



Unmanned Aircraft System Traffic Management (UTM) Project

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Topics

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

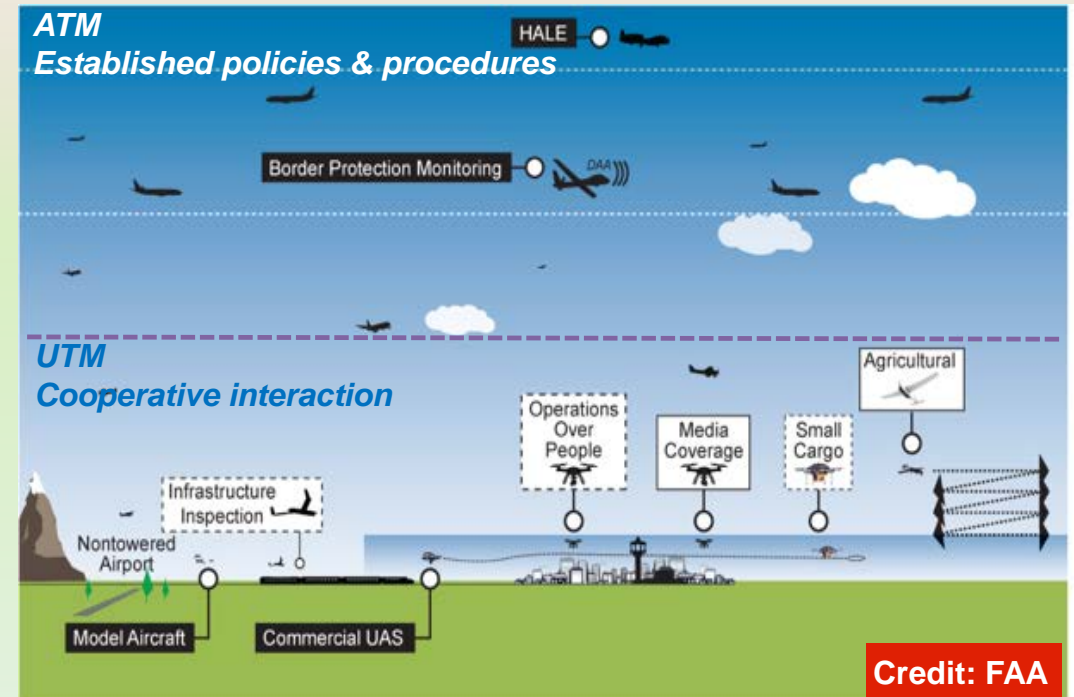
Why is UTM Needed?

- 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

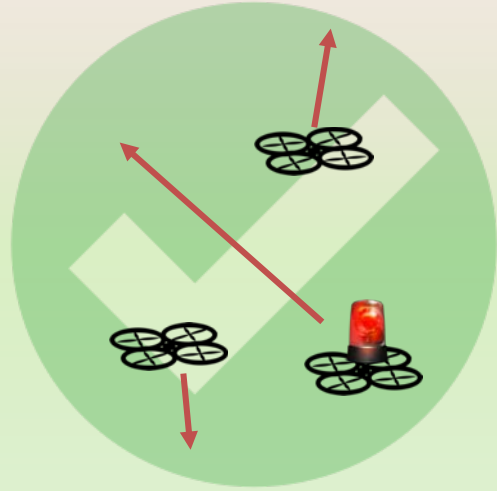
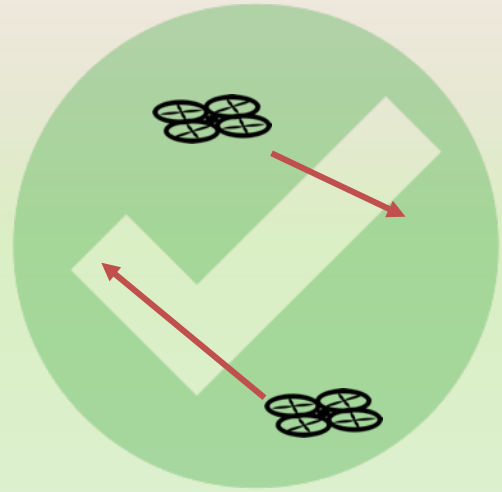


What is UTM?

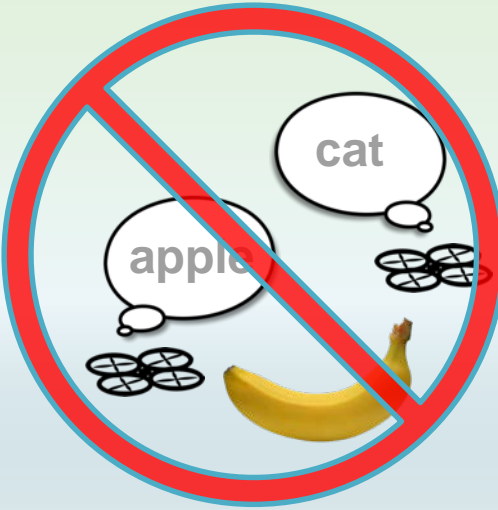
- UTM is an “air traffic management” ecosystem for uncontrolled airspace
- UTM utilizes industry’s ability to supply services under FAA’s regulatory authority where these services do not exist
- UTM development will ultimately enable the management of large scale, low-altitude UAS operations
 - Operational 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



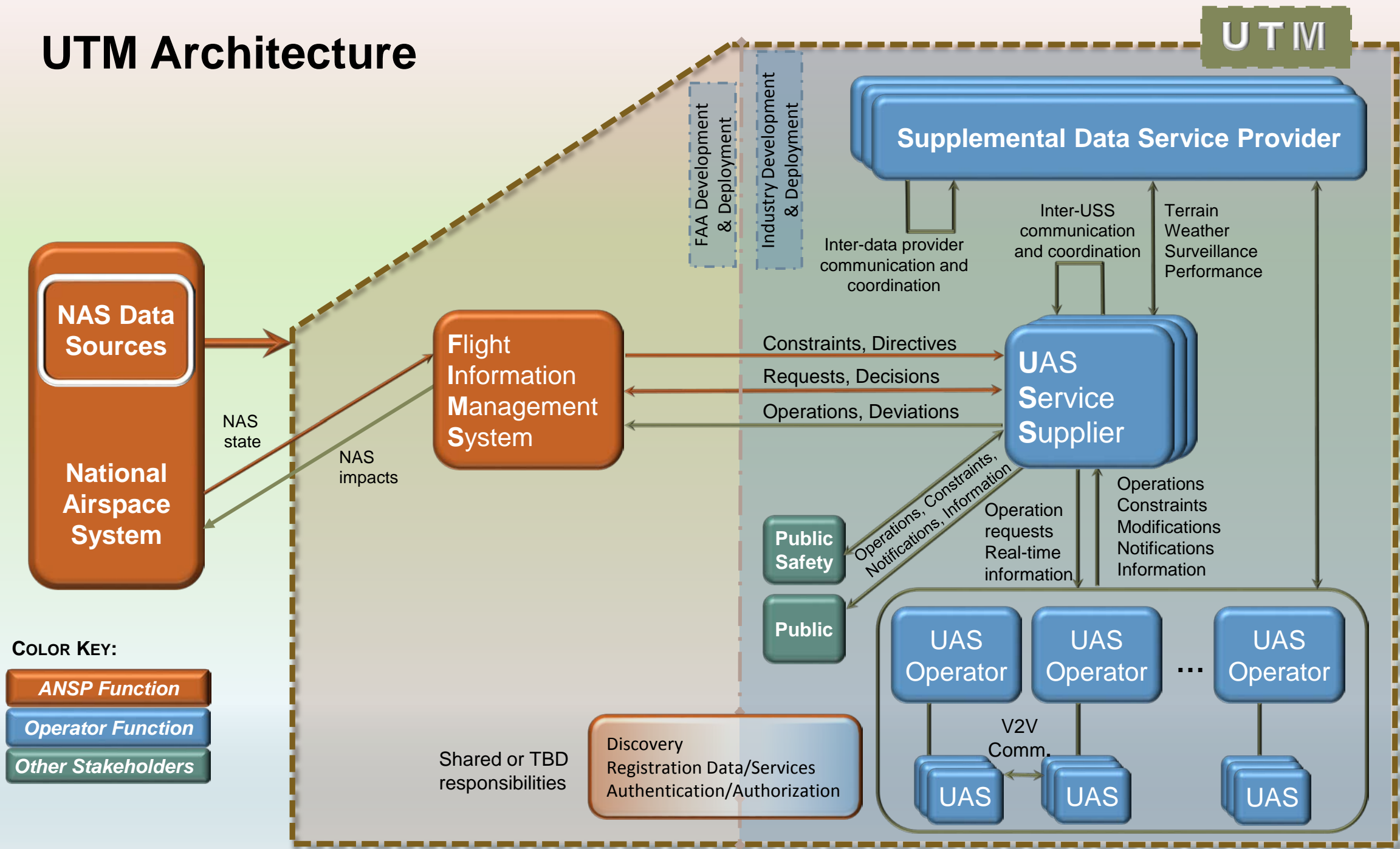


Key Operational Assumptions

- 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



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)

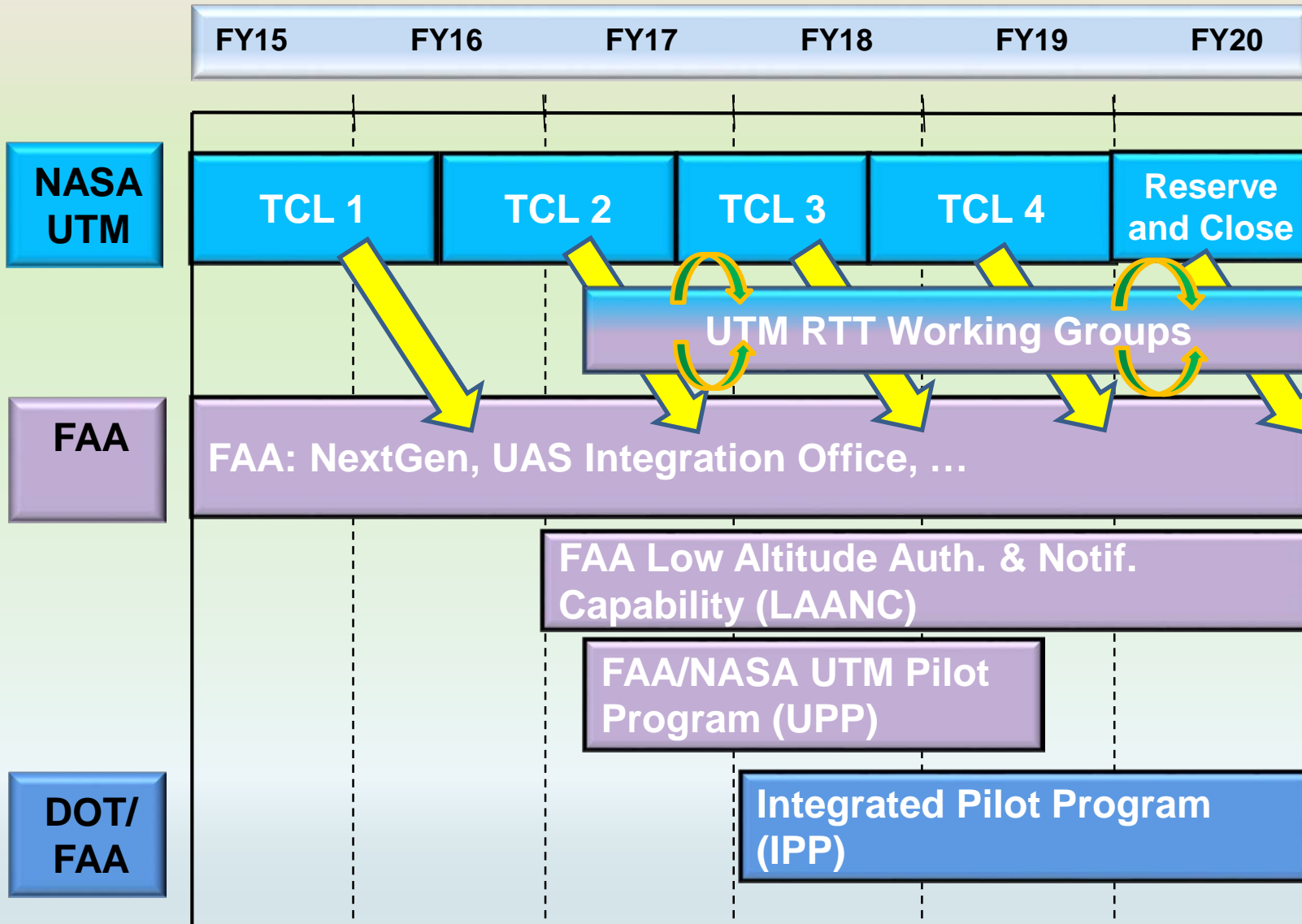
- Tech transfer - to FAA and industry
 - Concepts and requirements for data exchange and architecture, communication/navigation and detect/sense and avoid
 - Cloud-based architecture and ConOps
 - Multiple, coordinated UAS BVLOS operations
 - Multiple BVLOS UAS and manned operations
 - Multiple operations 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

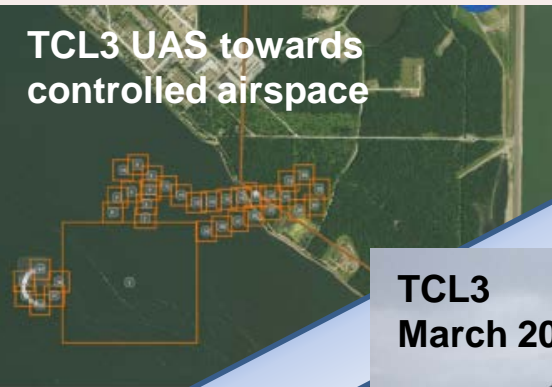
TCL 3

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

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

State of Nevada Test Site

SRIHawk Radar
Used to detect small UAS

Weather Equipment
30 ft tower used to collect weather data

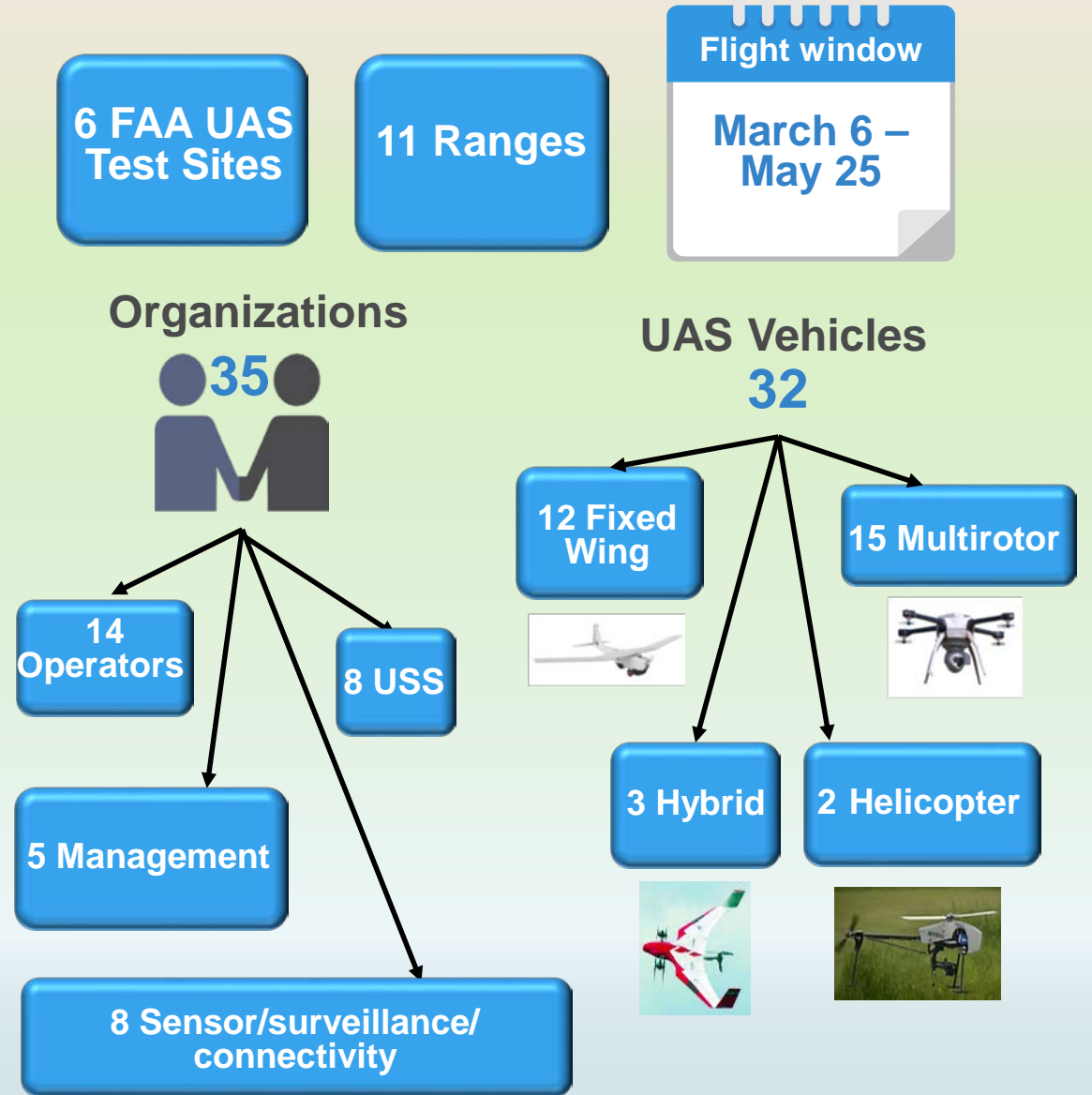
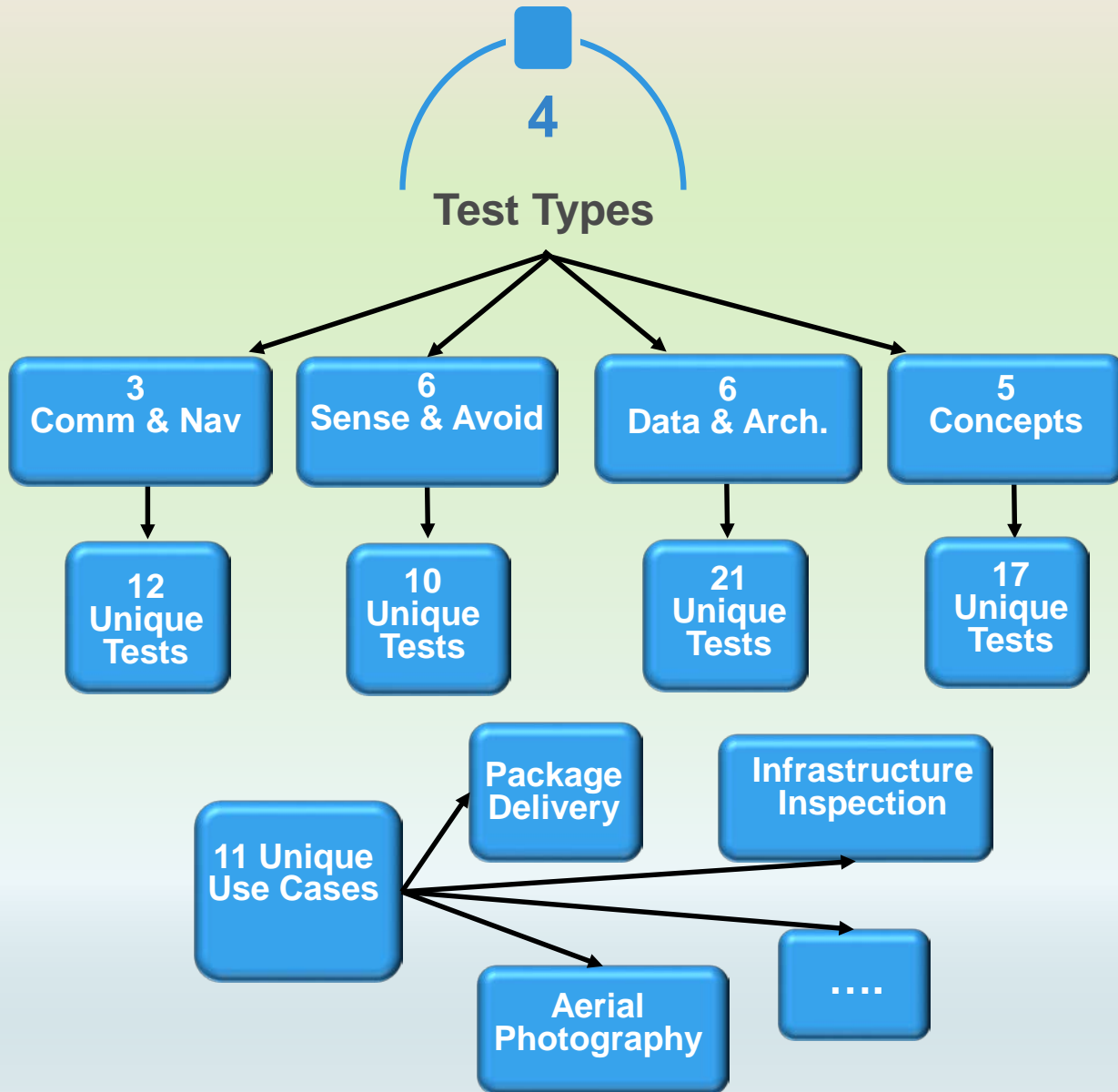
LSI
Used to detect manned aircraft

TCL 2 demo:
Oct 2016

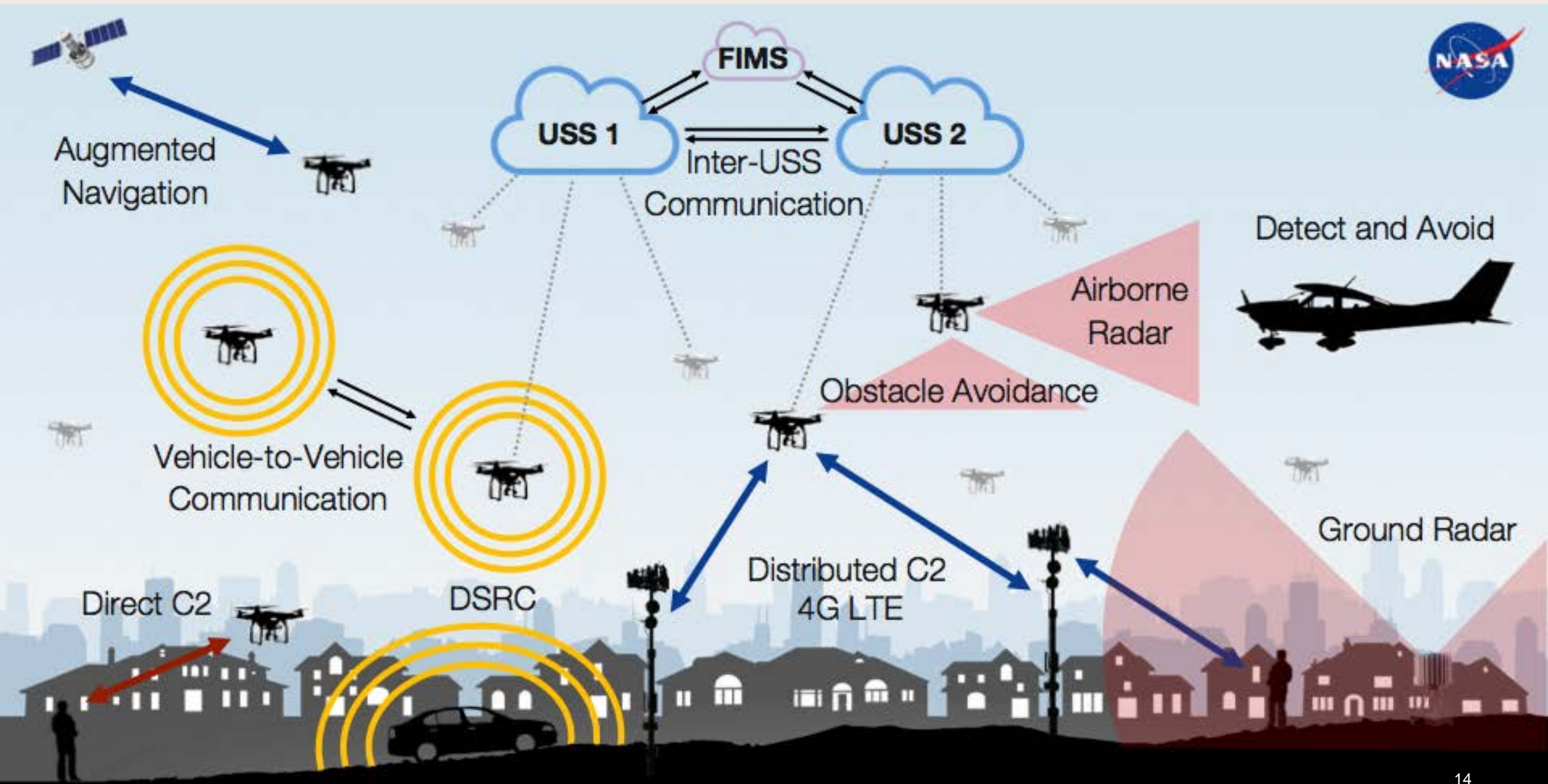
Participating Orgs	
TCL 1	19
TCL 2	42
TCL 3	35

TCL 1

TCL 3 Flight Test Highlights



Technical Capability Level 3 Flight Tests



Upcoming TCL 4 Testing, Complex Urban Environments



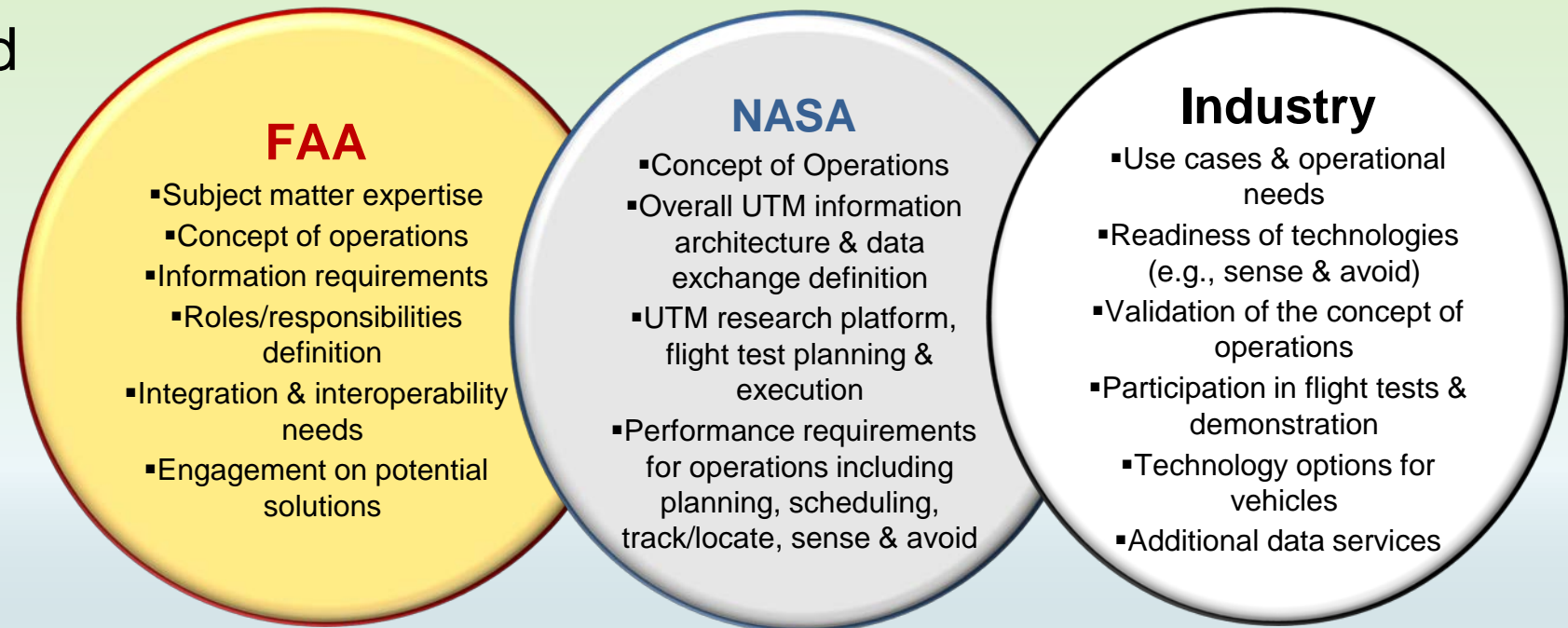
- Key research areas
 - High density BVLOS operations
 - Large scale contingency management
 - USS/USS contingency procedures
 - Public safety data exchange and security
 - Obstacle avoidance
 - Off nominal separation
 - Distributed and degraded communications
 - GPS-denied environment
 - Supplemental 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
 - 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