

# SMALL RPAS Integration in ATM : first steps and perspectives



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Ressources, territoires, habitats et lo  
Energies et climat Déve  
Prévention des risques Infrastructures, tra

Présent  
pour  
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Ministère  
de l'Écologie,  
du Développement  
durable,  
des Transports  
et du Logement

Direction générale de l'Aviation civile  
Direction des services de la Navigation aérienne



DSNA



# DGAC /DSNA /DTI

## French Air Navigation Service Provider

Responsible for delivering Air Traffic control services within the French metropolitan airspace (800.000 km<sup>2</sup>) and overseas dependencies

Handles roughly 2.8 million flights a year  
more than 80 control towers  
7 ACC (2 overseas, 5 in ECAC airspace).

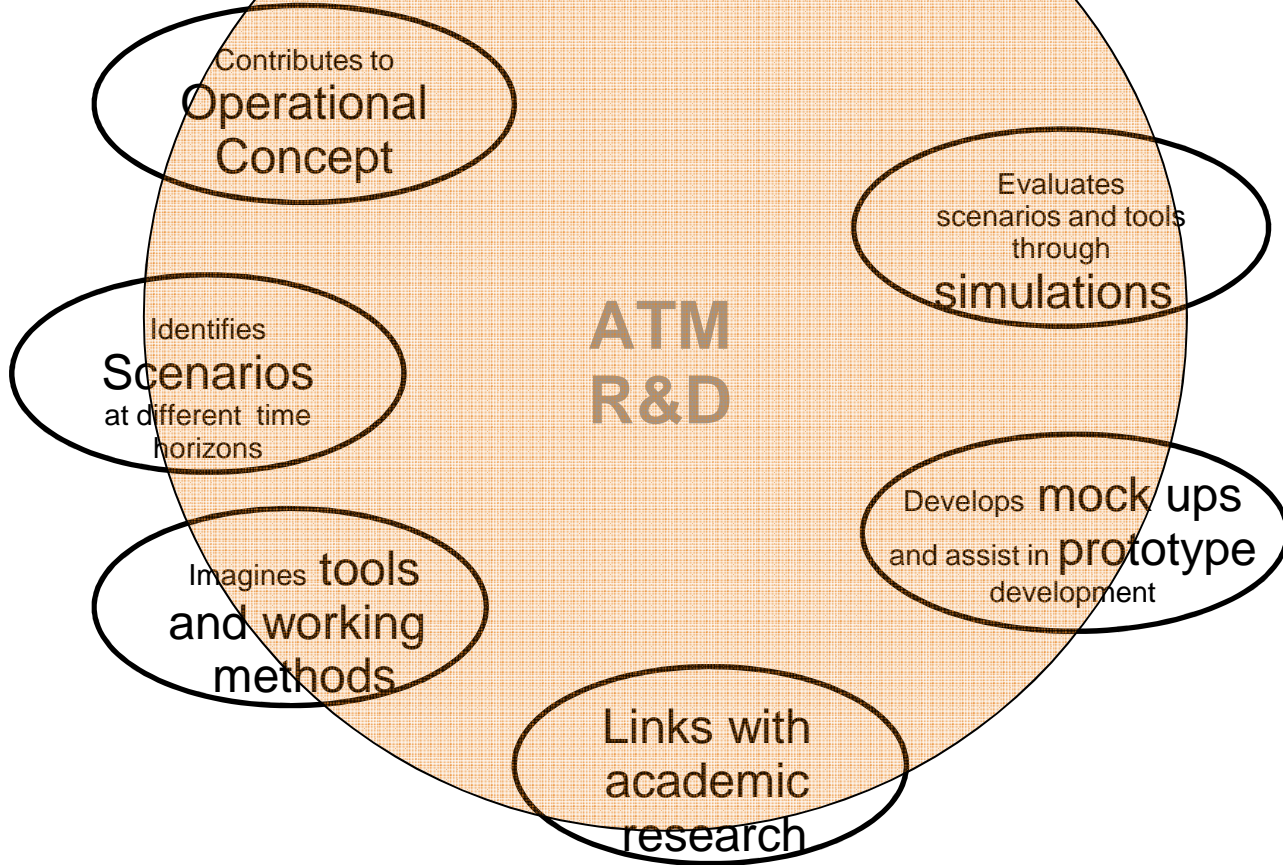


DTI (DSNA technical center) has participated as a leader or contributor in more than 70 projects during the SESAR steps 1 & 2 (2009/2013).



*In collaboration with  
European partners ; ANSP,  
Supply Industry, Research centers...*

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« the  
french  
ANSP  
»



**Other  
DTI  
domains**

**Laboratories**



# OUTLINE

Introduction

The French regulation

The market growth

Next steps

- ATM principles

- D&A

- C2Link

- Human Factors

Perspectives



# INTRODUCTION : Vocabulary

UAS : Unmanned Aircraft System



RPAS : Remotely Piloted Aircraft System  
(ICAO 2011 328)

**Remotely piloted aircraft (RPA)** – an unmanned aircraft which is piloted from a remote pilot station.

**Remotely piloted aircraft system (RPAS)** – a remotely piloted aircraft, its associated remote pilot station(s), the required command and control links and any other components as specified in the type design.

**Remote pilot station (RPA)** – the component of the RPAS containing the equipment used to pilot the RPA.

**Remote pilot** – a person charged by the operator with duties essential to the operations of an RPA and who manipulates the flight controls, as appropriate during flight time.



# INTRODUCTION : Institutions involvment

- ICAO

circular 328 (2011)

amendment 43 to Annex 2 (Rules of the air), amendment 6 to Annex 7 (Aircraft Nationality and Registration Marks) (2012)

RPAS Panel (2014)

RPAS Manual and RPAS Symposium (2015)

- EASA & JARUS roadmap for RPAS Integration



# In France ...

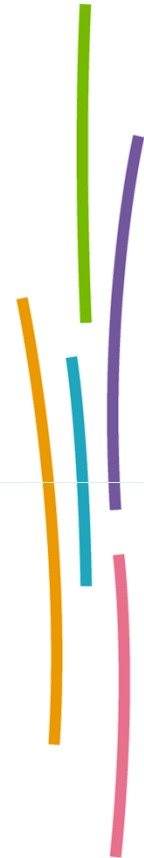
- Two Decrees dated 11 April 2012
  - relating to the use of French airspace by Remotely Piloted Aircraft
  - concerning the design of civil aircraft which fly without anyone on board, their condition of use, and the skills required of their users.
- Specific procedure for prototypes : for experimental purposes, aircraft shall not be classified on the basis of the Categories referred in Chapter II. They may be flown after a specific temporary autorisation is obtained in the form of a « laissez-passer »
- Next version of the decrees is expected in 2015



# Overview of the French regulation

- Rules for recreational usage (aeromodelling), aerial work (4 different usage scenarios) and experimentations
- Operations above 150 m AGL or in the vicinity of airports are forbidden
- Activities in populated areas are subject to prior authorizations

VLOS		BVLOS	
<b>SCENARIO 1</b> Unpopulated area  < 25 kg <150 m	<b>SCENARIO 3</b> Populated area Security perimeter  < 4 kg <150 m	<b>SCENARIO 2</b> Unpopulated area No third party on the surface  <1 km < 2 kg <50 m	<b>SCENARIO 4</b> Unpopulated area No distance limitation  < 2 kg <150 m





# Airworthiness and pilot qualification

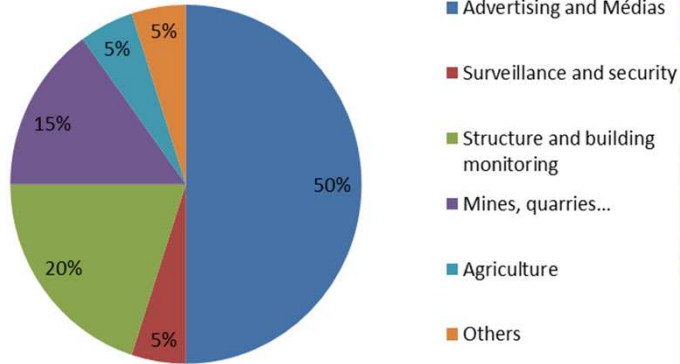
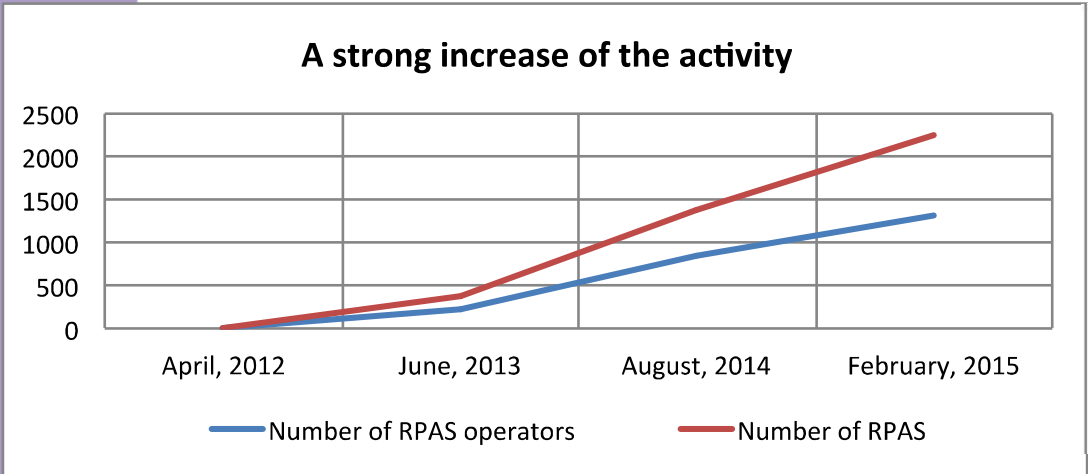
- Airworthiness
  - Document and identification for aircraft weighing more than 25 kg
  - Special autorisation for S2/S3 after specific verification of aircraft equipment/ S4 after overall safety analysis
  - Manual of specific activities + declaration of compliance with the requirements
  - In addition for S4 : Agreement on co-signed document by operator and his client ordering the mission
- Pilot qualification
  - Theoretical piloting knowledge for all remote pilots (from either ULA, PPL, glider or FCL ... licences)
  - Practical skills demonstration to the French DGAC of the competences of the remote pilot for aircraft weighing more than 25 kg
  - Practicall skills requirements for the specific activity under the operator's responsability (declaration of level of competence)
  - S4 : PPL licence and 100 flight hours as a pilot-in-command + 20 RPAS flight hours in VLOS



# Growth of the market in France

## A sector in full expansion

- 2012 : 50 companies
- February 2015 : 1 300 companies operating 2 250 RPAS / 3 000 jobs
- Turnover 2014 (professional RPAS) : about 50 M€

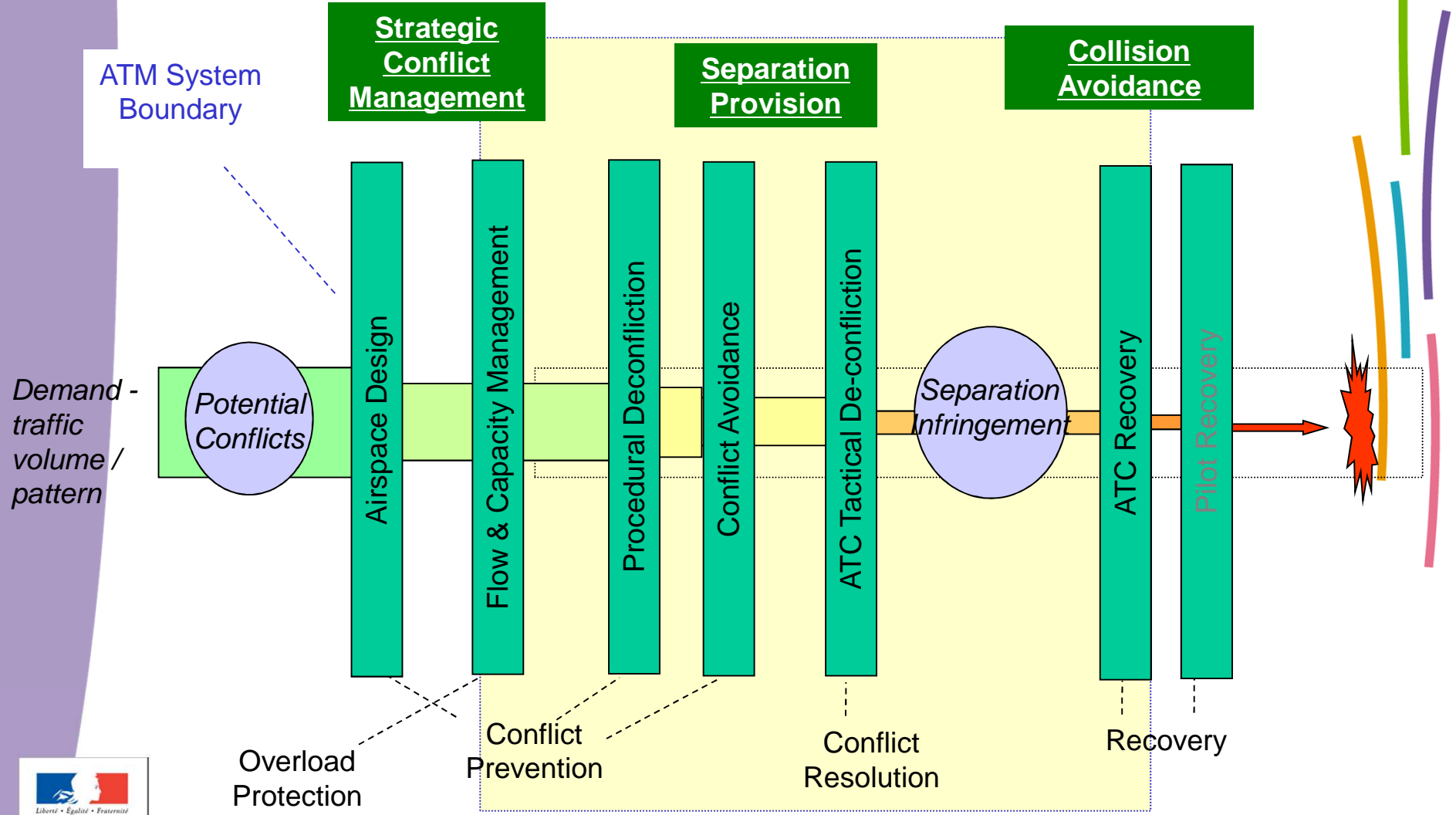


## ... With mainly very small firms and SMBs, and majors in the R&D

- including 45 manufacturers (4 offering fully self designed products)
- many start-ups with high level of innovation
- providing services and data more than aerial vehicles



# Next steps : ATM principles



# Next steps : R&D topics

ATM LAYERS	DESCRIPTION	ACTORS
Strategic	Flight planning Flow Control	<p>Modelization</p> <p>RPAS Pilot submitting Flight Plan ATC processing of flight plans</p>
Separation	Aircraft-to-aircraft separation between RPAS and other traffic	<p>ATC providing separation service RPAS maintaining self separation when ATC separation service is not C<sup>2</sup> Linked (D&amp;A)</p> <p>4D Nav</p>
Collision avoidance	« Last resort » collision avoidance alert and maneuver	<p>RPAS D&amp;A system collision avoidance resolutions and maneuvers TCAS Compatibility</p> <p>IHM Human factors</p> <p>D&amp;A</p>



# Next steps : D&A issue

- Airborne Collision Avoidance Systems
  - Detect
    - Be equal or better than the theoretical see and avoid-capability of a human pilot (that's not only the eyes !)
    - Have the reliability of a flight-critical system
      - autonomous RPAS decision or
      - reliability & reaction-time of the datalink
  - Provide separation
  - Perform an avoidance maneuver
- Ground and Obstacle D&A
- Weather D&A
- Ground-based D&A Systems
- Wake vortex and other hazard D&A



# Next steps : D&A systems

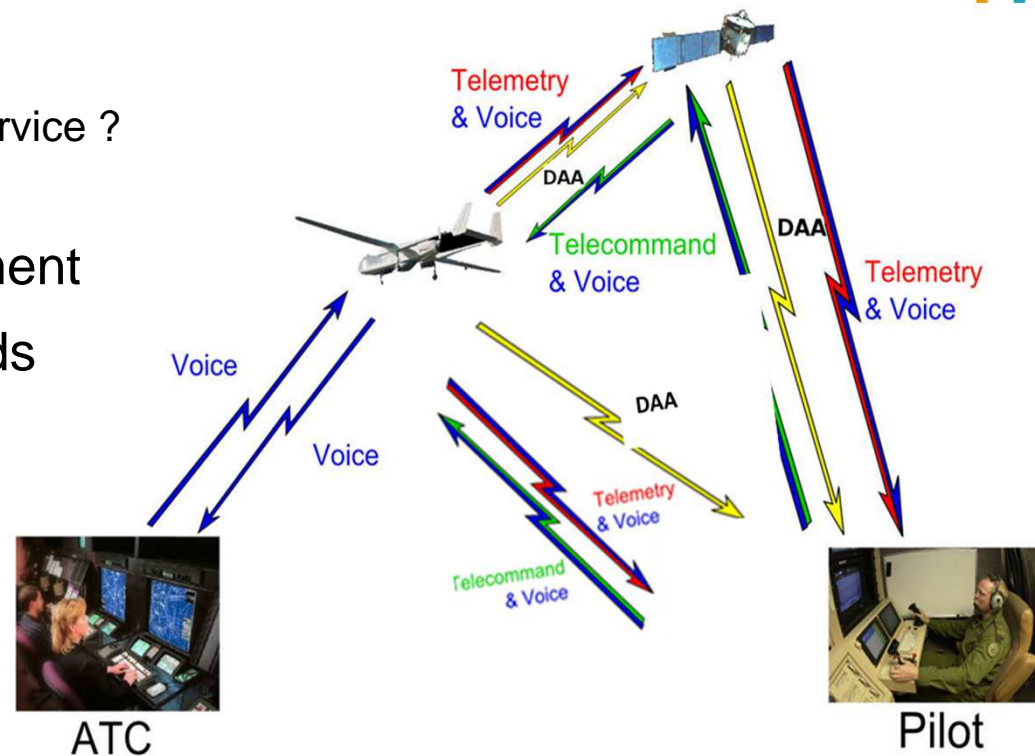
## From an ATC perspective

- A to D Class Airspace ( All traffic must contact ATC):
  - ACAS Xu compatibility
  - Certified systems
  - Backup system for non cooperative traffic in case of Mode S/ ADS-B failure
- E to G Class Airspace ( ATC may ignore some traffic):
  - Cooperative and/or non cooperative sensors
  - Certified systems
  - Backup system for non cooperative traffic in case of Mode S/ ADS-B/FLARM/UAT... failure



# Next steps : C2Link issue

- Required communication performances
  - Reliability (availability, confidentiality, integrity ...)
  - Security,
  - Latency ...
- Architecture
  - Use of Fixed Satellite Service ?
  - Backup ?
- Performance Assessment
- Demonstration methods
- ...



# Next steps : C2Link requirements

## From an ATC perspective

- C2 Link availability must be comparable with VHF link availability:
  - On board and RPS C2 systems certification
  - Quality and integrity of transmissions monitored in real time
  - Use of Fixed-Satellite Service ?
- Use of C band (5030-5091 MHz)
  - Need to define the system : protocole, quality of service, list of messages, individual specification of messages...





# Next steps : Human factors

## From an ATC perspective

- Need for demystification of RPAS towards CAA, pilots and ATCos
- Insertion of RPAS into airspace will be a continuous process. Segregation is the beginning, full insertion is the aim, but various intermediate steps may be taken (for example: increased vertical or lateral separation standards for RPAS).
- Emergency procedures must be clearly defined and ATC must be aware of RPAS trajectory when the machine flies in an « autonomous » mode.



# Perspectives

- Regulation of 2012 allowed the rise of the activity
  - Ensure safety of third parties on the ground and of other aircraft
  - On going work for new provisions concerning pilot training and competencies
- But ...
  - Numerous eyewitnesses of illegal RPAS flights over cities or restricted areas
  - Need for solutions to detect, identify and neutralise RPAS in case of malicious acts
- Very Low Level Operations
  - D&A
    - All traffic cooperative ?
    - Which type of device ADS- B, FLARM, UAT...?
  - C2Link Frequencies
  - Failsafe modes
  - Security



# Conclusion

- Manned and unmanned aviation shall coexist in a common airspace with the same level of safety
- In 2035, according to Volpe National Transportation study 245 000 RPAS will fly, among them 175 000 for aerial work
- Need for R&D in ATM and tight collaboration between CAA, laboratories, Industry, EASA, JARUS and ICAO
- Time is critical : global guidance is needed !

