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Challenges and Barriers to UAS Integration into the NAS

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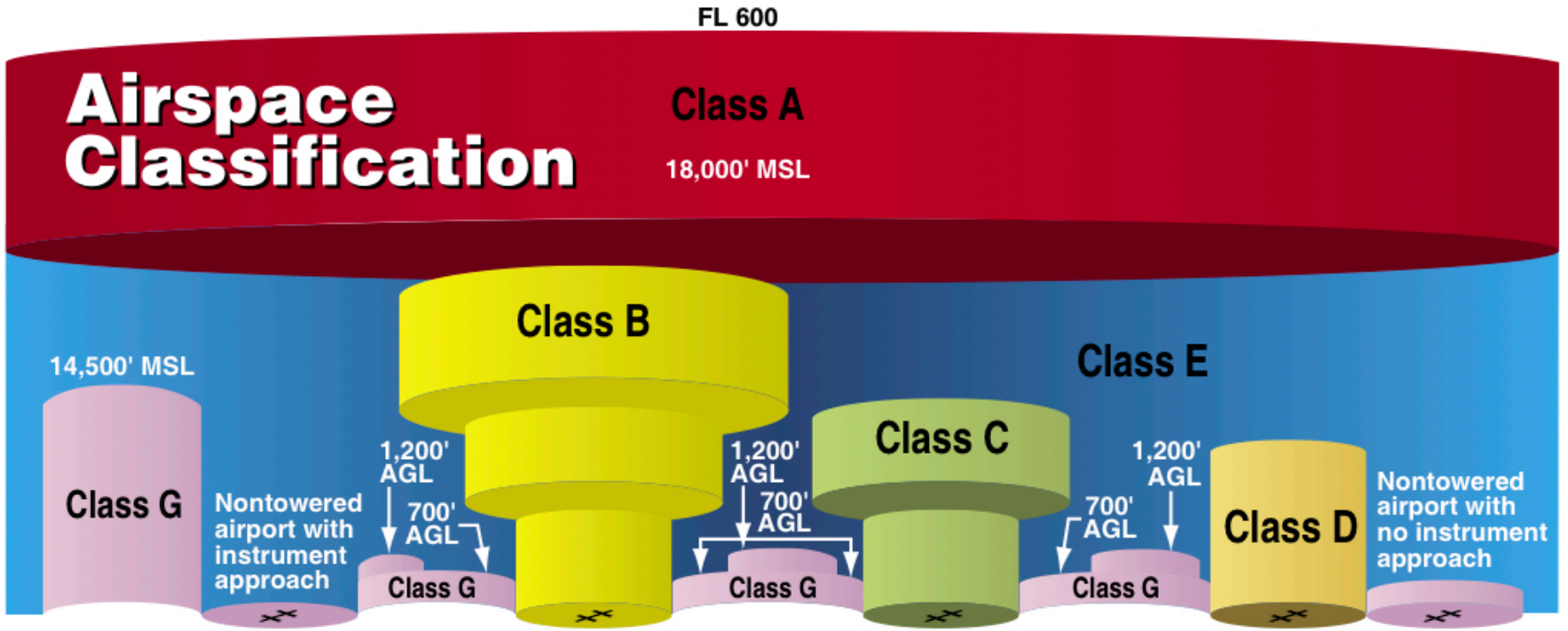
Introduction

- Unmanned Aircraft Systems (UAS), also referred to as Unmanned Aerial Vehicles (UAVs), Unmanned Aircraft (UA), or Remotely Piloted Aircraft (RPA), have already demonstrated significant advantages in military applications
- UAS have existed for many decades in one form or another
- New lightweight technologies (structural materials, efficient engines, and payload/sensor systems) make UAS increasingly attractive for civil and commercial applications
- Although technologies continue to mature, integration of UAS operations into the United States' National Airspace System (NAS) still faces challenges

Class A, B, C, D, E (controlled) and Class G (uncontrolled)



Operations in the NAS – Legislative Background

- FAA provides oversight for all operations in the NAS
- Promulgates and enforces Federal Aviation Regulations ("FARs")
- FAA manages risk
- Zero risk is unattainable
- What is the "tolerable risk" threshold?
- 14 CFR §91.113 (b) requires:

  "***General.*** When weather conditions permit, regardless of whether an operation is conducted under instrument flight rules or visual flight rules, vigilance shall be maintained by each person operating an aircraft so as to **see and avoid** other aircraft. When a rule of this section gives another aircraft the right-of-way, the pilot shall give way to that aircraft and may not pass over, under, or ahead unless it is well clear."

Operations in the NAS – Current UAS Operations

- No doubt UAS offer significant potential value
- Certificate of Waiver or Authorization (COA) for public operators
- Special Airworthiness Certificate for civil operators
- The main difference between the two is the airworthiness approval authority:
  - Public operators have the authority to certify the airworthiness of their aircraft
  - For civil operators, the FAA evaluates the UAS and issues a special airworthiness certificate
- Focus hitherto has been on accommodation rather than integration

See and Avoid, Sense and Avoid, and Detect and Avoid

- UASs are unable to comply directly with Title 14 CFR Part 91, Paragraph 113(b) as published, because they are unable to "see and avoid."
- Since UAS are unable to meet the "see and avoid" requirement, the concept of an alternative "Sense and Avoid" (SAA) replaced it for "beyond visual range" UAS operations in the NAS (term used throughout the duration of RTCA SC-203).
- More recently the more expansive ICAO term "Detect and Avoid" (DAA) has become the preferred term (and is the term used currently by RTCA SC-228)

Autonomous Operations

- Autonomous operations refer to any system design that precludes any person from affecting the normal operations of the aircraft.
- For UAS operations that are integrated into the NAS, a key FAA CONOPS assumption is that autonomous operations are not permitted.
- It has not been possible to calibrate the impact upon safety of the removal of a human pilot.
- Automation provides a solution for known and programmed eventualities.
- A human pilot on the other hand is often able to adapt to deal with unforeseen contingencies.

Challenges Facing UAS Integration

- Technological
- Regulatory
- Political
- Performance characteristics
- Airspace classification and protection
- Aviation fleet diversity (interoperability)
- Cost of equipage
- Mission effectiveness
- Susceptibility to wake upsets

Technological Challenges

- Validated, resilient, and universally applicable technologies for safe separation not yet available
- Secure and scalable command and control (C2) communications systems for UAS
- Robust and certified pilot/aircraft interfaces for Ground Control Stations (GCS)

Regulatory Challenges

- Specific certification standards for UAS do not exist
- RTCA SC-228 has been created after the sunset of RTCA SC-203 to develop Minimum Operational Performance Standards (MOPS) for Detect and Avoid (DAA) and Command and Control (C2) by July 2016
- Technologies cannot be approved or certified until the appropriate standards are developed
- Operating rules are currently based upon existing regulations that apply to manned aircraft
- Adapted, and/or new operating rules or procedures may be needed

Political Challenges

- UAS are being introduced to an existing environment and will inevitably affect the equilibrium of that environment
- Competition for electromagnetic spectrum needed for DAA and C2
- Environmental factors, such as noise and other pollution
- Privacy concerns
- States and local communities already passing legislation to ban or restrict the use of UAS

Interoperability Challenges

- Differing levels of equipage
  - Who is responsible for accommodating?
- Differing performance characteristics
  - Turn rates
  - Climb and descent rates
  - Maneuverability
  - Response latency

Susceptibility to Wake Upsets

- All aircraft are affected by the wake turbulence created by other aircraft
- UAS are generally smaller and lighter than many manned aircraft, and are vulnerable to “wake upsets” when flying in close proximity behind, below or downwind of larger aircraft
- Upsets may be more likely to result in loss of control (not to be confused with “lost link”) due to situational awareness and C2 latency