ASTRAEA – the findings so far

Lambert Dopping-Hepenstal, FREng

RPAS CivOps 2014
3rd December 2014

© ASTRAEA 2014. All rights reserved.
Contents

- The ASTRAEA programme
- Regulatory engagement
- Programme achievement examples
  - Communications
  - Detect & Avoid
  - Virtual Certification
- Next steps
Programme Objectives

• Enable the routine use of Unmanned Aircraft Systems (UAS) in all classes of airspace without the need for restrictive or special conditions of operation.

• Develop and demonstrate key technologies and operating procedures required to open up the airspace.

• Support the development of the regulatory framework for this new class of operation.
Systems approach
Functional Architecture

Complex Flight Management System
Regulatory engagement

RPAS organisations (ASTRAEA connection)

JARUS Secretariat - Implementation Steering Group and EC Regs development coordinator (Through ASD)

ICAO RPAS Manual and ICAO SARPS (Through ICCAIA)

JARUS group

RPAS Specifications (Through ASD)

EUROCAE

MOPS and MASPS (Direct support)

CAP 722
ICAO support
JARUS support
EUROCAE support (consultancy contract)

The Aerospace and Defence Industries Association of Europe (Partner representation)

ASD

The International Coordinating Council of Aerospace Industries Associations (Through ASD)

ASTRAEA Regulatory, Technology and Societal workshops - For programme information, collaboration and dissemination

JARUS secretariat

JARUS group

Agreed set of deliverables to JARUS Secretariat

RPAS standards and regulations stakeholders

EASA

Airworthiness Operations Personnel Licencing

IAW EC RPAS Regulatory, Technology and Societal Roadmaps

Phase 1
Accommodation of UAS in Class A airspace

Regulatory Development

Phase 2
Partial integration of UAS in Class A-D Airspace

Techniques and validation

Phase 3
Emulated full integration of (surrogate) UAS/OPV in Class A-D airspace

Virtual certification of development system

ASTRAEA

JARC

Regulatory engagement

Transparency
Contingency management
Security
Detect and avoid
Surface operations
Operational utility

Scenario creation
External workshops
Representation

EuroCAE

• WG73 Secretariat
• WG73 SG1 Airworthiness
• WG73 SG2 Collision Avoidance
• WG73 SG3 Communications

• WG72 Security

ICAO

• RPAS Panel
• Frequency Spectrum Management Panel (FSMP)
Main themes

- Autonomy & Decision Making
- Ground Operations & Human Systems Interaction
- Communications, Security & Spectrum
- Detect & Avoid

© ASTRAEA 2014. All rights reserved.
Communications, Security & Spectrum

- Tests have established that Satellite communications for RPAS operations are only feasible in low ATC workload due to latency issues.
- Increased access to terrestrial communications is needed for higher ATC Workload areas.
- Ad hoc networking with seamless transition has been demonstrated as a feasible solution for BRLOS communications.
- Spectrum requirements have been analysed in support of WRC2012 and WRC2015.
- UAS security requirement defined and method of certification has been proposed.
Communications, Security & Spectrum

Next steps

- Airborne demonstration of ad-hoc network solution.
- Whole platform solution – including deployable ground infrastructure.
- C2 required communications performance evidence gathering.
- Continuing support to WRC2015, EuroCAE WG73, ICAO RPASP and ICAO FSMP
- UAS security validation for airworthiness and operations support to EuroCAE WG72
Detect & Avoid

ADS-B (Cooperative Sensing)
- Proved Highly Reliable
- Detection performance typically >6 mins
- Sufficient to accommodate Rules of the Air

Electro Optical (Non Cooperative Sensing)
- High resolution optical sensors that can detect intruders against complex clutter backgrounds
- Determine whether they pose a threat
- Alert RPAS Operator to the danger

Current Architecture / Algorithms
- Detection performance typically ~ 1 min
- Acceptable False Alarm Rate
- Missed Detections ~ nil
Detect & Avoid

Next Steps

The baseline performance of the optical detect and avoid system has been demonstrated across a wide number of encounters:

- It shows a good detection and false alarm rate performance in challenging conditions.
- Work is on-going to further improve both the false alarm rate and the accuracy with which the system can predict the time until collision.

Future laboratory and trials work includes:

- Investigating the ability of novel imaging techniques to improve the exposure of the imagery in high-contrast situations.
- Testing the system against extreme environmental conditions
- Enhancing the characteristics of the processing system for integration and trials on a tactical RPAS platform.
Virtual Certification

Define a Concept of Operation

+ Take an existing certified aircraft

+ Introduce a UAS architecture

Embody the Technology developed under ASTRAEA

- Autonomy and Decision Making
- Ground Ops & Human System Interaction
- Comms & Spectrum
- Detect and Avoid

Produce a Virtual Certification Document Suite in partnership with the CAA (34 documents)

© ASTRAEA 2014. All rights reserved.
Virtual Certification

- Virtual Certification document set jointly developed with UK CAA based on the four ASTRAEA sub-themes.
- ASTRAEA 2 Virtual Certification document released (EuroCAE Web Portal)
  - RPAS Compliance Checklist derived from CS-23 and CS-25 Certification Specifications
  - RPAS Special Conditions
  - Functional Specification
  - Functional Hazard Analysis
  - Proposed Acceptable Means of Compliance
- Supplementary tasks such as:-
  - CAP722 – Pre version update technical review
  - Communications Security study

© ASTRAEA 2014. All rights reserved.
Virtual Certification

Next steps

• Continued Development of RPAS Virtual Certification documents, to focus on new ASTRAEA sub-themes
• Maintain engagement with UK CAA
• ASTRAEA 3 to engage with other (European) work groups to enable shared learning
• Use of Virtual Certification documents to help inform emerging regulatory requirements
• Development of body of evidence to underpin a Qualification process for the sub-themes
• Develop ETSO level information for each of the sub-themes
Alignment with RPAS Roadmap

3B

Integration timeline
- Initial operations
- Integration
- Evolution

Critical path:
- Initial operations
- Integration
- Evolution

© ASTRAEA 2014. All rights reserved.
ASTRAEA 3B

- **Regulation and Certification**
  - continuation of the regulatory framework development with the CAA
  - engagement with appropriate European and international organisations developing performance standards and guidance material
  - extension of the Virtual Certification process.

- **Capability Development and Demonstration**
  - continued development of key technologies
  - synthetic environment experiments
  - hardware-in-the-loop rig trials
  - surrogate and UAS flight trials.

- **Virtual Operations**
  - end-user and non-technical stakeholder engagement
  - public perception engagements

© ASTRAEA 2014. All rights reserved.
Safe to fly

Flown safely

© ASTRAEA 2014. All rights reserved.

www.ASTRAEA.aero