Autonomy Certification

A Measured and Holistic approach to Autonomy

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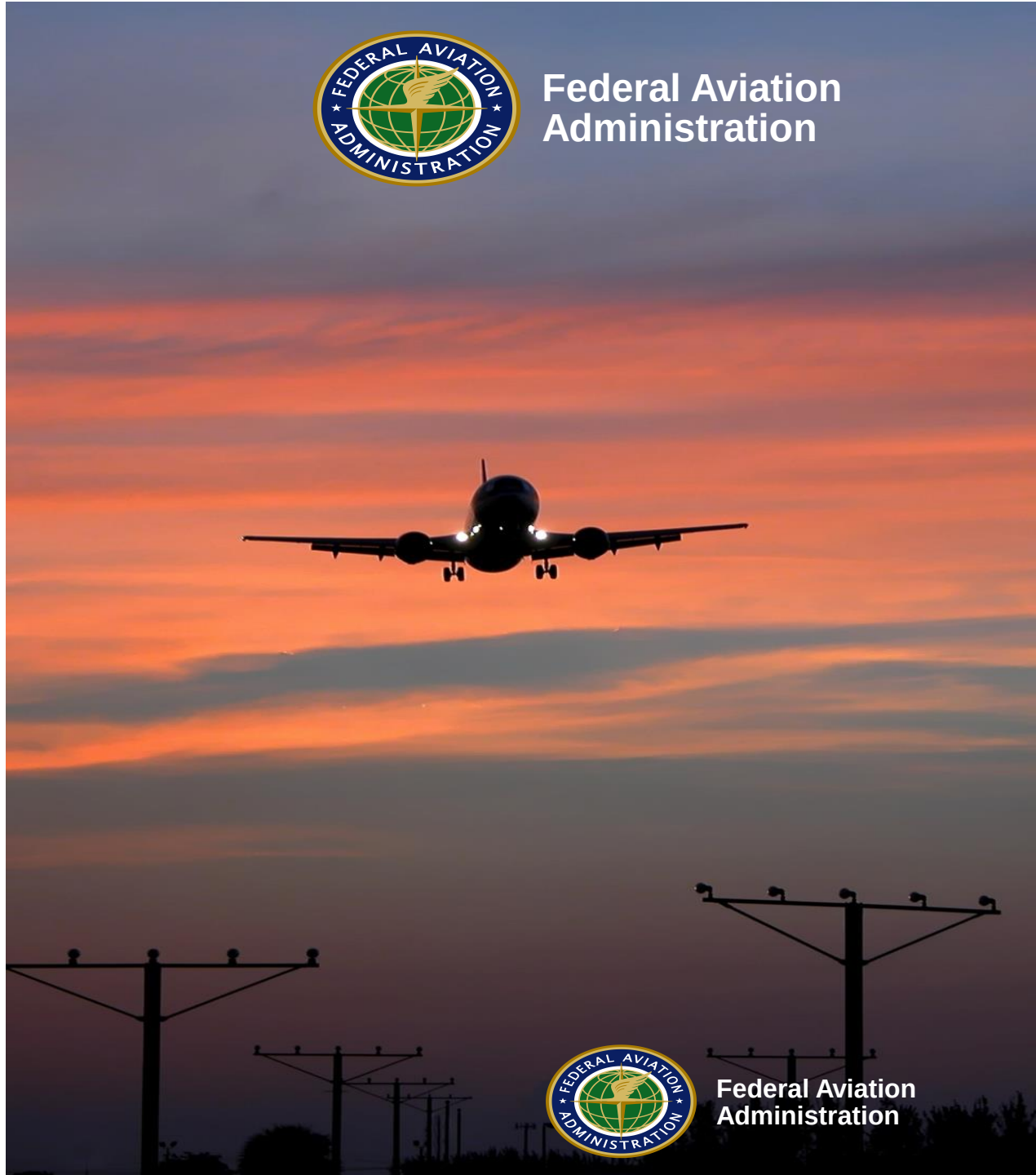

Many new projects supported by FAA

- All information proprietary and private to applicants – (FAA Cannot disclose in public)
- For new and novel projects - early FAA engagement through Center for Emerging Concepts and Innovation
  - Many UAS projects (“Drones” of many sizes)
  - Many AAM* (Advanced Air Mobility) projects
    - new definition

  Transportation System for people and property, using aircraft with advanced technologies …. Controlled and Uncontrolled airspace.
- Term Urban Air Mobility still used – subset of above.

* New bill 10-17-22, S516

Applicants for certification very varied

- Established aircraft companies – Deep funding pockets
- Newcomers – Venture funding, in increments, need demonstrated progress to maintain funding
- Newcomers with naïve expectations
- Variety of Con-Ops (Concepts of Operations)
  - Remote Pilots
  - Pilots with levels of autonomy assist (single or multiple)
  - Autonomous flight - with Pilots monitoring
  - Fully Autonomous

New AAM vehicles

- 6 or more lift propellers
- Rotation, pitch, perhaps angle-off-vertical not in pilots direct control
- Pilot knows majority of lift propellers are working
- Failed propeller - remainder automatically balanced

No direct control by pilot

- But! We need unified control laws (Helicopter, Airplane - blend)
- We need redundancy for flight controls
- How much dissimilarity is required (hardware/software)?
- How do we manage catastrophic single event errors/single event failures?

Use of Monitors:

- If pilot is present, then pilot can be the monitor
- Monitors for simple functions – good!
- Monitors for complex functions – must be safe
  - what if monitor switches off good controller?
- Multiple monitors must track state of controlled system (graceful engagement/degradation)

As Autonomous controls become more complex, this becomes more difficult

Introduction of Autonomy

- Makes it harder to ensure performance of intended functionality
- Operating conditions harder to quantify
  - Sensor degradation
  - Subsystem malfunctions
  - Operator errors / interaction errors
- Added complexity make interactions harder to constrain

But, rewards are higher if successful!

e.g. Aerial firefighting reduces risks for pilots!

Trust in Automation

- Current approach to Software:
  - Lots of experience over many years
  - Very conservative design and implementation
  - Established guidelines understood well
  - Prescriptive approach (everyone knows what to do)
  - Verification - Completion criteria understood

Need to evolve

- Certification of Autonomy hard
  - Hard to scale up
  - Introduction of Artificial Intelligence and Machine Learning – complicates the issues
    - Lots of research underway
    - When can we trust it?
    - Are we ready to develop the regulations?

Overall at FAA

- Technology is moving very quickly
- Partnership with applicants – exchanging experience and knowledge
- Research at FAA, Collaboration with NASA and other bodies
- FAA is adapting and remains flexible
- Software base is growing rapidly. (Applicants trying to use COTS/Open source solutions)
- AI-M/L - we still do not know what we don’t know
- FAA is promoting innovation, but must temper this with management of risk

Let’s build trust in Autonomy, as we are able