UNMANNED AIRCRAFT SYSTEMS – CURRENT OPS, INTEGRATION AND CHALLENGES

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Scope

- UK policy towards UAS operations
- Current Situation
- Challenges for Integration
- Future requirements/steps
The scale/range of the subject
Fundamental Principles

- They are Aircraft – not ‘drones’ ‘toys’ ‘UAVs’ etc
- They are Piloted – albeit remotely
- equivalence – to manned aviation
  - doesn’t mean ‘identical’, looking for an equivalent capability
- No ‘automatic rights’ - to airspace or special privileges

CAA’s responsibility is to Protect the Public – Risk?

General Considerations
- Piloting ‘function’ same for manned and unmanned – both ‘move’ aircraft through the air
  - Same Airspace, Same Weather, Same Rules
- Operations - Avoidance of collisions/Lookout principles
- Airworthiness
  - Integrity of ‘link’ to aircraft
  - Complex Flight Control Systems

Pilots - Operators - Airworthy Aircraft
UAS Ops Within UK Airspace

- **Visual Line of Sight (VLOS)**
  - ‘See and Avoid’ responsibilities through direct visual observation (visually managed)
  - Limited range- Size/Colour, weather conditions
  - 400ft vertical, 500m horizontal – basic limits
  - Extended VLOS - ops within/beyond 400ft/500m, RP’s ‘direct visual contact’ requirement addressed differently – collision avoidance still achieved through ‘visual observation’

- **Beyond Visual Line of Sight (BVLOS)**
  - Detect and Avoid System
  - Segregated Airspace (if no DAA system fitted)
The Current Situation
UK Policy/Regulation developed and published through CAP 722. Provides regulatory guidance to those who are involved in the development of UAS. (1st point of reference). Used by other nations as a reference document (and frequently plagiarised). CAP 722 will evolve as needed in line with continuing UAS development.
Small Unmanned Aircraft (SUA)

▪ “Any unmanned aircraft, other than a balloon or a kite, having a mass of not more than 20kg without its fuel but including any articles or equipment installed or attached at the commencement of its flight”

▪ Note - this **does not differentiate between model/recreational or other uses**

▪ SUA are exempted from the majority of the UK Air Navigation Order (UK Air Law), but 3 specific articles apply: **Arts 138, 166 & 167**
Small UAS Operations

- Regs proportionate to the potential risk, ‘light touch’ where suitable
- Specific aim “to protect those not involved in the activity”
- Permissions – required where greater level of risk is evident
  - Aerial work, flight close to people/property
- For safety purposes only, not ‘privacy’ (Privacy aspects are covered by the data protection regulations)
- Small UAS Currently the biggest/most notable development area (Police, Fire, ‘security’, Aerial Phot Surveys)
- Over 200 Small UAS operators currently flying in UK
UK Small UAS Operating Permissions

2006: 8
2007: 7
2008: 17
2009: 16
2010: 59
2011: 62
2012: 133
2013: 192 (to Sep)
But........................................

- Reason for the rapid expansion in UK?
- Cheap and simple
  - Simple/light touch – no licensing
  - No ‘airworthiness’ specifications - ‘hobbyist’, no major testing/reliability requirements
  - VLOS only ops – simple collision avoidance
  - Basic responsibility on ‘person in charge’
  - Risk based - size of a/c, how much damage?
- Next ‘step up’ (close to/over people, BVLOS) is a big one....
  Airworthiness + Collision Avoidance = Costly!
Larger/BVLOS Operations
Larger RPAS/UAS (over 20kg mass)

- All elements of the ANO apply
  (Registration, Equipment, Crew Licensing, Rules of the Air etc)
- Airworthiness – dependent on the Basic EASA Regulation
  (150kg mass, State a/c, research, experimental, scientific)
- Segregated airspace (until DAA ‘arrives’)
  - UK uses Danger Areas as prime tool for UA segregation purposes
  - Short term needs may be catered for through temporary airspace restrictions - TDA
- But….Segregation denies airspace to other users
BVLOS Airspace Challenges

- Airspace types/classifications
  - Different Access permissions
  - Flight Rules – VFR/IFR
  - Conspicuity

- ATC Cannot monitor all UA
  - radar coverage
  - workload
  - uncontrolled airspace aspects
  - cannot track ‘small’ a/c

- Link Loss and Emergencies
Visual Lookout......... or lack of it !
Detect and Avoid

- Generic expression used to reflect a technical capability commensurate with a pilot’s ability to ‘see and avoid’ other air traffic and other hazards/objects

  - Not ‘just’ Collision Avoidance
  - Needs to work in ‘Real Time’

- The ‘key’ to full integration
Detect and Avoid’ must enable the pilot of an Unmanned Aircraft to:

- Separation/Traffic avoidance
  - Perform the same ‘give way’/‘maintain sufficient distance so as not to cause a hazard’ roles undertaken by the pilot of a manned a/c iaw the Rules of the Air

- Collision Avoidance
  - Undertake collision avoidance manoeuvres (ie. ‘last ditch’ avoidance) if the normal separation provision fails
  - ‘Automatic’ system also required (Eg. If control link is lost)
Detect What?
The challenges of UAS certification

• Certification will be new & novel - system elements?
• UA must be safe to fly over the UK landmass
• UAS specific Certification Specifications still being developed - to some extent, we are going into the unknown
• Certification also includes ops, airspace and other ‘traditional’ pilot actions which are not normally considered for manned aviation – wider and more involved process

• Airframe systems are considered separately from the Synthetic Pilot, (the Complex Flight Control System)
  • ‘known’ airframe elements = no change
  • What are the differences/additions that enable it to fly Unmanned/Remotely Piloted?
No UK specific regulations under development

- No point in UK ‘going it alone’ – no ‘demand’ as yet
- Work underway at international level (ICAO and EU) to achieve ‘harmonised’ regulations – UK contributing to this, but rulemaking (ie. lawmaking) takes time (rightly)

Initial Ops – Accommodation - Integration

- In the meantime……..

Operational Limitations

Airworthiness
Detect & Avoid
Next Steps Toward Integration?

- **Step-by-Step expansion of operations:**
  - Visual Line of Sight – below 400 ft / 500m range
  - Extended Visual Line of Sight
  - In segregated airspace over sterile surface
  - In segregated airspace – surface may be populated
  - In segregated - ‘managed’ interaction with manned aircraft
  - In airspace with very low traffic densities/populations (remote, over water)
  - Airspace and overflight as for manned aircraft
Autonomy/Autonomous?

- Subject of differing interpretation
  - ‘mouse and keyboard’ as opposed to the more familiar ‘stick and throttle’ interface found in a manned aircraft?

- “having self government” and “acting independently or having the freedom to do so”; - implies an ability to self-determine.

- Although highly advanced, UAS are still pre-programmed (ie. automatic) rather than displaying true autonomy (at the moment)

- Aligned with ICAO
  - Autonomous aircraft - An unmanned aircraft that does not allow pilot intervention in the management of the flight.
  - Autonomous operation - An operation during which a remotely-piloted aircraft is operating without pilot intervention in the management of the flight.
Autonomy/Autonomous?

- Manned aircraft - ‘pilot-in-command’
  - Competent human who is directly responsible for the safe conduct of the flight
  - Makes appropriate decisions to maintain this safety should circumstances change as the flight progresses.

- Concept of ‘real time, direct human responsibility’ still required for ‘unmanned’ flights
  - potential for interaction with manned aircraft or the overflight of populated areas?
  - only difference is how this responsibility is discharged

- Aviation ‘establishment’ unlikely to seriously consider UAS operations without a remote pilot (except, perhaps, very simple scenarios) for many decades
To Sum Up

- As for manned aircraft, unmanned aircraft will only be permitted to operate in UK airspace if it is considered that it is safe for them to do so.
- In the UK today we have a growing and diverse civil UA industry with many SMEs involved using small rotary and fixed wing aircraft under VLOS. UK’s SUA regulations are proportionate, scaleable and have allowed the industry to develop.
- BVLOS ops (for both large and small types) will require much closer assessment – little demand to date, but changes starting to appear – this is where the ‘technical’ work is needed.
- Full (and safe) airspace integration is challenging. DAA a must for full airspace integration, Class G ‘the ultimate challenge’. Step by step approach to the future.
- We are developing appropriate regulation as a part of an international effort.
- ‘Safe to be Flown’- Airworthiness/Cert
- ‘Flown Safely’ – Operational – DAA, Remote Pilot Quals
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Detect what?

In Flight Conditions – VMC/IMC?

Visibility?

Distance From Cloud
Integration with the Aerodrome Environment
How will a UA/RPA interact with these?
Wilts/Salisbury – EGD120, 122 A/B/C
Radio Spectrum

To ensure the safety of ‘Remote’ flight, reliable communications are required for:

- flight direction commands, response feedback and positional awareness for the Remote Pilot.
- communication between the Remote Pilot and ATC for ATM purposes, (where applicable).
- C2 Link Architecture
  - ‘Direct’ to aircraft ? – RLOS
  - ‘Relay’ Eg via satellite ? – BRLOS
- Latency?
- Loss of C2 Link ?
Radio Spectrum

There is only a small amount of protected radio spectrum allocated for civil UAS operations.

UAS ‘C3’ is potentially ‘spectrum hungry’

Frequency spectrum for all applications is allocated by the “World Radio Conference” – Next Conference 2015

• How much is required for each aircraft?
• How do you ‘certify’ a signal in space?
• How do you ensure the signal cannot be interrupted? (Airworthiness and Security aspects)
UAS – ATC Communications
Crew Licensing Requirements

• National and EU law demands that those in command of aircraft are licensed.

• Beyond VLOS UAS flying for commercial gain - qualification on a par with the Commercial Pilot’s Licence is likely to be required - Remote Pilot’s Licence (RPL)

• Type ratings? Association with the Remote Pilot Station (rather than the RPA)...or both?

• Awaiting formal UAS pilot licensing requirements. Until then, CAA will work on an individual case-by-case basis.

• Although ‘unmanned’, Human Performance still a very important factor
Progress Within ICAO

- UASSG
- ICAO Circular – published Dec 10
- Guidance Manual being developed, publication anticipated Mid 2014
  - Airworthiness
  - Operations
  - Detect and Avoid
  - Personnel Licensing
  - Command, Control, ATC Comms
  - ATM integration
- SARPS expected to follow from GM
ICAO Timeline

- Standards and Recommended Practices (SARPs) and Procedures for Air Navigation Services (PANS)
  - 2016 - 2018 timeframe
    - on airworthiness, operations, licensing, detect and avoid, C2 / C3 and basic ATM provisions should be applicable;
  - 2020 - 2023 timeframe
    - refinement of all SARPs / PANS with addition of aerodrome and ATM operational requirements can be expected;
  - By ~ 2028
    - all provisions needed to support transparent operation of RPA in all classes of airspace and at aerodromes are expected;