Low Level RPAS Traffic Management

Potential systems solutions

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Context

150 m AFSC

VLL

50 m AFSC
The airspace below 500ft/150m is used by many air vehicles

Small RPAS VLL operations (below 150m) raise safety/security/privacy concerns

VLL operation regulations in progress in many European countries

The increasing demand for BVLOS RPAS VLL operations (mostly commercial) makes the definition of enablers (technical and regulatory) necessary

The small size of many RPAS modifies the basic and legacy See & Avoid principle: the pilot of a manned aircraft may not be able to detect a small RPA in time to pass well clear
What are the typical needs for BVLOS Ops?

- Railways network monitoring

**SNCF Network**

- One of the densest and most complex network in Europe
- 58,000 km of tracks
- 14,000 km of electrified lines
- 2,500 km of High Speed Lines
- 17,000 trains
- 10 millions passengers each day

For safety and security, lines need to be controlled regularly

- Power lines network monitoring
Low Level flight: safety issues

• Do not harm people or damage properties on ground
  • Airworthiness
  • Concepts of operation
  • Pilot selection, education and training

• Pass well clear of other airspace users and, ultimately, do not collide with them
  • Detect and avoid
  • Concepts of operation
  • Pilot selection, education and training
Detect and avoid issues

Problem assessment:

• Conspicuity issue: RPA are so small that the conventional see and avoid principle is made dissymmetric
• Asking all airspace users to be cooperative in order to be seen by RPAS and to see cooperative RPAS is not a short term option

Potential solutions:

1. Equip the RPAS with an onboard D&A system
2. Transfer the Detect function to the ground and provide the pilot with traffic information (GBDAA) and/or to other actors (RPAS Traffic “Manager”):
   • Easy to detect cooperative aircraft
   • More complicated to detect non-cooperative aircraft
3. « Share » the airspace: creation of corridors /airspace layers for an exclusive RPAS use
Detect and avoid issues

Potential solutions:

1. Equip the RPAS with an onboard D&A system
   - Need for low weight/low volume/low power cooperative & non cooperative sensors (transponders, ADS-B, FLARM & EO/IR sensors, radar) robust to weather conditions and to insects/other elements contamination
   - Need reliable link to keep pilot in the loop at any time (separation/well clear + automatic collision avoidance)

2. Transfer the Detect function to the ground and provide the pilot with traffic information (GBDAA) and/or to other actors (RPAS Traffic Manager):
   - Need for low weight/low volume/low power cooperative & non cooperative sensors (transponders, ADS-B, FLARM & EO/IR sensors, radar) robust to weather conditions and to insects/other elements contamination
   - Need link to keep pilot in the loop at any time (GBDAA + RTM)
3. « Share » the airspace: creation of corridors /airspace layers for an exclusive RPAS use

- Seems to be the Google and Amazon perspective

- “Amazon’s Drone Highway – Organizing the Drone Friendly Skies” would restrict airspace use by other current users
- Legal and societal acceptability ?
- Safety and security issues
Operational context: where can we fly?

In airspace classes and zones

Controlled airspace
- Class A
- Class B
- Class C
- Class D
- Class E
- Traffic is known by ATC

Separation is provided by ATC
Collision avoidance remains pilot’s responsibility

Uncontrolled airspace
- Class F
- Class G
- No ATC or ATC does not know who is where

Separation & Collision avoidance are pilot’s responsibilities
Operational context: Airspace in France

Controlled airspace between 0 & 150 m:
- Red: class A & C
- Blue: class D

Anywhere else, class E or G (or specific zones) where, generally, ATC do not know all traffics

The largest portion of the low altitude airspace is uncontrolled
Operational context: a flight path example

Contact with Paris CTR (class A)
No ATC (Class G airspace)
Contact with Pontoise CTR (class D)

Railway network and controlled airspace between 0 and 150 m in Paris area
Operational context: a flight path example

- Pontoise CTR 0 to 1500 ft
- Paris CTR 0 to 1500 ft
- Class G
- 150 m AFSC
- 50 m AFSC

VLL
LLRTM (Low Level RPAS Traffic Management) concept

LLRTM system provides a set of capabilities:
- All traffic monitoring & RPAS traffic management in uncontrolled airspace
- All traffic monitoring & coordination with ATC in controlled airspace
- Ground based detect and avoid functions

- Controlled airspace
  - Class A
  - Class B
  - Class C
  - Class D
  LLRTM manager coordinates with ATC and relays ATCOs instructions to RP, RP uses LLRTM system information to manage the flight and for collision avoidance

- Uncontrolled airspace
  - Class E
  - Class F
  - Class G
  RP executes LLRTM manager instructions and uses LLRTM system information for self-separation and collision avoidance
Low Level RPAS Traffic Management (LLTRM)

- Ground-based system to manage RPAS operations below 500 ft (class E/G)
- Using a combination of sensors:
  - Airborne collaborative alerting system
  - Ground sensor to detect non-cooperative traffic
- Role of human actors:
  - Remote pilot
  - Operation manager
- HMI design

© LLTRM
LLRTM system components

- **Cooperative sensors**
  - Mode A/C transponder receiver
  - Mode S & ADS-B receiver
  - FLARM receiver

- **Non cooperative sensor**
  - Radar

- **Sensors data processing**

- **HMI**
  - GBSAA
  - RPAS Traffic Management
Human centered design of HMI for UTM: detect & avoid by the remote pilot

- Preliminary development of an HMI for remote pilot alerting
- Some issues:
  - Frame of reference, orientation
  - Filtering & timing
  - Alerting philosophy & modality
  - Resolution aids
- Future work:
  - Complete the integration
  - Testing in simulation & in real environment
Human centered design of HMI for UTM: RPAS traffic manager

- Preliminary development of an HMI for in support of the RPAS traffic manager

- Some issues:
  - Integration of flight planning and ATM information
  - Management procedures vs the remote pilots
  - Link and coordination with ATC (where present)

- Future work:
  - Refine the role & procedures
  - Testing in simulation & inflight
Conclusion & perspectives

- The increasing demand for BVLOS RPAS VLL operations requires efforts of the whole ATM community to find technical solutions and procedures to accommodate safely these new airspace users alongside legacy airspace users.

- The LLRTM system can be a first step to enable some RPAS operations (airworthiness issue is still to be solved to overfly population).

- The LLRTM system architecture can be seen as an opportunity to experiment present and future global (all traffic, all classes of airspace) ATM principles, including new concepts/approaches: 4D contracts, task sharing between remote pilots and controllers, low cost technologies to make most of the airspace users cooperative...

- SESAR should help in making progress to guarantee airliners’ safety when approaching airports.
Passenger Plane in Near Miss with Drone Close to Heathrow

http://www.newsroom24.co.uk
14:16 GMT on 22 July 2014, altitude of 700ft

Thank you for your attention... and have a safe flight back!