UAS Global Airspace Integration
RTCA Special Committee 203

ICAO & LACAC UAS Seminar
For Caribbean + South America Regions

Lima, Peru
18 April, 2012
A Global Challenge

Unmanned Aircraft System (UAS)
Access to Civil Airspace

Managing Expectations
Creating an Environment of Trust
Making Positive Progress
Making Communications and Collaborations Effective
Outreach to Stakeholders
UAS Airspace Integration a Systems Challenge Requiring Systems Solutions
Global Unmanned Aircraft Activities

- ICAO UAS Study Team
  Circular 328
  - UAS Advisory Rulemaking Committee
  - UAS Executive Committee
  - FAA/DoD/NASA/DHS
  - sUAS Notice Proposed Rulemaking
  - RTCA/ASTM/SAE (UAS Standards)
  - Congressional UAS Test Site Criteria (six sites)
  - FAA NextGen Program
  - Joint Planning & Development Office

- South America
  - ICAO Region - Lima
  - UAS Symposium
    (& other ICAO Regions)

- Brazil UAS Program

- European Commission
  - UAS Studies

- Single European Sky ATM Research (SESAR)

- EUROCAE (UAS Standards)

- Eurocontrol / European Safety Agency (EASA)

- Joint Authorities for Rulemaking Unmanned Systems (JARUS) Civil Aviation Authorities

- ASTRAEA (Autonomous Systems Tech)
  - UK

- ICAO UAS Study Team
  - MPA
  - Australian UAS Program
  - Robust with initial civil regulations

- Japan UAS Program
  - Agriculture UAS

- Australia UAS Program

- India UAS Program

- China UAS Program

- South Africa UAS Program

- Israeli UAS Program
  - Global

- South America
  - ICAO Region - Lima
  - UAS Symposium
    (& other ICAO Regions)
Global View of Air Traffic Navigation Service Provider Delegated Airspace

Today Air Traffic Airspace is highly fragmented
Global Initiatives

- RTCA SC 203 / EUROCAE WG 73/93
- ICAO UAS Study Team
- ICAO Regional Seminars
- Joint Authorities for Rulemaking on Unmanned Systems – JARUS
- NATO Flight into Non-Segregated Airspace (FINIS)
- NextGen / SESAR UAS Activities
- South America / Central America / China / India Middle East
- NextGen / SESAR / European Commission
Challenges & Opportunities

Increased need to operate UAS in Global Airspace:
- National/State Security Missions
- Defense Training & Support
- Emergency Management
- Path towards “birthing” Commercial Market

Routine UAS Airspace Access into Global Airspace currently limited due to lack of:
- Standards & procedures so UAS are safely separated from other aircraft
- Robust Command & Control for UAS
- Certified Ground Control Stations (GCS)
- Separation Assurance / Sense & Avoid
- Safety Management System / Mitigation
- Spectrum

Technologies, procedures, and regulations for Global Airspace integration:
- To be Developed, Validated, and Implemented by ICAO/EASA/FAA/etc.
- Through rulemaking and policy development
UAS Path Forward for Airspace Integration

1. **Accommodation** – Ability to take current UAS and apply special mitigations and procedures to safely facilitate limited access to the NAS.

2. **Integration** – Establishing threshold performance requirements for UAS that would increase access to the NAS.

3. **Evolution** – All required policy, regulations, procedures, technology and training are in place and routinely updated to support UAS operations in the NAS.

4. **Navigation/Surveillance/Communication** - Operating in civil airspace ubiquitously with manned aircraft
Examining “Manned vs. Unmanned”
Performance Gap between UAS and Manned Aircraft

**Unmanned Aircraft**

**Global Hawk**
- FL300 to FL600+
- *Cruise 250 to 340 knots*

**Predator**
- FL180 to FL450
- *Cruise 140 to 240 knots*

**Scan Eagle**
- 2,000’ to 12,000’
- *Cruise 40 to 65 knots*

**Commercial Aircraft**
*Cruise FL350 @ 500 knots*

**General Aviation Aircraft**
*Cruise FL050 @ 120 kts*

How will differences in aircraft performance impact the NAS?
Manned Aircraft Performance

**Established performance**
- Demonstrated through pilot practical test standards
  - Maintain altitude, assigned heading, standard rate turns
- Airspace requirements (e.g. minimum speeds, speed limits)
- Aircraft performance envelope

**Expected performance**
- Not quantified. Dependent upon environment and situation
- Interfacing with other aircraft and ATC
- Immediacy/timeliness/accuracy of response
UAS Performance

- Determine acceptable end-to-end UAS performance for operations within the NAS
  - Acceptable performance requirements for UAS representing diverse functionality and capabilities
  - Acceptable performance requirements for various environments and classes of airspace
- Characterize UAS system elements and their individual and collective contribution to performance
- Determination and validation of performance levels through research assures minimal impact on NAS users and ATC
## RTCA SC 203
Terms Of Reference (TOR) / Milestones

<table>
<thead>
<tr>
<th>Product</th>
<th>Description</th>
<th>Due Date</th>
<th>Change DO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Guidance Material for Unmanned Aircraft System (UAS)</td>
<td>Provides key definitions and assumptions. Published as DO-304</td>
<td>Mar, 2007</td>
<td>DO 304</td>
</tr>
<tr>
<td>Operational Services &amp; Environment Definition (OSED)</td>
<td>Provides baseline descriptions of UAS operational functions and performance characteristics, ATC services, NAS environment and procedures. This information is used to support safety, interoperability, and performance assessments</td>
<td>Mar, 2010</td>
<td>DO 304</td>
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<tr>
<td>UAS MASPS</td>
<td>Provides quantitative performance standards for overall UAS system. Allocates functions to subsystems.</td>
<td>Dec, 2012</td>
<td>DO 320</td>
</tr>
<tr>
<td>Sense and Avoid MASPS</td>
<td>Provides quantitative performance standards for SA subsystem.</td>
<td>Dec, 2013</td>
<td>DO 320</td>
</tr>
<tr>
<td>Control and Communication MASPS</td>
<td>Provides quantitative performance standards for CC subsystem.</td>
<td>Dec, 2013</td>
<td>DO 320</td>
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*MASPS = Minimum Aviation System Performance Standards*
RTCA SC-203 MASPS Objectives

- Clearly derive all Operational, Functional, Safety, Interoperability and Performance Requirements from *Anticipated UAS Operations* in non-segregated airspace with no gaps or overlap.
- Ensure a consistent approach is being used by all SC-203 Work Groups leading to uniform well connected System and Subsystem MASPS.
- Ensure Safety Assessments lead efficiently into Subsystem MASPS development.
- Ensure Interoperability Assessments lead efficiently into Subsystem MASPS development.
- Document process to defend traceability of Requirements.
RTCA SC-203 UAS MASPS

Contains the “Aviate”, “Navigate” and “Manage” Functions

Part 1 – OPERATIONAL AND FUNCTIONAL REQUIREMENTS

• Contains all system-level Operational & Functional Requirements for the entire UAS
  • Reference Standards for manned aircraft will be used as applicable
  • Clear traceability from Operation to Function

• UAS System MASPS – Part 1 – Operational & Functional Requirements receives Plenary Final Review and Comment (FRAC)

Part 2 - SAFETY AND INTEROPERABILITY REQUIREMENTS

• Contains all system-level Safety & Interoperability Requirements for the entire UAS
  • Safety and Interoperability Requirements are organized by Function and subFunction
  • Contains the Allocation of Safety Objectives & Requirements as an appendix

• UAS System MASPS – Part 2 – Safety & Interoperability Requirements receives Plenary Final Review and Comment (FRAC)
SC-203 Command & Control MASPS

Content Example

- Operational Goals, including:
  - Operational modes and limitations
  - Throughput
  - Latency
  - Availability and continuity
  - Integrity
  - Failure modes, warnings, and flags

- System Performance Requirements

  General Requirements
  - Peak Loading
  - Time-Critical Scenarios

  System Performance under Standard Conditions
SC-203 Sense & Avoid MASPS

Content Example

- Applicability of Right of Way (ROW) Rules
- Concept of Use/Operations
  
  Operational environment

  Encounters and timelines

  Collision Avoidance Threshold (CAT) and:
  Self-Separation Threshold (SST)

- Software and Algorithms
- Hardware and Software Design Assurance
- System Safety Tools and Methods
NextGen/SESAR Architecture Goal

Establish UAS Operational Environment

- Describes the environment where UAS will interact with the NAS
  - Airspace classes
  - Air traffic service units / Terminal & Enroute
  - Air traffic management systems

- Defines air traffic characteristics of the current Airspace
- Understanding traffic density estimates and characterization.
- Understand interfaces with NextGen architecture roadmap
Key Closing Points

- Importance of getting spectrum assigned for UAS Control and Communications at the International Telecommunications Union World Radio Communication Conference in 2015.
- Leverage UAS Standards/Airspace Access Integration Work
- Harmonization – Global initiative
- Focus needed on entire UAS system
- Systems Engineering Process / Operations Support
- Industry direction – establish S&A performance requirements - instead of using prescribed, standardized algorithm
- Modeling & Simulation to assess performance and safety – support industry in trade offs between design elements
UAS’s Are Transformational and Must be Integrated into Civil Managed Airspace Safely

Technology/Policy/Regulatory Momentum Must be Continued

Civil Airspace Stakeholders Must be Involved to be Successful

Coordinated Domestic and International Action is Imperative to Ensure Fullest UAS Potential and Preserve Safety

Summary
Back Up Slides
SC-203 MASPS Development Process

- **STEP 1 – CAPTURE ALL ANTICIAPTED ENVIRONMENTS, OPERATIONS AND SERVICES** – DO-304 and DO-320 Complete and in use
- **STEP 2 – CAPTURE ACTIVITIES BY FLIGHT OPERATIONS** – Architecture Doc – baseline Complete
- **STEP 3 – DERIVE OPERATIONAL REQUIREMENTS FROM ACTIVITIES** – In Process
- **STEP 4 – TRACE ACTIVITIES TO SUB-FUNCTIONS** – In Process
- **STEP 5 – DERIVE FUNCTIONAL REQUIREMENTS FROM OPERATIONAL REQUIREMENTS** – Baseline done – Refinement in Process
- **STEP 6 – CONDUCT HAZARD ASSESSMENT** – In Process
- **STEP 7 – DEFINE SAFETY OBJECTIVES** – In Process
- **STEP 8 – RELEASE SYSTEM LEVEL MASPS** – Outlines being developed
- **STEP 9 – ALLOCATE SAFETY OBJECTIVES**
- **STEP 10 – DEFINE SAFETY REQUIREMENTS**
- **STEP 11 – CONDUCT INTEROPERABILITY ASSESSMENT**
- **STEP 12 – DEFINE PERFORMANCE OBJECTIVES**
- **STEP 13 – DEFINE PERFORMANCE REQUIREMENTS**
- **STEP 14 – RELEASE SUBSYSTEM LEVEL MASPS**