

# Unmanned Aircraft Systems (UAS) Concept Validation & Requirements Development

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**Federal Aviation  
Administration**

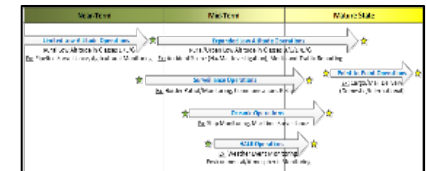


# Program Description

- Program will continue identifying and maturing UAS needs as they relate to air traffic systems and services, and refining operational requirements associated with ATM automation, airspace management, policies, and procedures.



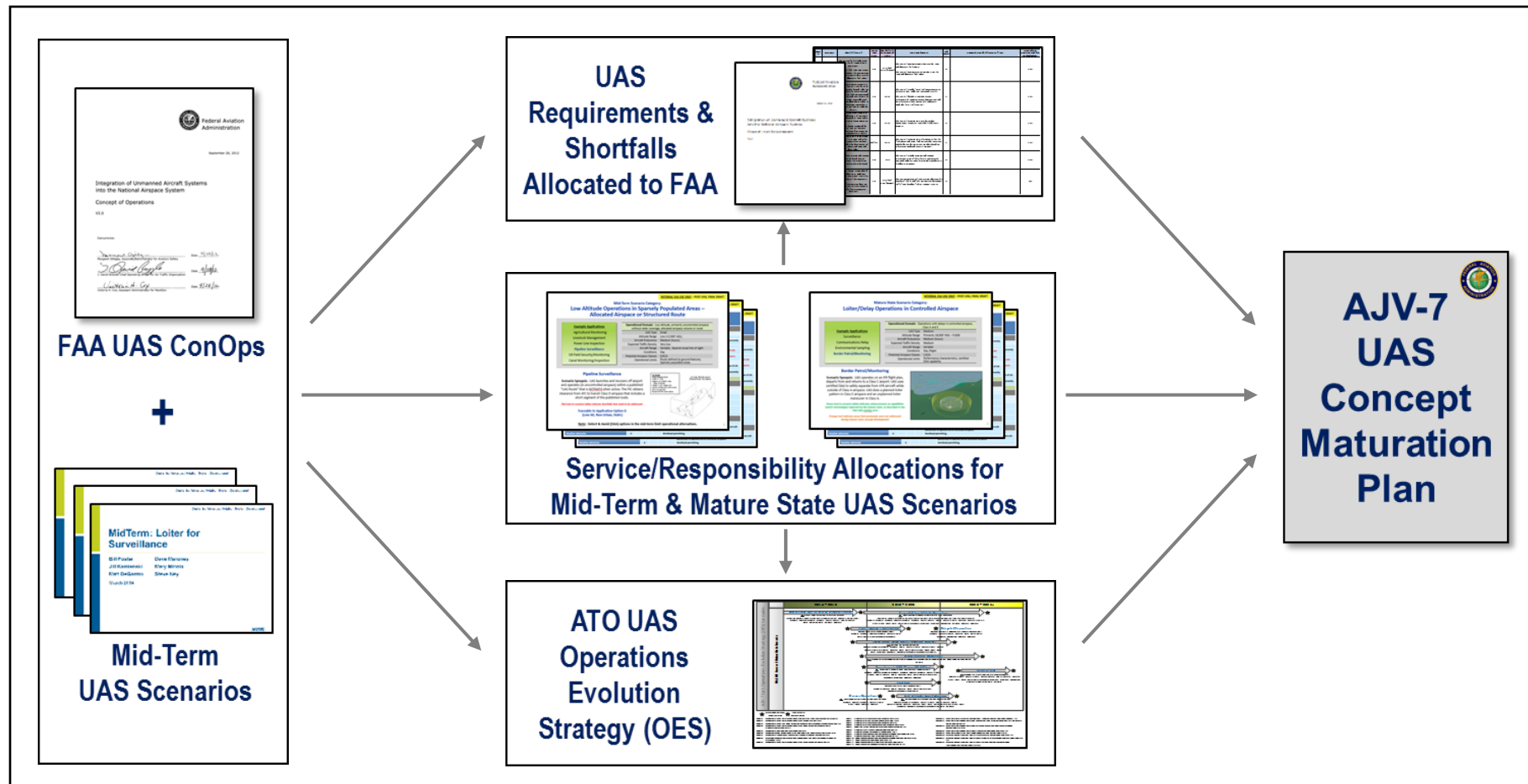
- Program will evaluate maximizing mid-term access while addressing future integration of UAS into the NAS.



- Program will conduct the necessary concept engineering, requirements development, investment analysis, and business case artifacts to introduce NAS changes needed to support UAS operations.

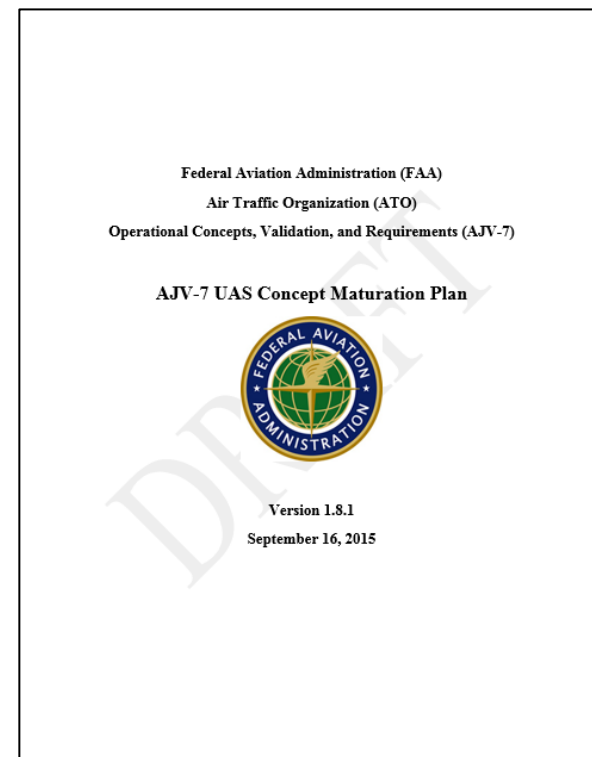


# From Concepts to Operational Focus Areas



# UAS Concept Maturation Plan

- Provides an overview of concept maturation activities necessary to support UAS integration
- Focuses on activities that address existing *FAA shortfalls associated with the provision of air traffic services* to UAS airspace users in the mid-term and beyond
- Identifies/Documents/Proposes questions to be addressed through concept exploration, development, and validation efforts
  - In some cases AJV-7 will assume a *leadership role* with accountability and responsibility for directing and executing the concept maturation activities
  - In other cases, AJV-7 will assume a *support and consultation role* and provide expertise to other FAA offices that will be responsible for specific concept maturation activities



# FY16-18 CM Activities (AJV-7 Lead)

Activity ID	Concept Maturation Activity	Associated Shortfall	Associated FAA Req(s)	Priority
R1.16	ATC Receipt and Display of Contingency Information	S1.16	1-120	High
R2.2	Radar Detection, Differentiation, and Tracking of Non-Cooperative UAS with Small Radar Cross Sections	S2.2	TBD	High
R4.8	Impact of Proposed Control Link and Communications Latency Thresholds on ATC	S4.8	1-51, 1-70	High
R1.19	Impact of Communications Latency Exceeding Acceptable Thresholds on ATC	S1.19	1-108	High
R1.15.1	Thresholds for Lost Link Duration	S1.15.1	1-65	High
R1.10	Impact of UAS Performance Limitations in the Terminal Domain	S1.10	1-133	High
R4.6	Incorporating UAS Type Designations and Performance Characteristics into ATC Automation	S4.6	1-129	High
R4.2	Trajectory Modeling of Unique (Planned and Unplanned) UAS Flight Profiles	S4.2	1-7, 1-91	High
R4.3	Conflict Detection and Resolution for Unique UAS Flight Profiles	S4.3	1-92	High
R4.12	UAS Flight Data for Flight Object	S4.12	1-68	High
R4.1.1	Increasing Flight Plan Route Elements and Characters	S4.1.1	1-89, 1-102	High
R5.12	ATC Interaction with Airborne DAA	S5.12	1-111	High
R1.5	Impact of Long Duration UAS Operations on ATC	S1.5	1-96	Medium
R4.1.3	Flight Planning Capabilities for Long Duration Flights	S4.1.3	1-6, 1-93	Medium
R4.1.4	Flight Plan Feedback for UAS	S4.1.4	1-8, 1-78	Medium
R4.1.6	Incorporating UAS 4D Trajectory Data into Flight Plans	S4.1.6	1-97	Medium
R4.1.5	Processing Flight Plans with Fixes in Latitude/Longitude Format	S4.1.5	1-132	Low
R4.4	Incorporating Operational Priority Assignments into ATC/TFM Automation	S4.4	1-44, 1-123	Low
R4.9	Data Communications for UAS	S4.9	1-42	Low
R4.5	Automation Support for Demand and Capacity Balancing	S4.5	1-134	Low
R4.11	Lost Link Beacon Code	S4.11	1-114	N/A (Being Addressed)
R4.1.2	Identifying UAS Type Designations and Performance Characteristics	S4.1.2	1-80, 1-105	N/A (Being Addressed)



# FY16-18 CM Activities (AJV-7 Support)

Activity ID	Concept Maturation Activity	Associated Shortfall	Associated FAA Req(s)	Priority
R1.1.1	Notification of UAS Operations when a Flight Plan is Not Required	S1.1.1	1-130	High
R1.1.2	Flight Planning and Flight Rules when an IFR Flight Plan is Not Required	S1.1.2	1-113, 1-117	High
R1.14	Conditions Under Which Lost Link Constitutes an Emergency	S1.14	1-127	High
R1.13	ATC Procedures and Phraseology for Lost Link and Flight Termination Events	S1.13	1-124, 1-125, 1-126	High
R1.20	Segregation Alternatives for BVLOS UAS Operations in Controlled and Uncontrolled Airspace	S1.20	1-131	High
R1.6	ATC Procedures and Phraseology for Unique UAS Flight Profiles	S1.6	1-106	High
R1.4	Collection and Distribution of UAS Mission-Related Information	S1.4	1-107	High
R1.18	ATC Procedures for Lost Communications Events	S1.18	1-119	High
R5.8	Alternatives to Visual-Based Separation and Navigation	S5.8	1-61	High
R1.9.1	Concept for Delegated Separation	S1.9.1	1-10, 1-116	High
R1.17	ATC Procedures for Loss of DAA	S1.17	1-37	Medium
R1.12	FAA Guidelines for UAS Operator Contingency Responses (Plans)	S1.12	1-53	Medium
R1.9.2	ATC Procedures and Phraseology for Delegated Separation	S1.9.2	1-112	Medium
R1.3	Operational Priority for UAS Flights or Flight Segments	S1.3	1-9, 1-62	Low
R5.4	Proposed Control Link Latency Thresholds	S5.4	1-51	N/A (Being Addressed)
R5.5	Proposed Communications Latency Thresholds	S5.5	1-70	N/A (Being Addressed)
R1.15.2	Acceptable DAA Maneuvers During Lost Link Events	S1.15.2	1-115	N/A (Being Addressed)
R5.6	Quantitative Values for DAA Self-Separation and Collision Avoidance Functions	S5.6	1-60, 1-109	N/A (Being Addressed)



# FY16 Planned Activities

- **ATC Receipt and Display of Contingency Information [When an IFR Flight Plan is Filed]** – Identify contingency information and display requirements for terminal and en route automation systems when filing an IFR flight plan is required. Conduct interface alternatives analyses to establish the best mechanisms for delivering and displaying contingency information to ATC/ATM.
- **ATC Receipt and Display of Contingency Information [When a Notification is Submitted]** – Develop the concept, operational scenarios, and operational and information requirements for UAS contingency management when a notification is submitted (in lieu of an IFR flight plan). Determine applicability and suitability of the interface alternatives analyses results for the notification concept.



# FY16 Planned Activities (cont)

- **Recommendations for ATC Notification for Model Aircraft Operations** – Assess whether an alternative mechanism (in lieu of a phone call) is required for model aircraft operators to notify ATC prior to operating near airports given the predicted surge in model aircraft operations. If a need exists, determine viable mechanisms (interim and longer-term solutions) by which model aircraft operators may notify ATC prior to operating near airports.
- **Risk Assessment – Radar Detection, Differentiation, and Tracking Capability of Non-Cooperative UAS with Small Radar Cross Sections** – Assess the risk—associated with primary radar not detecting and identifying reduced radar cross section (RCS) aircraft, such as UAS, operating in terminal airspace.





## FY16 Planned Activities (cont)

- **Stakeholder Outreach** – Conduct outreach and messaging of concept maturation products to appropriate internal and external stakeholders, and update the products as necessary.
- **Scenario Impact Analysis and Human-in-the-Loop Demonstrations of Low-Altitude UAS Operating Concepts** – Explore and quantify the operational impacts of low-altitude mid-term UAS operational scenarios (and the concepts on which they are based) on the NAS and its operators in a fast-time modeling activity and a series of human-in-the-loop (HITL) demonstrations.



# FY17 Planned Activities

- Validation of UAS Contingency Work Human-in-the-Loop Simulations
  - ATC Receipt and Display of Contingency Information
  - Thresholds for Lost Link Duration
  - Conditions Under Which Lost Link Constitutes an Emergency
  - ATC Procedures and Phraseology for Lost Link and Flight Termination Events
- Communications Latency Operational Impact Analysis
  - Impact of Proposed Control Link and Communications Latency Thresholds on ATC
  - Impact of Communications Latency Exceeding Acceptable Thresholds on ATC
- Impact of UAS Performance Limitations
  - Impact of UAS Performance Limitations in the Terminal Domain
- Unique UAS Flight Profiles
  - Trajectory Modeling of Unique (Planned and Unplanned) UAS Flight Profiles
  - Conflict Detection and Resolution for Unique UAS Flight Profiles
  - ATC Procedures and Phraseology for Unique UAS Flight Profiles
- Stakeholder Outreach
- Scenario Vetting with CPCs
- Scenario Impact Analysis and Human-in-the-Loop Demonstrations (cont.)
- Update and Vetting of UAS Operational Requirements Database



# Multi Year Plan

FY16

FY17

FY18

FY19

FY20

FY21

FY22

- Stakeholder Outreach
- Scenario Impact Analysis and HITL Demonstrations
- CM Priorities - to support flight planning/notification—primarily for low-altitude VLOS and BVLOS UAS operations—while also addressing lost link and other contingency-related needs to support all types of BVLOS UAS operations

- AMS Artifact Development for CRDRD

- AMS Artifact Development for IARD

- Stakeholder Outreach
- UAS Scenario Vetting with CPCs
- Scenario Impact Analysis and HITL Demonstrations (cont.)
- Update and Vetting of Operational Requirements
- CM Priorities - validating the results of FY16 contingency-related work, as well as addressing ATC-PIC communication-related needs required to support most UAS operations in controlled airspace, procedures and automation enhancements to support unique UAS flight profiles and performance limitations, as well as other actions required to support operations in the mid-term timeframe

- AMS Artifact Development for IID

- AMS Artifact Development for FID

- Update of UAS CM Products, Shortfalls, and Requirements
- CM Priorities - required to support mature state UAS operations, such as addressing ATC interaction with airborne DAA, and incorporating UAS 4D trajectory data into flight plans
- Finalization of UAS requirements



# Example of Mature State UAS Operations

<<Imbedded Video>>

