



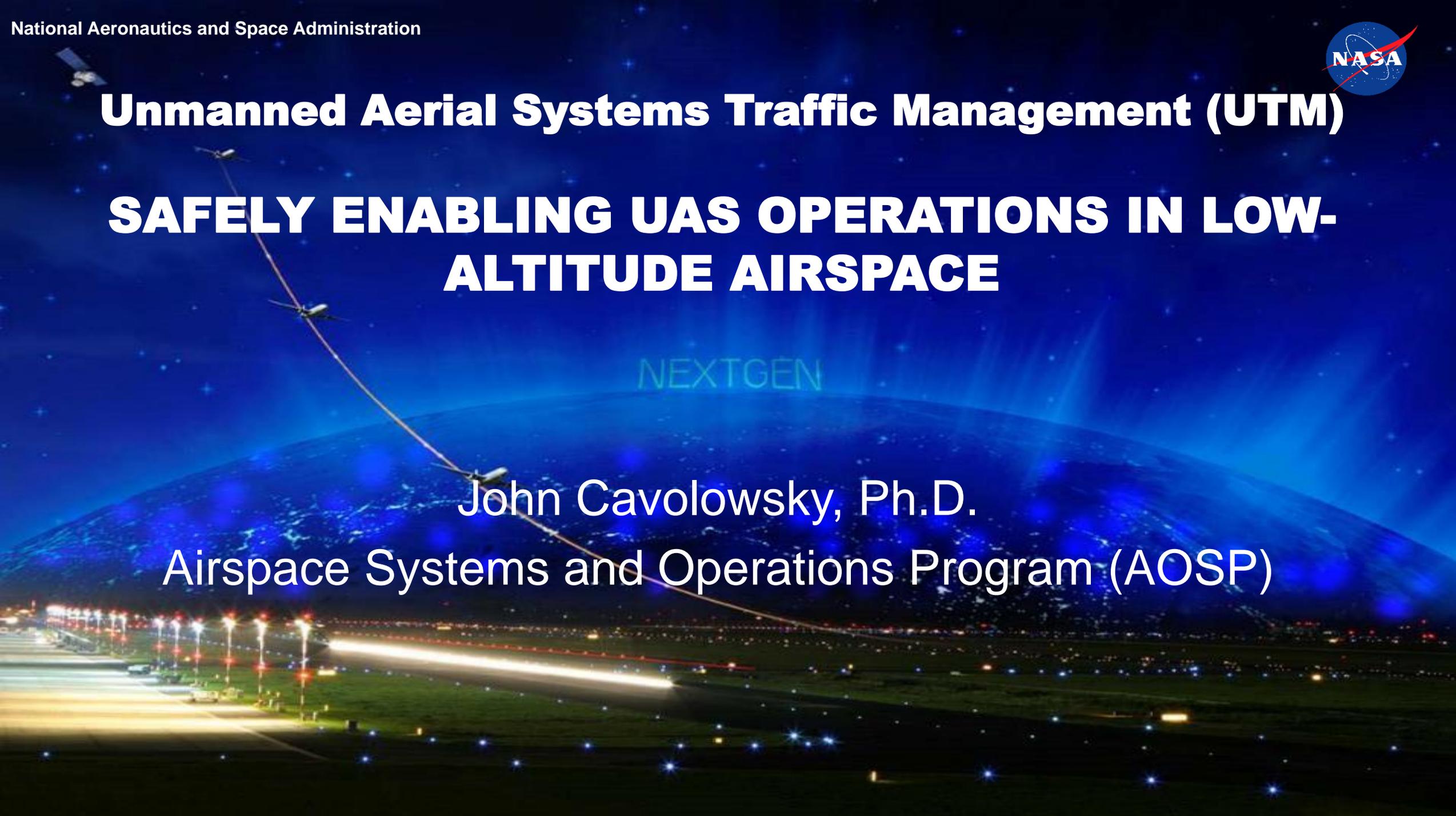
Unmanned Aerial Systems Traffic Management (UTM)

SAFELY ENABLING UAS OPERATIONS IN LOW-ALTITUDE AIRSPACE

NEXTGEN

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Airspace Systems and Operations Program (AOSP)

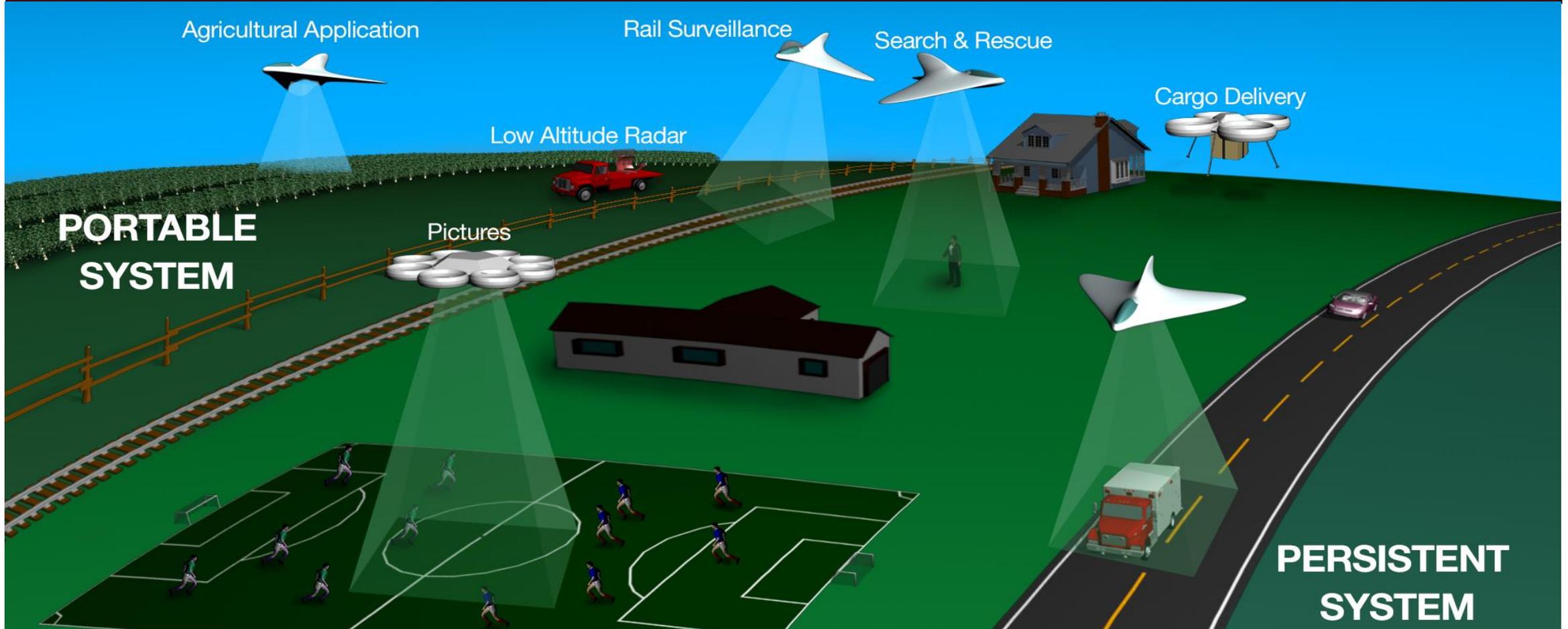


Unmanned Aerial System Traffic Management (UTM)



Near-term Goal: Safely enable initial low-altitude UAS as early as possible

Long-term Goal: Accommodate increased demand with highest safety, efficiency, and capacity



UTM: Balancing Multiple Needs



NATIONAL AND REGIONAL SECURITY

Protecting key assets

SAFE AIRSPACE INTEGRATION

Flexibility where possible and structure where needed

Geographical needs, application, and performance-based airspace operations

SCALABLE OPERATIONS FOR ECONOMIC GROWTH

Ever-increasing applications of UAS: Commercial, Agricultural, and Personal

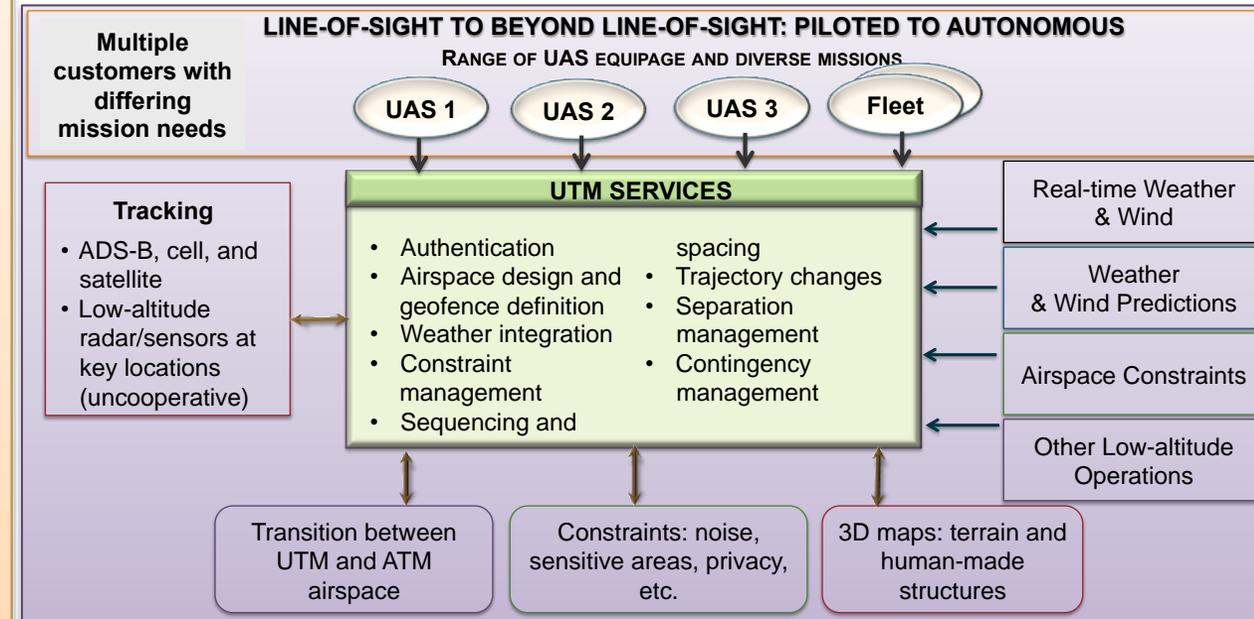
UTM Design Functionality: Cloud-based



Self-driving car does not eliminate lanes and rules for efficient and safe operations

DIGITAL, VIRTUAL, & FLEXIBLE RISK-BASED APPROACH AND SERVICE INFRASTRUCTURE

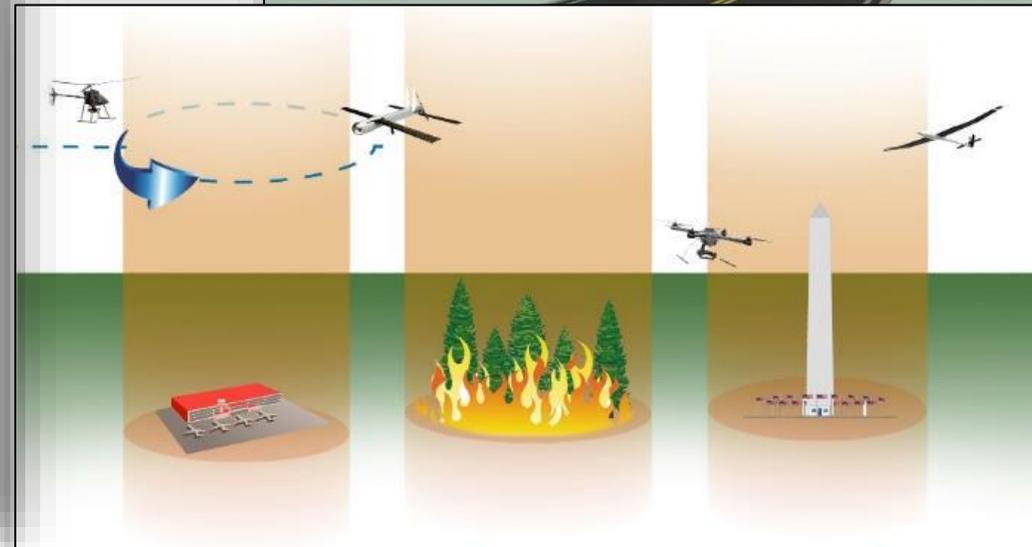
- Safe low-altitude UAS operations with
 - Airspace management and geofencing
 - Weather and severe wind integration
 - Predict and manage congestion
 - Terrain and man-made objects: database and avoidance
 - Maintain safe separation (Airspace reservation, V2V, & V2UTM)
 - Allow only authenticated operations



UTM Functions

AIRSPACE OPERATIONS & MANAGEMENT

- ~500 ft. and below
- Geographical needs and applications
- Rules of the airspace: performance-based
- Geofences: dynamic and static



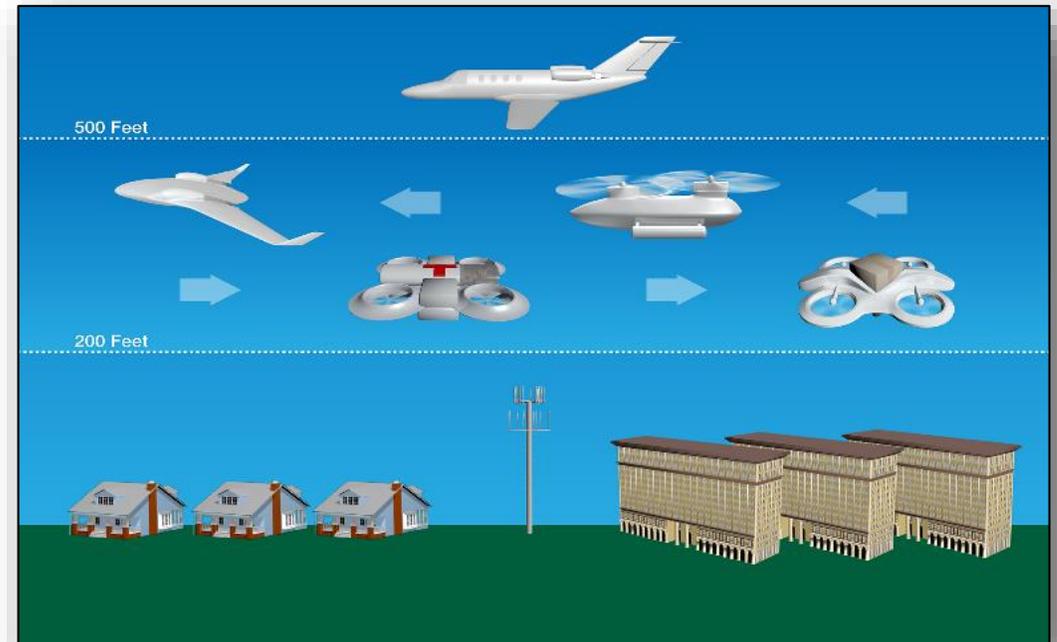
UTM Functions

WIND & WEATHER INTEGRATION

- Actual and predicted winds/weather

CONGESTION MANAGEMENT

- Demand/capacity imbalance
- Only if needed – corridors, altitude for direction, etc.



UTM Functions

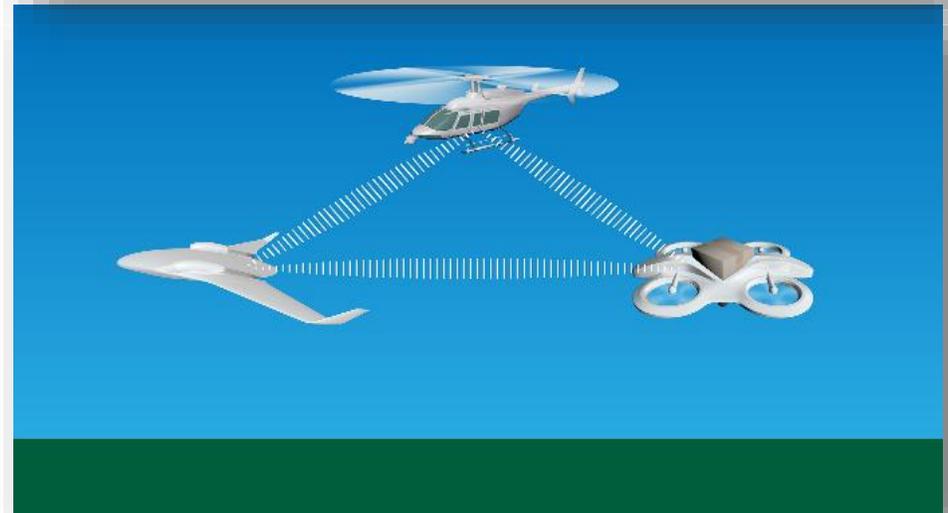
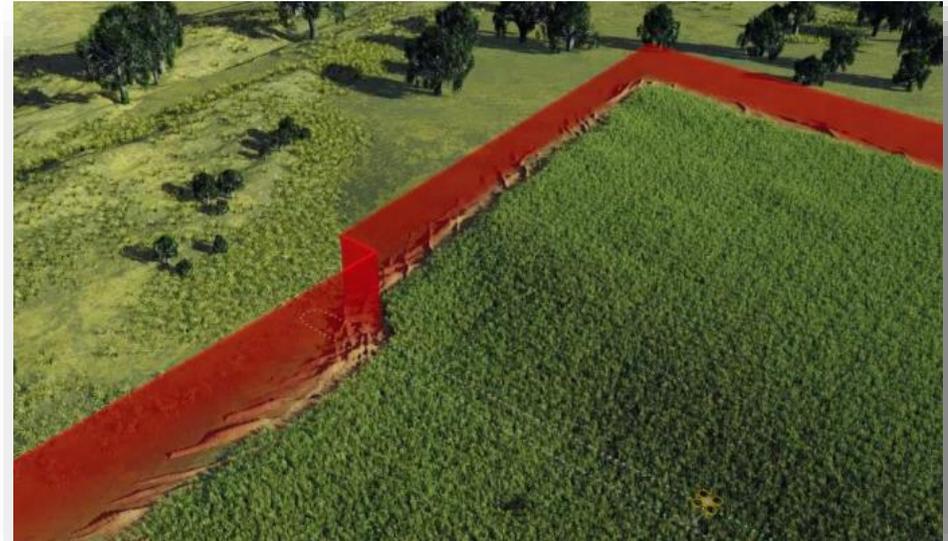


SEPARATION MANAGEMENT

- Airspace reservation
- V2V and V2UTM
- Tracking: ADS-B, cellphone, & satellite based

CONTINGENCY MANAGEMENT

- Large-scale GPS or cell outage
- 9-11 like situations





BUILD 1 (AUGUST 2015)

- **Reservation of airspace volume**
- Over unpopulated land or water
- Minimal general aviation traffic in area
- Contingencies handled by UAS pilot
- Enable agriculture, firefighting, infrastructure monitoring

BUILD 2 (OCTOBER 2016)

- **Beyond visual line-of-sight**
- Tracking and low density operations
- Sparsely populated areas
- Procedures and “rules-of-the road”
- Longer range applications

BUILD 3 (JANUARY 2018)

- Beyond visual line-of-sight
- Over moderately populated land
- Some interaction with manned aircraft
- **Tracking, V2V, V2UTM and internet connected**
- Public safety, limited package delivery

BUILD 4 (MARCH 2019)

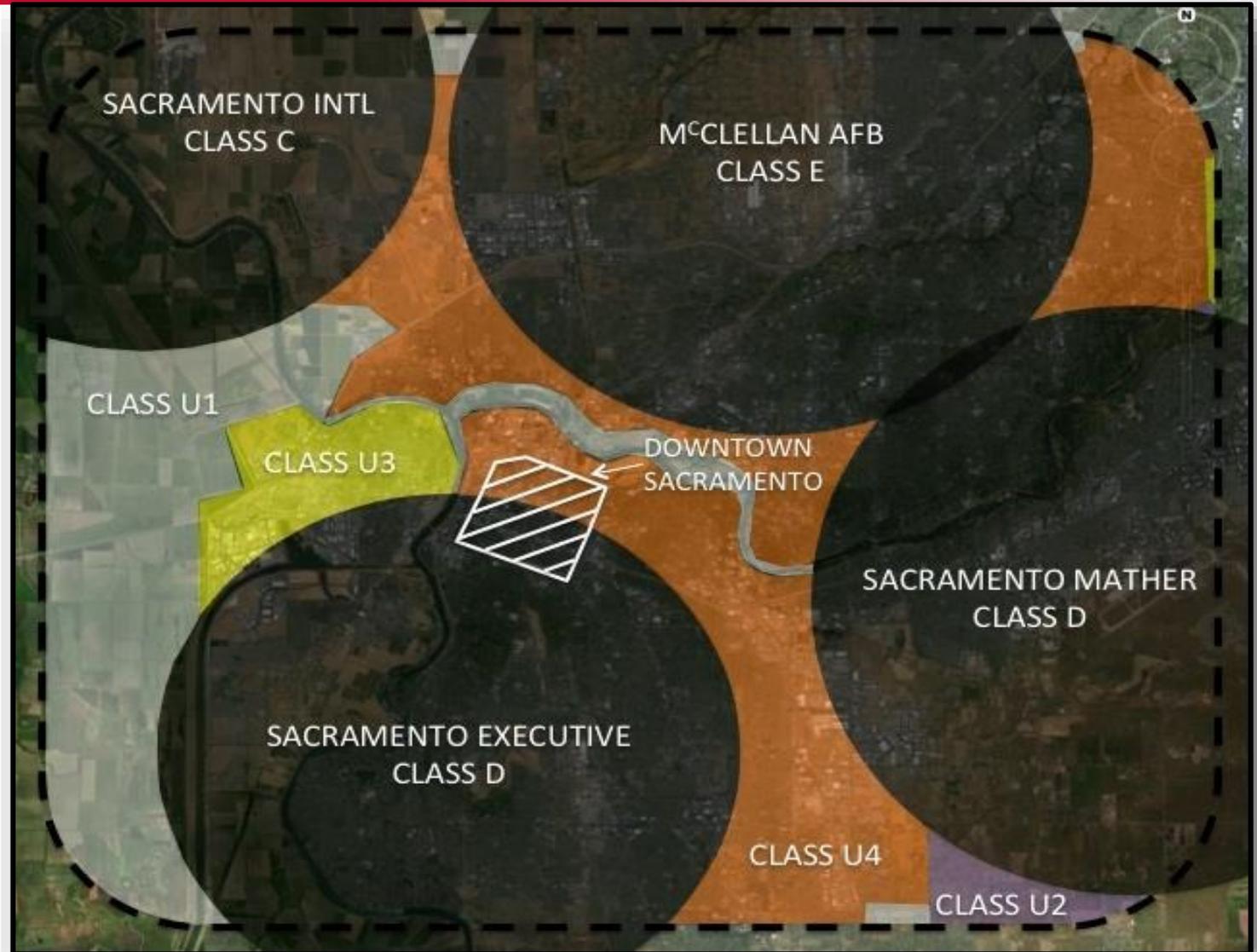
- Beyond visual line-of-sight
- **Urban environments, higher density**
- Autonomous V2V, internet connected
- Large-scale contingencies mitigation
- News gathering, deliveries, personal use

Notional UTM Airspace

Multiple providers could offer some UTM services

Tailoring operational services based on geographical area needs

Vehicle performance could be different





Consideration of Business Models

Single service provider:
government entity

Traditional ANSP, like the FAA

Single service provider: a
non-government entity

Web services - General Aviation
flight service station model

**UTM POTENTIAL
BUSINESS MODELS**

Each state may implement or
delegate to counties/cities

Regional implementations by
various companies - customized

Multiple service providers:
state/local government entities

Multiple service
providers: non-
government entities

**Regulator has a key role in certifying UTM system and operations.
All UTM systems must interoperate.**

- Research Transition Team with FAA, DHS, and DoD
- **125+** industry and academia collaborators and increasing
- Initial UTM Concept of Operations: Industry, academia, and government
- Client interface allows to connect partners to the UTM
- **Build 1 tests** with 12 partners were successfully completed – data is being analyzed
 - Included NASA and partner vehicles, ADS-B, cell-based communications, and low-altitude radar for non-cooperative targets
 - Data: Trajectory conformance accuracy, geo-fencing conformance reliability, UTM usability
- International interest

RTCA - FACA



- NASA and FAA will work together to institute RTCA committee
- Terms of reference are being finalized
- Close coordination between NASA and FAA will be maintained for one government voice for move forward strategy
- UTM construct may be adapted based on FAA and industry inputs, as well as UTM field tests

Next Steps



- UTM Build 1 testing in August
 - Development, simulations, and testing of UTM Builds 2-4
 - Safety analysis
- NASA will continue to work with industry, academia, and government groups
 - Refine operational requirements, system architecture(s), prototype, and conduct tests – Continue until safe airspace integration is proven!
- National initial safe UAS integration campaign: coordinated effort for data collection and demonstrations
 - Through FAA test sites and other approved locations

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