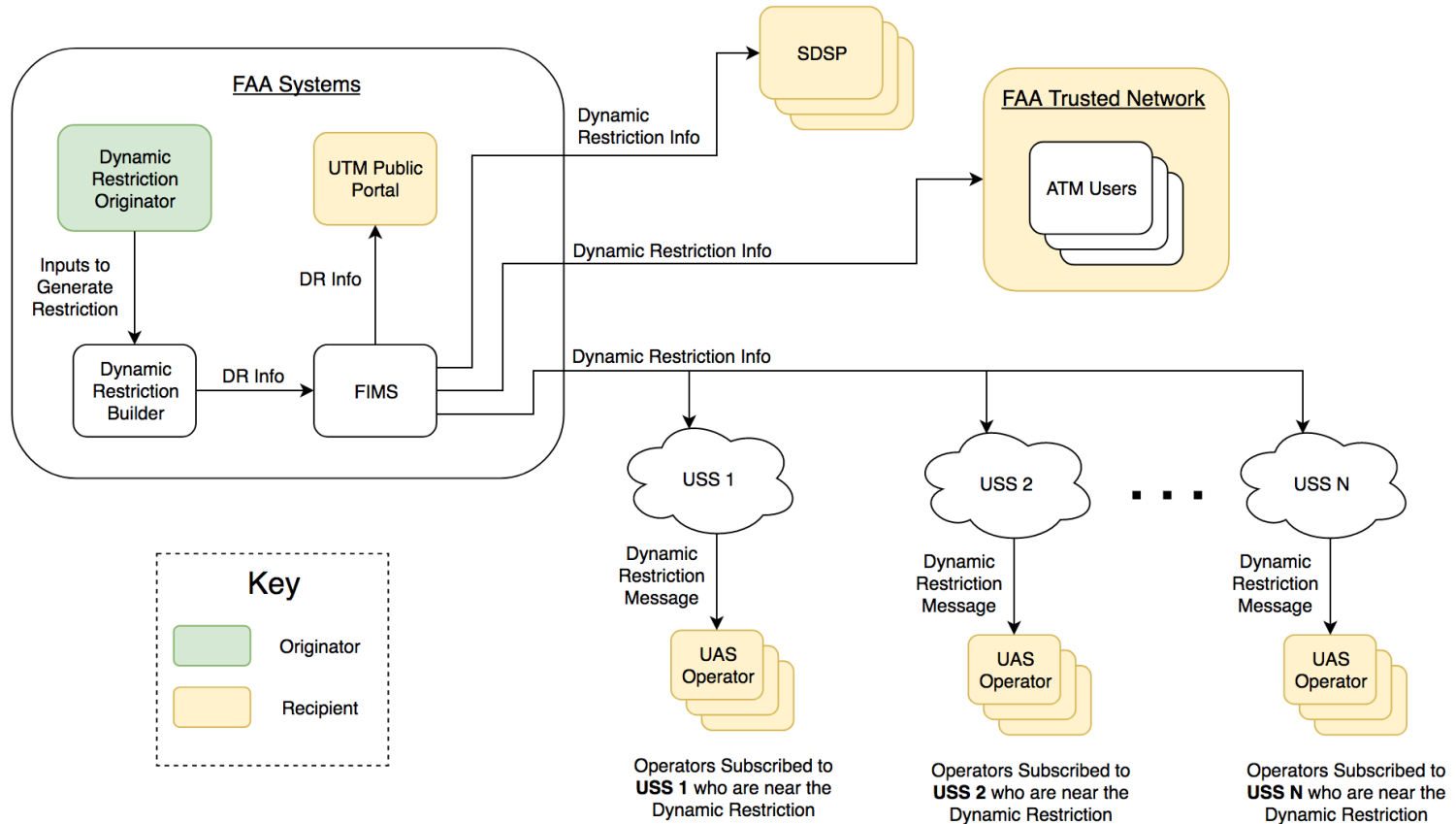
**Inspection Operation
Segment 2 Volume**
Floor = 125 ft AGL
Ceiling = 225 ft AGL

**Inspection Operation
Segment 3 Volume**
Floor = 0 ft AGL
Ceiling = 225 ft AGL

2 miles



Dynamic Restriction Distribution



NOTE: If an Operation is active, RPICs also receive alerts from their USS regarding Dynamic Restrictions.

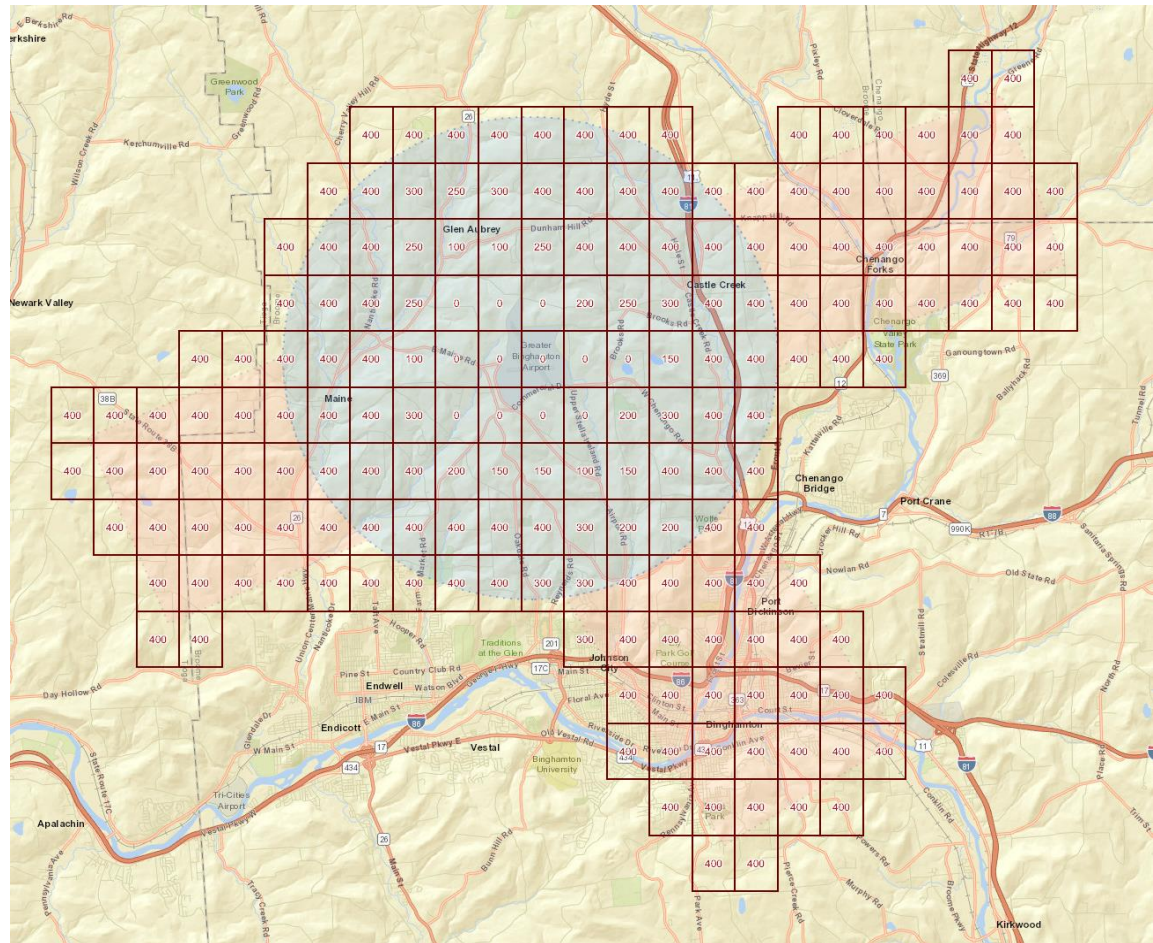
Part 101(e) Notifications & Part 107 Authorizations

- Part 107 UAS Operators are required to get ATC Authorization when operating within controlled airspace
 - The LAANC program has enabled Automatic Authorizations during its initial implementation phase
 - USSs are provided UAS Facility Maps (UASFM) by FAA systems
 - UAS Operations that occur underneath the ceilings for a map grid are considered automatically authorized
 - The USS sends a notice of authorization to both the UAS Operator and ATC
- Part 101(e) Hobbyist UAS Operators are required to notify airports when operating within 5 miles
 - The LAANC program is still developing the process of sending notifications to FAA systems
 - The subject of notifying towered airports is not part of the current UPP concept
 - The UTM Pilot Program will demonstrate 101(e) notifications to non-towered airports operated by private or municipal organizations
 - An Airport Operator will provide contact information that allow USSs to send automated notifications



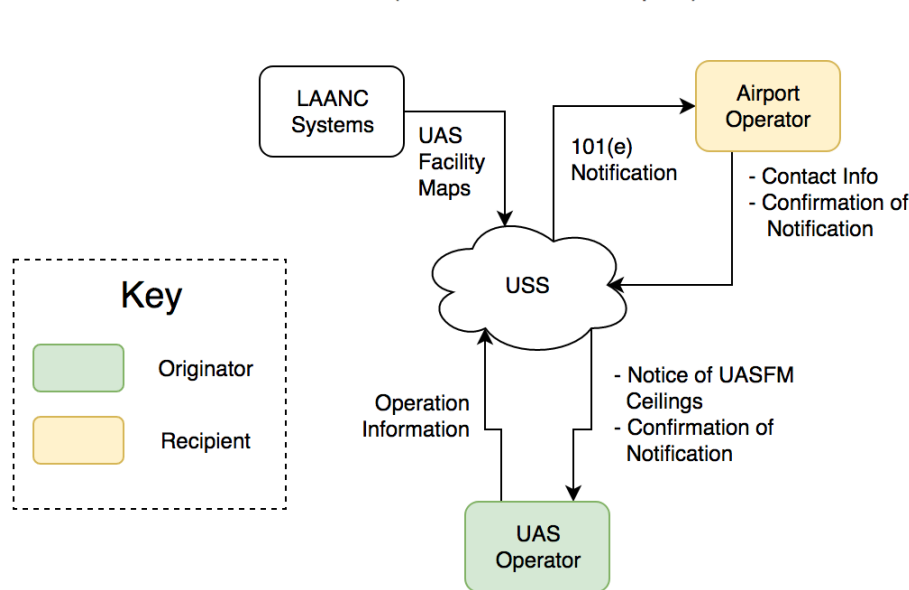
UAS Facility Maps

- Created for the lateral boundaries of controlled airspace that touches the ground
 - Class B core
 - Class C core
 - Class D
 - Class E (surface)
- The map to the right is for an airport with Class D and Class E (surface) airspace
- Each grid indicates the maximum height for which UAS Operators may be granted an automatic authorization



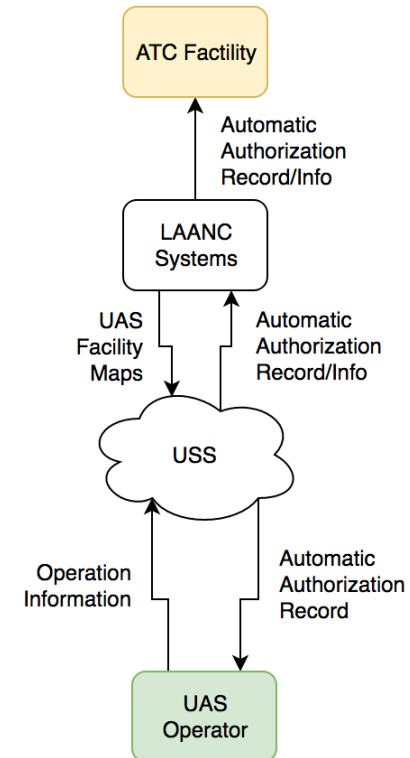
Part 101(e) Notifications & Part 107 Authorizations

Part 101(e) Notification (for non-towered airport)



NOTE: For 101(e) Operators, USSs only provide UAS Facility Map information as a warning threshold for where these Operators may start seeing manned operations when in controlled airspace; they may operate above the UASFM ceilings.

Part 107 Authorization



UPP Use Cases & Scenarios



Use Case 1

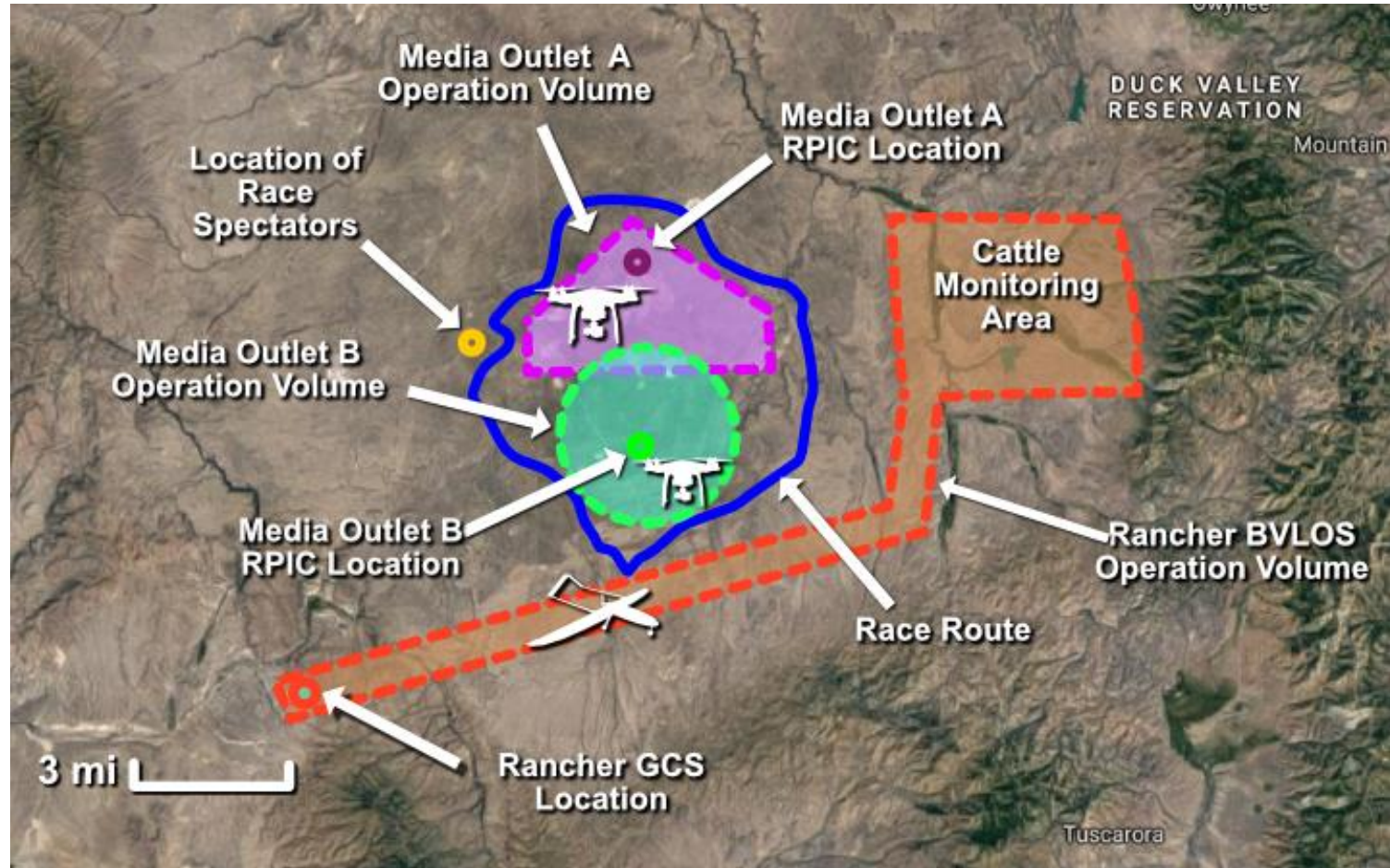
VLOS & BVLOS Operations in Uncontrolled Airspace

- Environment:
 - Uncontrolled Airspace
 - Remote/Rural
- Scenario:
 - An Off-road race bring media outlets who use UAS for videography. A nearby rancher uses a UAS to track a herd
- This use case Introduces:
 - Shared information between Operators
 - Information planning
 - Sharing of Intent via USS
 - VLOS (107) and BVLOS operations



VLOS & BVLOS Operations in Uncontrolled Airspace

Overview of Operations



VLOS & BVLOS Operations in Uncontrolled Airspace

- Operations:
 - 2 Part 107 Operations conducting media videography of an off-road truck race in the Nevada Desert
 - Uncontrolled airspace means no Part 107 Authorizations are required
 - The two media UAS Operators choose to participate in UTM by sharing their Operation Intent; both subscribe to USS ABC
 - 1 BVLOS Operation near the race event area conducted to track down cattle on a rancher's property
 - The rancher UAS Operator is required to participate in UTM, due to the operation including BVLOS flight
 - The Rancher is subscribed to USS XYZ



VLOS & BVLOS Operations in Uncontrolled Airspace

- Events:
 - Night before: Media Outlet A creates and shares their Operation Intent, which is made available to USS ABC's subscriber base (those who operate near Outlet A), as well as other USSs active in the area through a LUN (in this case, USS XYZ)
 - Morning of race: Media Outlet B creates and shares their Operation Intent (they are able to see the Operation Intent of Outlet A while planning). Outlet B's Operation Intent is made available to the LUN; Outlet A gets notification of Outlet B's planned operation
 - Beginning of race: Both Media Outlets activate their operations; the status change is made available to the LUN by USS ABC
 - Their volumes overlap, and each RPIC maintains separation for the other UAS through visual scanning of the area around their own UAS
 - During the race: The Rancher is able to see the active operations while planning his flight. He creates an Operation Volume that maintains separation from the Media Outlets. His Operation Intent is shared with the LUN by USS XYZ
 - USS A provides notification to the RPICs for Outlet's A and B of the new nearby operation. Both RPICs determine it does not affect them and take no additional actions
 - The Rancher conducts his flight, sharing position information with USS XYZ. USS XYZ monitors the position to make sure the UAS conforms to the shared Operation Intent
 - All operations conclude per their shared intent. As each RPIC indicates to their applicable UAS the conclusion of their flight, the USS updates the Operation Status to "Closed" and makes it available to the LUN



Use Case 2

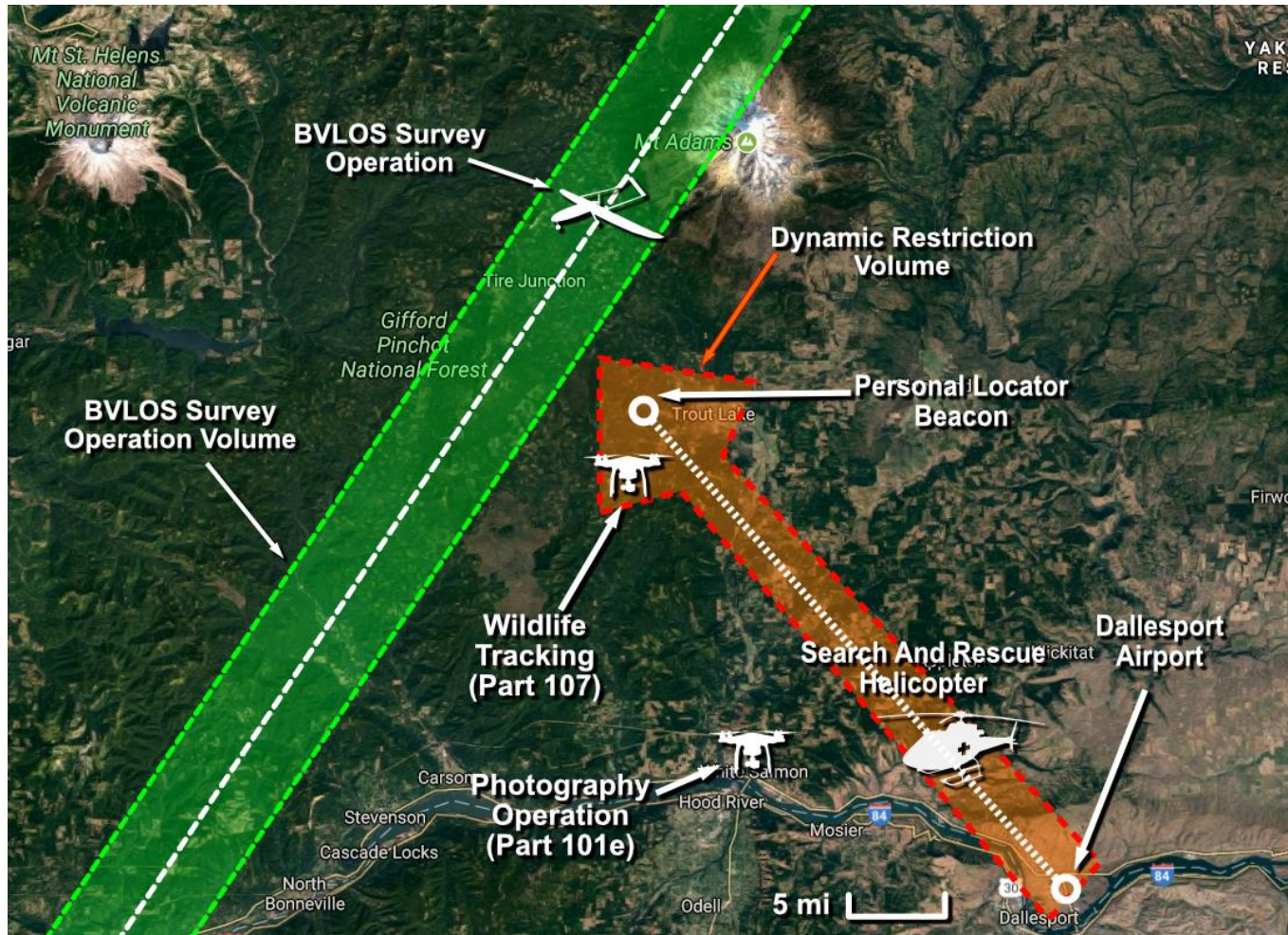
Dynamic Restriction near VLOS/BVLOS Operations in Uncontrolled Airspace

- Environment:
 - Uncontrolled Airspace
 - Remote/Rural
- Scenario:
 - Search and Rescue (SAR) helicopter flight results in the FAA creating a Dynamic Restriction to keep UAS from interfering with the rescue.
- This use case introduces:
 - Dynamic Restrictions
- Prior concepts also in this use case:
 - Shared information between Operators
 - VLOS (101(e)/107) and BVLOS operations



Dynamic Restriction near VLOS/BVLOS Operations in Uncontrolled Airspace

Overview of Operations



Dynamic Restriction near VLOS/BVLOS Operations in Uncontrolled Airspace

- Operations
 - 1 Part 101(e) hobbyist photography operation
 - No airport within 5 miles means no notification required
 - Does not share Operation Intent (considered to not be participating in UTM)
 - 1 Part 107 wildlife tracking operation
 - Not conducted in controlled airspace means no authorization is required
 - Participates in UTM by sharing Operation Intent and subscribes to the services of USS ABC
 - 1 BVLOS survey operation
 - Required to share Operation Intent and subscribes to USS XYZ



Dynamic Restriction near VLOS/BVLOS Operations in Uncontrolled Airspace

- Events:
 - Prior to the Dynamic Restriction:
 - UAS Operation Planning:
 - The survey and tracking UAS Operators create and share their Operation Intent with the LUN via their respective USSs. Similar to the previous use case, each participating UAS Operator is made aware of the other through sharing of intent information.
 - The photo UAS Operator does not share any information.
 - All 3 UAS Operators take off and are in active flight once the SAR helicopter is dispatched
 - Creation of the Dynamic Restriction (DR):
 - SAR operator contacts the FAA to request the DR; an FAA originator uses DR Builder to generate the DR.
 - DR Builder sends the DR to FIMS, which forwards it to the public portal, the USS Network, and other applicable stakeholders capable of communication with FIMS.
 - The 2 UTM participants receive notification of the DR from their respective USS. The non-participant gets information about active DRs through the FAA public portal.
 - The survey Operation Volume does not overlap with the Dynamic Restriction Volume, so no action is taken.
 - The wildlife tracking Operation Volume is fully overlapped by the Dynamic Restriction Volume. Flying any further than the limits of the volume would result in BVLOS flight, which they are not capable of supporting, so they land; their USS updates the Operation Status to “closed”, and no further actions are taken.
 - The photo hobbyist is outside of the Dynamic Restriction Volume and is not required to take any action.

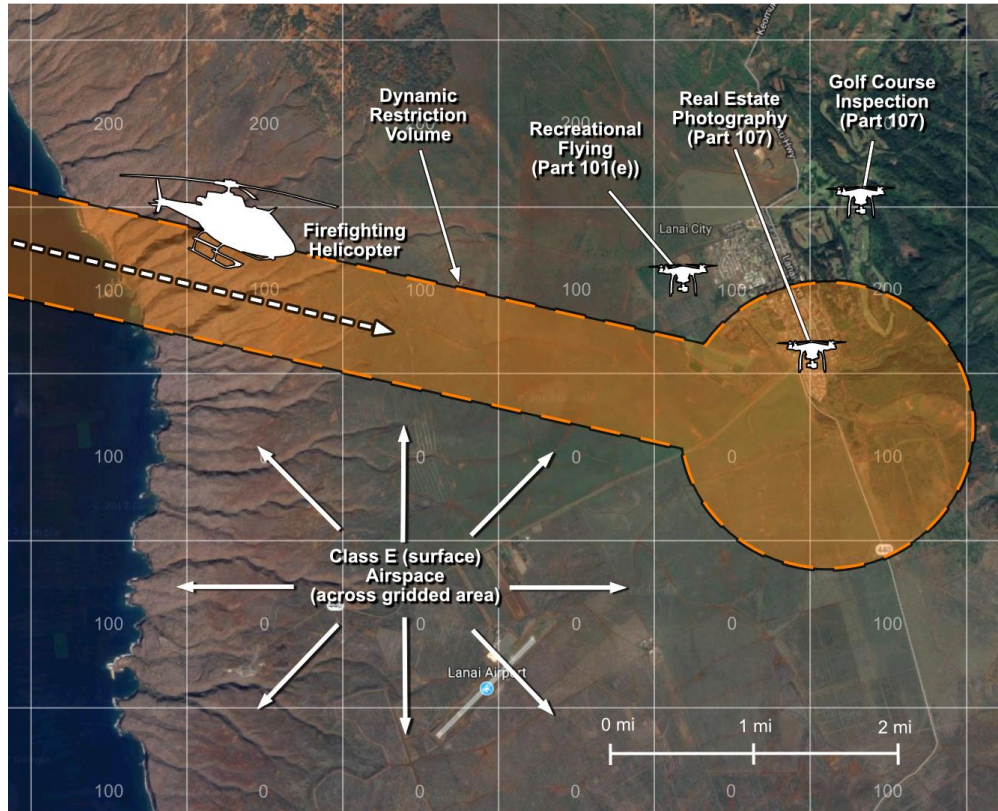
Use Case 3

Dynamic Restriction near VLOS Operations in Controlled Airspace

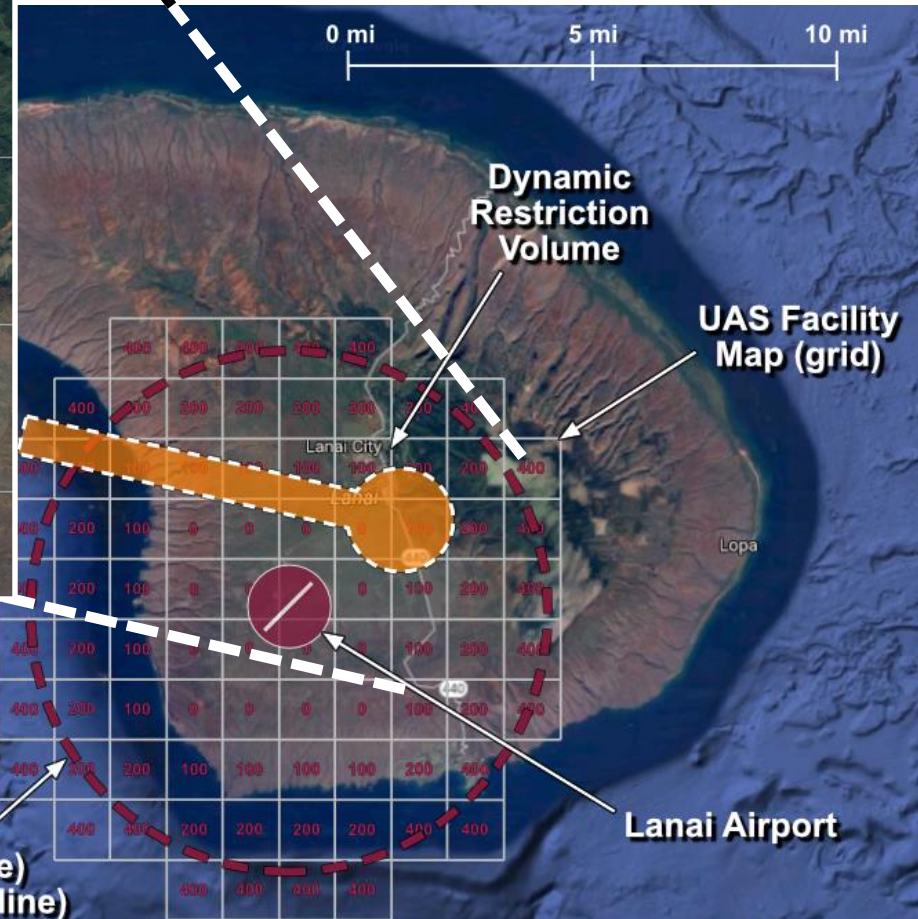
- Environment:
 - Controlled Airspace
 - Lanai Airport - Class E (surface)
 - Airport is operated by the State of Hawaii (no ATC facility at the airport)
 - Suburban
- Scenario:
 - Firefighting helicopter operations in Lanai City results in the FAA creating a Dynamic Restriction to keep UAS from interfering with the operations.
- This Use Case Introduces
 - UTM operations in controlled airspace
 - Part 107 Automatic Authorization
 - Part 101(e) Notification
- Prior concepts also in this use case
 - Shared information between Operators
 - VLOS operations only in this use case
 - Dynamic Restrictions



Dynamic Restriction near VLOS Operations in Controlled Airspace



Overview of Operations



Dynamic Restriction near VLOS Operations in Controlled Airspace

- Operations
 - 1 Part 101(e) hobbyist operation (recreation flight)
 - Lanai Airport is less than 5 miles away; notification is required to the Airport Operator
 - Lanai Airport is not towered, so notification to ATC is not required
 - The hobbyist subscribes to USS ABC to provide notification to the airport; also voluntarily shares Operation Intent
 - The hobbyist also voluntarily shares Operation Intent
 - 2 Part 107 operations
 - Real estate photography and golf course inspection
 - Operations in controlled airspace require ATC Authorization
 - Both UAS Operators subscribe to USS XYZ to get automatic authorization
 - Both participate in UTM by sharing Operation Intent and subscribes to the services of USS ABC



Dynamic Restriction near VLOS Operations in Controlled Airspace

- Events:
 - Part 101(e) notification*
 - The hobbyist UAS Operator develops his Operation Intent
 - The USS determines notification to Lanai Airport is needed
 - The USS sends notification to the airport via an email address the airport has made available to the USS Network
 - The airport operator system responds to the email, indicating receipt
 - The USS forwards the receipt notice to the hobbyist
 - The hobbyist also opts to share the Operation Intent with the LUN
 - Part 107 automatic authorizations
 - Both UAS Operators develop their Operation Intent
 - The USS determines that each operation is in controlled airspace for Lanai Airport and that ATC Authorization is required
 - The USS receives UAS Facility Map (UASFM) data from FAA LAANC systems
 - The USS verifies that the Operation Volume for each UAS Operator falls under the ceiling for applicable grids of the UASFM
 - The USS sends notice to the Operators that each of their operations is automatically authorized by ATC. A record of the automatic authorization is sent to the ATC facility servicing the Class E airspace around Lanai Airport
 - Both UAS Operators also opt to share their Operation Intent with the LUN
 - All three (3) UAS Operators know of the other operations near them due to the sharing of Operation Intent



Dynamic Restriction near VLOS Operations in Controlled Airspace

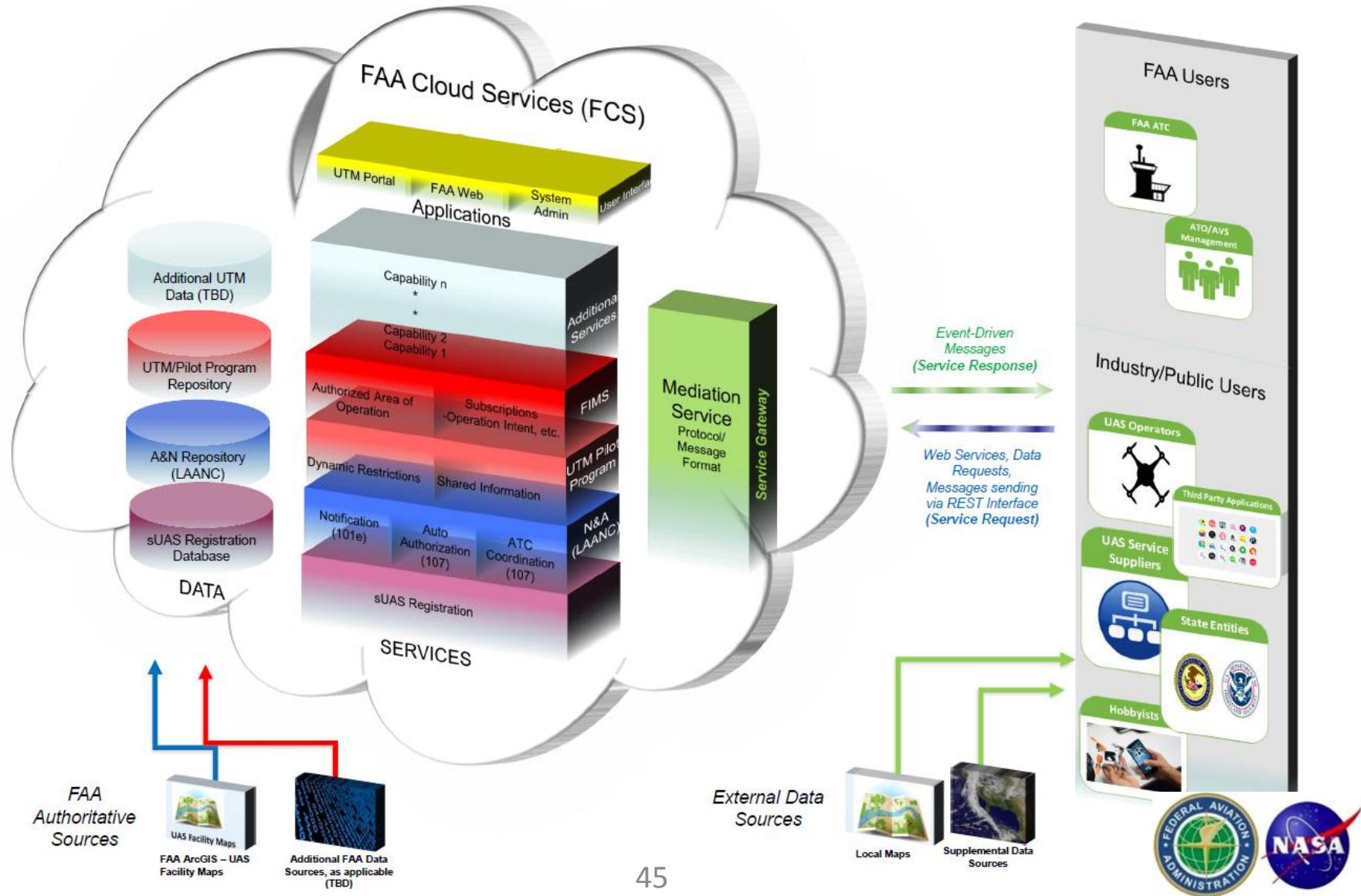
- Events, continued...
 - Dynamic Restriction Event
 - Similar to the previous use case, a Dynamic Restriction (DR) is created to support the manned helicopter operation (in this case, a firefighting operation). The process for creating/distributing the restriction is similar.
 - At the moment the DR is sent to the USS network:
 - The hobbyist is already flying
 - The real estate photographer is already flying
 - The golf course inspector has not started flying
 - The inspection operation starts after the DR will be active.
 - USS ABC sends notice to the hobbyist; USS XYZ sends notice to the photographer and inspector
 - The hobbyist determines the DR Volume does not overlap his Operation Volume; he continues to fly with no actions taken with respect to the DR
 - The real estate photographer determines the DR Volume completely overlaps his Operation Volume. He lands, ceases operations for the day, and updates his Operation Intent to indicate the operation concluded earlier than planned
 - The golf course inspector determines the DR volume does not overlap his Operation Volume; he makes no changes to his planned operation.
 - The firefighting operations finish earlier than the DR end time. The FAA originator updates the restriction to end at an earlier time. This update is made available to stakeholders as previously noted





UPP Requirements Discussion





UTM Ecosystem





FAA Technical Capabilities

Description	Establish the ability for government and Industry stakeholders to demonstrate FIMS and LAANC capabilities
 Capabilities	<ul style="list-style-type: none"><input type="checkbox"/> Demonstrate a developed API with the following technical capabilities:<ul style="list-style-type: none"><input type="checkbox"/> Dynamic restriction information<input type="checkbox"/> Information sharing between FAA, UAS operators, and multiple USSs, as applicable<input type="checkbox"/> Part 101(e) Notifications & Part 107 Authorizations<input type="checkbox"/> Connectivity to the FAA service gateway<input type="checkbox"/> Establish and manage the interface with USS(s)
 Reference Documents	<ul style="list-style-type: none"><input type="checkbox"/> UPP Specification Document<input type="checkbox"/> LAANC-AP ICD<input type="checkbox"/> FAA sUAS LAANC Phase 1 USS Operating Rules

USS Technical Capabilities

Description	Communication between the LAANC, FIMS and the set of USSs is central to the UTM System
 Capabilities	<ul style="list-style-type: none"><input type="checkbox"/> Demonstrate a developed API with the following technical capabilities:<ul style="list-style-type: none"><input type="checkbox"/> Receive information from subscribing UAS operators<input type="checkbox"/> Receive Part 107 authorization requests<input type="checkbox"/> Receive and translate UAS facility map information<input type="checkbox"/> Allow UAS operators to create Part 101(e) notifications<input type="checkbox"/> Enable information sharing between FAA, UAS operators, and multiple USSs, as applicable<input type="checkbox"/> Issue and communicate a dynamic restriction<input type="checkbox"/> Connectivity to the FAA service gateway for mediation services<input type="checkbox"/> USS tracking of subscribing BVLOS UAS real-time position data<input type="checkbox"/> Establish and manage the interface with UAS Operator(s)
 Reference Documents	<ul style="list-style-type: none"><input type="checkbox"/> UTM-USS Specification<input type="checkbox"/> LAANC-AP ICD<input type="checkbox"/> FAA sUAS LAANC Phase 1 USS Operating Rules

UAS Operator Capabilities

Description	Operator communication within UTM is performed through a USS. UAS Operators do not communicate directly with LAANC and FIMS.
 Capabilities	<ul style="list-style-type: none"><input type="checkbox"/> Client Implementation to connect to USS<input type="checkbox"/> Illustrate situational awareness of UTM data
 Reference Documents	<ul style="list-style-type: none"><input type="checkbox"/> UTM-UAS Operator ICD

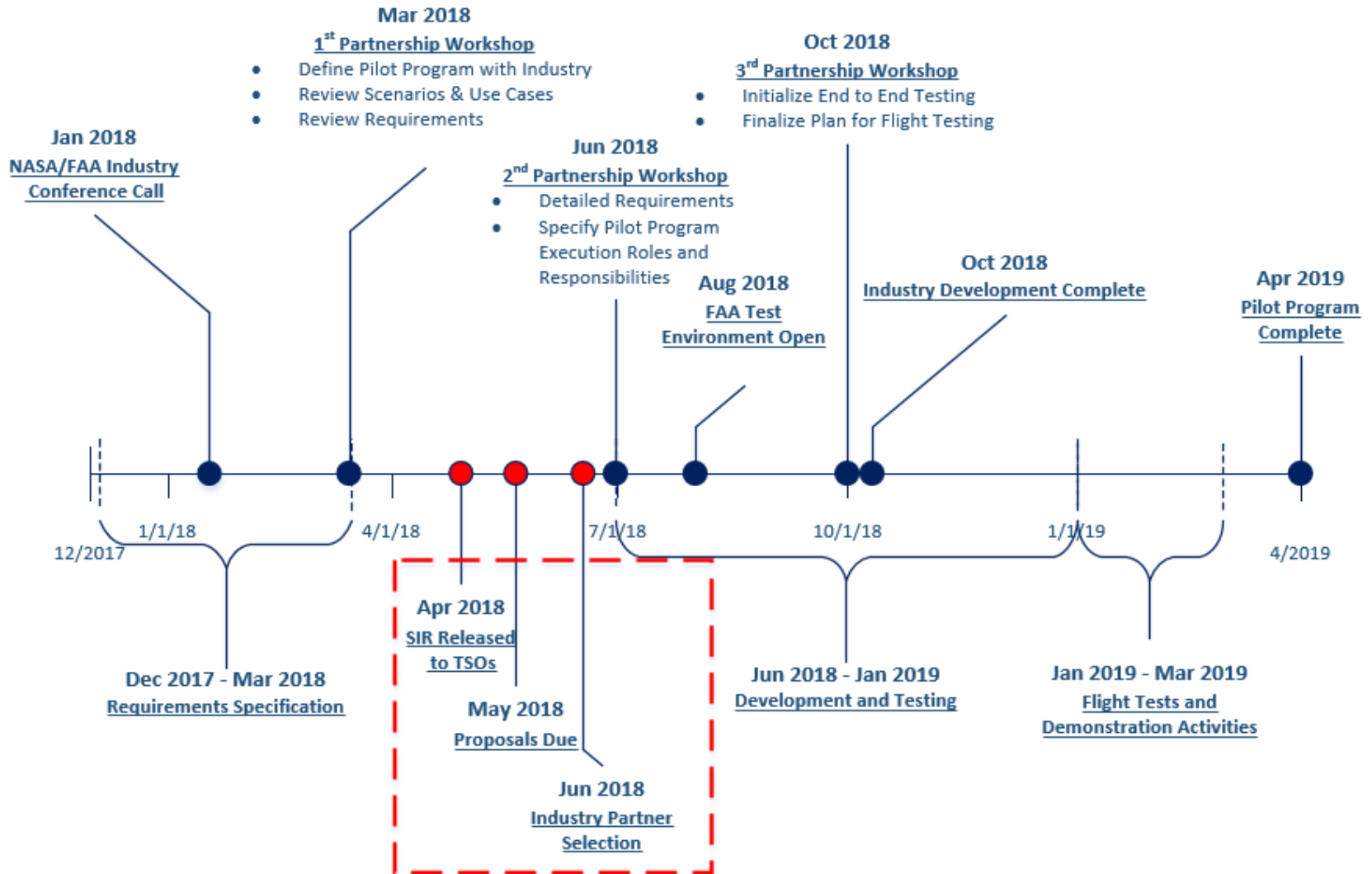
Test Site Capabilities

Description	Test Site Organizations (TSO) that are interested in hosting the UPP Demo and events leading to the successful demo in late 2018/early 2019
 Requirements	<ul style="list-style-type: none"><input type="checkbox"/> Meet range requirements to perform planned operations (i.e., situational awareness tools and radar equipment in place as needed)<input type="checkbox"/> Provide appropriate staffing to meet the daily mission requirements as prescribed in the demo plan<input type="checkbox"/> Assist proponents on obtaining necessary approvals to fly the tests (COAs, spectrum approvals, etc.)
 Reference Documents	<ul style="list-style-type: none"><input type="checkbox"/> Communication Protocol Plan<input type="checkbox"/> Data Management Plan

Partnership Engagement Timeline Review & Next Steps



Partnership Engagement & Execution Schedule



Next Steps

- Test Site Organizations
 - Review initial capabilities and provide feedback by March 30 to faautm@faa.gov
 - Form partnerships to meet required functionality
 - Be on the lookout for SIR release
- USS, UAS Operators, and other potential partners
 - Interested parties should work with the FAA Test Sites Organizations to form partnerships to meet requirements of the Pilot Program



Questions & Answers

