

NASA

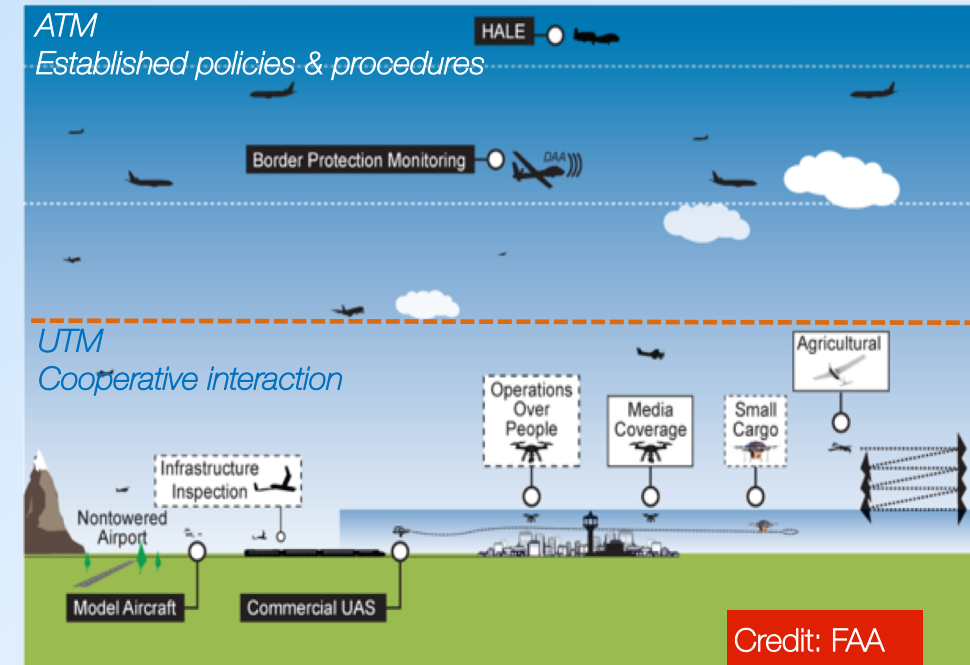


UTM Technical Capability Level 4 Testing

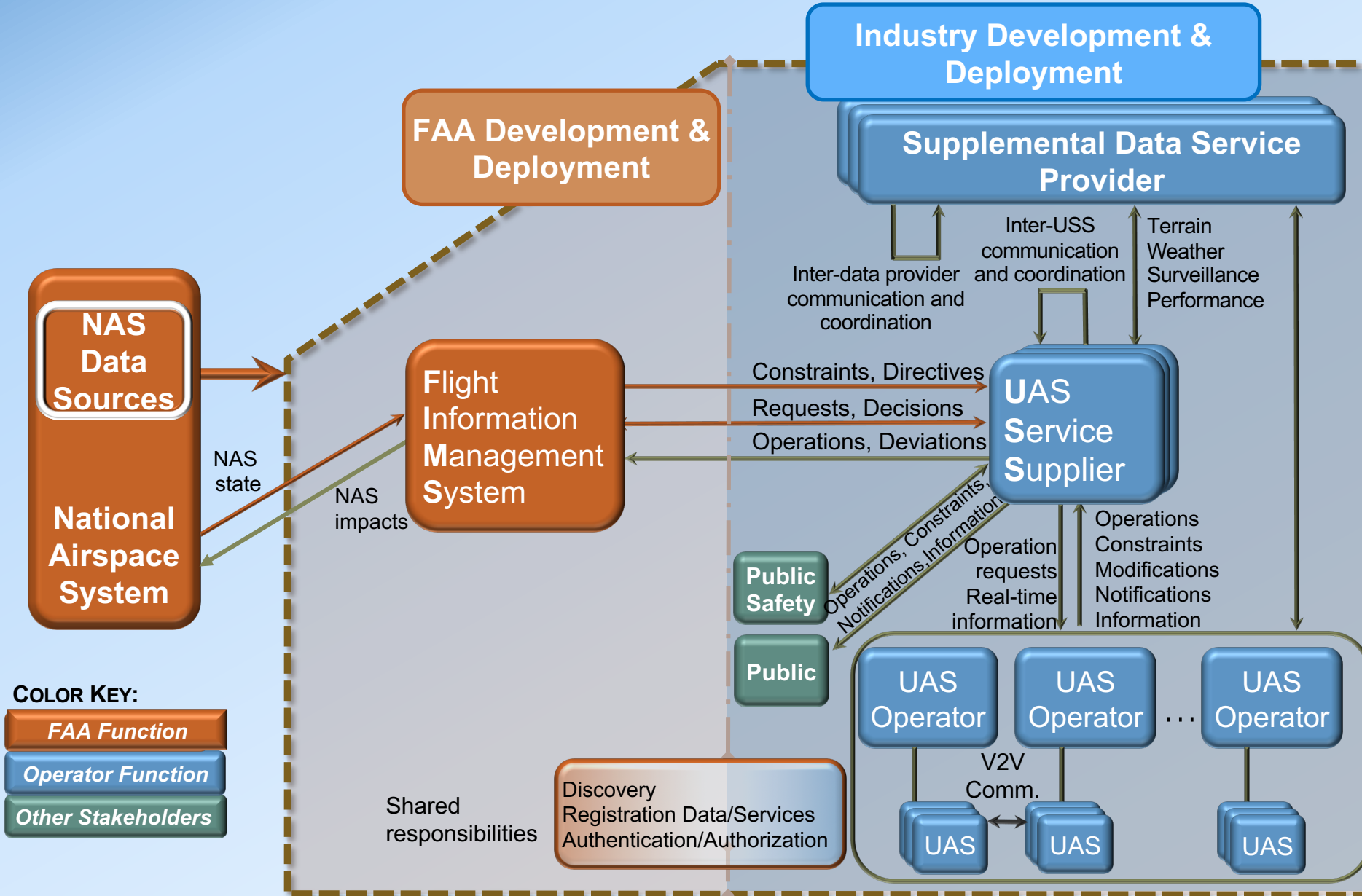
What is the UTM System?



- UTM is an “air traffic management” ecosystem for small UAS in low-altitude airspace
- UTM utilizes industry’s ability to supply services under FAA’s regulatory authority where these services do not exist
- UTM development will enable the management of large scale, low-altitude UAS operations
 - Address beyond visual line of sight UAS operations under 400 ft. AGL
 - Define roles/responsibilities of FAA, operators, and other stakeholders
 - Define information architecture, data exchange protocols, software functions
 - Recommend performance requirements



UTM Service-Based Architecture



Flight Information Management System

- Enables airspace controls
- Facilitates requests
- Supports response in emergencies impacting NAS

UAS Service Supplier

- Federated Structure
- Cloud-based system
- Automated System
- Supports UAS with services (e.g. separation, weather, flight planning, contingency management, etc.)

Supplemental Data Service Provider

- Supplies supplemental data to USS and UAS Operator to support operations

UAS / UAS Operator

- Individual Operator
- Fleet Management
- On-board capabilities to support safe operations

Technical Capability Levels (TCL)



Risk-based development and test approach along four distinct TCL

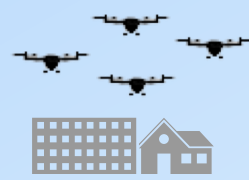


TCL1

What: Concept for management of airspace in lower risk environments and multiple visual line-of-sight (VLOS) UAS operations

When: Aug '15, May '16

Outcomes: Validation of cloud-based service oriented architecture



TCL 2

What: Complex multiple beyond visual line of sight (BVLOS) UAS Operations in lower risk environments

When: Oct '16, May '17

Outcomes: Information sharing between operators, and established federated 3rd party service model

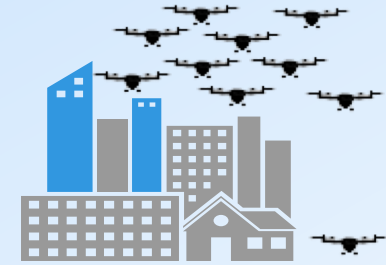


TCL 3

What: Technologies needed for BVLOS UAS Operations over populated areas and near airports

When: March-June 2018

Outcomes: Technologies for detect and avoid, comm. and nav., and data exchange between multiple USS



TCL 4

What: Complex BVLOS operations in urban environment, nominal and contingency situations

When: Summer 2019

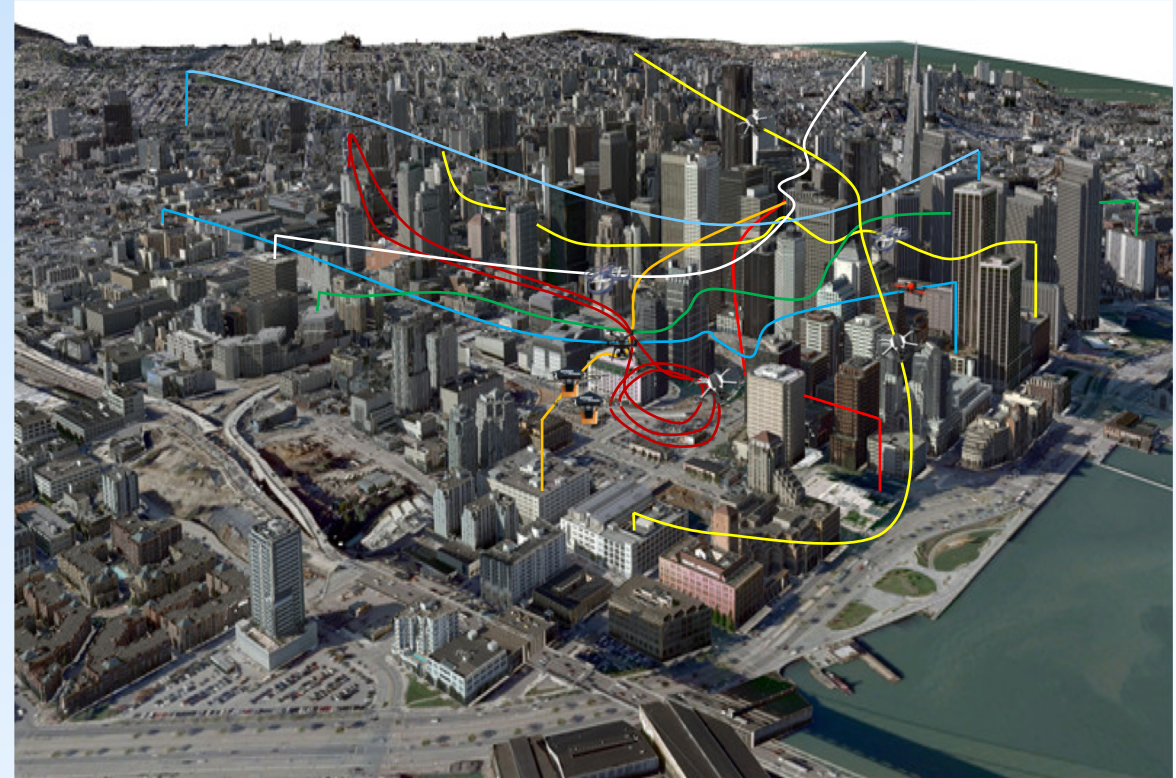
Outcomes: Operational concept, vehicle technologies, and data exchanges for operations near large structures and in highly populated areas

TCL 4 Testing Challenges Associated with Complex Urban Environments



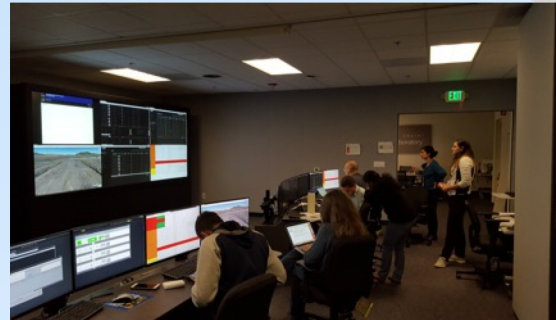
Key Technical Areas to Investigate

- Communication/ Navigation degradation and denial
- Vehicle separation in nominal off-nominal conditions
- Remote identification of UAS
- Obstacle Avoidance (dynamic and static)
- High density / high tempo operations
- USS-USS discovery and negotiations
- Supplemental Data Services supporting operations (e.g. weather, health monitoring, risk monitoring)
- Safe Landing





Reno test range
Image courtesy of NIAS



ARC UTM Command Center

*TCL 4 awards made to Nevada and Texas
FAA-designated UAS test sites*



Corpus Christi test range
Image courtesy of LAUASC6

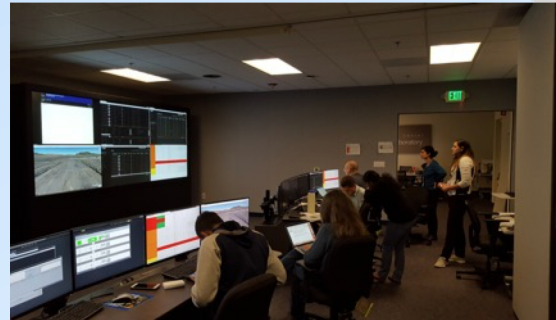


Challenges for Both Test Sites

- Integration of detect and avoid, communication, navigation technologies onto multiple UAS platforms
- Integration of UAS with USS
- Installation and integration of ground instrumentation
- FAA approvals for flight testing (Part 107 waivers)
- Test range safety during operations
- Community awareness and engagement



Reno test range
Image courtesy of NIAS



NASA UTM Command Center

TCL 4

- *It is finally happening!*
- *Stay tuned for exciting results!*



Corpus Christi test range
Image courtesy of LAUASC



Sources of Credits

- Image from Nevada Institute of Autonomous Systems (NIAS)
 - Source document: NIAS Test Plan 2, v1.0, UTM TCL4 Task Plan 7, 1/28/2019
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 - Source document: LSUASC NASA UTM TCL4 Demonstration Test Plan 2 , 3/5/2019
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