



Unmanned Aerial System Traffic Management (UTM)

SAFELY ENABLING LOW-ALTITUDE AIRSPACE OPERATIONS

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Collaborators: 125+ industry and academia members, FAA, DHS, DoD, DOI, and NOAA

UTM Convention 2015

NASA, Moffett Field, CA

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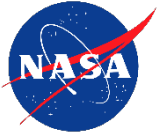
Unmanned Aerial System Traffic Management (UTM)



- Flexibility Where Possible Structure Where Necessary
- Performance Based Airspace and Traffic Management



- **Near-term Goal** – Enable initial low-altitude airspace and unmanned aerial system (UAS) operations with demonstrated safety as early as possible, within 5 years
- **Long-term Goal** – Accommodate increased UAS operations with highest safety, efficiency, and capacity as much autonomously as possible (10-15 years)



UTM: Balancing Multiple Needs

National and Regional Security

Geo-fences around fixed and dynamic areas (Protection, Detection, and Mitigation)

Non cooperative and intentional rogue elements

Safe Airspace Integration

Flexibility where possible structure where needed

Performance based airspace operations

Tracking and allowable airspace

Scalable Operations for Economic Growth

Agriculture, News Gathering, Infrastructure Inspection, and Commercial operations

Humanitarian, Public Safety, Fire fighting

Every home will have drone and serve as aerodrome



UTM Design Functionality

- Low-altitude UAS operations will be safer 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 (reservation, V2V, and V2I)
 - Allow only authenticated operations

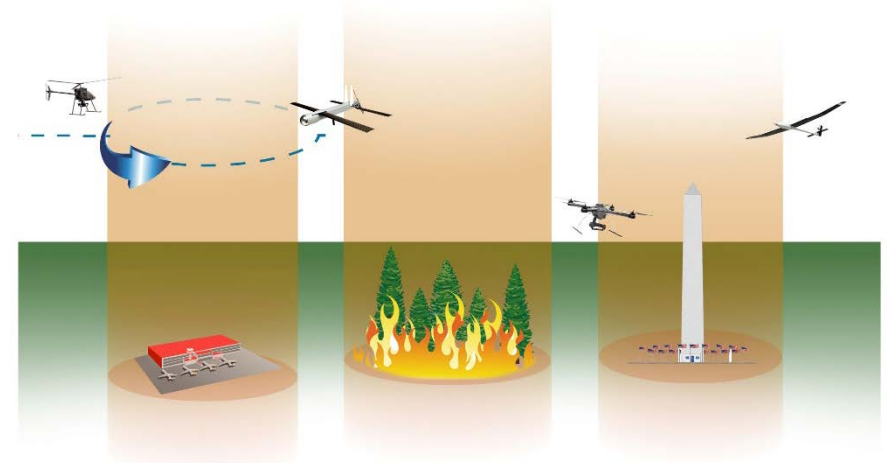
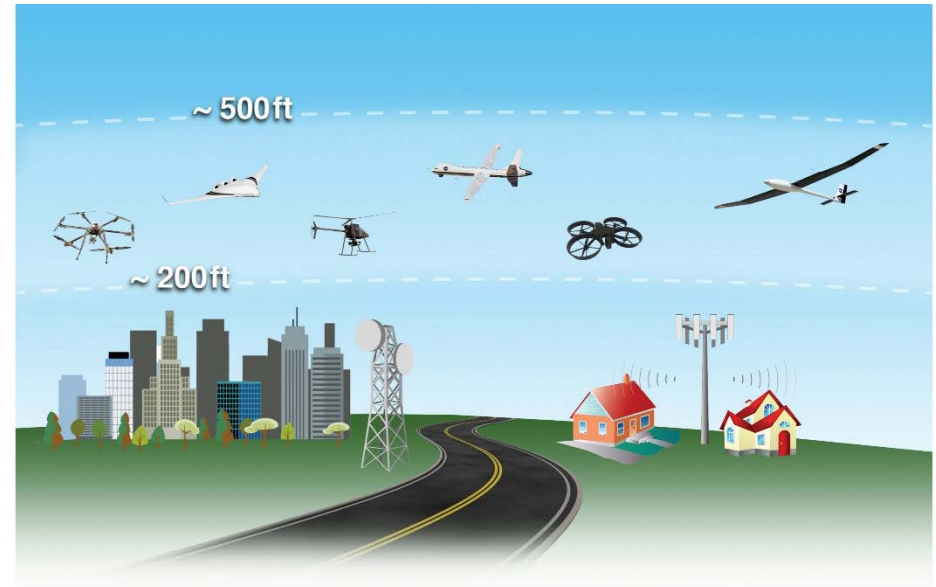
- **ANALOGY:** Self-driving or person driving a car does not eliminate roads, traffic lights, and rules
- **MISSING:** Infrastructure to support operations at lower altitudes

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

UTM Functions

Airspace Management

- Performance based airspace operations
- Demand-capacity imbalance management, if needed
- Geo-fences: dynamic and static
- Tracking vehicles



UTM Functions

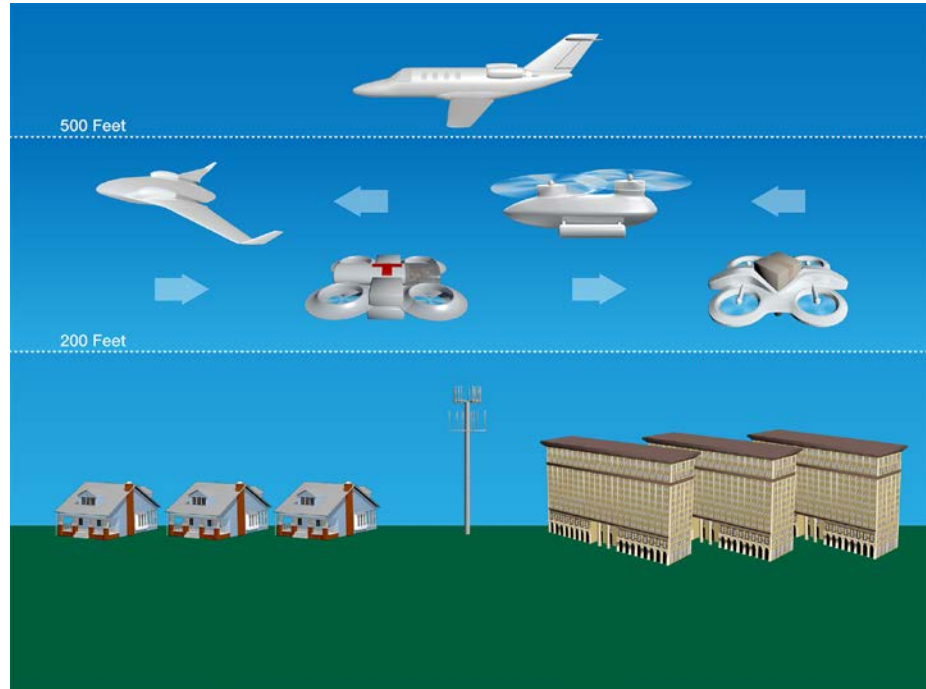
Wind and Weather Integration

- Actual and predicted weather (winds)



Congestion Management (Demand/Capacity Imbalance)

- Only if needed – Corridors, Altitude for direction, etc.



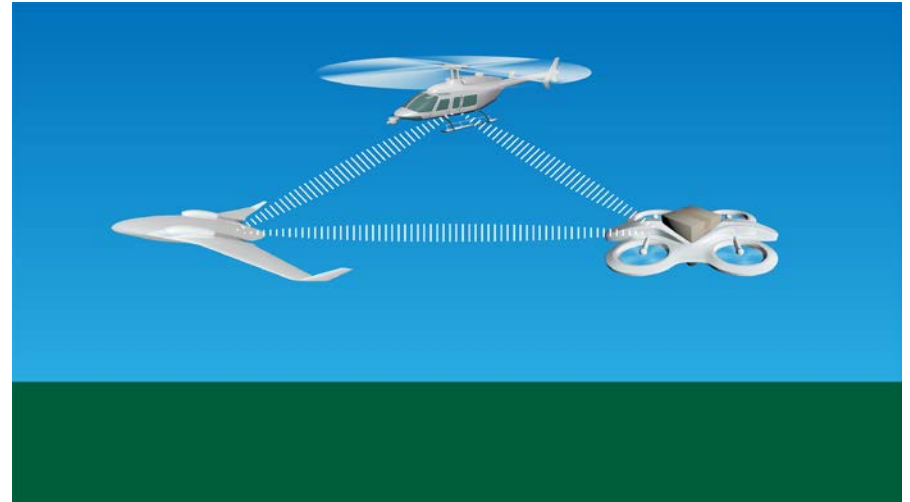
UTM Functions

Separation Management

- Airspace Reservation
- V2V and V2I
- Tracking – ADS-B, Cellphone, and satellite based

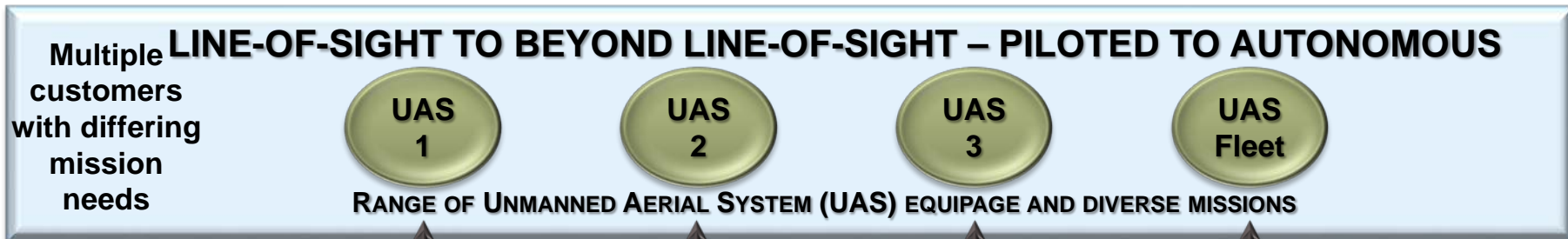
Contingency Management

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





UTM - One Design Option



Tracking:

- Low-altitude radar
- Surveillance coverage (cell and satellite)
- Communication

Unmanned Aerial System Traffic Management (UTM)

SERVICES

- Authentication
- Airspace design and geofence definition
- Weather integration
- Constraint management
- Sequencing and spacing
- Trajectory changes
- Separation
- management
- Transit points/coordination with the National Airspace System
- Geofencing design and adjustments
- Contingency management

- Real-time Weather & Wind
- Weather & Wind Predictions
- Airspace Constraints
- Other low-altitude operations

Transition between UTM and Air Traffic Management airspace

Constraints based on community needs about noise, sensitive areas, privacy, etc.

3D maps: terrain and human-made structures



High-Level UTM Builds

- **Build 1 (August 2015)**

- Reservation of airspace volume
- Over unpopulated land or water
- Minimal general aviation traffic in area
- Contingencies handled manually by UAS pilot
- Enable agriculture, firefighting, infrastructure monitoring, mapping use cases amongst others

- **Build 3 (January 2018)**

- Beyond line-of-sight
- Over moderately populated land
- Some interaction with manned aircraft
- In-flight separation of UAS
- Some contingencies resolved
- Law enforcement, limited package delivery, and other use cases

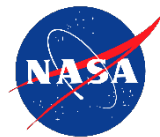
- **Build 2 (October 2016)**

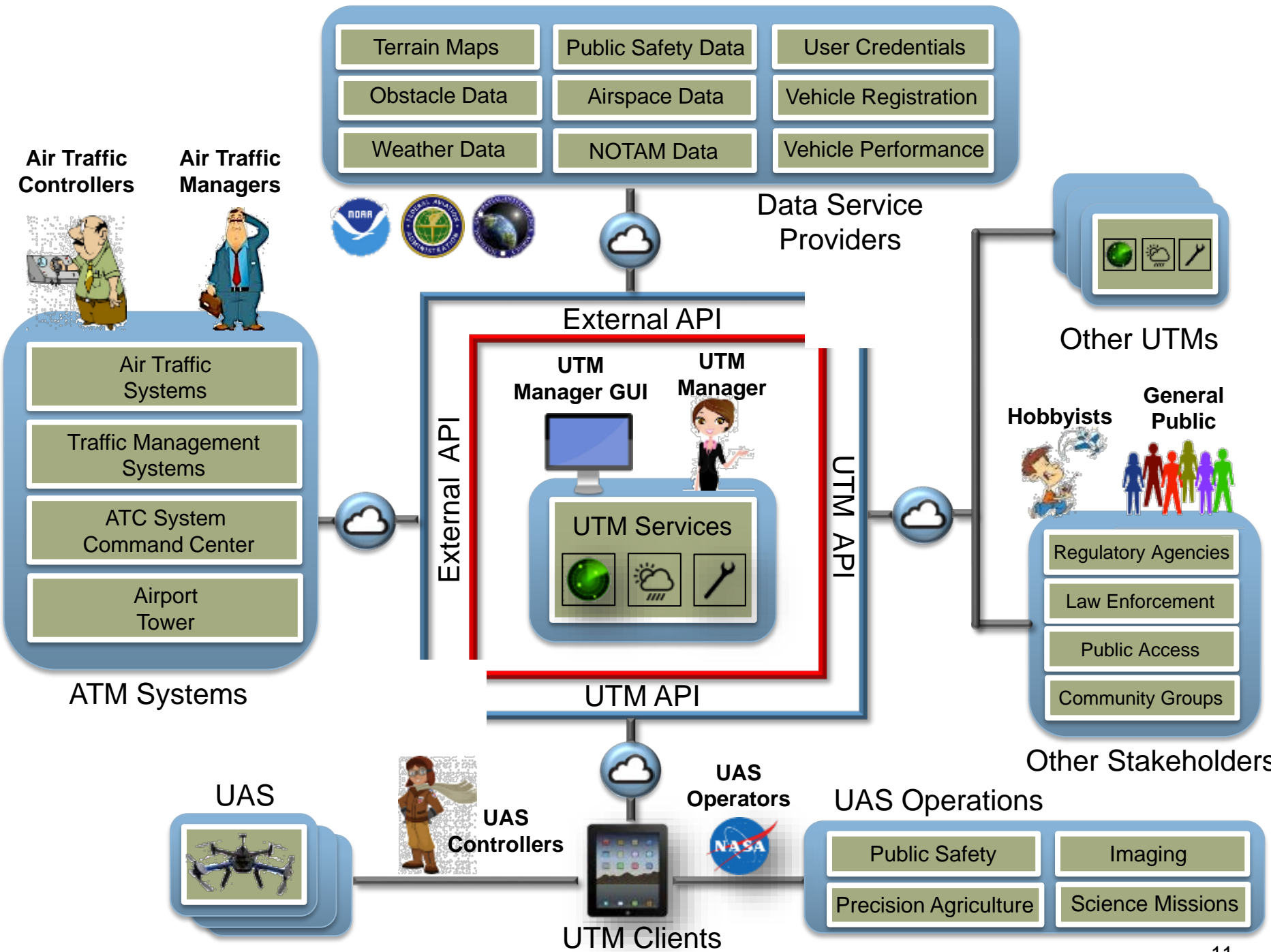
- Beyond line-of-sight
- Sparsely populated areas
- Procedures and “rules-of-the road” separate UAS
- Contingencies alerted to UAS operator

- **Build 4 (March 2019)**

- Beyond line-of-sight
- Urban environments
- Manned aircraft commonplace
- Autonomous separation of UAS
- Large-scale system-wide contingencies resolved

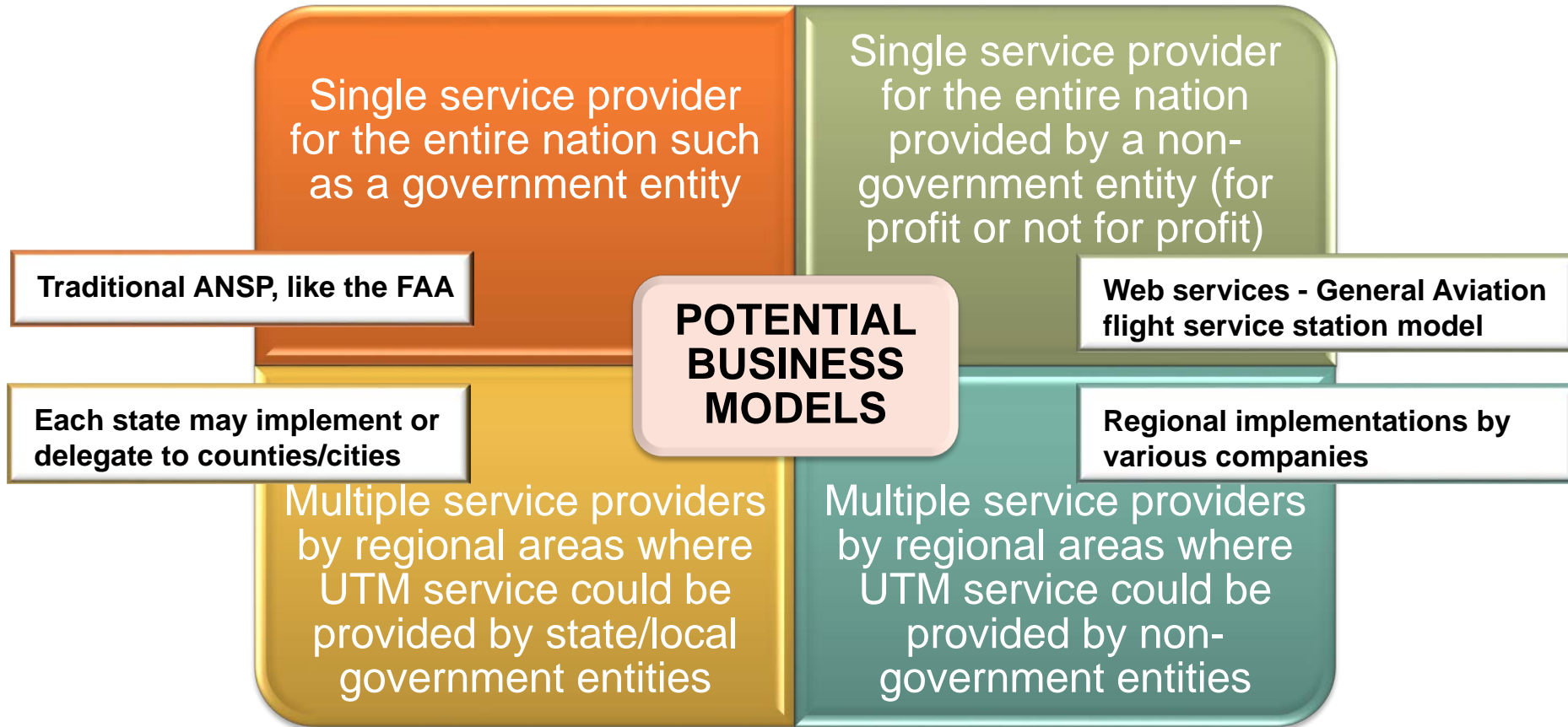
Notional UTM Airspace







Consideration of Business Models



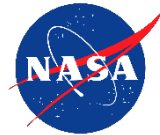
- Regulator has a key role in certifying UTM system and operations
- All UTM systems must interoperate



Key Considerations

- Multiple providers could offer UTM services
- Flexibility where possible, structure where absolutely necessary
- Digital, virtual, and dynamic airspace management
- Geo-fences national assets, airports, and other areas
- Separation management: airspace reservation and/or V2V
- Surveillance – Cell phone and satellite based communication, ADS-B where available
- Weather integration
- Large-scale contingency management procedures

Progress



- Research Transition Team with FAA, DHS, and DoD
- Over 125+ responses for collaboration and growing
- Initial UTM Concept of Operations shared with industry and government feedback (200+ comments incorporated)
- Client interface is ready – You can connect with UTM
- Build 1 is ready: Collaborative tests with 12 partners start end of August
- Demonstration on Thursday morning
- Initial UTM system and simulation platform are ready – Exhibit hall



Next Steps

- UTM Build 1 testing in August
 - Development and testing Build 1-4
 - Continue safety case for BVLOS through analysis and tests
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- **National Initial Safe UAS Integration Campaign** – coordinated effort for data and demonstrations
 - Through FAA test sites and other approved locations
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- NASA will continue to work with industry, academia, and government group to further refine operational requirements, use cases, system architecture(s), and conduct tests – Continue till safe airspace integration is proven!