

Preparing for an Unmanned Future in SESAR

Real-time Simulation of RPAS Missions

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3rd SESAR Innovation Days

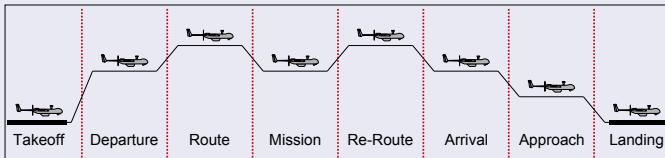
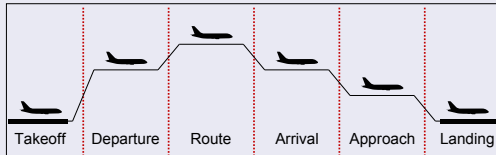


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RPAS peculiarities

Flight plan stages

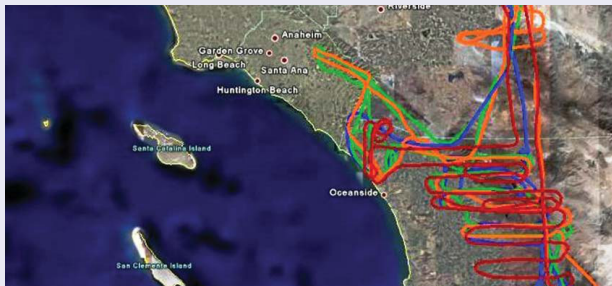
- Civil RPAS applications: Surveillance, SAR, terrain mapping...



RPAS peculiarities

The mission stage¹

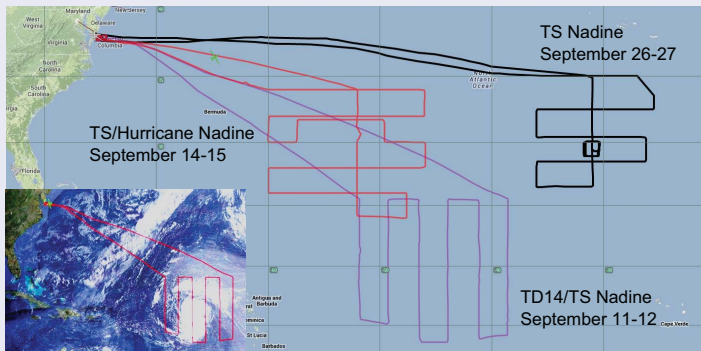
- VFR-like missions in an IFR environment.



¹Courtesy of NASA (V. Ambrosia); Google Earth background image used by permission to the NASA Wildfire Research and Applications Partnership project.

RPAS peculiarities

The mission stage²



²Courtesy of NASA

RPAS peculiarities

Performance dissimilarities

Performance Parameter	RPAS	Manned Aircraft
Cruise airspeed	↓↓↓	↑↑↑
Rate of climb	↓↓↓	↑↑↑
Cruise altitude	≈	≈
Endurance	↑↑↑	↓↓↓

Other issues

- Datalink related:
 - Communication latency.
 - Lost-link.
- Contingency related:
 - Loss of control/navigation capabilities.

RPAS Integration. State-of-the-art

Gaps for the integration of civil RPAS into the European aviation system³ have been identified. They are related to:

- **EC 1:** Development of a methodology for the justification and validation of RPAS safety objective.
- **EC 2:** Secure command & control / data links / bandwidth allocation.
- **EC 3:** Insertion of RPAS into the air traffic management system, detect & avoid (air and ground) and situational awareness (including for small RPAS), weather awareness.
- **EC 4:** Security issues attached to the use of RPAS.
- **EC 5:** Safe automated monitoring, support to decision making and predictability of behaviour.

³European RPAS Steering Group. *Roadmap for the integration of civil Remotely Piloted Aircraft Systems into the European Aviation System*, Jun 2013

Research goals

Regarding the roadmap

- To provide an environment that permits the analysis of specific areas/gaps.

Towards higher levels of automation

- To investigate the active interaction of the RPAS pilot and the ATCo through the extensive use of automation and information exchange.
- Higher automation to provide flexibility and situational awareness rather than become an obstacle to perform a safe operation.

What we propose

A novel real-time simulation environment

- Simulation of a realistic RPAS operation.
- ATC simulation environment that can integrate traffic and RPAS.
- Historical or predicted IFR traffic and its corresponding airspace structure.

Outline

1 Introduction

2 ISIS+

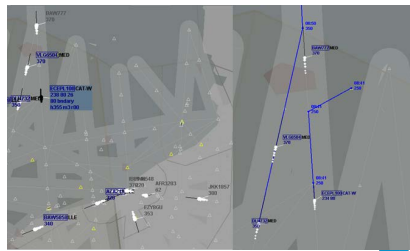
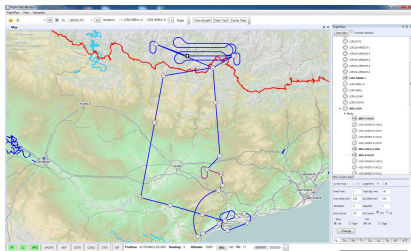
3 Use case

4 Conclusions & Further work

The ISIS+ ATM-RPAS simulation environment

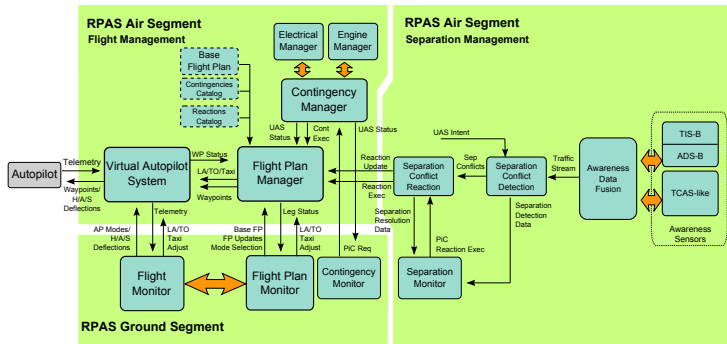
Characteristics

- Integration of two separated simulators:
 - ISIS: In charge of running an environment in which RPAS operations and subsystems can be tested.
 - eDEP⁴: Low cost, lightweight ATC simulation platform.



⁴Developed by EUROCONTROL Experimental Center

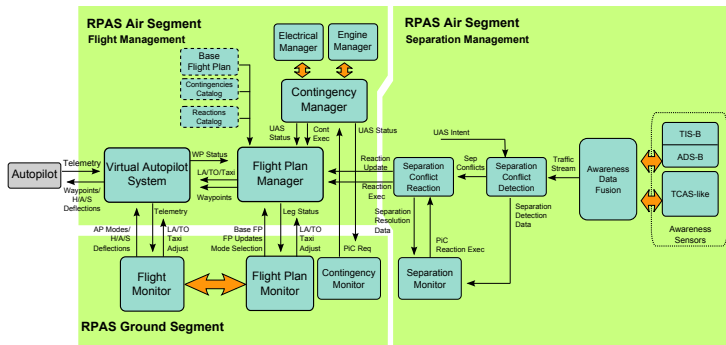
ISIS. Internal architecture



Air Segment

- **VAS-FMo:** In charge of abstracting from the particular autopilot.

ISIS. Internal architecture



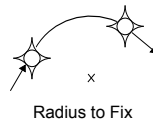
Air Segment

- **FPMa-FPMo:** The core of the autonomous operation of the RPAS under the supervision of the PiC.

Flight Plan Manager (FPMa)

FPMa

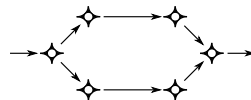
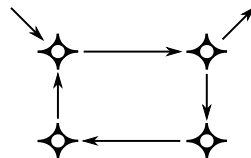
- Towards a high semantic level of flight plan specification.
- Usage of extended leg and path terminator concept (RNAV):
 - Basic (RNAV) legs:
 - Control (extended RNAV) legs:
 - Iterator.
 - Conditional.
 - Parametric (extended RNAV) legs.
 - Flight path generated using a reduced number of parameters.



Flight Plan Manager (FPMa)

FPMa

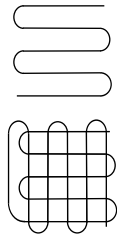
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Flight Plan Manager (FPMa)

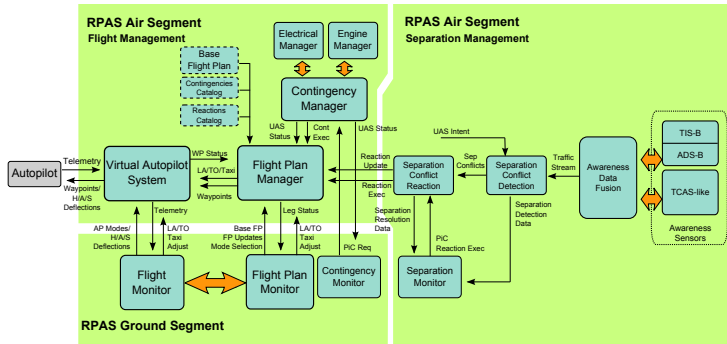
FPMa

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parametric
scans

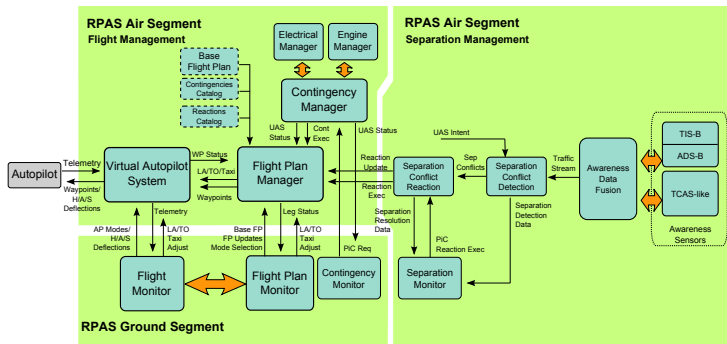
ISIS. Internal architecture



Air Segment

- **CMA-CMo:** In charge of managing contingency situations.

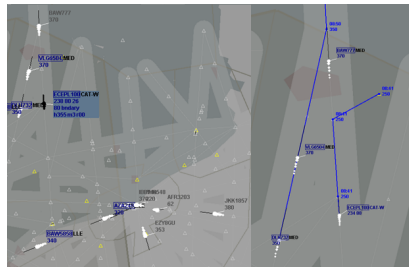
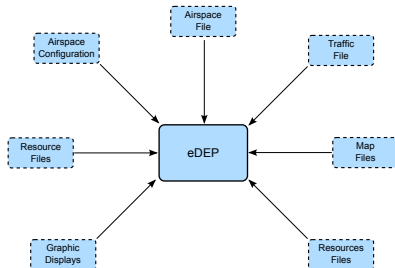
ISIS. Internal architecture



Air Segment

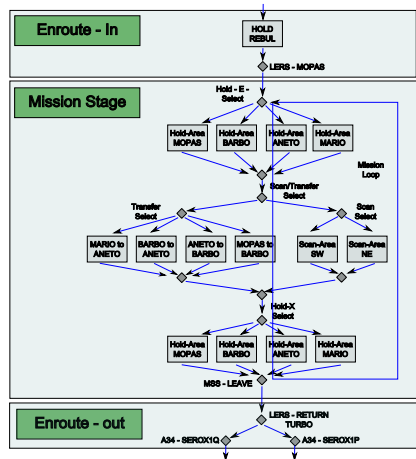
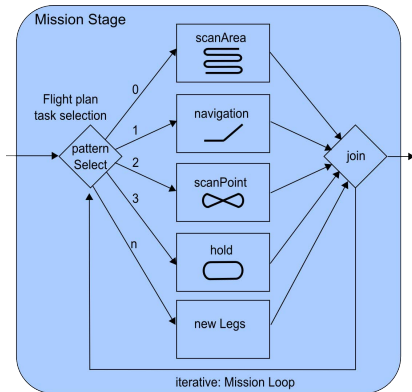
- **Separation Management:** In charge of dealing with separation issues with other collaborative traffic.

eDEP. Overview



Characteristics

- Human-in-the-Loop ATC simulator.
- Provides access to the ATC controller's capabilities and interactions.
- Two working stations are provided:
 - Controller Working Position
 - Pilot Working Position



Description

- Departure, arrival and approach are also simulated.
- Mission is formed by two scan patterns and four hold patterns.

Conclusions & further work

Conclusions

- ISIS+ development to study and evaluate complex scenarios in which RPAS are integrated into non-segregated airspace.
- RPAS simulator is integrated with eDEP, an Eurocontrol air traffic simulator.

Further work

- Some work need to be done to tackle specific RPAS airspace integration gaps