**Safely Enabling Civilian Unmanned Aerial System (UAS) Operations In Low-Altitude Airspace By Unmanned Aerial System Traffic Management (UTM)**

**MOTIVATION**
- Many UAS will operate at lower altitude (Class G, below 2000 feet)
- There is urgent need for a system for civilian low-altitude airspace and UAS operations
- Stakeholders want to work with NASA to enable safe operations

**PROGRESS**
- Developed UTM vision document
- Defined initial UTM design characteristics
- Conducted an all-stakeholder workshop to gather feedback

**CONCEPT OVERVIEW**
- UTM System will provide following services:
  - Airspace design and geo-fencing
  - Weather integration
  - Congestion management
  - Separation management
  - Contingency management

**PARTNERSHIPS**
- UAS manufacturers
- Online retailers
- Communication/navigation/surveillance providers
- System integrators
- Emerging UAS operators
- Cargo operators
- FAA, NOAA, DoD
- UAS test sites

**NEXT STEPS**
- Obtain authorization to proceed with further development of UTM
- Refine UTM design, architecture, and use cases
- Explore partnership arrangements to engage traditional and non-traditional partners
- Define a spiral development process to do rapid prototyping and early fielding with regular updates

**UTM WORKSHOP KEY FINDINGS**
- Overwhelmingly positive response
- Stakeholders support NASA’s leadership and vision
- Many partners are ready to engage
- There is urgency to put a system in place

**LINE-OF-SIGHT TO BEYOND LINE-OF-SIGHT**

- **UAS 1**
  - Range of unmanned aerial system (UAS) equipage and diverse missions
  - Unmanned Aerial System Traffic Management (UTM)
  - Characteristics:
    - Authentication
    - Airspace design and geo-fence definition
    - Weather integration
    - Constraint management
    - Sequencing and spacing
    - Trajectory changes
    - Separation management
    - Contingency management
    - Geo-fencing design and adjustments
    - Contingency management
  - Services:
    - Autonomy
      - Self-configuration
      - Self-optimization
      - Self-protection
      - Self-healing
      - Appropriate operational data recording

- **UAS 2**
  - Real-time weather & wind
  - Weather & wind predictions
  - Airspace constraints
  - Other low-altitude operations

- **UAS 3**
  - 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

- **UAS Fleet**
  - Communication, navigation, and surveillance (CNS) options including but not limited to:
    - Low-altitude radar
    - Surveillance coverage (cell and satellite)
    - Navigation
    - Communication

Near-term goal: enable low-altitude operations within 5 years
Long-term goal: accommodate increased demand 10-15 years

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