Towards Routine Global, Commercial RPAS Operations

Presented To:
AAUS RPAS in Australian Skies 2019
Global effort to Integrate UAS/RPAS into the Aviation System

- **Unmanned Aircraft System (UAS)**
  - Globally accepted term for small UAS (sUAS), i.e. Part 107
  - Primarily U.S. centric term in the context of large aircraft
- **Remotely Piloted Aircraft System (RPAS)**
  - Globally accepted term for large aircraft
  - Remotely Piloted Aircraft (RPA)
  - Remote Pilot Station (RPS) with Qualified Remote Pilot
  - C2 Link (i.e. Control and Non-Payload Communication [CNPC])
- **ICAO RPAS Panel**
  - International Operations under Instrument Flight Rules (IFR)
  - Updates to SARPS and PANS within many Annexes
- **National and Regional Regulations**
  - FAA’s Drone Advisory Committee (DAC)
  - JARUS (Joint Aviation Regulators of Unmanned Systems)
  - **FAA UAS in Controlled Airspace Aviation Rulemaking Committee (ARC)**
- **Standards Development Organizations**
  - RTCA, EUROCAE, ISO, ASTM
  - ARINC

SARPS = Standards and Recommended Practices
PANS = Procedures for Air Navigation Services
Use Case 1

FILE-AND-FLY TRANSIT USE CASE - FIRST PRIORITY

- Upper E Entry/Exit
- Coop IFR Aircraft
- STD LOST LINK PROCEDURES
- DYNAMIC ATC RE-ROUTING
- VARIABLE DESTINATIONS
- IN-FLIGHT AIR CHANGES
- CONTINGENCY DIVERSION
- Entry Point
- IFR FLIGHT PLAN
- REVERSE ROUTING FOR RTB
- CLASS A
- Standard Backup Communication Channel

Coop IFR Aircraft
Use Case 2

LOCAL AREA OF OPERATIONS USE CASE

Not Allowed to interfere with Major Routes or Jetways

FREEDOM OF MOVEMENT

Standard Lost Link Procedures

No interference with commonly used arrival/departure corridors

DEFINED GEOGRAPHICAL AREA

FLIGHT PLAN REQUESTS

START & STOP TIME

Procedures for Accommodation based on Priority of Mission

Request Redefinition of Area, Altitude or Time in Flight

CLASS A

UPPER & LOWER ALTITUDE BOUNDARIES
5 Critical Changes Required to Aviation System

- **Operational Context:** Commercial RPAS operating under IFR in Controlled Airspace
- **Changes to Operating Rules (Part 91)** to enable normalized operations
- **Standardized lost link procedures for UAS/RPAS**
- **ATC/ATM Automation Changes**
- **Develop Process for Commercial UAS Operator to Establish a Local Area of Operation**
- **Develop standards, guidance material, and regulations to enable GNSS-based navigation for UAS**

IFR = Instrument Flight Rules  
ATC = Air Traffic Control  
ATM = Air Traffic Management  
UAS = Unmanned Aircraft System  
RPAS = Remotely Piloted Aircraft System
Updates to Operating Rules

- **Part 91 changes submitted by the previous UAS ARC be implemented.**
  - Much more than just modification to 91.113 (see and avoid)
  - 2 New Rules:
    - Transfer of Control of UAS
    - Loss of C2 Link Procedures

- **Amend 14 CFR § 91.135**
  - Require that UAS operating in class A provide a level of performance for area navigation (RNAV) equal to or better than RNAV2.

- **Operationalize DAA and CNPC C2**
  - DO-365/366 and TSO-C 211/C 212
    - Need AC material
  - DO-362 and TSO-C 213
    - Need AC material and Spectrum Management Plan

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ARC = Aviation Rulemaking Committee  
CNPC = Control and Non-Payload Communication  
UAS = Unmanned Aircraft System  
RPAS = Remotely Piloted Aircraft System  
DAA = Detect and Avoid  
AC = Advisory Circular
Standardized Procedures for Loss of C 2 Link

- **FAA/NATCA Lost Link Working Group**
  - Recommendations released in 2019
  - Generally following procedures for Loss of Voice Communication

- **Updates to Terminal Area Instrument Procedures for Loss of C2 Link**
  - Based on US NORTHCOM Joint Test
  - Contingency Hold Points
  - Autoland Considerations
  - Alternative Means of Communication
Process to Establish a Local Area of Operation

• Develop a process to request temporary airspace volumes for UAS Local Area of Operation missions, to include:
  – The ability to define lateral boundary, vertical boundary, and time limits of a Local Area of Operation
  – The ability to reduce pre-coordination and planning requirements to be consistent with today’s IFR Flight Planning process under Part 91 operations
  – The ability to identify flight in the vicinity of existing routes, procedures, or areas that would negatively impact routine airspace operations, indicating that overlap with these would result in higher likelihood of rejection.
  – The ability to include airspace volume features in an IFR Flight Plan or something similar
  – The ability to dynamically change or file a new airspace volume for the operation
  – Monitoring to ensure fair and equitable use of the process and timely dispute resolution.
GNSS-based Navigation for UAS

• **Update Performance Standards and Guidance Material to enable GNSS-based UAS operations to meet Performance Based Navigation (PBN) requirements for all phases of flight**
  - GNSS-based = Without the need for ground-based navigation aids (e.g., VOR, DME, ILS)
  - Updates may be needed to:
  - New Standards and Guidance Material may be needed to support:
    • Anti-jam capability for GNSS receivers
    • Anti-spoof capability for GNSS receivers
    • INS performance requirements to coast through GNSS outages

• **Update Performance Standards and Guidance Material to enable GNSS-based Precision Approach Capability with Auto-Takeoff and Auto-Land Features for UAS**
  - Updates may be needed to:
    • AC 120-28D, RTCA DO-245, AC 90-101A
  - New Standards and Guidance material may be need to support:
    • UAS Auto-land capabilities
    • UAS Auto-takeoff capabilities
    • INS performance requirements to coast through GNSS outages
R&D Gaps for All of Controlled Airspace

- **Research into UAS specific operating rules in controlled airspace**
  - Use of DAA Systems in VFR-like operations in IMC
  - Use of Terrain Avoidance Systems to enable operations below MSA in IMC
  - Use of Obstacle Avoidance Systems to enable operations below Obstacle Clearance Surfaces in IMC
  - Use of ground-ground voice and data communication to enable operations below MCA
  - UAS operations in a VFR traffic pattern at airports
  - UAS flying through IMC without the need for ATC clearances
  - Use of weather radars, ice detection systems, and other environmental sensors to gain awareness of the operating environment

- **Local Area of Operations Use Case outside of Class A Airspace**

- **Scalability to large number of UAS operations**
  - UAS ground operations at airports where seamless integration will be required.
  - Acceptable Transaction Expiration Times (TET) in dense and/or complex airspace.
  - Determine whether air traffic controllers require unique UAS-specific symbology on controller displays to facilitate handling of off-nominal events.
  - Research should be conducted to determine how UAS specific elements for procedure design could scale.

DAA = Detect and Avoid  
MCA = Minimum Communication Altitude  
MSA = Minimum Safe Altitude  
UTM = UAS Traffic Management  
IFR = Instrument Flight Rules  
VFR = Visual Flight Rules  
ATC = Air Traffic Control  
UAS = Unmanned Aircraft System  
RPAS = Remotely Piloted Aircraft System  
IMC = Instrument Meteorological Conditions
Testing and Demonstration on NASA Ikhana: 2014-2018

- NASA successfully flew Ikhana UAS outside of Restricted Airspace using Airborne DAA System
  - Transit to/from Class A
  - Air Traffic Control: Los Angeles and Oakland

- Full coordination with FAA
  - Informs FAA Advisory Circular and ATC Training
NASA Ikhana Video

https://www.youtube.com/watch?v=x79LOfy6k
NASA SIO Flight Demonstration with GA-ASI SkyGuardian: Summer 2020

Legend
- Preliminary Flight Path
- Southern Pacific Railroad
- Coachella Canal
- Power Lines
- Kinder Morgan Pipeline
- San Diego & AZ Railroad

McClellan-Palomar (CRQ)
Law Enforcement

1. San Diego & AZ Railroad
2. Power Lines
3. Southern Pacific Railroad
4. Coachella Canal
5. Power Lines
6. McClellan-Palomar (CRQ)
7. Law Enforcement
8. Power Lines
9. Power Lines
Conclusion

- **Significant progress is being made at the International level to integration UAS/RPAS into the Global Aviation System**
  - Translating International regulations into National regulations will take substantial collaboration between Regulators, Service Providers, Industry, and Stakeholders

- **Normalized Commercial Operations are close**
  - RPAS-specific Technology Standards Published
  - Type Certification Projects are progressing

- **Operations under IFR will enable the Safe and Efficient integration of UAS/RPAS into the Global Aviation System**
  - IFR offers the structure to ensure safe and predictable operations
  - UAS/RPAS will ultimately desire the operational flexibility of VFR
Questions?

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