UAS Traffic Management Deep Dive

- Future vision vs. present reality
- Implementation Roadmap
- Industry Priorities
- FAA Priorities
- Present Research Efforts
- Forthcoming Needs
What are we enabling?

• UTM provides distributed services that enable UAS operations below 400 feet AGL
• Controlled or uncontrolled airspace
• Concepts and service models *may also apply* to UAS operations at higher altitudes (e.g. drone cargo)
• This will also be the basis for cooperative management of AAM/UAM passenger-carrying flights.
Diverging Priorities

- Industry wants to be able to deploy and scale quickly
- Industry has short timelines

- FAA needs the regulatory framework first – be able to approve services independent of airframe and operator
- FAA inaction is already influencing negative outcomes
Who provides the services?

• Mostly industry!

• The FAA has some important roles:
  • Single source of truth for aeronautical information
  • System-wide safety assurance
  • Ensuring fair and equitable access
  • Defining and enabling integration with ATO functions
  • Approving new services
  • Ensuring ongoing compliance with regulations

Easier said than done?

Requires rulemaking
Two Rules of Air Traffic Control

• Don’t keep secrets.

• Work smarter, not harder.
ATCO Continuous decision loop

- Line Up and Wait 3-9-4
- Cross runway Threshold 3-10-5
- Runway exit 3-10-3
- Cleared for takeoff 3-9-9
- 6000 ft and airborne 3-10-3
- Radar identification 5-3-2
- Approach separation 5-9-5
- Speed adjustment 5-7-2
- Radar separation 5-5-2
- Missed approach 4-8-9
- Successive departure separation 5-8-3

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This is the end state of fully deployed services with high levels of autonomy

Enables high-tempo, complex operations coordinated and managed by UTM services
What Exists Today?

Registration (DroneZone) LAANC
Notional Implementation Timeline

**Initial SDSPs via Operator Waiver**

**Standalone SDSP Approvals**

**Streamlined Operator Approvals using SDSPs**

Data collection informs subsequent phases

**Initial USSs via Operator Waiver**

**Standalone USS Approvals**

**Streamlined Operator Approvals using USSs**

Development of interoperability requirements (including continuous test framework)

**Performance Authorization requirements, implementation**

**Rulemaking for UTM Service Approvals**

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**UTM deployment and iteration at scale**

- Limited number of UTM-enabled operations
- Growing number of approved UTM services
- Increasing numbers of UTM-enabled ops, with faster approvals

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**SDSP ODA**

**USS ODA**

**USS-Operator Handshake (decreasing oversight)**
Why Interoperability Matters

• Common data requirements ensure quality of information exchange

• Successful strategic deconfliction requires that multiple actors have shared understanding
  • Other operations
  • Capabilities of other operators
  • Impact of constraints

• With time: Increasing need for fast and efficient solutions
Future Research Needs

• Driven by gaps in service approvals
• How does the FAA know that a service interoperates correctly?
• How can service providers push updates without re-certifying?
• How does a service handle *unknown* edge and corner cases?
• What are the impacts on *other services* when one stops working?
Speaking of Deconfliction...

- Optimizing for operators vs optimizing for airspace
- DSS (Discovery and Synchronization Service) model
- How is quality of strategic deconfliction evaluated?
- How do all participants (including FAA) evaluate equity and fairness of solutions?
  - Are some operators being unwittingly locked out, or charged excessively?
Strategic Deconfliction Flow

- Compute requirements and multi-combinatory solutions as number of operators and USSs increases

Source: ASTM UTM Draft Standard v0.3
DSS and USS-USS Interactions

- What is required to test interoperability of each connection?
- Are industry-defined message formats and contents sufficient?
- Should there be rules for direct negotiations? Side deals?
- How does the FAA monitor and enforce these interactions?

Source: ASTM UTM Draft Standard v0.3
The Battleship Model

• Your operations are on the blue side of the board
• You (or your USS) must use the green side to “ping” the rest of the airspace and determine where you can fly.
• This is not the most efficient way to find a route!
  • But we also don’t know its limitations
The Battleship Model

• Remember, this is a five-dimensional problem!
  • Adjust left/right ($X-Y$)
  • Adjust cruise height or climb/descent profile ($Z$)
  • Adjust departure time ($t$)
  • Adjust speed ($v$)

• Compute resources to find a solution for one operator at a time
• How well do different algorithms perform at solving these problems?
• Which variables should be probed to find a solution?
• What about high-priority operations that come after?
• What about multiple operators probing at the same time?
• Is it possible to find a solution that optimizes for multiple operators?
Volume Size and Strategic Deconfliction

When should Operator A be required to change their allocation?

How does Operator B know that Operator A is negotiating in good faith?

Source: Terry Martin, Revolution Aerospace
The demand for these segments may be low…

But securing this at low price…

…is useless without this

Fairness Implications
System-Wide Safety

- What metrics?
- What dependencies?
- Safety event chain traceability
- Service-level contribution to system-level safety outcomes
- What data? Where does it live and how is it processed?
- What tools do FAA, industry and partners need?