



# Unmanned Aircraft System Traffic Management (UTM) Project

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# Topics

- What is UTM?
- Progress to Date
- What's Next
- Partnering
- Summary

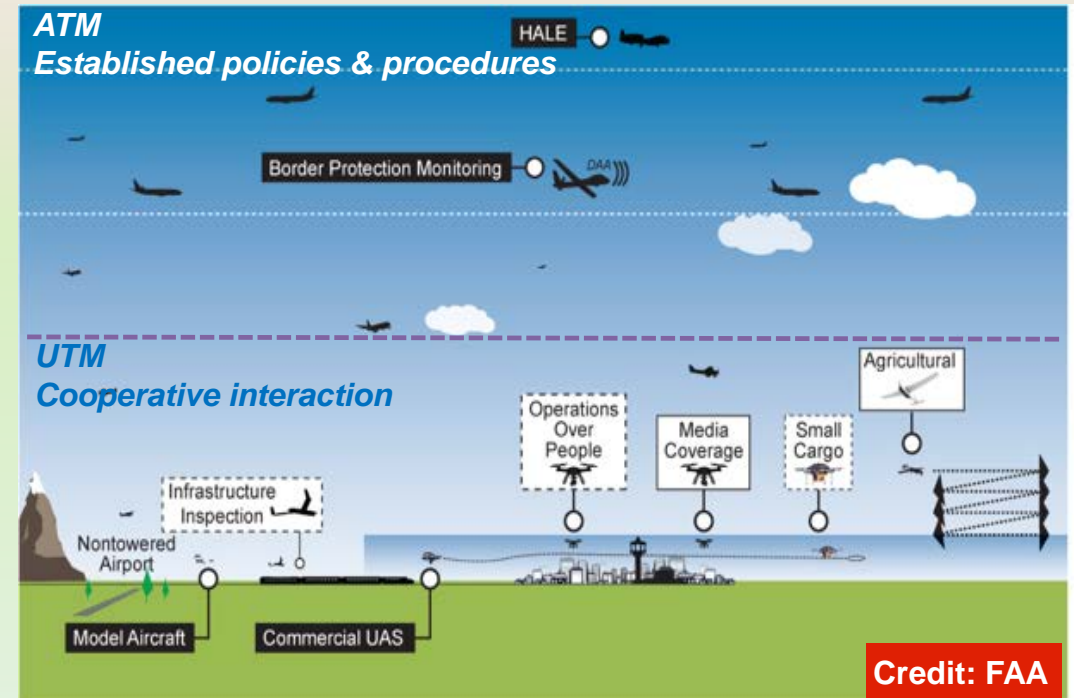
# Why is UTM Needed?

- FAA small UAS forecast – 7 million total, 2.6 million commercial by 2020
  - Many use cases: package delivery, news collection, precision agriculture, infrastructure inspections, public safety, disaster response, etc.
- New entrants desire access and flexibility for operations
- Current users want to ensure safety and continued access
- Regulators need a way to put structure as needed
  - Current approach for air traffic control of manned aircraft won't scale up for small UAS operations
  - Need to assure safe integration into the National Airspace

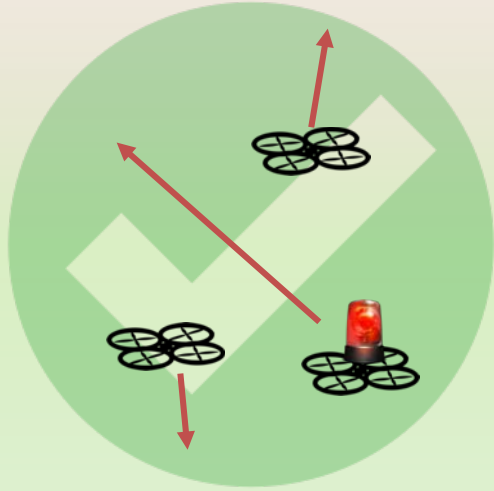
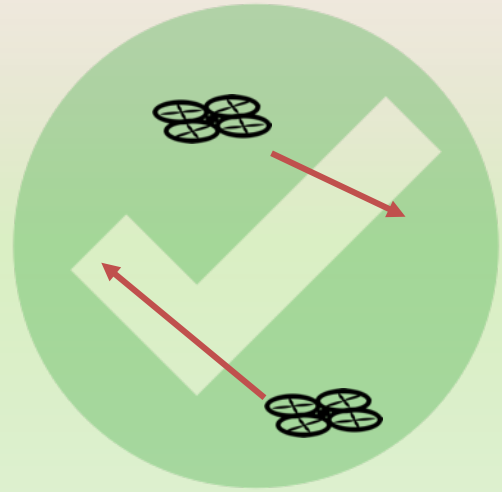


# What is UTM?

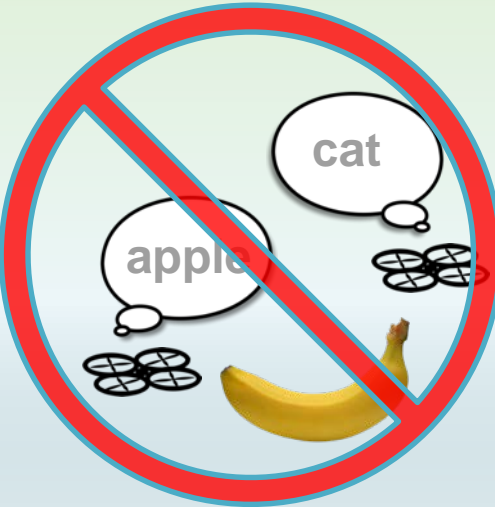
- UTM is an “air traffic management” ecosystem for uncontrolled airspace
- UTM utilizes industry’s ability to supply services under FAA’s regulatory authority where these services do not exist
- UTM development will ultimately enable the management of large scale, low-altitude UAS operations
  - Operational concept will address beyond visual line of sight UAS operations under 400 ft. AGL, Class G airspace
  - Roles/responsibilities of FAA and operators
  - Information architecture, data exchange protocols, software functions
  - Performance requirements



# UTM Principles (Things That UTM Will Help With)



VS





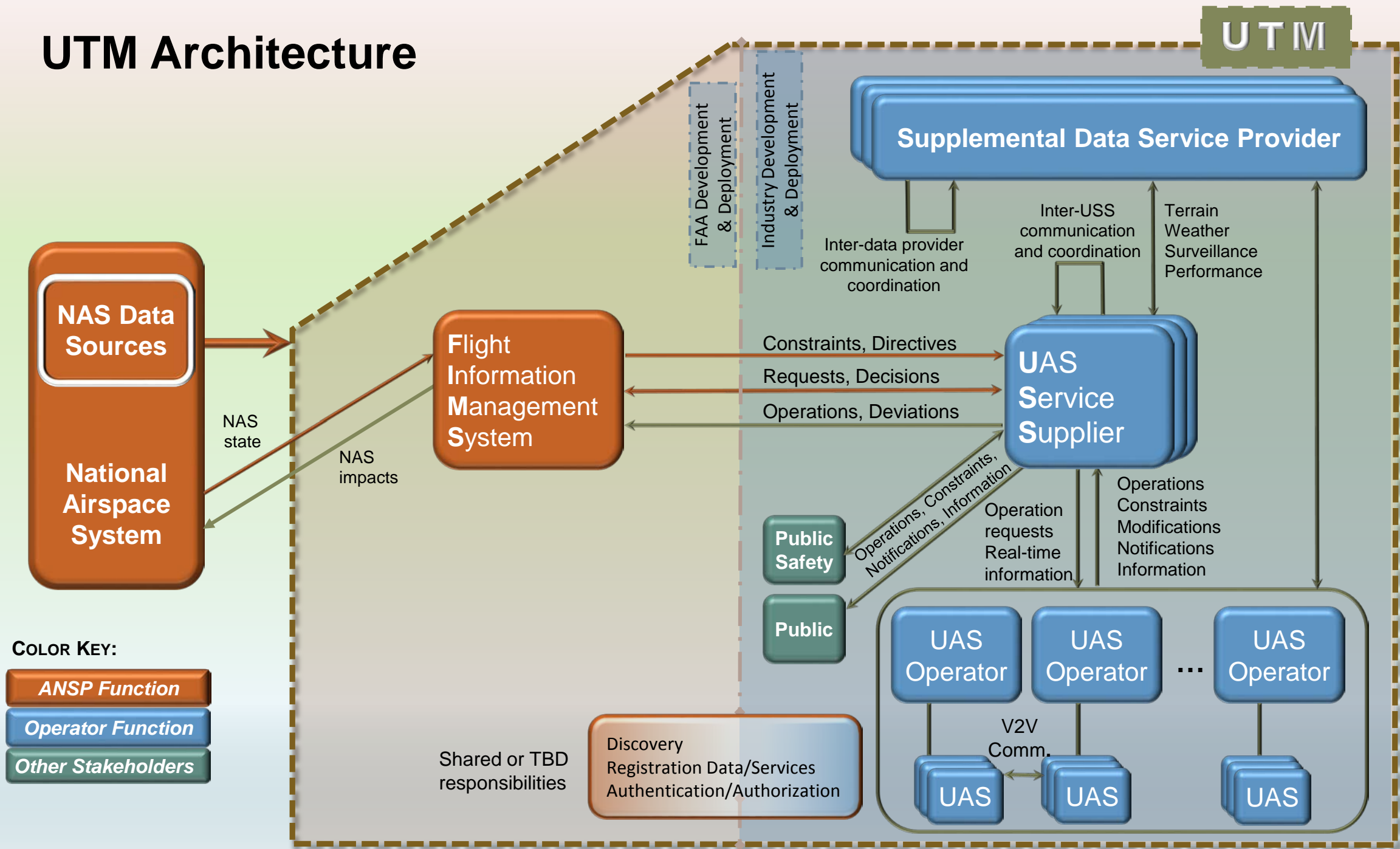
# Key Operational Assumptions

- FAA maintains regulatory *AND* operational authority for airspace and traffic operations
- UTM is used by FAA to issue directives, constraints, and airspace configurations
- Air traffic controllers **are not required** to actively “control” every UAS in uncontrolled airspace or uncontrolled operations inside controlled airspace
- FAA has on-demand access to airspace users and can maintain situation awareness through UTM
- UTM roles/responsibilities: Regulator, UAS Operator, and UAS Service Supplier (USS)
- FAA Air Traffic can institute operational constraints for safety reasons anytime

**Key principle is safely integrate UAS in uncontrolled airspace without burdening current ATM**



# UTM Architecture



**COLOR KEY:**

- ANSP Function** (Orange)
- Operator Function** (Blue)
- Other Stakeholders** (Green)

# UTM Project and Its Impact



## Research Activities

### Research Transition Team Working Groups

- Concepts and Use Cases
- Data and Information Exchange
- Sense and Avoid
- Communications and Navigation

### Concept and Software Development

- Flight Information Management System
- UAS Service Supplier
- Supplemental Data Service Providers
- UAS Operator Client
- Public Portal

### Field Testing and Technology Evaluation

- TCL Field Demonstrations
- Targeted Technology Evaluations

### Simulation and Risk Analysis

- Real-time and Fast-time Studies
- Hazard Analysis.

## Products

### Software Prototypes

- FIMS Prototype
- NASA UAS Service Supplier (USS)
- USS Discovery Service
- UAS Operator Client
- Authentication/Authorization Service

### ICDs and APIs

- USS-FIMS Specification
- USS-USS Specification
- Weather and Surveillance SDSP ICD
- V2V Communication Specification

### Concept Documents

- UTM CONOPS and Use Cases
- USS Onboarding Process
- Communication and Navigation Model
- UTM Conflict Mitigation Model
- Hazard Identification and Analysis

### Reference Technology Implementations

- UAS Detect and Avoid System
- Urban Operations UAS System

## Outcomes

### Fielded Systems

- FAA LAANC uses UTM concept
- FAA to use UTM in their Pilot Program (UPP) demonstration in FY2019
- DoT/FAA expected to use UTM system for the Integrated Pilot Program (IPP)

### UAS Rule Making

- Beyond Part 107 (BVLOS)
- FIMS/USS Roles and Responsibilities

### Industry Guidance

- Safety Case Development
- Data Exchange and Protocols
- Industry Standards

### International Harmonization

- UTM Construct and Architecture (e.g. ICAO)
- Use Cases (e.g. JAXA Disaster Relief)



# NASA/FAA Research Transition Team



## • Purpose

- The RTT provides the forum for NASA researchers and FAA implementers to collaborate on UTM system and operational concepts and effectively transfer the project results

## • Four Working Groups

- Concepts and Use Cases
- Data Exchange and Architecture
- Sense and Avoid
- Communication and Navigation

## • Key RTT Deliverables (FAA needs)

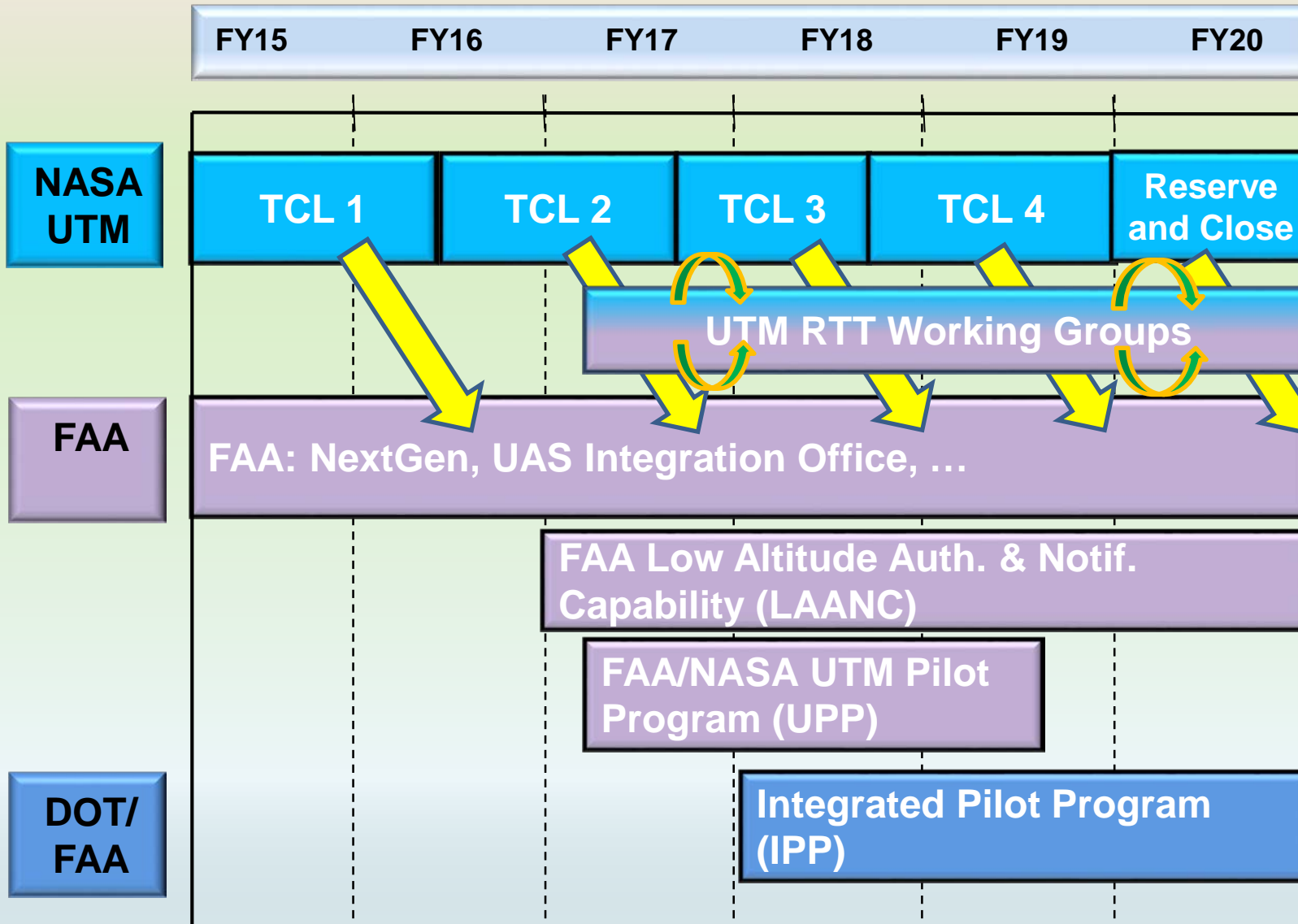
- Tech transfer - to FAA and industry
  - Concepts and requirements for data exchange and architecture, communication/navigation and detect/sense and avoid
    - Cloud-based architecture and ConOps
    - Multiple, coordinated UAS BVLOS operations
    - Multiple BVLOS UAS and manned operations
    - Multiple operations in urban airspace
- Tech transfer to FAA
  - Flight Information Management System prototype (software prototype, application protocol interface description, algorithms, functional requirements)

## • FAA-NASA Key RTT Deliverable

- Joint FAA-NASA UTM Pilot Program

**RTT will culminate into key technical transfers to FAA and joint pilot program plan and execution**

# UTM Development and Implementation



- Tech transfers to the FAA support:
- NextGen
  - UAS Integration Office
  - Flight Standards
  - Aircraft Cert. Service
  - And others

# Technical Capability Levels (TCL)



Risk-based development and test approach along four distinct TCL



## TCL1

Remote Population  
Low Traffic Density  
Rural Applications  
Multiple VLOS  
Operations  
Notification-based  
Operations

## TCL 2

Sparse Population  
Low-Mod Traffic Density  
Rural / Industrial  
Applications  
Multiple BVLOS  
Operations  
Tracking and  
Operational Procedures

## TCL 3

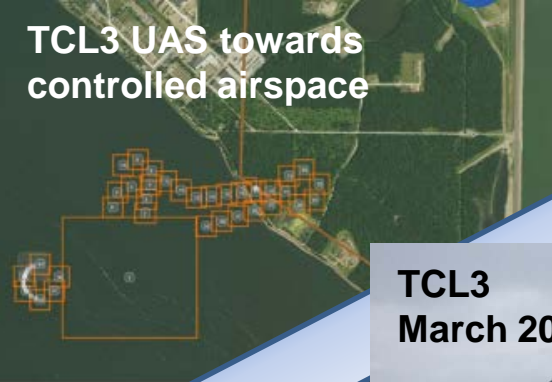
Moderate Population  
Moderate Traffic Density  
Suburban Applications  
Mixed Operations  
Vehicle to Vehicle  
Communication  
Public Safety Operations

## TCL 4

Dense Population  
High Traffic Density  
Urban Applications  
Dense BVLOS Operations  
Large Scale Contingency  
Management



# TCL 1, 2 and 3 (in progress)



TCL3 UAS towards controlled airspace



TCL3 March 2018

TCL 3



Nat'l Campaign 2: May 2017



TCL3 First Responders



Nat'l Campaign 1: May 2016

TCL 2



Nat'l Campaign 2



TCL 1 demo: August 2015

**Operational Area**

Reno-Stead Airport

**UAS Range**

- Elevation: 5050 feet
- Desert Terrain
- Missions up to 500 ft
- Operations at 5 Locations

**State of Nevada Test Site**

Reno

**SRHawk Radar**  
Used to detect small UAS

**Weather Equipment**  
30 ft. radius, 100 ft. height, 100 ft. range

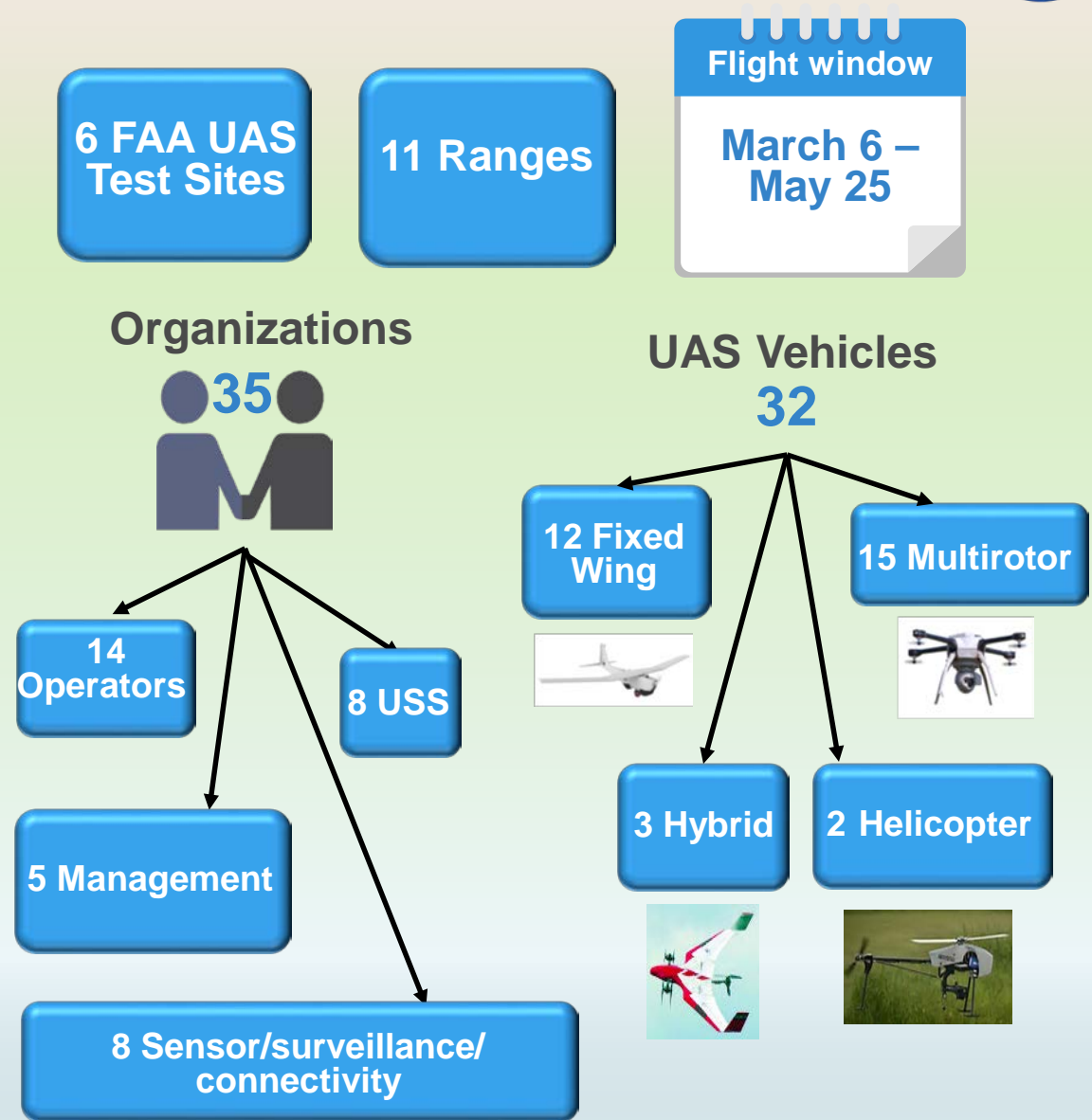
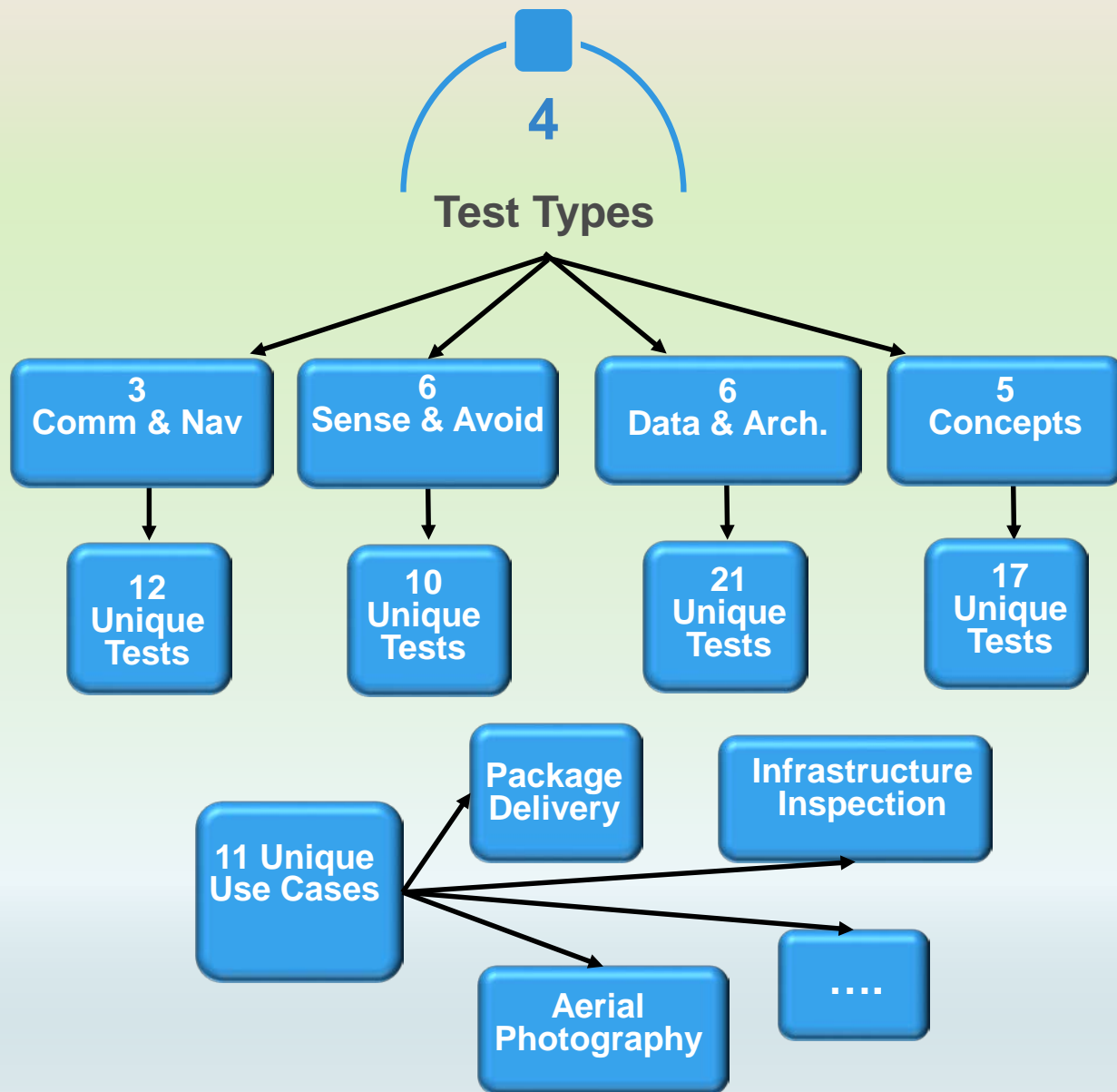
**LS**  
Used to detect manned aircraft

TCL 2 demo: Oct 2016

Participating Orgs	
TCL 1	19
TCL 2	42
TCL 3	35

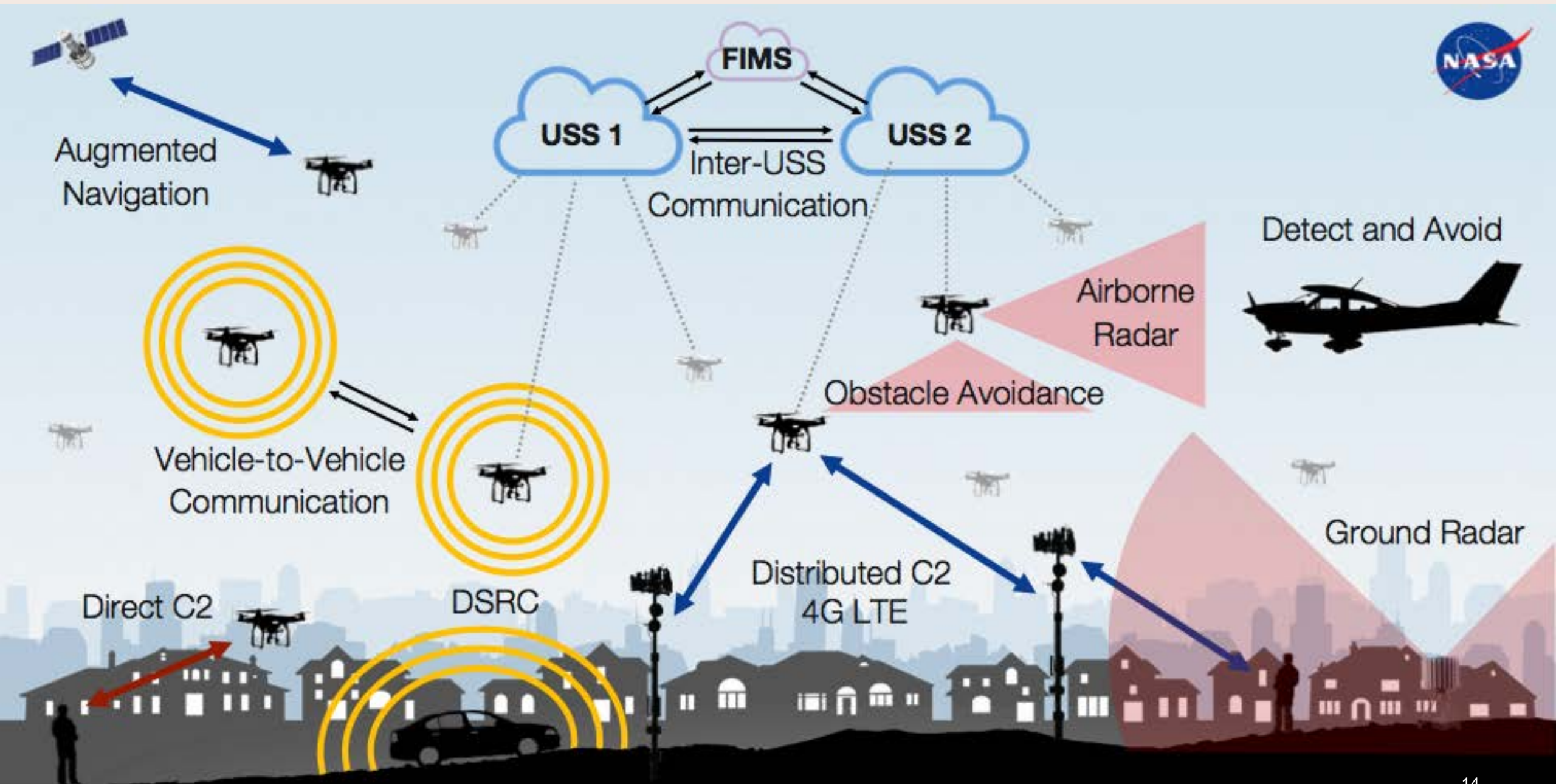
TCL 1

# TCL 3 Flight Test Highlights





# Technical Capability Level 3 Flight Tests

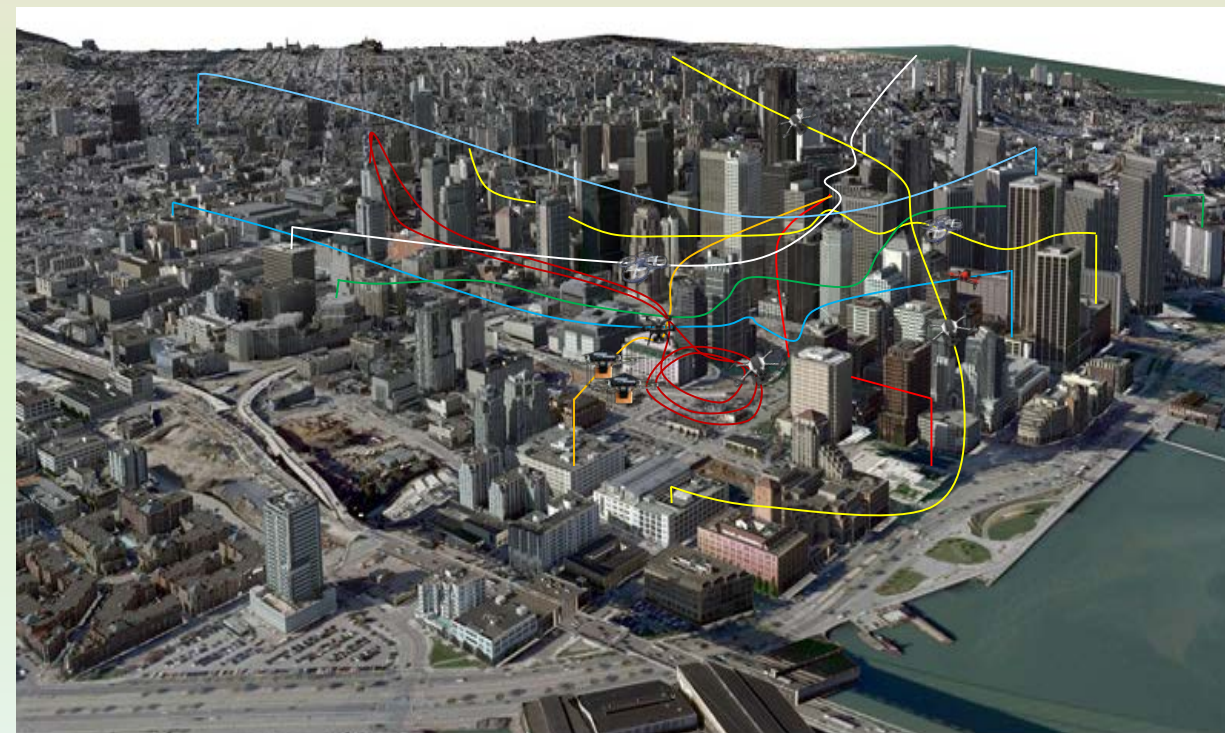




# Upcoming TCL 4 Testing, Complex Urban Environments

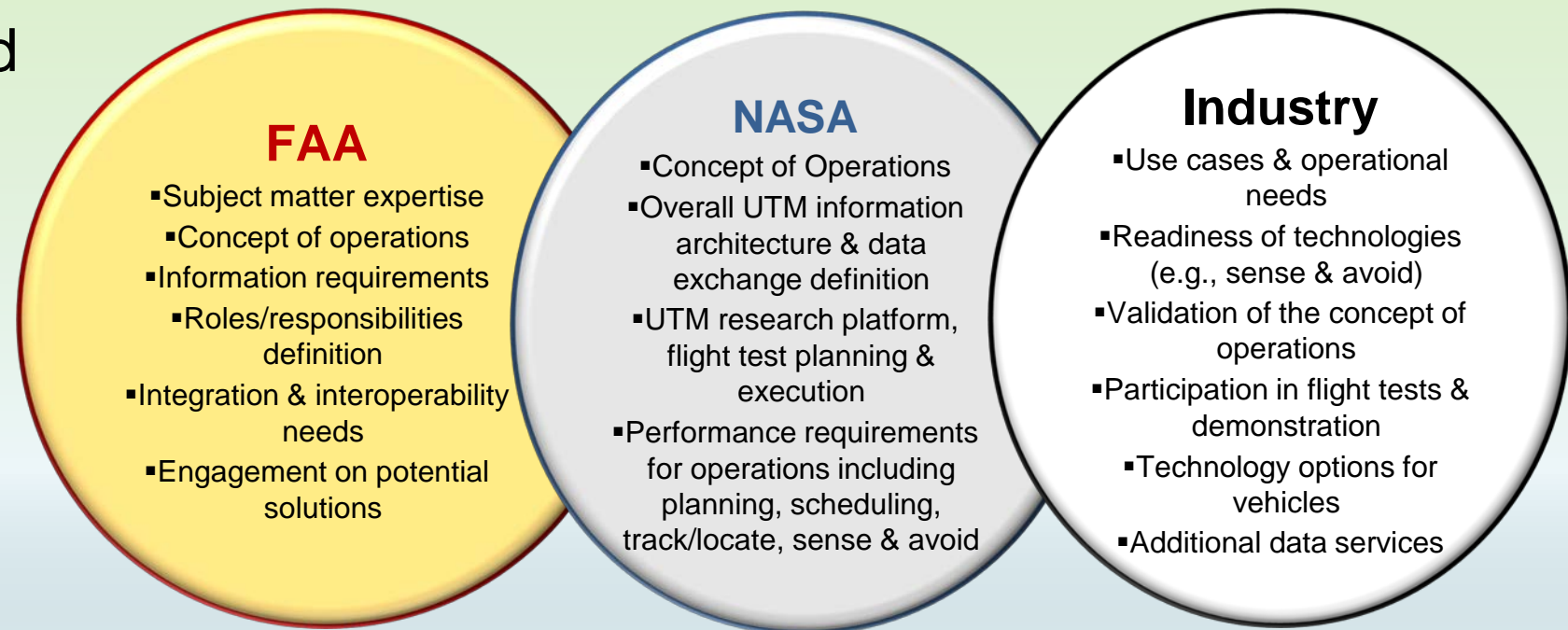


- Key research areas
  - High density BVLOS operations
  - Large scale contingency management
  - USS/USS contingency procedures
  - Public safety data exchange and security
  - Obstacle avoidance
  - Off nominal separation
  - Distributed and degraded communications
  - GPS-denied environment
  - Supplemental Data Service Providers: weather, urban maps, risk modeling, etc.



# UTM Partnering

- From project inception partnering has been a priority
- Very close collaboration with FAA and industry through RTT working groups which have approximately 40 partner organizations participating
- Many additional UTM partners in industry, government and academia with space act or other types of agreements
- FAA UAS test sites used for TCL 1-3 testing
- Each site collaborates with NASA partners and others



# Opportunities



- Participate in TCL 4 testing – information later this year
  - Sense and avoid, communication and navigation, vehicle and ground technologies
- RTT Working Groups
  - Engage in discussions, studies
- FAA/NASA UTM Pilot Program
  - Upcoming solicitation to FAA Test Sites opportunity to participate in UPP
- Respond to the NASA Request for Information to introduce your capabilities
  - [https://www.fbo.gov/index?s=opportunity&mode=form&id=34469d19af9f5745ea2cb4bf2e0145eb&tab=core&\\_cview=0](https://www.fbo.gov/index?s=opportunity&mode=form&id=34469d19af9f5745ea2cb4bf2e0145eb&tab=core&_cview=0)
  - Potential partnerships may result in Non Reimbursable Space Act Agreements





# Summary

- **UTM is successfully developing the framework** for large scale, small UAS traffic management. See UTM website for publications:  
<https://utm.arc.nasa.gov/documents>
- **NASA and the FAA are closely collaborating** to ensure appropriate regulatory and operational requirements are included and that technology transfers support the development of future operational systems
- **TCL Demonstrations include many testing organizations, industry, and academia partners** that are crucial to validating requirements and investigating technology solutions
- **Next up TCL 4** will evaluate the effectiveness and interoperability of technologies to support separation, communication, navigation, data-exchange, and airspace management in more complex operational urban environments