



Enabling Autonomous Flight and Operations in the National Airspace

Workshop 2
August 6 – 7, 2019

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Warm Welcome!

Embracing innovation in aviation while respecting its safety tradition



Workshop Focus

- Small unmanned aircraft systems and their operations
- Urban air mobility vehicle and their operations



Outline

- Autonomy definitions
- Not as easy as animations show
- Mixed equipage
- Minimum viable product
- Collaborations are key
- Clarity on progression will help entire ecosystem

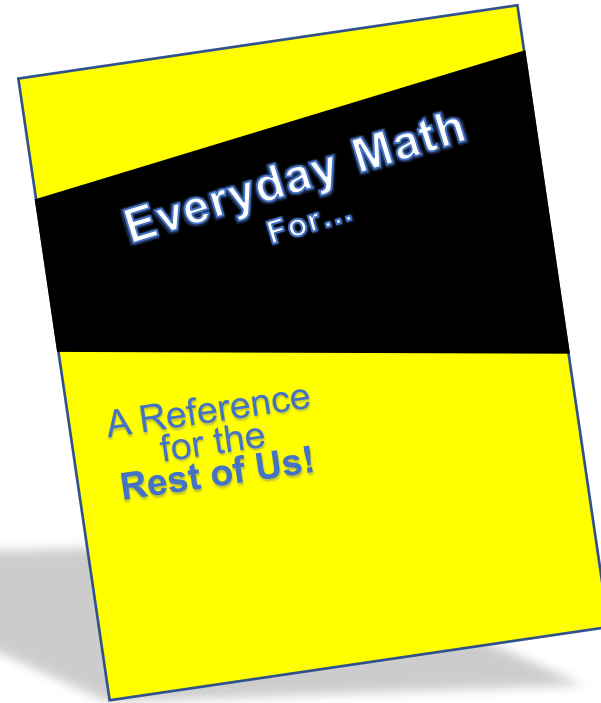


Many Definitions of Autonomy

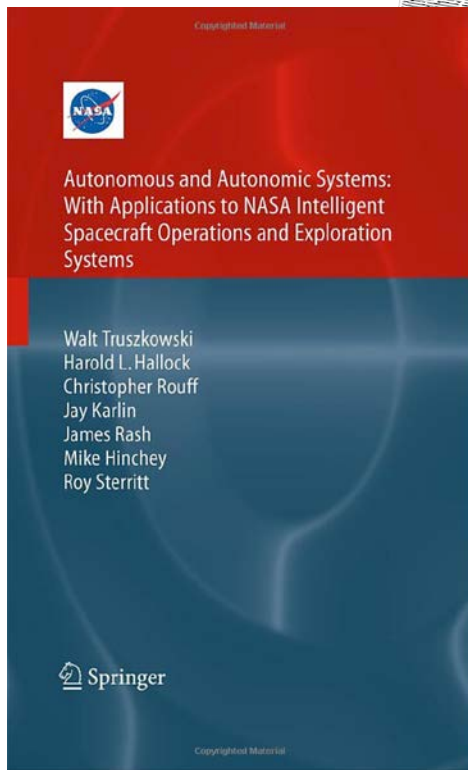
Autonomy: (of a vehicle) navigated and maneuvered by a computer without a need for human control or intervention under range of driving situations and conditions

Complex Issue

- Technology readiness
- Safety
- Human-autonomy teaming
- Certification
- Acceptance



Prior Work



<https://ntrs.nasa.gov>

NASA Technical Reports Server

Mixed Equipage Challenge and Interoperability Considerations





Strategy: Minimum Viable Product

Minimum Viable Product: a limited set of functions enough to get early adopters, extends to higher complexity later, and make a difference and unique



Minimum Viable Product

- Focus could be on entire system or could be a subsystem
- Amazon: started with book e-commerce
- Aircraft: 1:1 pilot with vehicle, m:n pilot to vehicles, simplified vehicle, remotely operated, auto land, perception, vehicle health management, and fully autonomous
- Airspace: UAS Traffic Management (UTM): started with smaller airspace portion – FAA implemented data exchanges thru LAANC
- Paths for fully autonomous small UAS
- Paths for urban air mobility vehicle



Small UAS

What is Remaining to Enable Fully Autonomous sUAS?

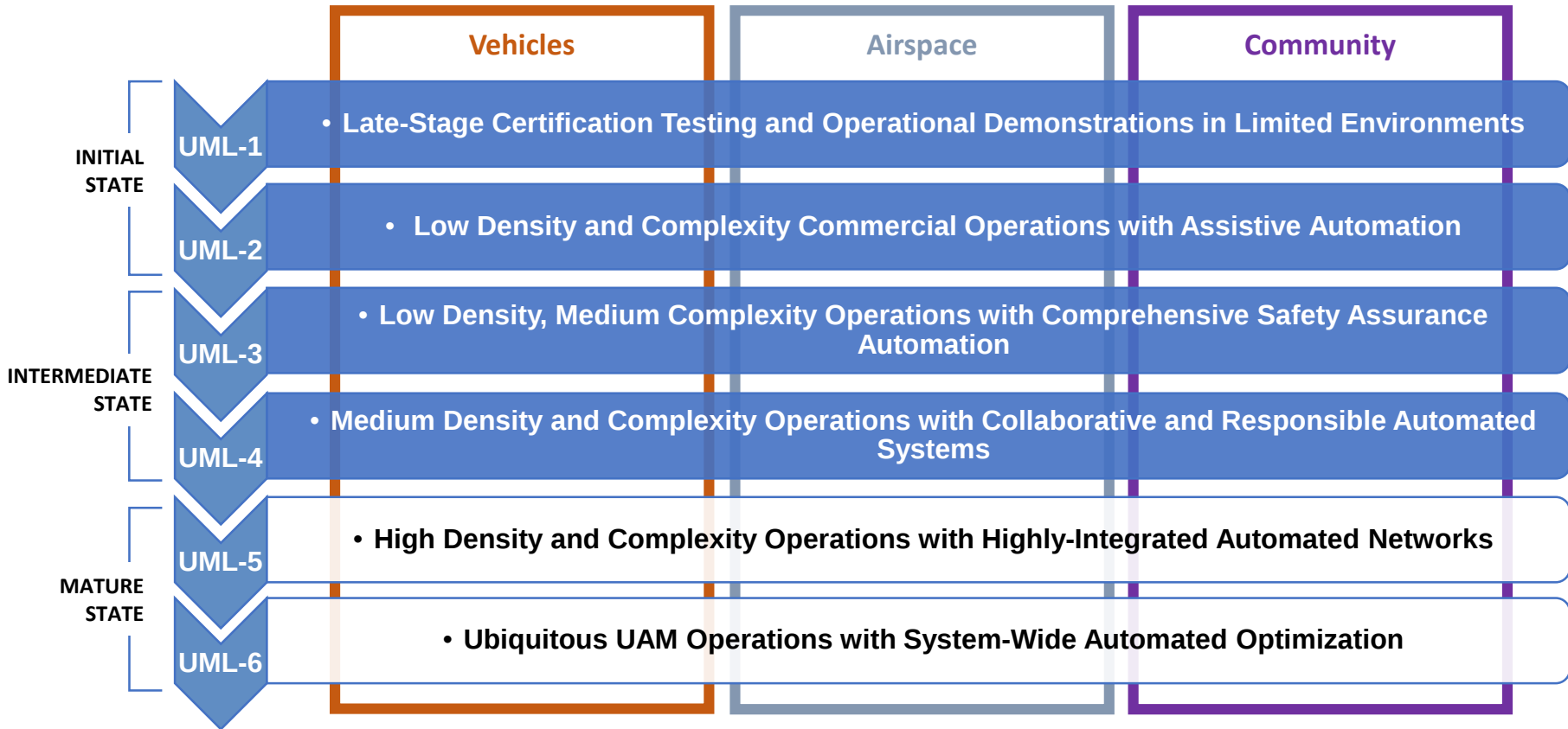


Urban Air Mobility— Passenger or Cargo-Carrying Vehicles





UAM Maturity Levels (UML)



* UML indicates operational system capability, not "technology readiness"

To invent an airplane is nothing. To build one is something. But to fly is everything.

-Otto Lilienthal

- To fly autonomously is more than everything!
- To interoperate with many other aircraft in airspace is very complex!





Workshop Purpose

- Get to worthy candidate MVPs – moderators will help you
- Identify where (pre-competitive) collaboration is most effective
- Identify research gaps and technology demonstrations that are most productive as entire community of interest
- Progression from here to enabling increasingly autonomous flight and operations
- We have 3 break-out sessions. You stay in the same room to ensure balance of participants



Workshop Outputs

- Minimum viable products
- Collaboration topics (pre-competitive)
- Clarity on progression will help entire ecosystem towards aircraft capabilities and operationalization



Points of Contacts

Text for urgent and critical matters during workshop:

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Path Forward to Responsible Autonomy

Embracing innovation in aviation while respecting its safety tradition



Back Up

Inter-island Autonomous Cargo Delivery (2025+)



Larger vehicle – single pilot, off-board manager, or fully autonomous depending on vehicle size



Transformation in Stages—Initial Applications

Larger than Small Drones (~2020+?)

Lowest Risk – Grand Canyon or Over Water Deliveries



Left photo by Daniel Piazza, <https://insider.si.edu/2016/08/grand-canyon-u-s-postal-service-still-delivers-mail-mule/>

Right photo: J.W. Westcott II <https://www.flickr.com/photos/cactuspinecone/29870951586/>

