AAM National Campaign Developmental Testing (NC-DT) Virtual Dry Run

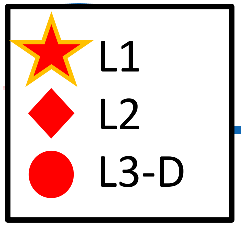
June 29, 2021

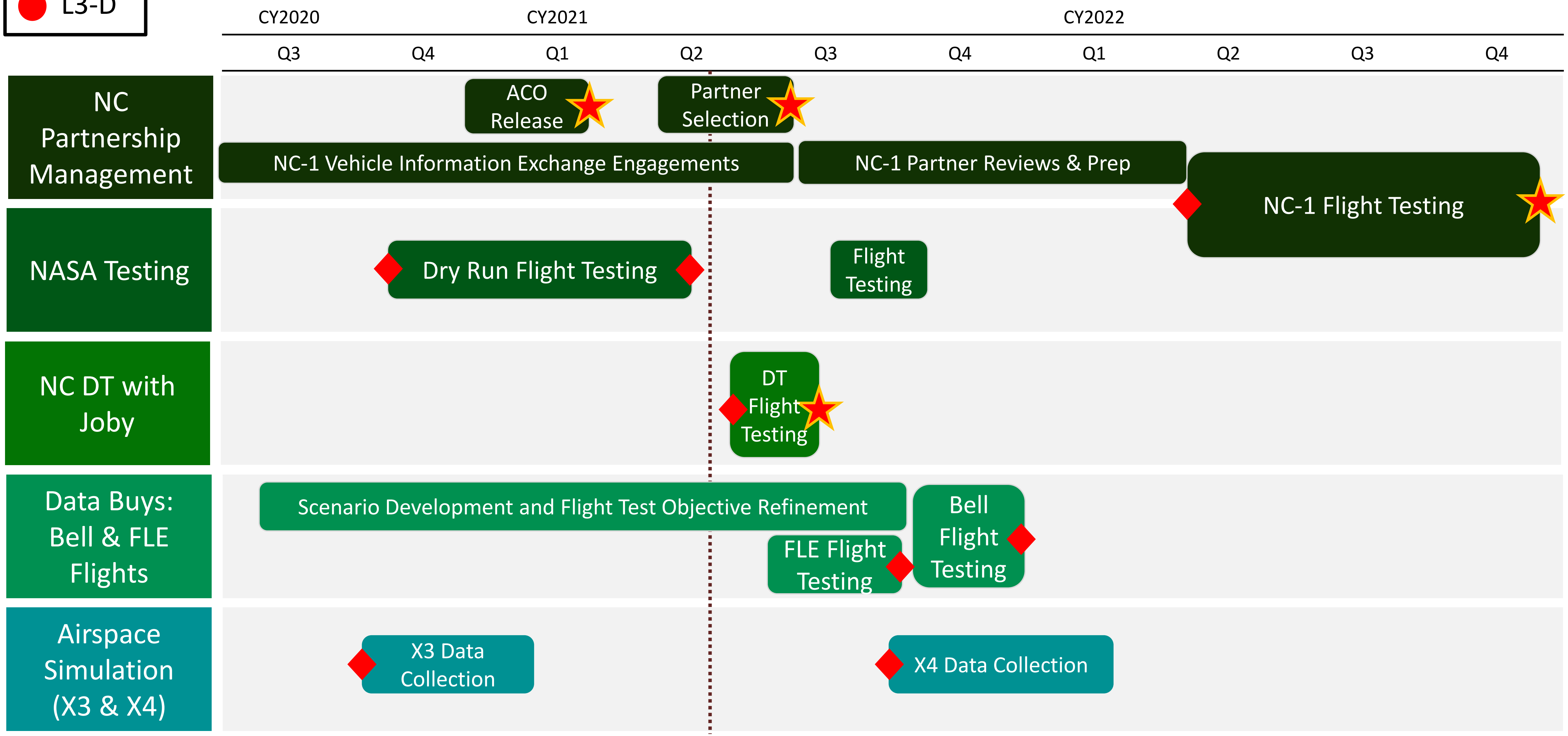
Crosscutting Working Group: AAM NC-DT Virtual Dry Run - Agenda

June 29, 2021		
TIME (PT)	**TOPIC**	**PRESENTER**
11:00AM – 11:15AM	NC Developmental Test Objectives	**Starr Ginn** National Campaign Lead
11:15AM – 11:30AM	NC Dry Run Overview	**Jeff Leigh** National Campaign Chief Engineer
11:30AM – 11:50AM	Pre-recorded Live Feed with Narration	**Starr Ginn** National Campaign Lead **David Zahn** National Campaign Airspace PI **Rick Simmons** Rotorcraft Test Pilot
11:50AM – 12:00PM	Airspace Procedure Overview During Pre-recorded Live Feed	**David Zahn** National Campaign Airspace PI
Q&A (20 minutes)		
12:20PM – 12:35PM	NC Flight Test Infrastructure Overview	**Shivanjli Sharma** National Campaign Deputy Lead
12:35PM – 12:50PM	Airspace Core Services for UAM	**Spencer Monheim** ATM-X UAM Tech Lead
Q&A (10 minutes)		
1:00PM – 1:20PM	Flight Test Plan Overview	**Dave Webber** FAA Vehicle PI
1:20PM – 1:35PM	Data Products and Process with FAA	**Bryan Brown/Sarah Eggum** FAA Data Coordinator **Mohana Gurram** NASA Data Manager
Q&A (20 minutes)		
1:55PM – 2:00PM	Closing	**Starr Ginn** National Campaign Lead

** This agenda may be subject to modification.*

NC Execution in FY21 – NC Developmental Test





NC-1 Objectives UML ½ and FAA Pillars Alignment

Accelerate Certification and Approval: *Develop and assess an integrated approach to vehicle certification, pilot licensing, and operational approval.*

Aircraft | Operations | Infrastructure

Develop Flight Procedure Guidelines: *Develop preliminary guidelines for flight procedures and related airspace design criteria.*

Aircraft | Airspace | Infrastructure | Operations

Evaluate the Communication, Navigation, and Surveillance (CNS) Trade Space: *Explore and evaluate CNS requirements, options, and trade-offs.*

Aircraft | Operations | Infrastructure

Demonstrate an Airspace Management Architecture: *Demonstrate and document an airspace system architecture capable of safely managing scalable AAM operations without burdening the current air traffic management system.*

Airspace | Operations

Identify Community Integration Needs: Conduct initial characterization of the community noise of AAM vehicles through measurements of vehicle ground noise.

Aircraft | Community

NC Developmental Test Objectives

NC-DT Goal: Ensure that NASA is fully prepared to execute NC-1 event in a manner maximizing benefits to the AAM community

DTO-1: Assess Maturity and Robustness of NASA Proving Ground

Full Success: Collect data to support analysis of the flight test and simulation infrastructure for Scenarios 1-4.

DTO-2: Assess Effectiveness of NC Testing Processes, Logistics, and Data Collection

Full Success: Guide one partner organization through technology readiness, test readiness, flight and simulation execution, and data collection processes.

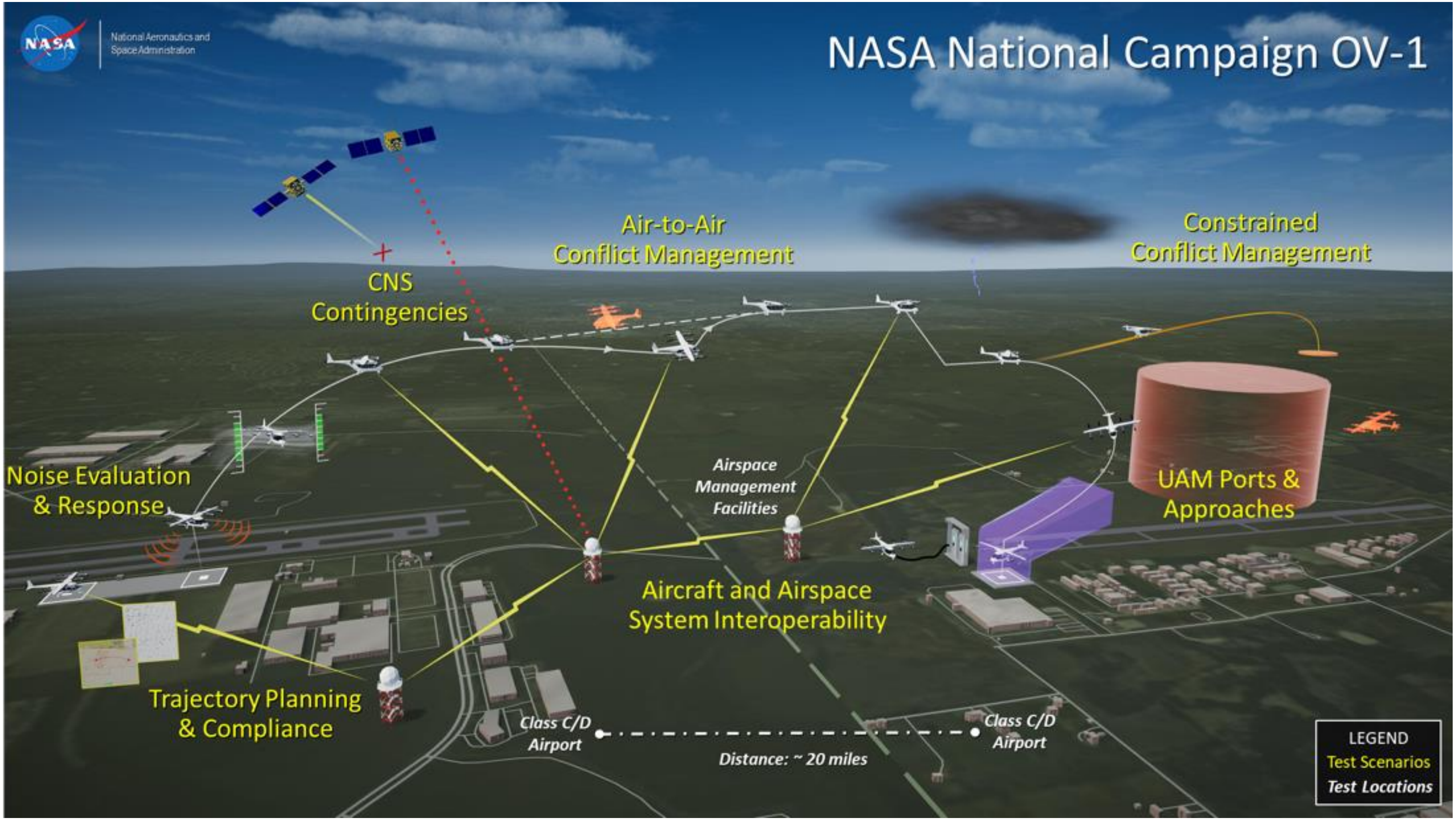
DTO-3: Preliminary Assessment of Partner Capabilities and Systems Performance

Full Success: Conduct flight test and simulation for at least one partner aircraft/airspace system to collect vehicle, airspace, and connectivity/communication performance data against the requirements for Scenarios 1-4.

DTO-4: Assess the Suitability of NC-1 Scenarios

Full Success: Assess the applicability of the scenarios through the execution of at least three of the NC-1 scenarios with at least one vehicle and one airspace partner.

National Campaign OV-1



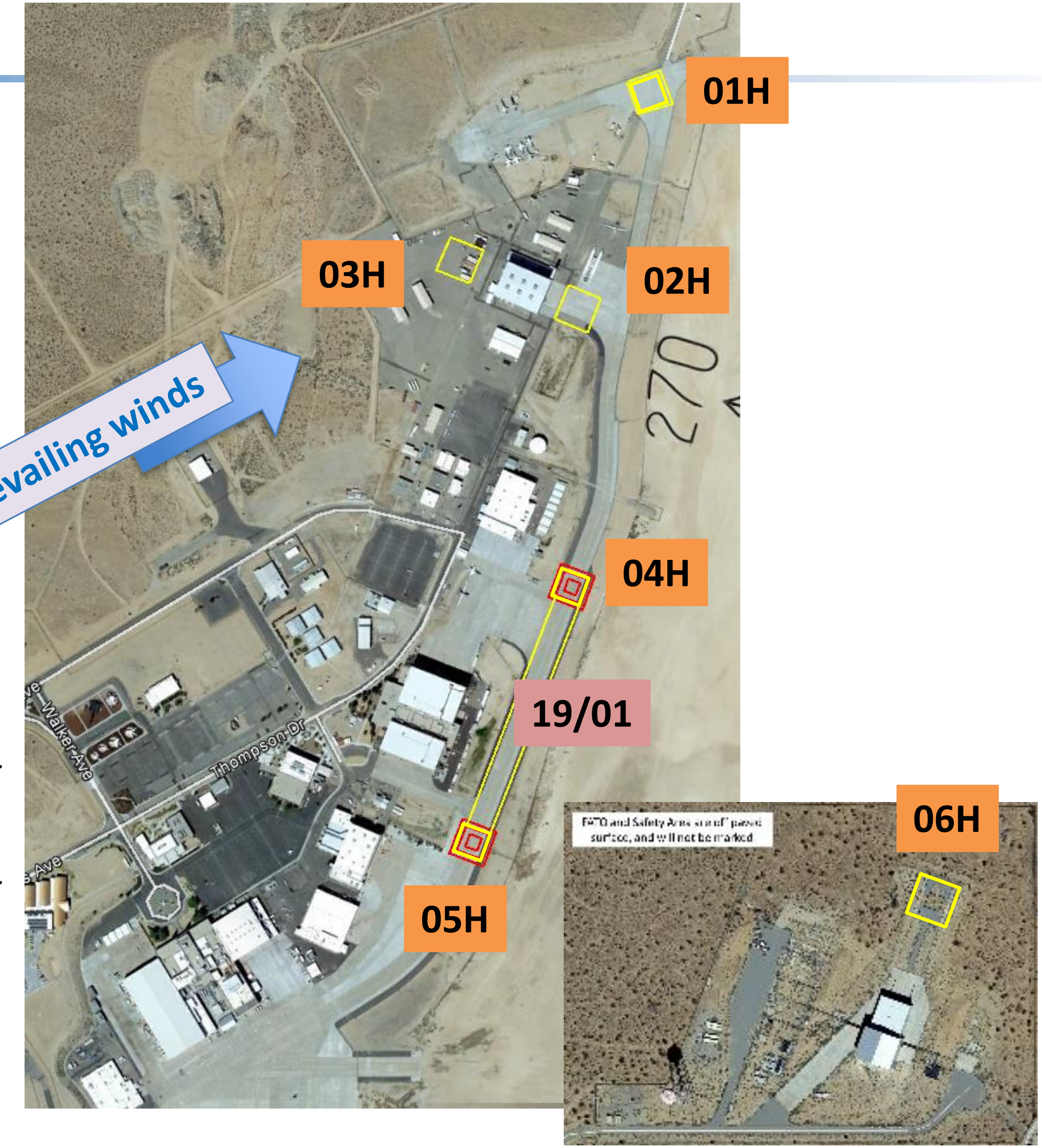
AAM NC Terminal Ops

6 AAM NC *"UAM Heliports"*

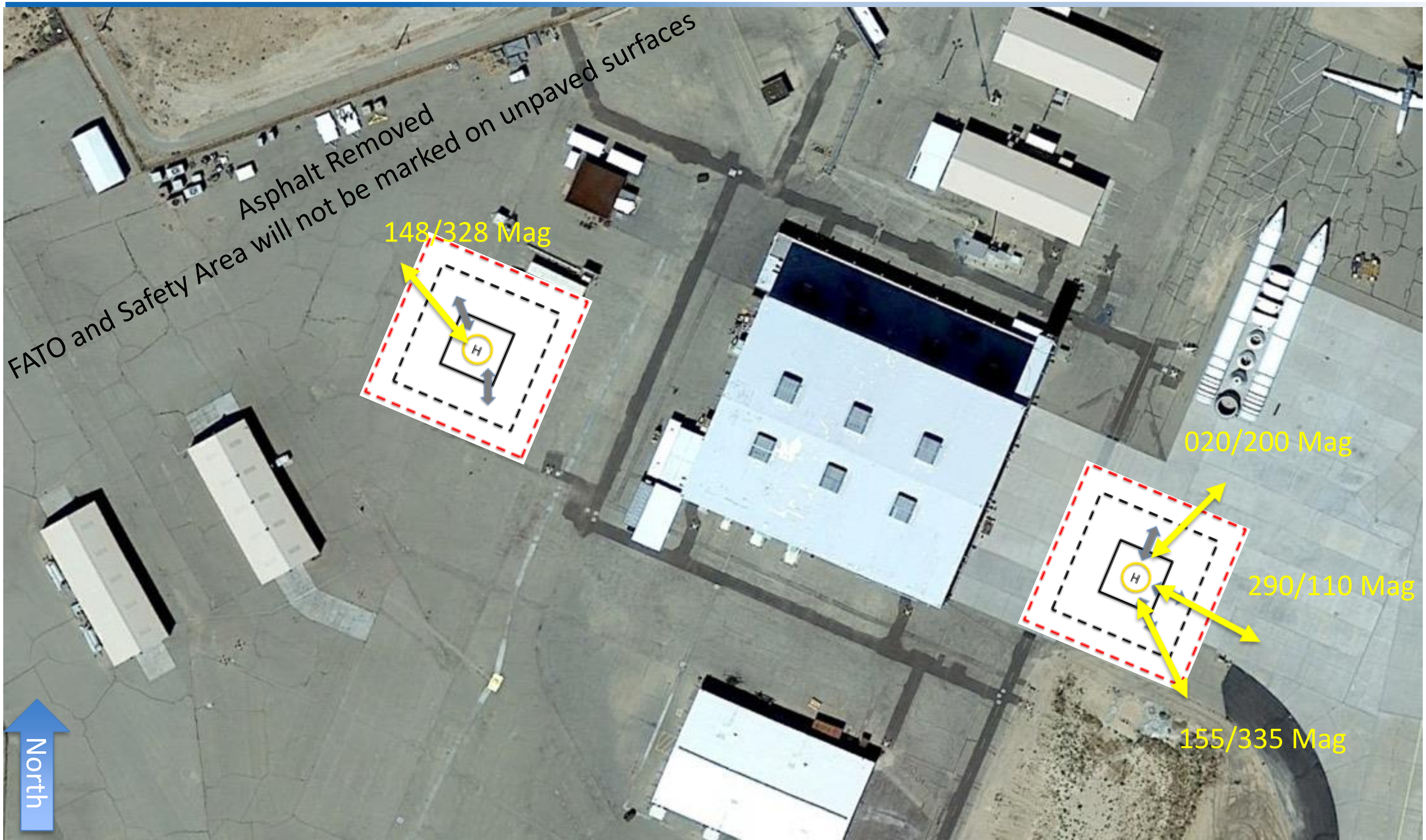
- 40x40ft TLOF
- Northern Heliports suitable for wind/controllability studies
- All Heliport design/placement IAW AC 150/ 5390-2C Heliport Design

1 AAM NC *"UAM Vertiport"*

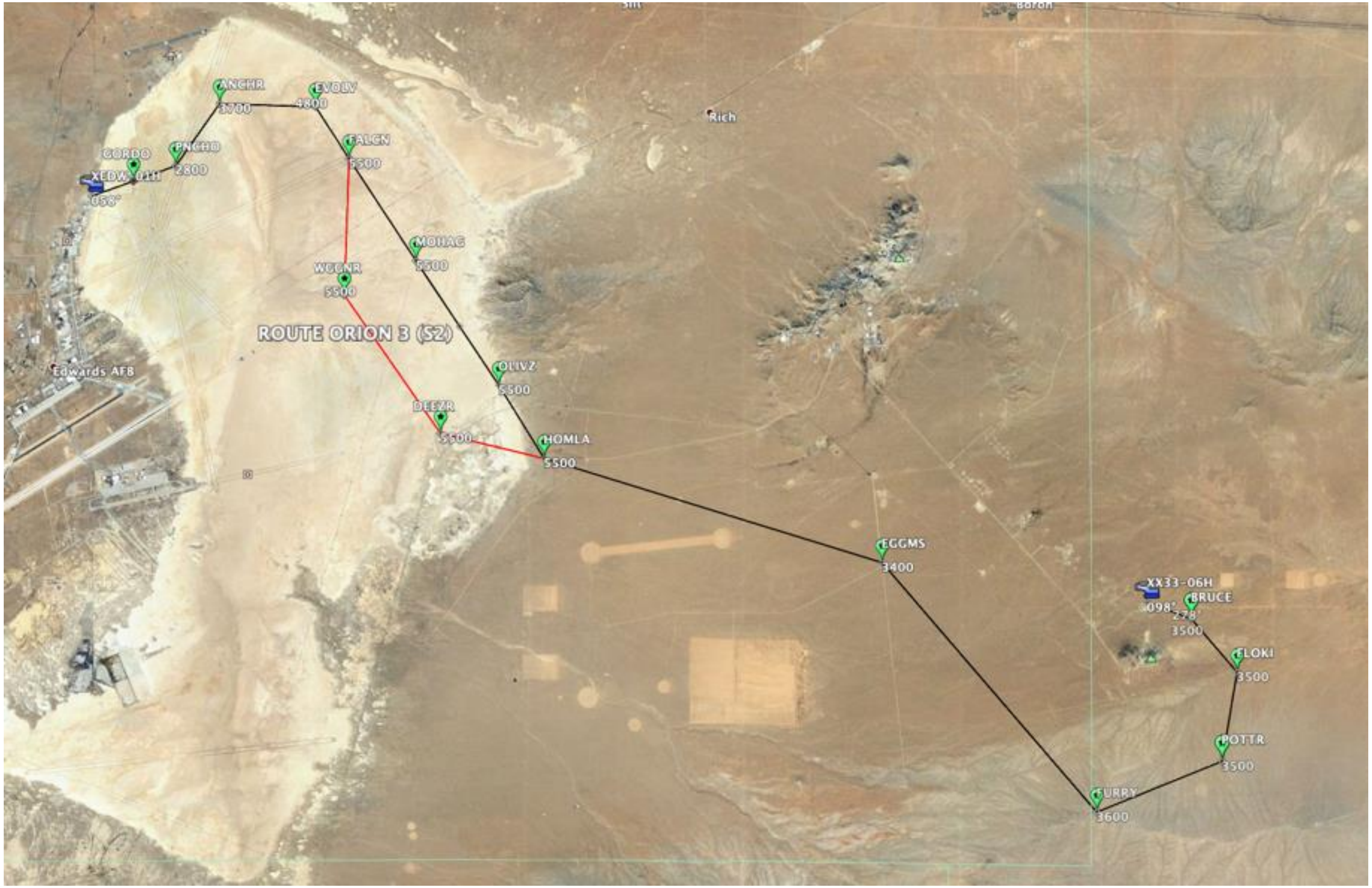
- 1090ft length x 120ft width TLOF/FATO
- 01H + 02H + 03H = XEDW *Research Airport*
- 04H + 05H + 19/01 = XVPT *Research Airport*
- 06H = XX33 *Research Airport*



4833 Helipads



ORION 3 Scenario 2 In-flight Re-route



Dance Card

Video Playback

UNCLASSIFIED

Aircraft:	Serial No:	Flight No:	Date:	Revision:	Card No.
OH-58C –	N173FR			Fri 3/12, R1	HA1
Event: NC Build 2 Flights, March 2021					

SEQ	CARD	COMMENT	LOCATION
		Calm Wind, Crit Az Veh Char (Winds <3 kts)	
1	ST1, U1	Startup, Takeoff	04H
2	C1	Hover IGE	NB
3	C2	Hover OGE	NB
4	C10.1	Crit Az, 090	NB
5	C10.2	Crit Az, 135	NB
6	C10.3	Crit Az, 180	NB
7	C10.4	Crit Az, 215	NB
8	C10.5	Crit Az, 270	NB
9	C16	Cntl Resp, Heave	01H
10	C17	Long Cntl Resp	01H
11	C20.1	Long Dyn Stab, Short	01H
12	C21	Cntl Resp, Yaw	01H
13	U20	Dynamic Interface	03H/02H
14	U6	Pirouette (C10 is prereq)	01H
15	SH1	Landing/Shutdown	
		NB, 01H, 02H, 03H, 04H, 05H	

Live Flight

UNCLASSIFIED

Aircraft:	Serial No:	Flight No:	Date:	Revision:	Card No.
OH-58C –	N173FR			Sat 3/13, R1	HA2
Event: NC Build 2 Flights, March 2021					

SEQ	CARD	COMMENT	LOCATION
		Deck: Scenarios	
1	ST1,U1	Startup, Takeoff	
2	R12	S2 - Orion 3 F A	
3	R15	S3A - Atlantis F	
4	R7	S1 - Mercury 1 F	
5	R19	S3C - Ulysses 1	
6	R26	OTR - Ulysses 2 R (2H)	
7	R17	S3B - Gemini 1 F	
8	SH1	Landing/Shutdown	
9	U8	HP App Char, Const Speed	
10	U9	VP App Char	
11	U20	Dynamic Interface	
		Approaches Used:	

JEFF LEIGH

National Campaign Chief Engineer

Key activities to support Dry Run and DT Flight Objectives

- A series of Performance, Trim, Stability, and Control flight test maneuvers intended to support or validate vehicle flight manual performance, operating characteristics, or operational limitations (Vehicle Characteristics) *these classical, proven, test techniques provide data that support compliance findings against current FAA minimum requirements for vertical flight aircraft dependent on the operational use case*
- A set of ground and flight tasks that represent the “building blocks” that make up a UAM mission, including simulated IMC approaches to defined “UAM Heliports” and “UAM Vertiports” in controlled, but varied, conditions (UAM Task Elements) *these “developmental” test techniques are intended to support FAA civil certification compliance findings for UAM aircraft that utilize highly-augmented flight control systems and/or “simplified vehicle operations.” NASA is a key collaborative partner with FAA for development of these so-called “Mission Task Elements.”*
- Flyability evaluations of research UAM approaches, departures, and enroute procedures utilizing an FAA evaluation application which operates independently from the flight vehicles’ avionics (Approach, Departure, Route Flight Checks)
- Flights that are specifically designed to simulate a “real world” urban air taxi mission including pre-flight planning, ground operations, flight operations, air traffic management and contingencies expected in the UAM mission. (Scenarios Testing).

Build 2 Purpose and Scope

- Purpose
  - Facilitate the development of the data collection systems and mobile range infrastructure required for NC-1;
  - Refine the NC Scenarios, test techniques, and safety assurance processes; and
  - Capture foundational vehicle and operational data to support evolutions in vehicle, infrastructure, and airspace requirements that will enable the advent of UAM in the National Airspace System (NAS).
- Scope
  - Approximately 25 hours of flight activity using a helicopter within the Dry Run Flight Test Infrastructure
  - Meet Flight Test Plan (FTP) objectives
  - Build on the lessons learned during December’s Fam Flights.
  - Integrate and test additional infrastructure systems to include PLASI, differential GPS, and additional helipads at building 4833 and X-33

Key activities to support Dry Run and DT Flight Objectives

Being the first set of flight tests that support the greater AAM National Campaign (NC) project, the tests contained herein also support the following objectives:

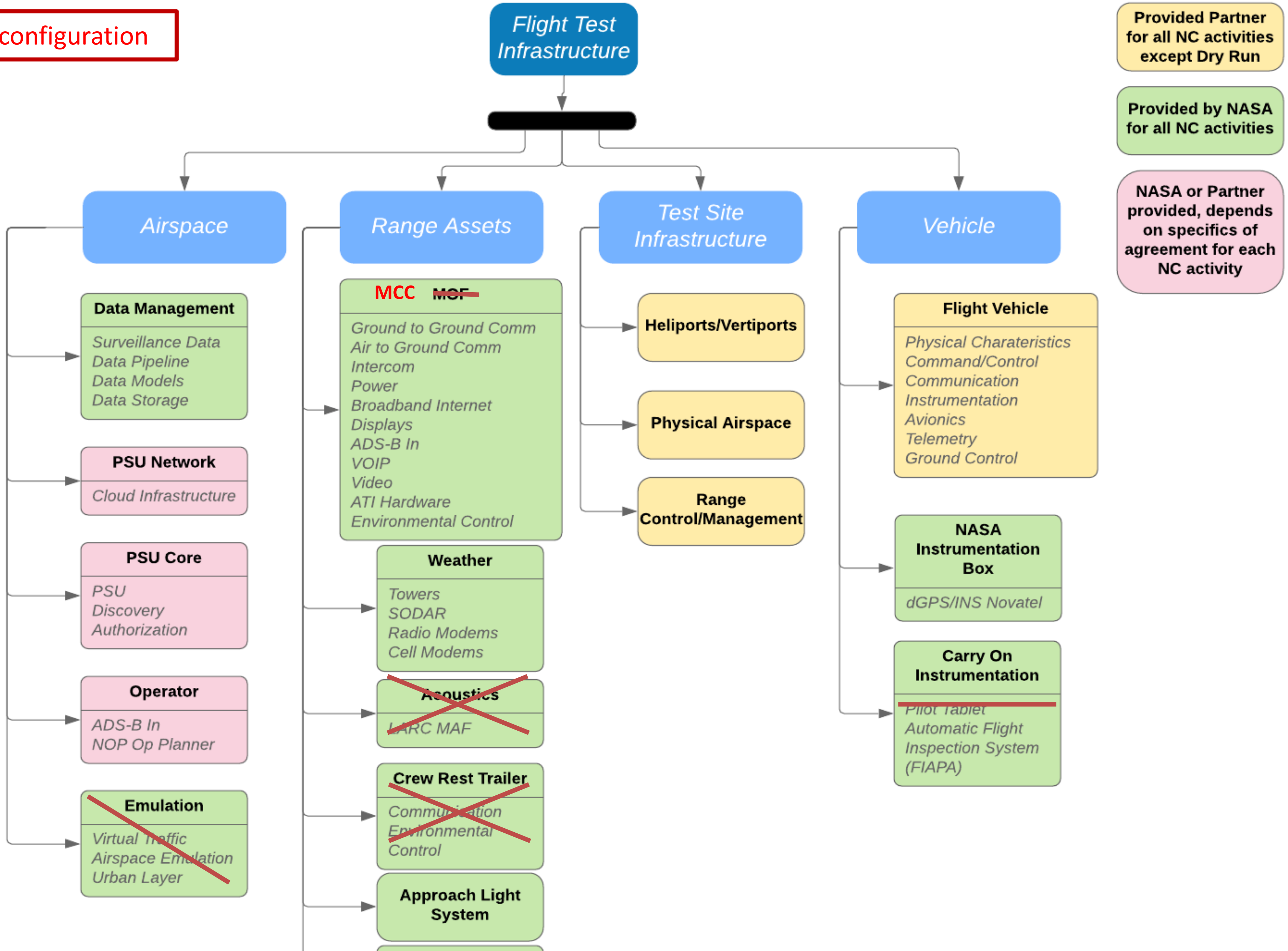
- Provide airborne data to support air traffic management research
- Validate a representative UAM test range construct
- Capture baseline Infrastructure/Terminal environment data
- Determine suitability of current aeronautical procedure development and recommend changes for future AAM/UAM development.
- Determine suitability of current ARINC 424 coding requirements in support of AAM/UAM.
- Look at FAA Flight Inspection Approach Procedures that could be appropriate for UAM operations
- Validate/refine Airspace assumptions for UAM
- Validate GSE design, test site design, and GSE layout
- Exercise the NASA Airworthiness Process in order to prepare for subsequent UAM participant vehicles
- Collect time/space/position data and video data that will support communication of AAM goals, conclusions and concepts

Build 2 Flight Test Infrastructure Overview

Redlined differences to final configuration

Flight Crew

Paul Davidovich FRI Pilot
(Flight Research Inc)
Jon Jordan FAA Cert Pilot
Dave Webber FAA FTE
(Flight Test Engineer)
Jay Sandwell FAA FIAPA
(Flight Inspection Airborne Processor Application)

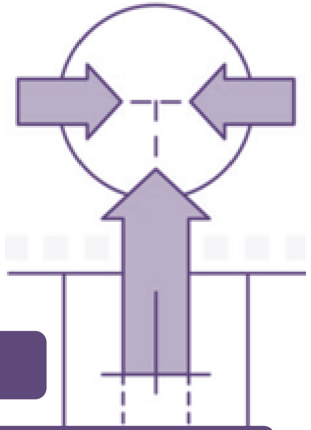


SHIVANJLI SHARMA

National Campaign Deputy Lead

National Campaign – Data and Information Exchange

Data Needs and Requirements

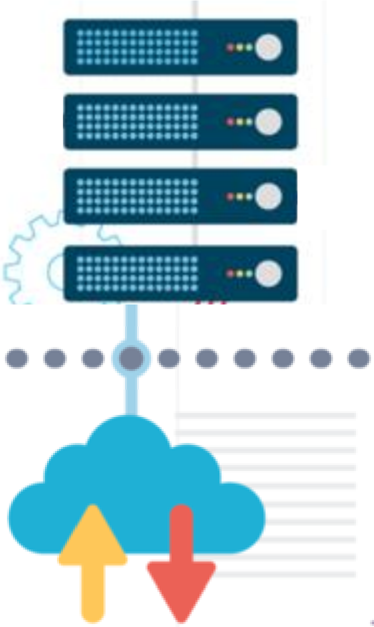


FAA

Industry Partners

NASA Research Projects

National Campaign Flight Test Infrastructure



National Campaign Operational Demos Data Collection & Analysis

MBSE Approach for CC

Gap Analysis for Current Standards

- **FAA** access to shared database and collaborative analysis to inform gaps in policy and standards
- Sharing key outcomes with **standards bodies**
- Using data to inform **NASA/FAA Working Groups** including development of concept of operations
- Leveraging **ULIs** to ensure consistent development with research institutions
- Community engagement through **AAM Ecosystem Working Groups**

Dry Run - Lessons Learned

Assessment of Flight Test Infrastructure

- Determined maturity and performance requirements of flight test infrastructure components
- Understood integration needs as well as power and connectivity requirements

Development of NC Flight Test Plan

- Established flight test points comprised of flight maneuvers and vehicle characteristics expected by UAM vehicles
- Providing Cooper Harper ratings on control margin with FAA Test Pilots and Flight Test Engineers
- Evaluating FAA Subpart B regulatory airworthiness standards

Development of Infrastructure and UAM Approach and Departure Procedures

- UAM approach and departure procedure design including iteration on angles and descent rates that incorporate vehicle dynamics as well as passenger ride quality
- Developed infrastructure requirements by establishing vertiport and heliport dimensions and markings

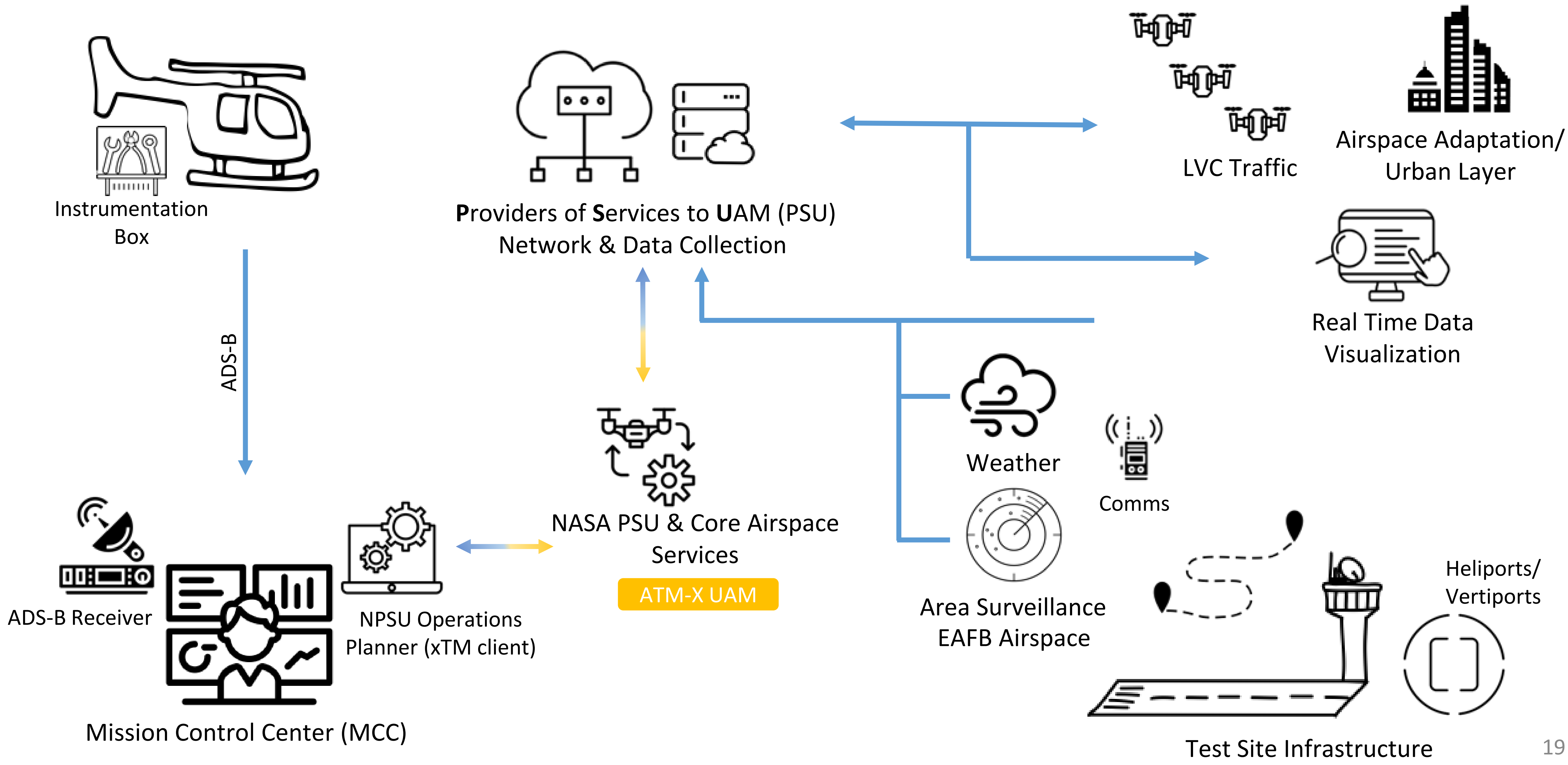
Assessed Data Collection Equipment and Procedures

- Exercised data collection systems including a differential GPS system, instrumentation on board the vehicle, as well as instrumentation provided by the FAA (FIAPA - Flight Inspection Airborne Processor Application)
- Developed data models, database schemas, and access controls to facilitate data analysis

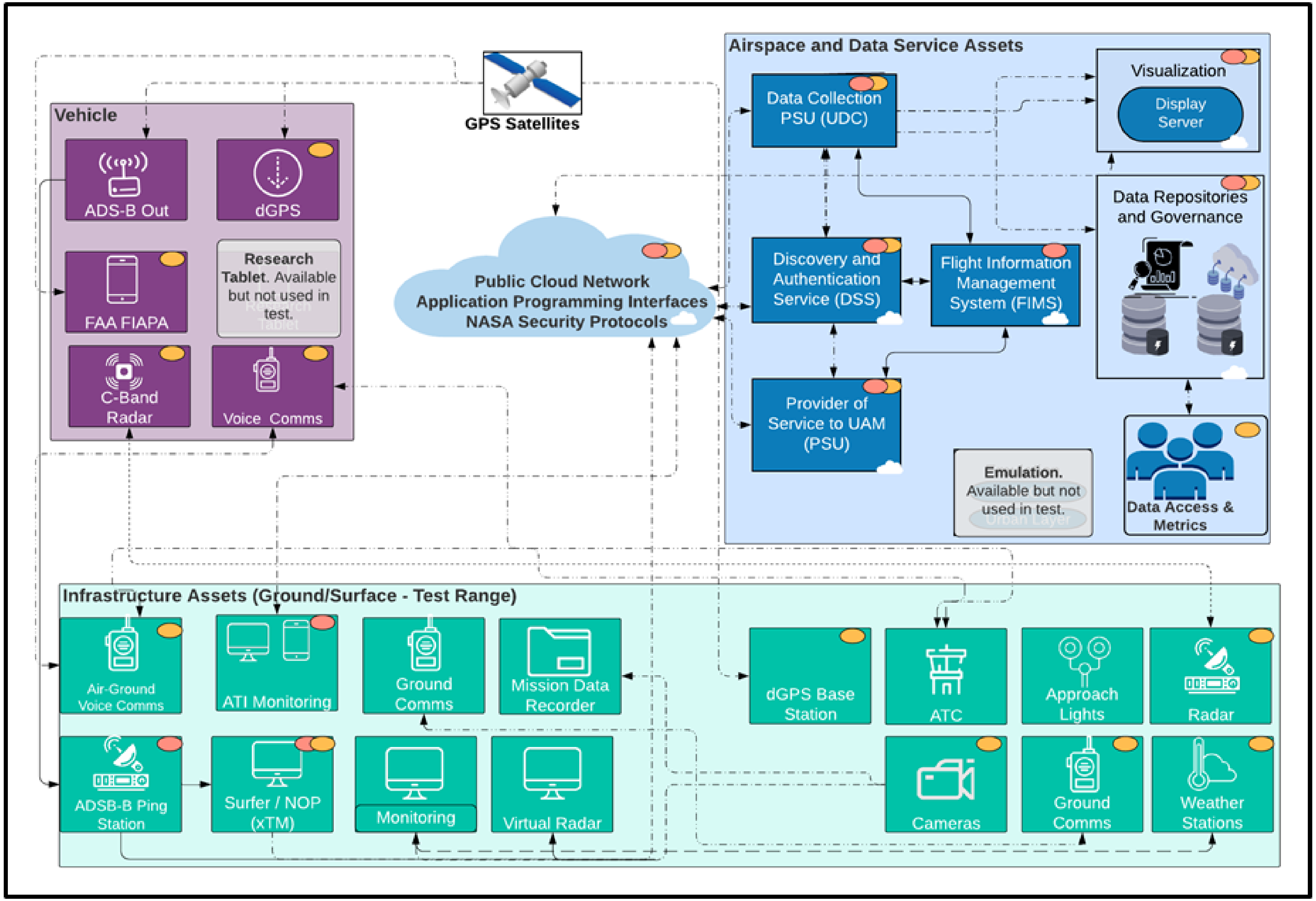
Assessment of Integrated Operations and Scenarios

- Simulated future UAM missions including pre-flight planning, ground operations, flight operations, and contingencies
- Real time ADS-B inputs to inform an airspace component (provided by ATM-X UAM) to represent a future third party airspace provider

NC Dry Run – Functional Architecture



Build 2 Flight Test Component Diagram



Legend

- Real-time test requirement
- Post-ops test requirement
- Both real-time and post-ops
- Cloud computing component

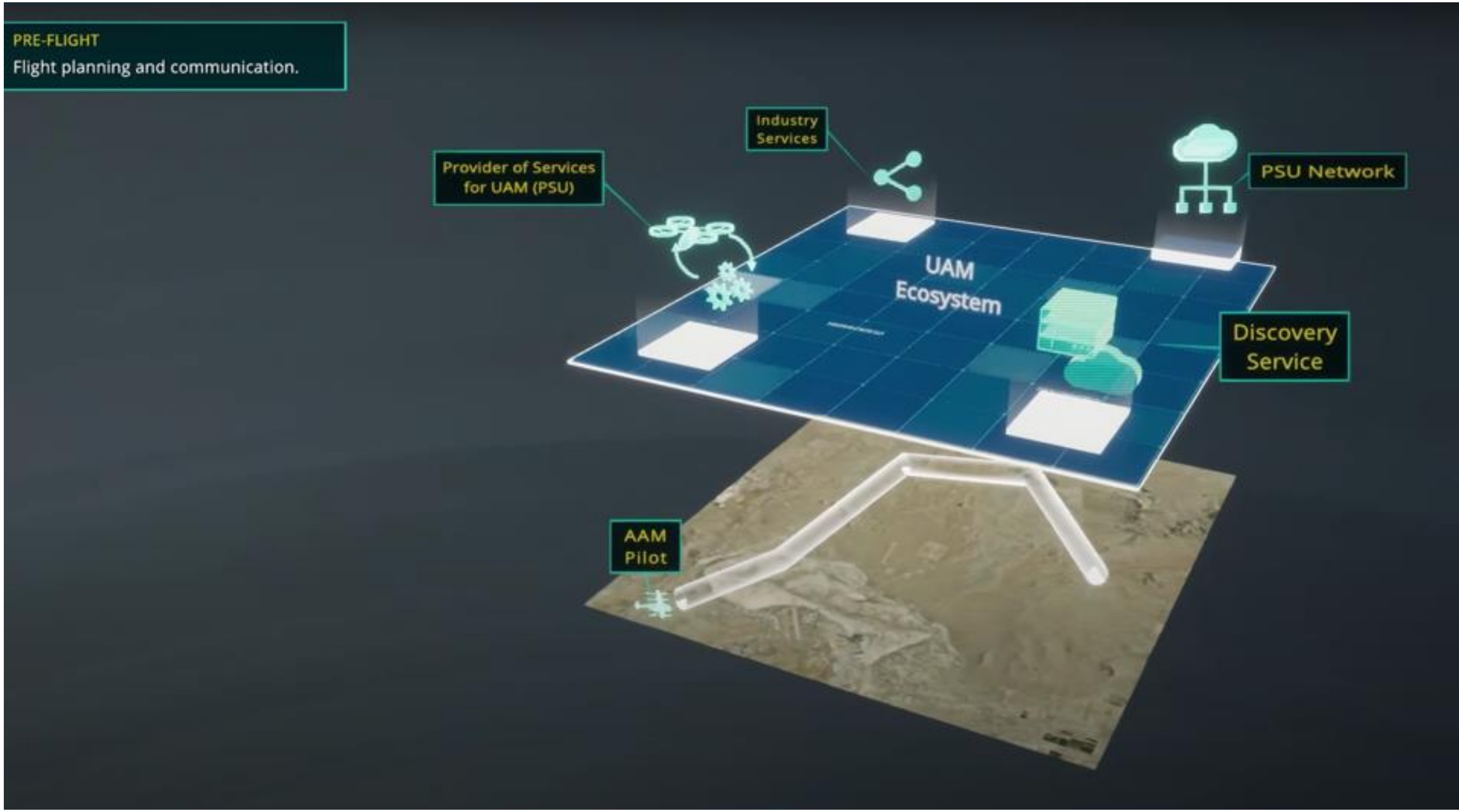
AIRSPACE COMPONENTS

Spencer Monheim

ATM-X UAM Sub-project Airspace Integration Testing & Demonstration Tech Lead

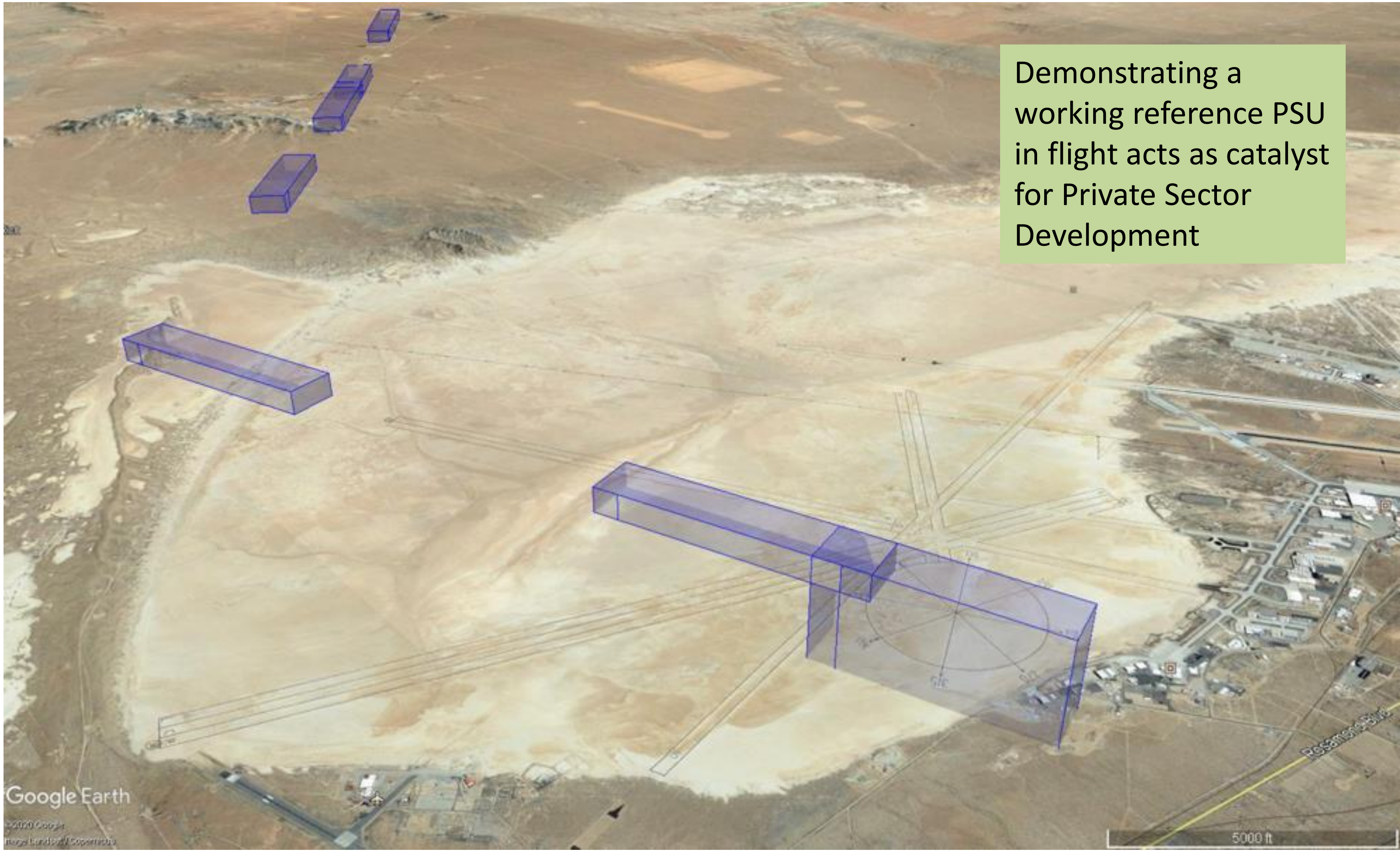
Airspace Components – UAM Subproject

- PSU – Provider of Services to UAM:
  - Communication Airspace Component between Operators
- Discovery – Informs a PSU of other PSUs operating in an airspace
- Authorization – ANSP-actor component, verifies the authenticity of a PSU/Operator



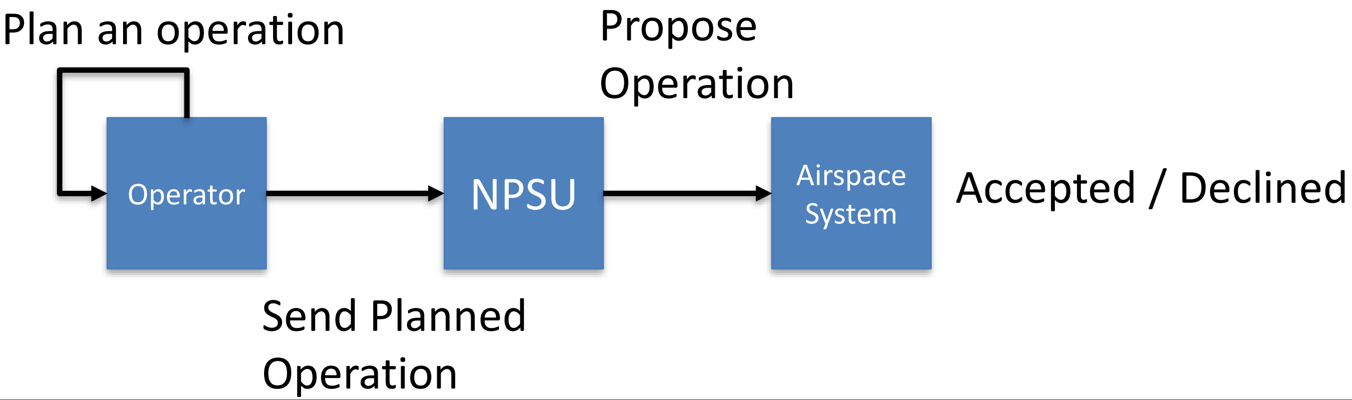
NPSU (NASA Provider of Services for UAM) High-Level Overview

- Communication standard was collaboratively developed and tested by Industry and Public Stakeholders
- Functionality of PSU is derived from FAA Conops

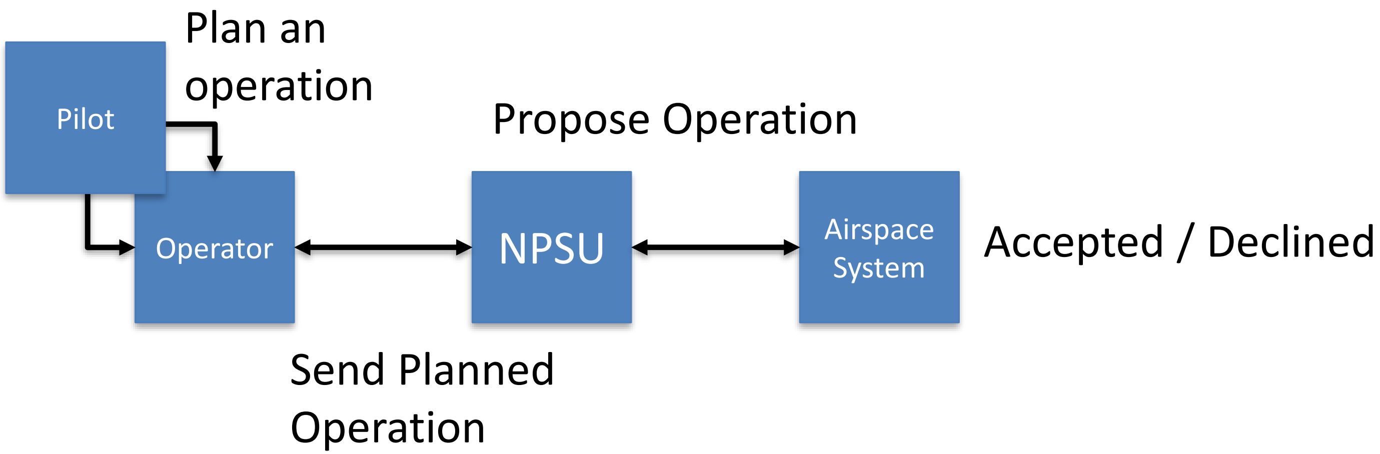


NPSU Operation Diagram Example (scenario 1)

Flight Demonstration provides opportunity to test data/information flow in a future UAM Airspace System



Propose Operation

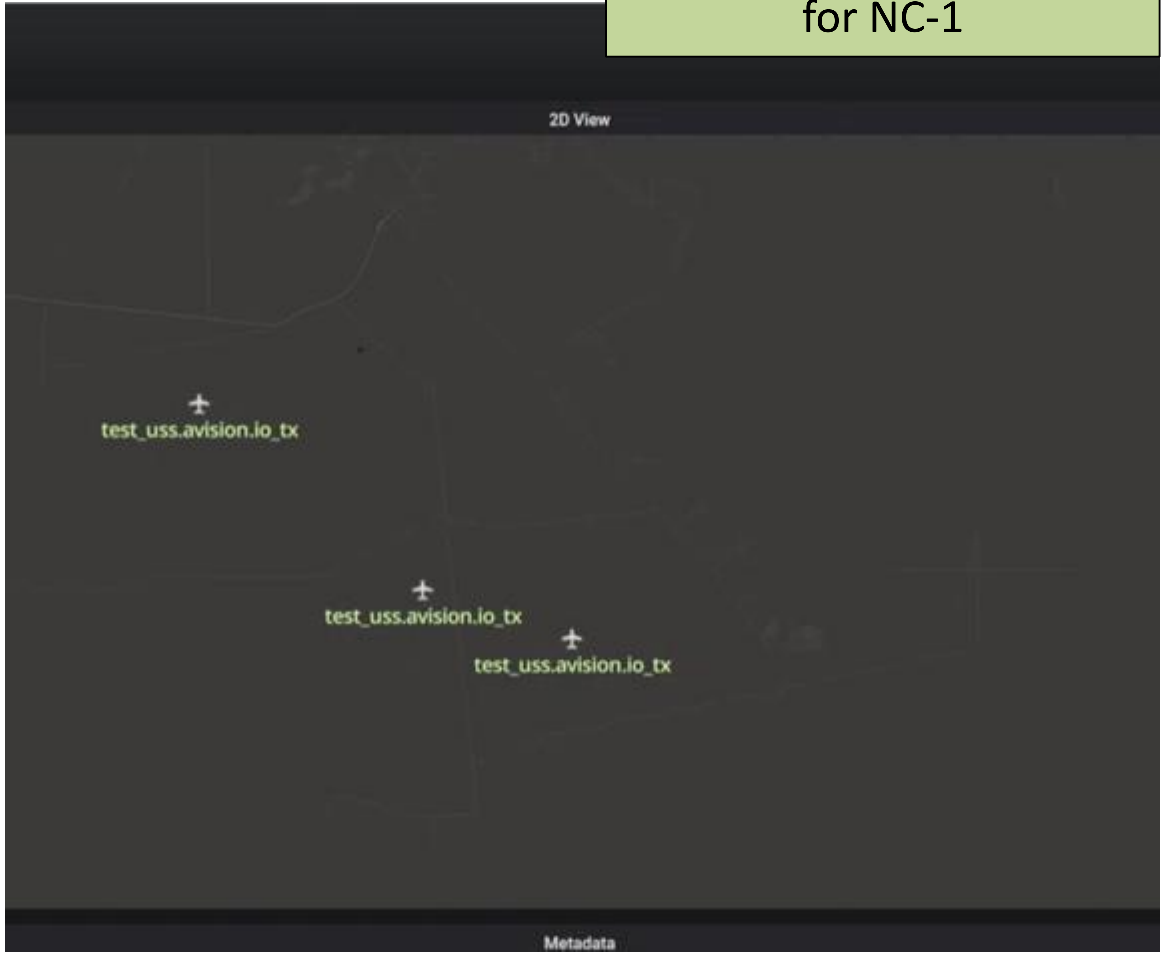


Future Information Flow

Next Steps

- X3 Simulation and NC Dry Run set foundation through executing operations in single operator baseline
- X4 Simulation increases complexity and interconnectivity through interactions between two simultaneous operators, one NASA operator and one Industry operator
- X4 Simulation enables testing concepts and software prior to flight test as preparation and risk reduction for NC-1

X3 – Foundation, prepare for Dry Run
X4 – Expand and Extend for NC-1



FLIGHT TEST PLAN OVERVIEW

Dave Webber

FAA Vehicle Cert Principal Investigator

The Urban Air Mobility (UAM) *mission*

Advanced Air Mobility (AAM) encompasses several nascent "operational use cases" in addition to innovative evolutions in existing aerial mobility/technologies

These new operational use cases need to be understood in order to develop appropriate regulatory (minimum airworthiness) requirements for vehicles

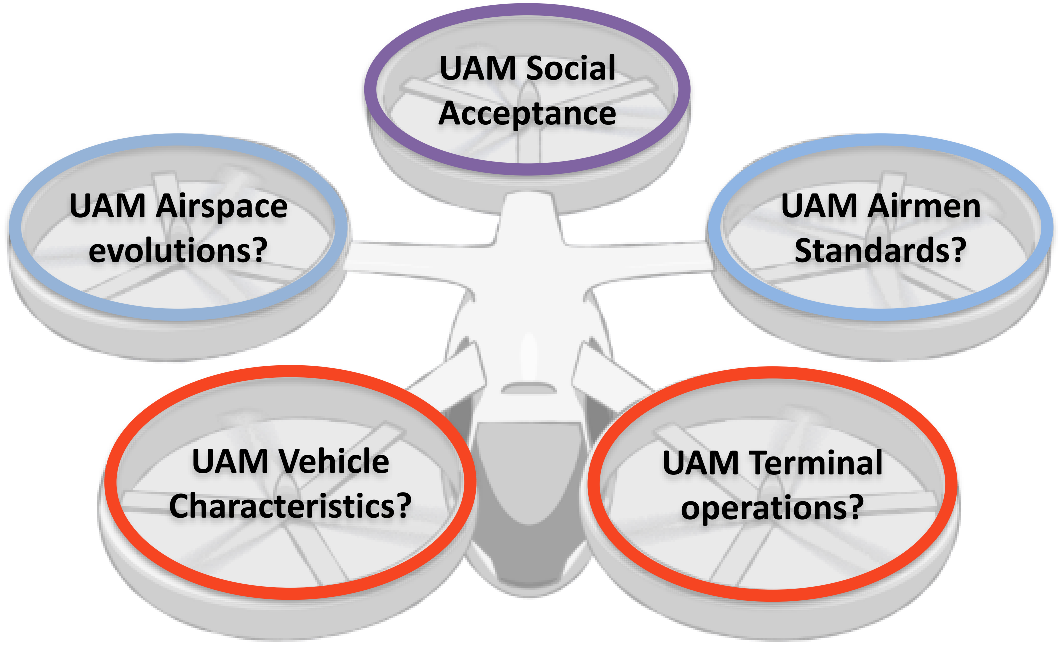
FAA Perspective

FAA recognizes that standards, across lines of business, must evolve to support UAM

FAA Vehicle Certification recognizes the "holistic" inter-dependence of standards

Assumption:

If, Vehicle Characteristics standards are Raised/Lowered – Terminal Ops volumes are Increased/Decreased

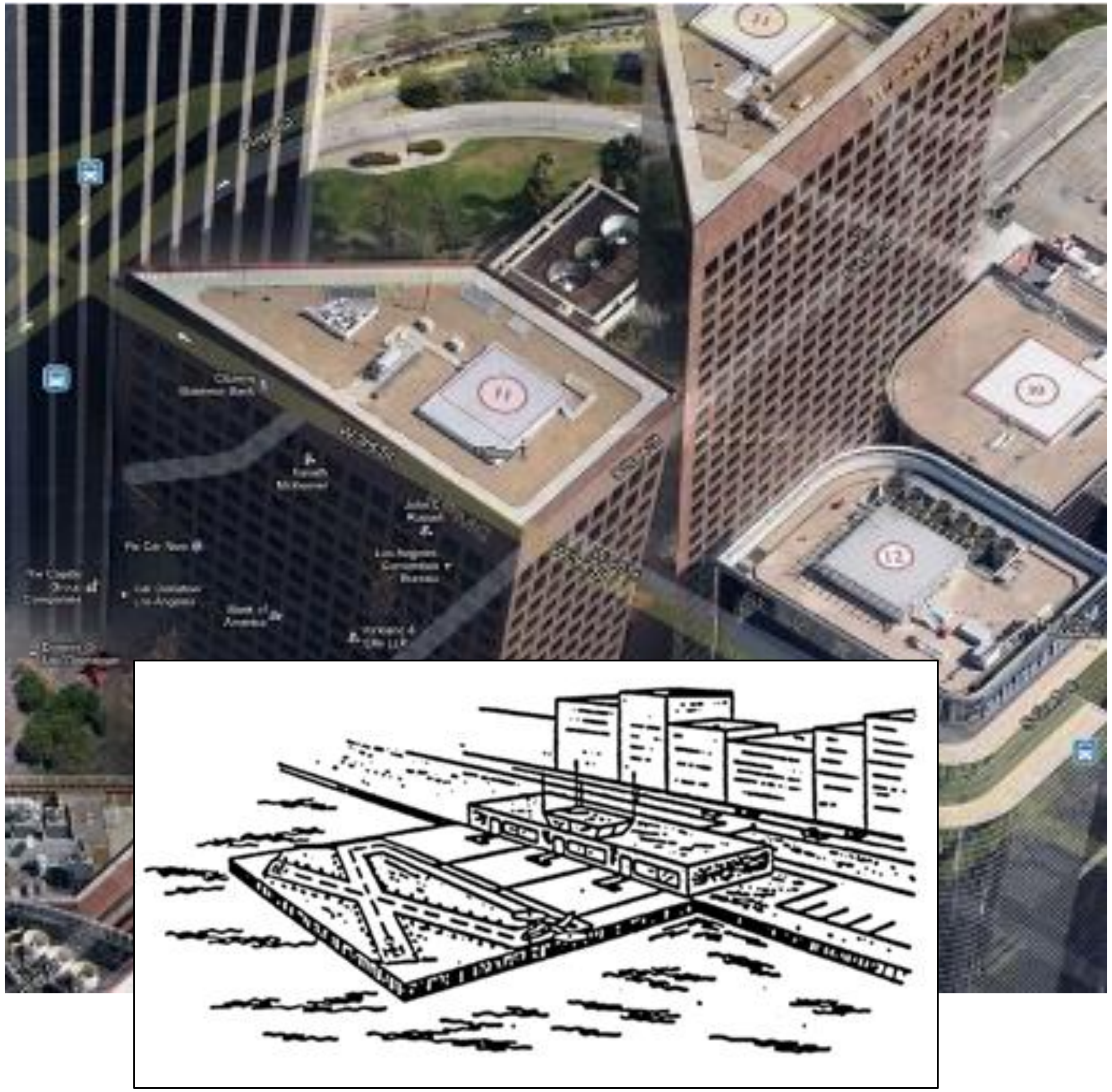


Vehicle technology itself will pace the introduction of new forms of transportation

FAA seeks the proper **balance of standards** that will enable social acceptance of perhaps the most challenging **new operational use case**: **Urban Air Mobility**

Anchoring to today's rotorcraft capabilities/heliport design –
The **UAM Helicopter Dry Run**, captures **foundational data to support evolutionary UAM concepts**

Urban Air Mobility operational assumptions

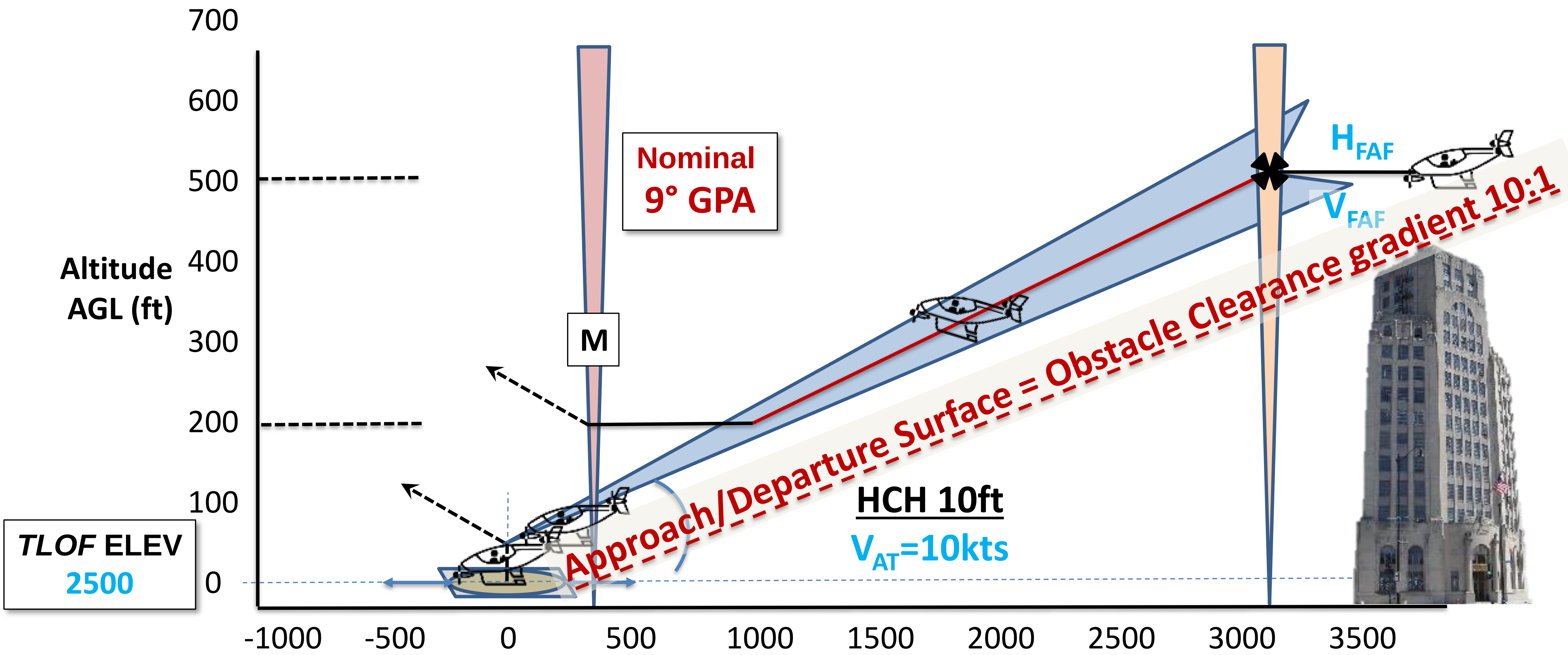


Small urban footprint – *public-use* UAM terminals
- Defined Approach/Departure “surfaces” coincident with obstacle clearance surface (OCS)
- Limited approach/departure paths
- Condensed surface operations
- Little control over urban landscape evolution

UAM “air taxi” must compete with ground-based transportation options
- Instrument Meteorological Conditions
- Limited icing capability
- 9 degree nominal approach angles – steeper less disruptive to urban planning
- Lower Altitude final approach fix (FAF) increases efficiency
- Aircraft must be capable of safe operations in urban wind environment
- UAM corridors above cargo delivery drones, but below general aviation traffic

UAM Vertiports can take advantage of urban rivers or other larger urban spaces

Nominal Approach Profile – NC UAM Heliport



***TLOF* = Touchdown/Liftoff Area (≈LDA); *FATO* = Final Approach/Takeoff Area (≈RPZ) –** ref: Heli/Verti/Airport AC

TLOF=Landing Surface available; FATO defines origin of Approach/Departure/Obstacle Clearance

Urban Air Mobility (UAM) configurations

Ref: Vertical Flight Society (VFS) eVTOL aircraft directory

- **Lift + Cruise** *Completely independent thrusters used for cruise vs. for lift without any thrust vectoring*

- **Electric Rotorcraft** *An eVTOL aircraft that utilizes a rotor, such as an electric helicopter or electric autogyro*

- **Wingless (Multicopter)** *No thruster for cruise/only for lift*

- **Vectored Thrust** *An eVTOL aircraft that uses any of its thrusters for lift and cruise.*

"UAM" is a subset of Advanced Air Mobility (AAM) – intended for ***paid passenger-carrying operations*** *(aka: on-demand mobility)*

Urban Air Mobility (UAM)

- The UAM economic/operations model ($$'s per seat-mile) demands an aviation version of "mass production" and operation that is new to small aircraft
  - 10's of thousands of aircraft operated by a single part 135 operator (in some cases this operator will be the manufacturer) -vs-
  - 100's of aircraft purchased by private parties and operated by several operators running a mixed fleet operation
- UAM are expected to exhibit engine and system isolation features similar to transport category rotorcraft (*Cat A flyaway capability*)
- UAM are expected to utilize "Simplified Vehicle Operations"
- UAM operational safety and efficiency will benefit from standardized takeoff and landing operations that:
  - utilize a critical engine/system failure concept, and;
  - assure adequate designated surface area and adequate performance capability for continued safe flight in the event of critical (propulsion or systems) failures.

Urban Air Mobility (UAM)

- Low speed controllability must account for constraints of the urban landscape
  - Urban "pinnacle" takeoffs and landings
  - Constrained approach and departure paths
  - Unpredictable winds associated with "urban canyons" coupled with urban development
- UAM economic model will demand flight characteristics that enable condensed IMC ops in the urban environment
  - Minimum Trim, Stability and Control, and maneuverability characteristics/limitations must be established for all UAM entrants (V_{MIN-I}, V_{Y-I}, V_{NE-I}, etc)
  - Many UAM entrants have highly-augmented, feedback-control, FBW FCS, that will provide 4-axis Stability Augmentation (a key enabler for low-speed Helicopter instrument operations)
- UAM Terminal Procedures (TERPS), Infrastructure and Airspace standards will need to align with **UAM Category/Class Vehicle Minimum Airworthiness Requirements***

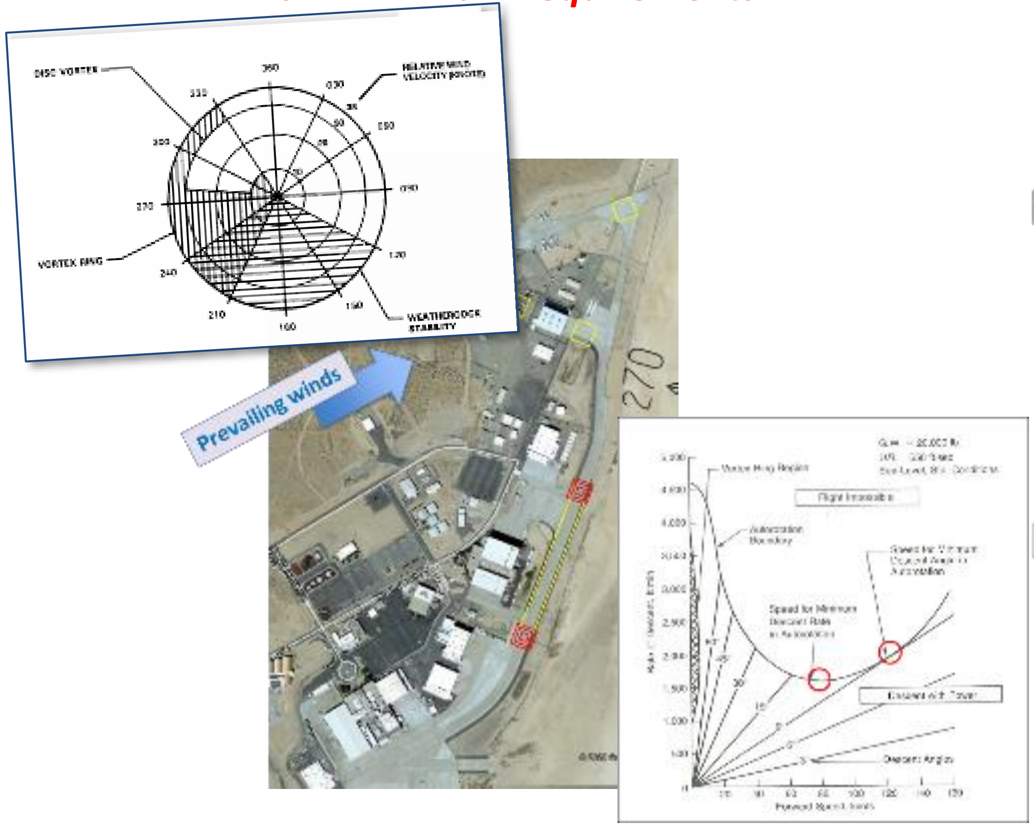
**which have not yet been established – here's where NASA's AAM National Campaign comes in...*

UAM key enablers

Minimum Flight Characteristics required for Urban Operations

- All Azimuth Capability
- Windward/Leeward effects on controllability
- Tailored UAM civil certification HQ tasks

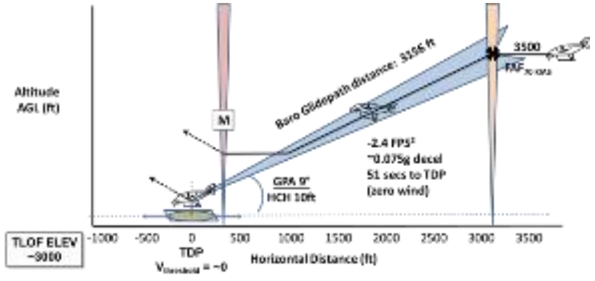
VEHICLE minimum requirements

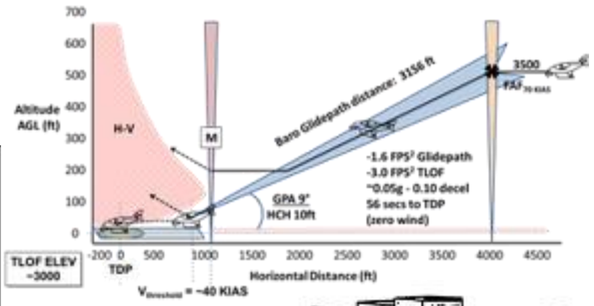


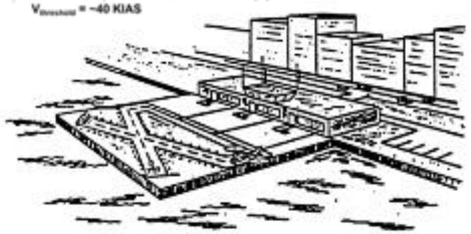
Condensed UAM Approaches/Airspace

- Viable UAM IMC approaches
- Heliport and Vertiport operations

AIRSPACE constraints



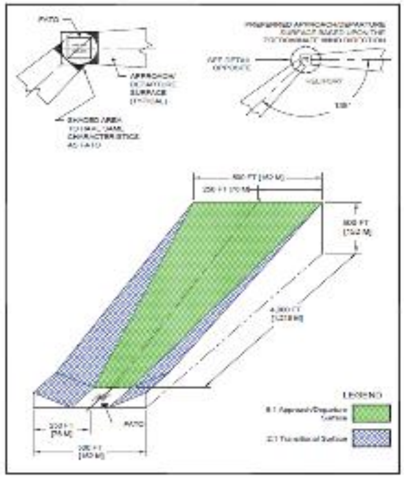




Required evolutions to existing standards to enable UAM

- Terminal/Instrument Procedures (TERPS)
- Urban Planning

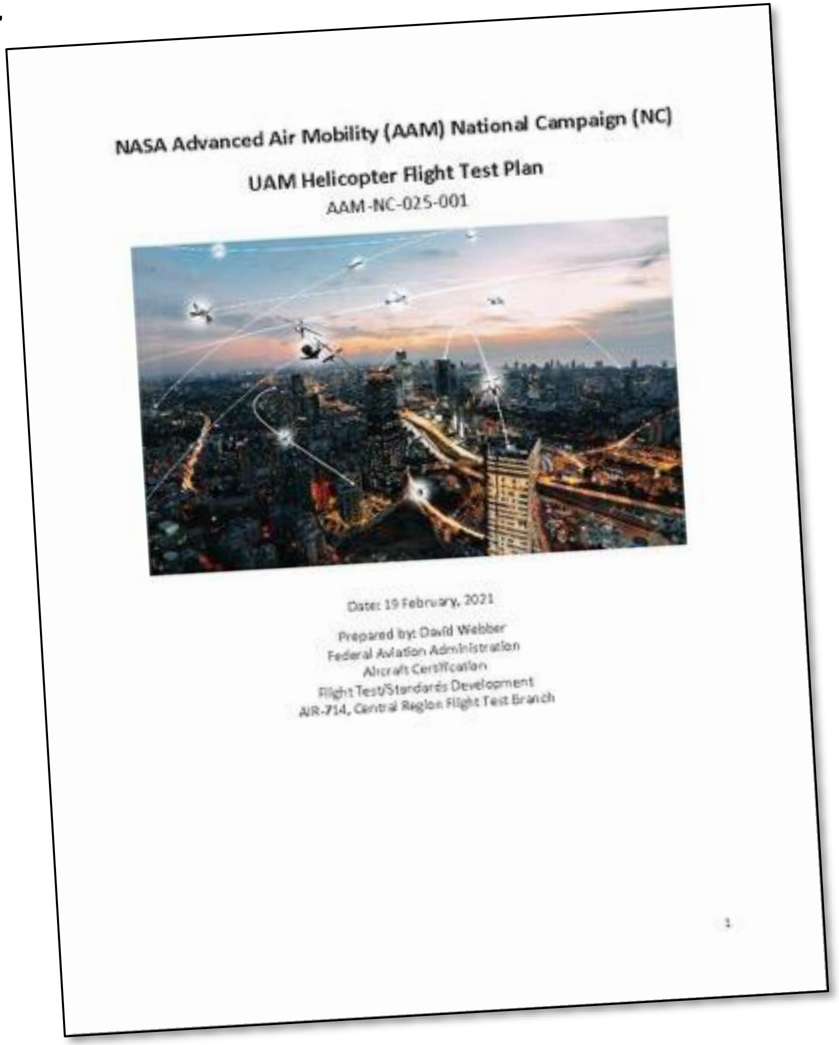
INFRASTRUCTURE needs



UAM Research Questions

Using a “Surrogate UAM” vehicle, the initial flight test plan endeavors to answer several UAM research questions:

- Are existing Airplane and/or Rotorcraft FAA Subpart B (stability, control, trim, and performance) airworthiness requirements appropriate for the UAM operational use case (aka, mission)?
- Can UAM vehicle designs deliver an aircraft that exhibits stability, control and performance that enables condensed, steep (nominal 9°), approaches, in Instrument Meteorological Conditions, into the expected UAM terminal environments?
- Are existing Heliport Design Criteria (dimensions, proximity to structures, and approach/departure surfaces) appropriate for the UAM mission? Can this criteria be reduced to further enable UAM goals?


NASA Advanced Air Mobility (AAM) National Campaign (NC)

UAM Helicopter Flight Test Plan

AAM-NC-025-001

Date: 19 February, 2021

Prepared by: David Webber
Federal Aviation Administration
Aircraft Certification
Flight Test/Standards Development
AIR-714, Central Region Flight Test Branch

1

UAM Helicopter Flight Test Plan

FAA "Subpart B" Vehicle Characteristics

Performance

- Hover Power Margin (IGE/OGE) – free flight method
- Level Flight
- Climb/Descent/Glide

Flight Characteristics

- Trimmed Flight Control Positions – Forward Flight
- Critical All Azimuth Controllability
- Maneuverability
- Static Longitudinal Stability
- Static Lateral/Directional Stability
- Dynamic Stability

Compare Results*

Approach/Departure Routes FIAPA (Flight Inspection Airborne Procedure Automation)

Integrated Scenarios Testing (Ops evaluation of an assumed UAM operation)

Other

PLASI Checkout

VIP sortie

UAM Task Elements

Ground and Hover Tasks

- Ground Handling/Taxi
- Precision Hover
- Lateral Reposition and Hold
- Hover Turn and Hold
- Pirouette
- Vertical Reposition and Hold

Takeoff and Landing Tasks

- Takeoff
- Heliport and Vertiport Approach
- Terminal Hover
- Landing
- Urban Landscape/Dynamic Interface
- Decelerating Turn (RESERVED)

Transition Tasks

- Deceleration IGE (Varied V_{AT})
- Acceleration IGE/OGE (RESERVED)
- Depart and Abort (RESERVED)
- Simulated Failure (Approach/Departure) (RESERVED)
- Balked Landing to Go-around

~25 hours – assuming ~1 hr sortie length

***OH-58C acts as an "experiment control"**
- known flying qualities deficiencies can help "tune" developmental UAM (Handling Qualities) Task Elements

Flight Research OH-58C instrumentation

- Aircraft provides all the necessary parameters for basic Flight Characteristics (S&C&P) evaluations

VFTE IADS Display

Parameter	Range	Units
Airspeed	0 to 120	KIAS
Altitude	0 to 20,000	ft
N_1	0 to 100	%
N_R (Rotor RPM)	0 to 100	%
ϕ, Roll	+/-80	°
Θ, Pitch Attitude	+/-90	°
Ψ, Heading	0 to 360	°
P, Roll Rate	+/-50	°/s
Q, Pitch Rate	+/-50	°/s
R, Yaw Rate	+/-50	°/s
Nx, fwd accel	+/-8	g
Ny, side accel	+/-8	g
Nz, normal accel	+/-8	g
Static Pressure	0 to 15	PSI
Dynamic Pressure	+/-2	PSI
Collective Control Position	0 to 100	%
Lateral Control Position	0 to 100	%
Longitudinal Position	0 to 100	%
Directional Control Position	0 to 100	%
Throttle Position	0 to 100	%
Torque	0 to 100	%
β, sideslip	+/-90	°
OAT	0 to 100	° C

DATA PRODUCTS AND PROCESS WITH FAA

Sarah Eggum – FAA Data Manager

Mohana Gurram– NASA Data Manager

Data Products & Processes with FAA

NASA I FAA Collaboration

NASA & FAA

National Campaign Working Group

FAA UAM Focals

- AVS – Aviation Safety
- AJO – Air Traffic Organization
- APL – Policy, International Affairs, and Environment
- ASH – Security & Hazardous Materials Safety
- ARP - Airports
- ANG - NextGen
- AGC – Office of the Chief Counsel
- TSI – Transportation Safety Institute

Anchor

Current Standards & Policies

Data Element Card

Title	Critical Azimuth Controllability (OH58C)		
Data Element Type	Dynamic		
Scenario	1,2,3	UTE	NA
Metric Type	Vehicle	Maneuver	Trimmed Flight Control Positions (TFCP)
Phase of Flight	Inflight	Event	Range Flight

Objective

Review participant provided engineering data and notes on low speed flight characteristics. Critical Azimuths should be identified for participant designs, and an all azimuth chart provided to show the ability of the UAM vehicle to hover in ground effect in varying wind conditions. Note any reductions in all azimuth capability as a function of altitude, weight, temperature, failure state, etc.
Critical Azimuth tests for the OH-58C will be conducted to validate "book" numbers for all azimuth capability, and to demonstrate flight test techniques. Low-speed forward, rearward, and sideward flight tests will be conducted to observe control margins and critical control axes for the OH-58C. Record GW, HP, OAT.

Configuration

dependent on UAM vehicle design

Test Conditions

ref: Gross Weight (GW), Center of Gravity (CG), Azimuth (ψ), Groundspeed (KTAS), Torque/Power (Q)
Test Limitations: <3 knots wind
Test Tolerances:
Knock it Off: >=10% control margin remaining

Data Requirements

Description

All Azimuth demonstration (no calibrated pace vehicle)
In Level Flight (IGE) – maintain 10 foot skid height, slowly increase translation speed at the target azimuth (side/front/rear), record control positions. Evaluate areas of emphasis around and at critical azimuths. Translate at a given Azimuth angle, ψ, while monitoring control position until 10% control margin is reached in any control axis. Capture comments on controllability characteristics.

Notes

Knock it off - 10% control margin remaining

Test Course Description

Flat Surface with reference lines

Evolve

Identify Gaps

AAM Implementation Plan

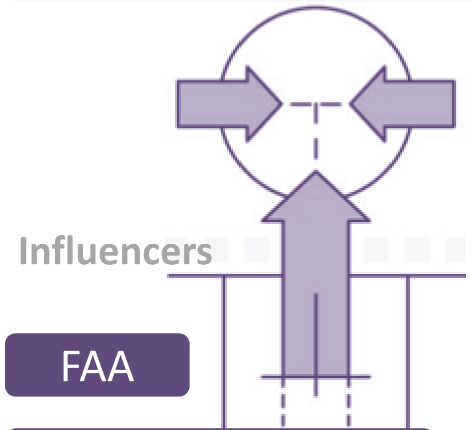
Credits: David Dunning, FAA NC Lead

Collaborative gap analysis for existing standards & policies across all FAA lines of business to enable UAM operations

Data Products & Processes with FAA

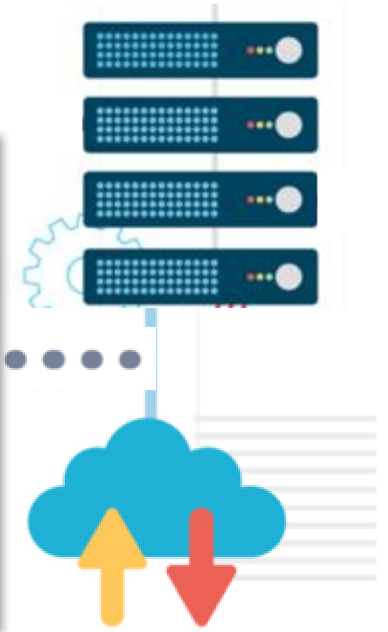
Approach to Data

Data Needs and Requirements



- FAA
- Industry Partners
- NASA Research Projects
- NC Scenarios
- ASTM Specifications

Spreadsheet



Airspace Test Infrastructure

- Data Ingestion
- Data Storage
- Data Models
- Data Flows

- Test Plans
- MOF
- Range
- Vehicle

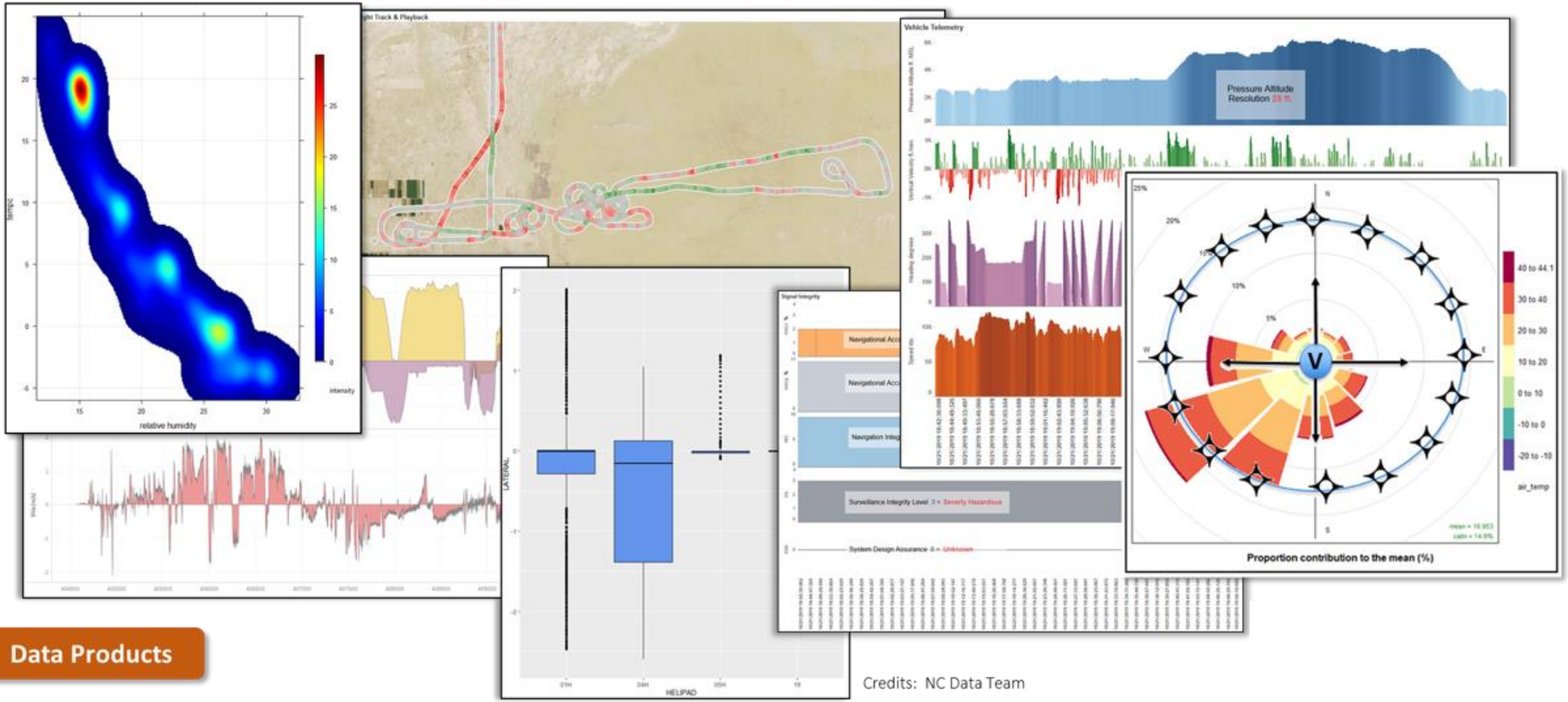
Flight Test Infrastructure

Credits: NASA Ames ATI

Data Products & Processes with FAA

Collections of Data

Performance Graphs | Conformance Graphs | Flight Track | Signal Validation | Atmospheric Graphs | Deviations | Messaging | ARINC Coding



Data Products

Credits: NC Data Team

QUESTIONS & WRAP UP

BACKUP

DAVID ZAHN

National Campaign Scalable UAM Operations Principal Investigator

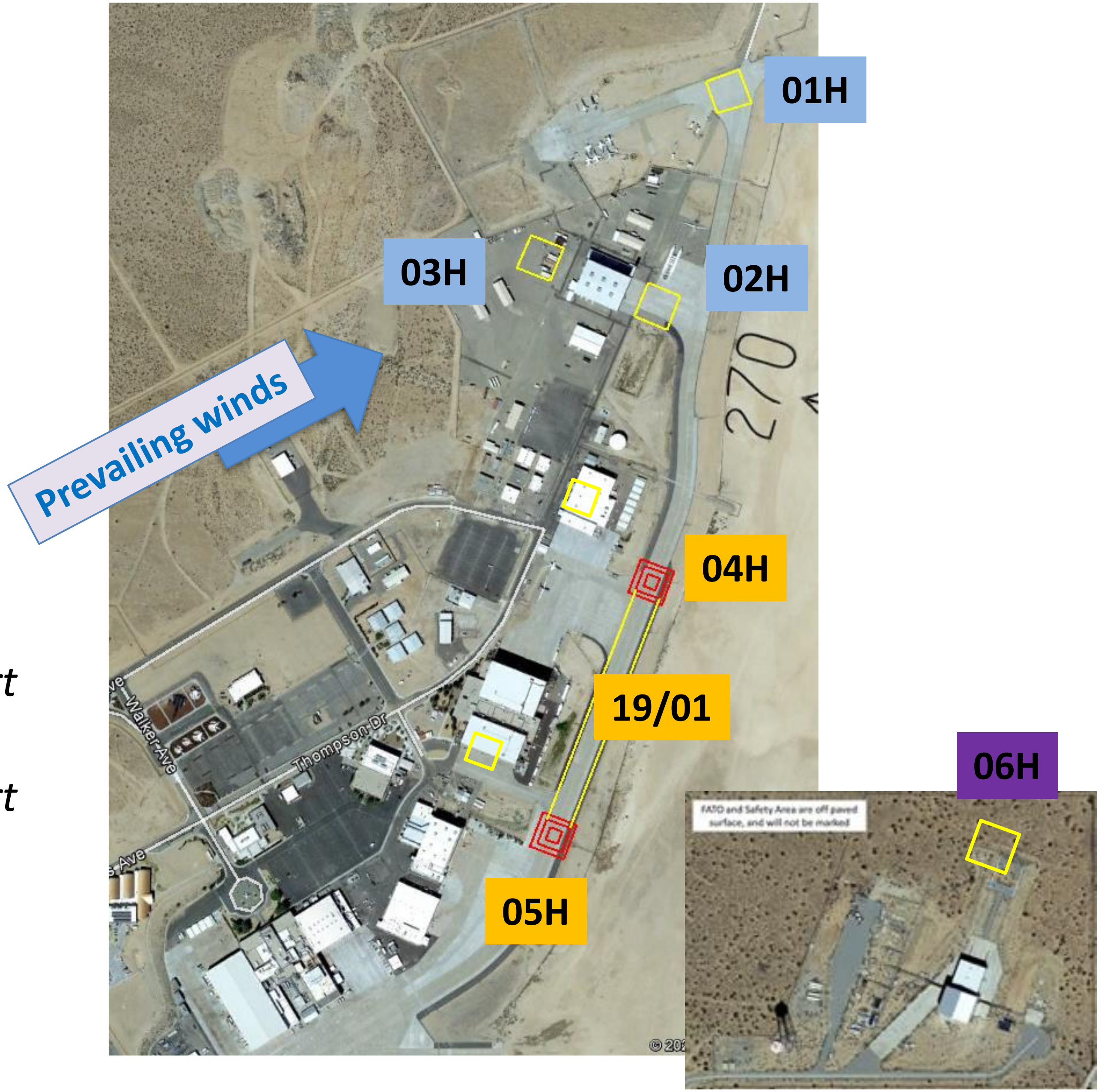
AAM NC Terminal Ops

6 AAM NC *"UAM Heliports"*

- 40x40ft TLOF
- Northern Heliports suitable for wind/controllability studies
- All Heliport design/placement IAW AC 150/ 5390-2C Heliport Design

1 AAM NC *"UAM Vertiport"*

- 1090ft length x 120ft width TLOF/FATO
- 01H + 02H + 03H = XEDW *Research Airport*
- 04H + 05H + 19/01 = XVPT *Research Airport*
- 06H = XX33 *Research Airport*



XEDW - 01H

RNAV - XEDW (01H)

Facility Search

Identifier: XEDW

AIRNAV Data

Airport

AIRPORT ID	XEDW
STATE	CA
COUNTRY	US
MVAR	E12
STATUS	Active

Runway

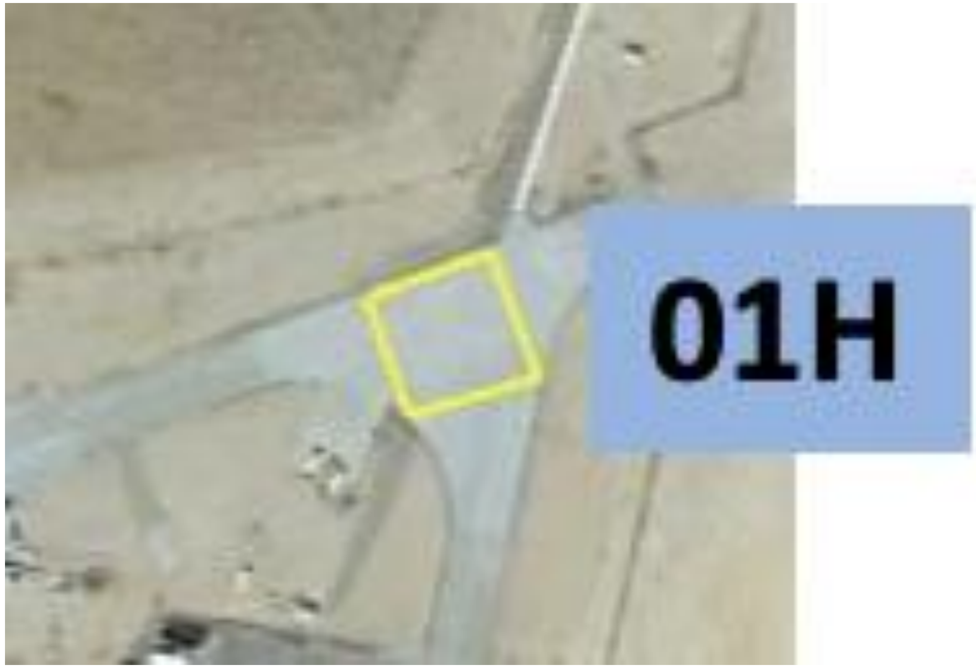
01H (A)

General

LANDING LENGTH	96 FT
TRUE BEARING	250.35°
PUB DATE	09/28/2020
FI RWY LENGTH	
FI RWY HEIGHT	

Helipad

LATITUDE	N34° 57' 32.8320"
LONGITUDE	W117° 52' 54.1200"
ELEVATION	2276.0 FT
ELLIPSOID ELEV.	2170.7 FT
MODEL / SOURCE	WGS84 / E
HORZ. DATUM	WGS84
VERT. DATUM	EGM_96
CALC ELLIP HT	2170.8 FT
IS DISPLACED	



XVPT RWY 19

RNAV - XVPT (19)

Facility Search

Identifier: XVPT

AIRNAV Data

Airport

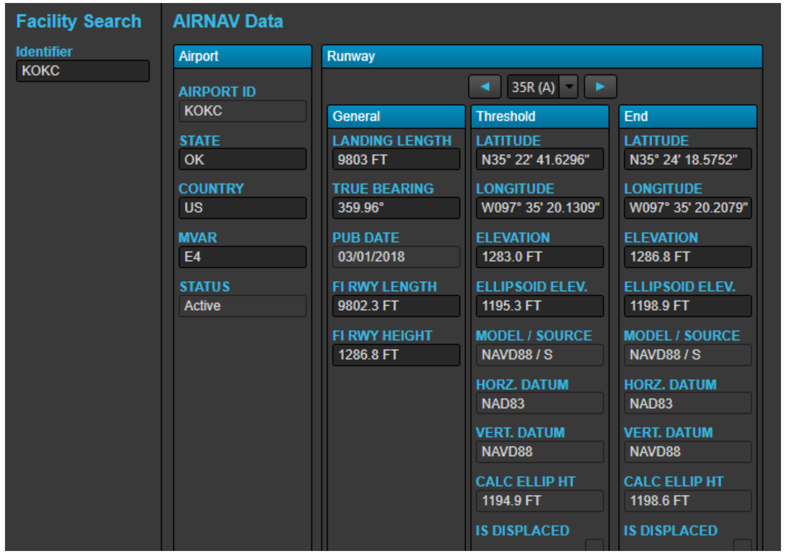
AIRPORT ID	XVPT
STATE	CA
COUNTRY	US
MVAR	E12
STATUS	Active

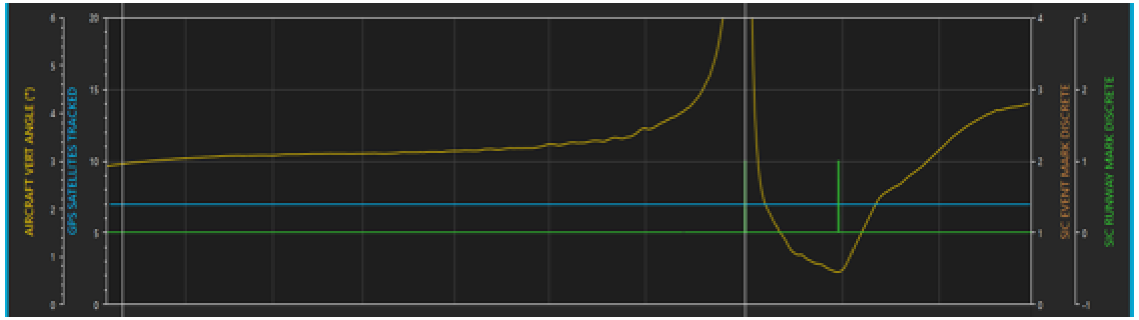
Runway: 19 (A)

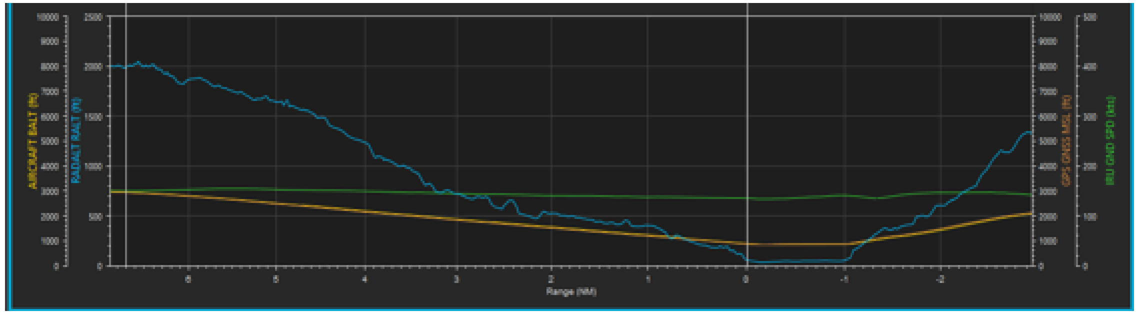
General		Threshold		End	
LANDING LENGTH	1094 FT	LATITUDE	N34° 57' 03.8880"	LATITUDE	N34° 57' 13.6440"
TRUE BEARING	21.01°	LONGITUDE	W117° 53' 02.4000"	LONGITUDE	W117° 52' 57.7200"
PUB DATE	09/16/2020	ELEVATION	2276.0 FT	ELEVATION	2279.0 FT
FI RWY LENGTH	1124.0 FT	ELLIPSOID ELEV.	2170.7 FT	ELLIPSOID ELEV.	2173.7 FT
FI RWY HEIGHT	2302.8 FT	MODEL / SOURCE	WGS84 / E	MODEL / SOURCE	WGS84 / E
		HORZ. DATUM	WGS84	HORZ. DATUM	WGS84
		VERT. DATUM	EGM_96	VERT. DATUM	EGM_96
		CALC ELLIP HT	2170.8 FT	CALC ELLIP HT	2173.8 FT
		IS DISPLACED	☐	IS DISPLACED	☐

Flight Inspection Airborne Processor Application

- Ingests FAA AIRNAV data
- Ingests ARINC 424 for RNAV procedures
- Performs data quality checks
- Collects detailed data over runway threshold and runway end (e.g. HP Lat/Long, Rad Alt, IRU, air data, GNSS)
- Estimates the North, East, Up errors of the spatial data used for the procedure
- Logs all data for replay and/or analysis







NC Data Element Card

Example UTE Test Sheet : Static

Research areas Airspace, Flight, and Infrastructure

Assign POC's from NASA and FAA for Data Exchange

FAA POC's delegated in areas of responsibility
- Technical
- Policy

Identify gaps in current criteria, standards, and regulations

Summarize suggestions for change

Data Element Card

Title	**Post-flight Weather Data & Study**		
Data Element Type	Static		
Scenario	All	UTE	All
Metric Type	Infrastructure	Maneuver	N/A
Phase of Flight	Post-Flight	Event	Weather

Objective

The objectives are to (1) collect data that describe atmospheric conditions near helipads/vertiports during flight tests, (2) deliver data to stakeholders post-flight

Configuration

N/A

Test Conditions

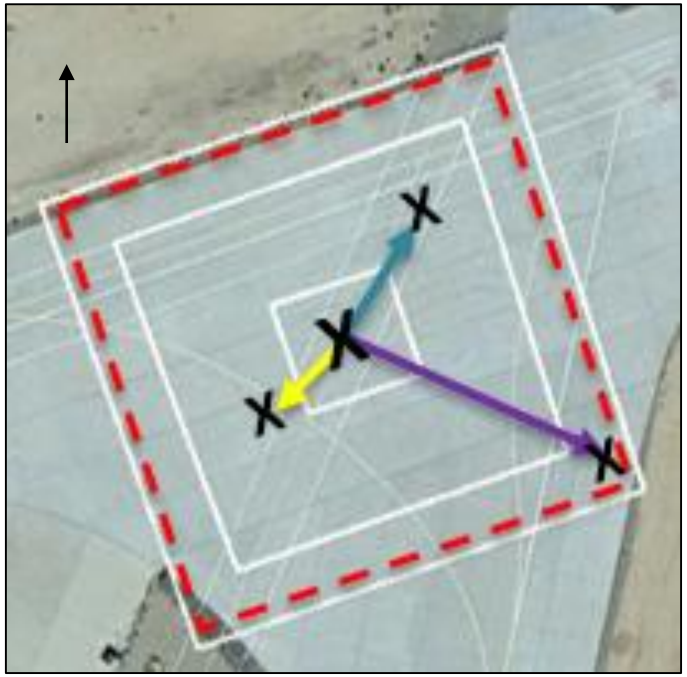
1. Conduct site survey
2. Deploy weather-sensing equipment
3. Perform operations check on equipment
4. Measure and record weather data
5. Perform quality control and formatting checks
6. Distribute data

Description

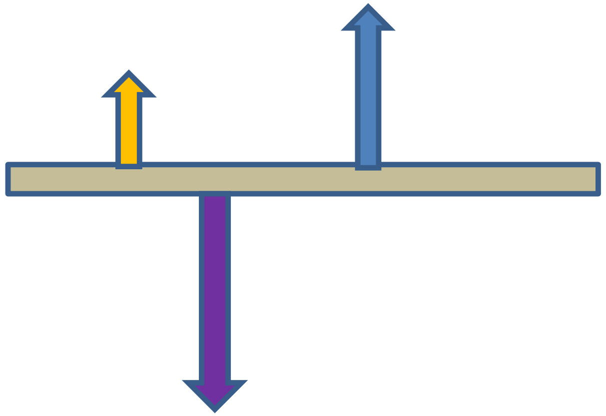
Weather data will be collected during National Campaign flight activities and made available post-flight for stakeholders to use in their analyses. Surface weather data will be collected/recorded at 1-second resolution, and SoDAR data will be collected/recorded at 2-minute resolution. The SoDAR records average wind data every 20m (65ft) between 20-250m (65-820ft) AGL. All data will be tagged with UTC time.

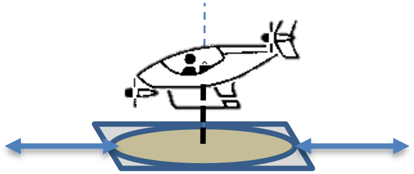
Spatial Data Integrity

Spatial Data Position Errors **Area A – XEDW – 01H**

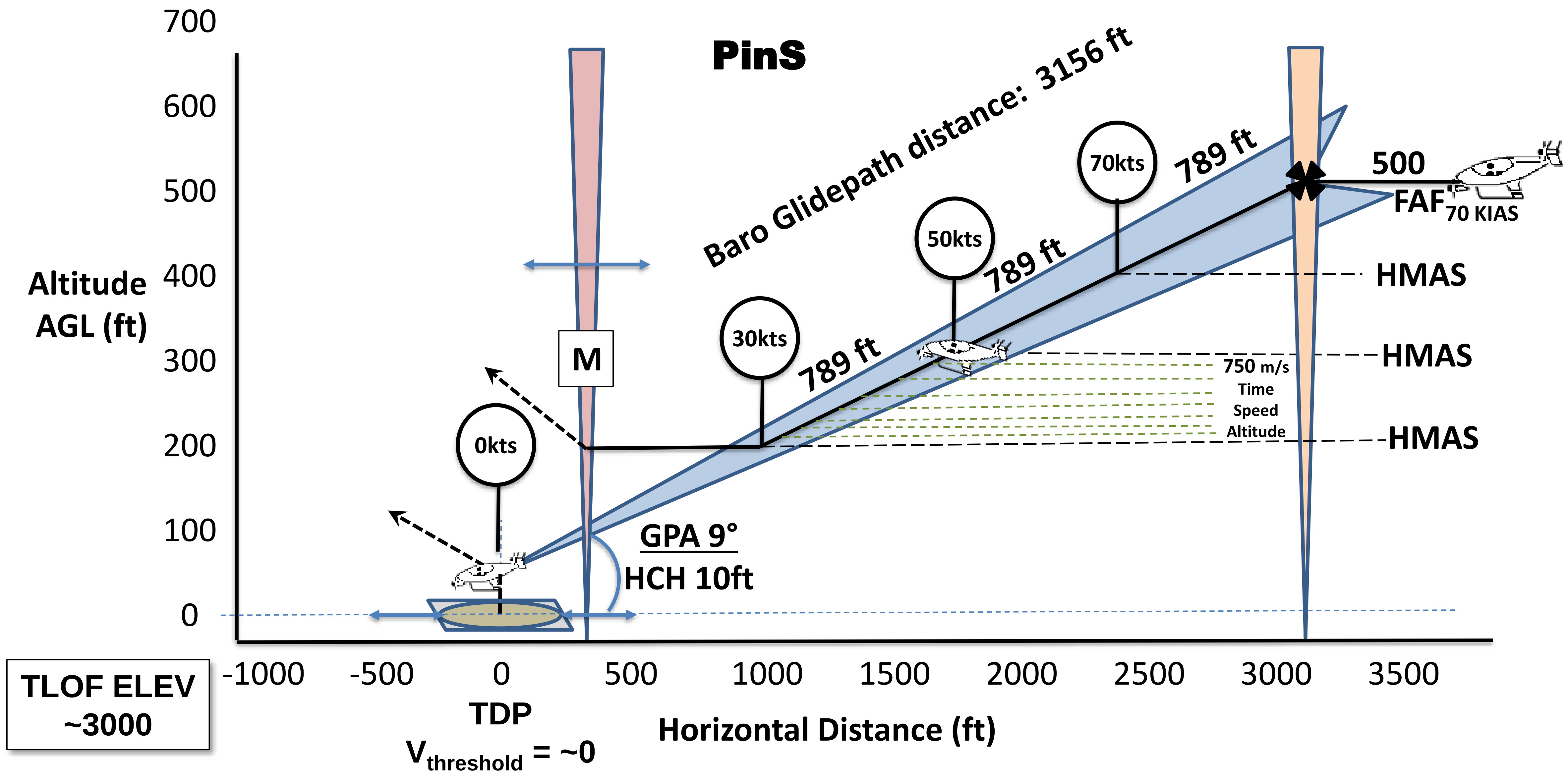


Instrument	Location	Elevation	Vertical Error (from Garmin)	Lateral Error (from Garmin)
Garmin Handheld Survey	(34 57 32.88 N, 117 52 54.07 W)	2274 ft.	Most Accurate	Most Accurate
Google Earth	(34 57 32.84 N, 117 52 54.20 W)	2276 ft.	+2 ft.	(-0.04 degrees, .+0.13 degrees) 11.55 ft. 249.50 True Bearing
TARGETS	(34 57 32.69 N, 117 52 53.29 W)	2241 ft.	-33 ft.	(-0.19 degrees, - 0.78 degrees) 67.71 ft. 106.48 degrees True Bearing
Surveillance Broadcast Services Monitor	(34 57 33.01 N, 117 52 53.97 W)	2280 ft.	+6 ft.	(+0.13 degrees, -0.10 degrees) 15.56 ft. 32.34 True Bearing
FIAPA	Pending Flight Data			





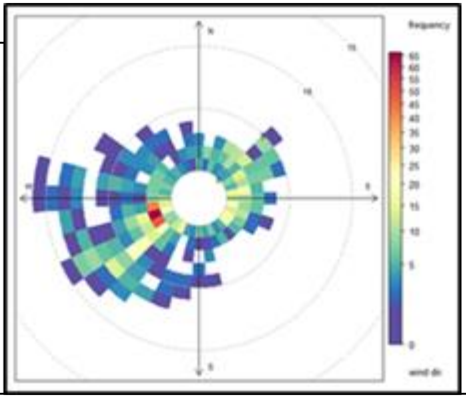
Quad Zero Approach

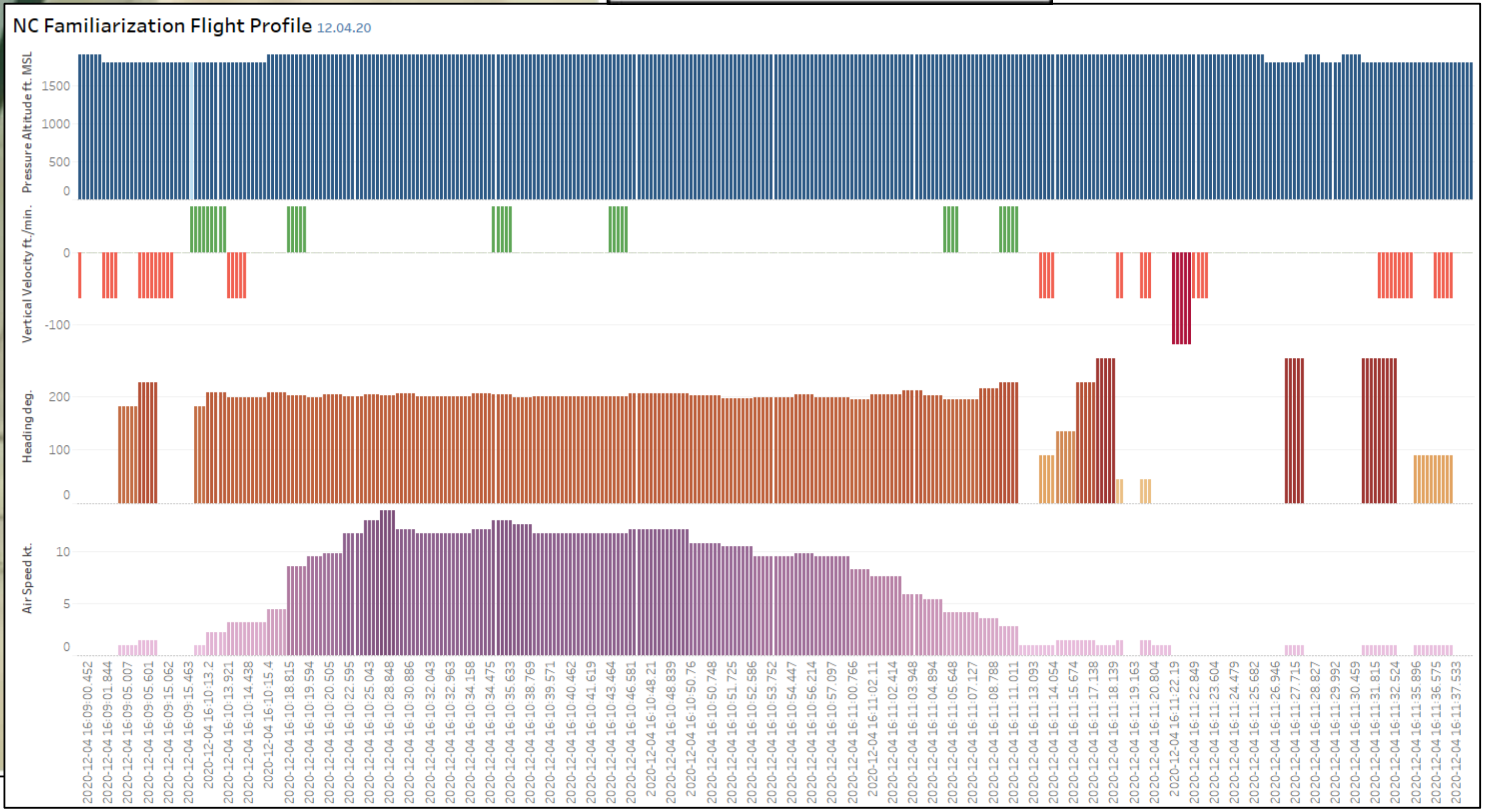


UAM Dep/App Theory

Work Underway: Fusing data to apply to approach

Data Element Planning

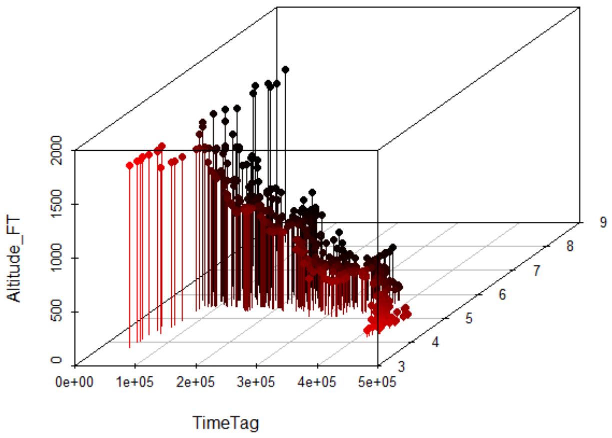


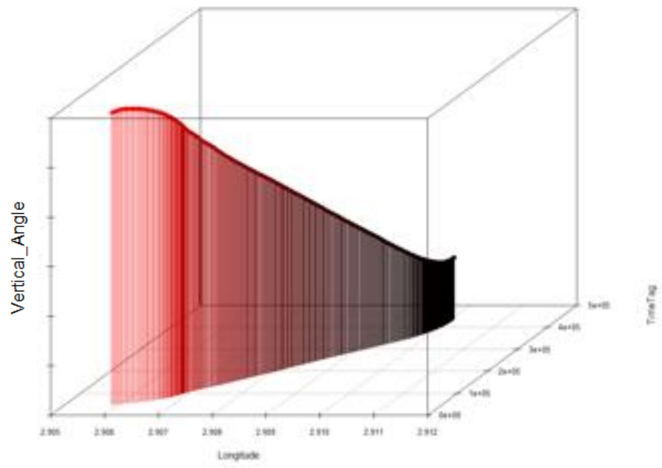


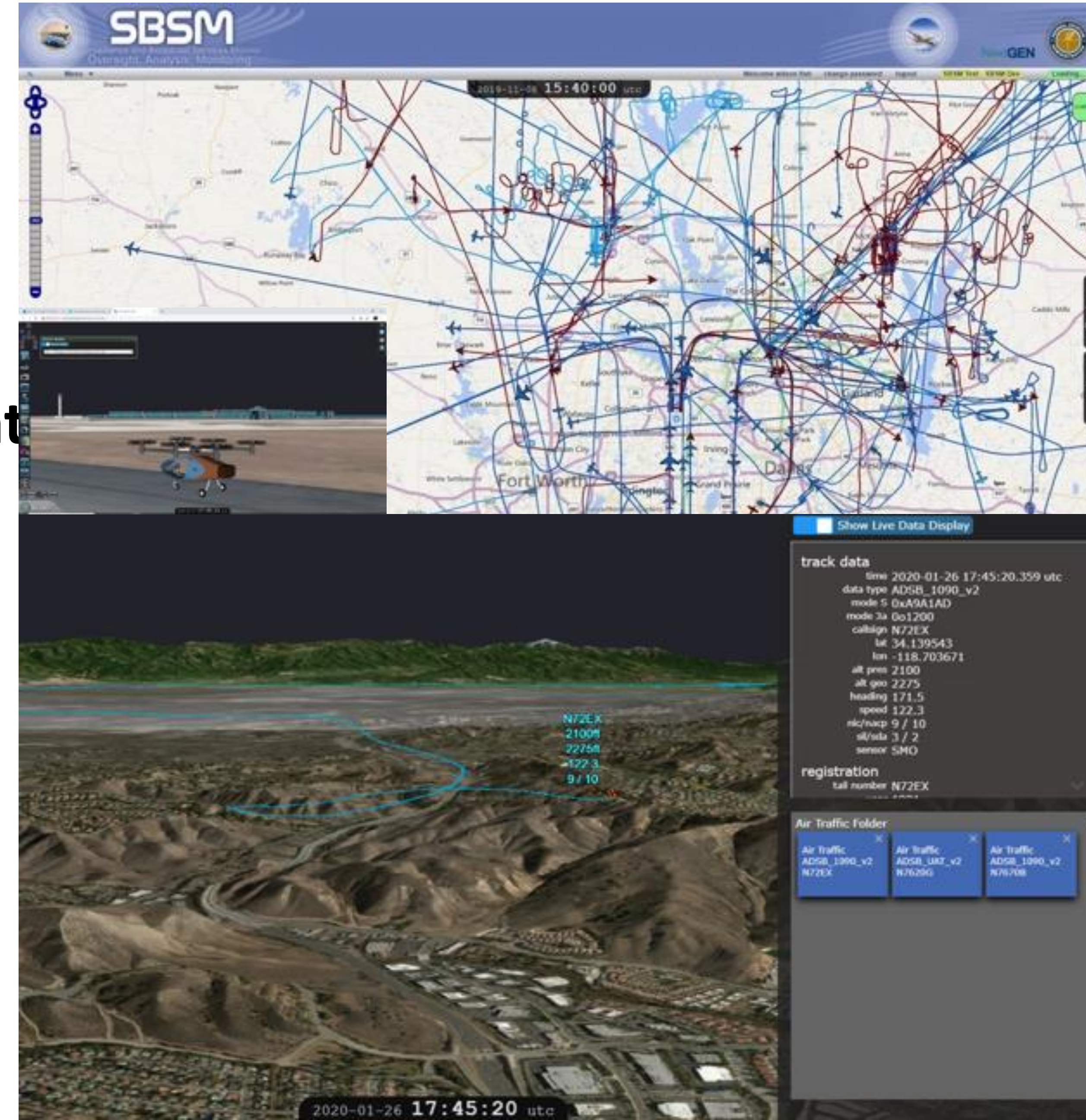
UAM Dep/App Theory

NASA/FAA Flight following collaboration:

- Real time (1 sec refresh rate)
- Pilot deviations
- Route tracking and conformance
- Enforcement/Contingency Management
- Post flight data analysis







FAA’s Surveillance Broadcast Service Monitor Tool