Remotely Piloted Aircraft Systems Integration in Controlled Airspace

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Content

RPAS
To be integrated within the European Roadmap

Spaceplanes
A new type of aircraft to be integrated
The "Law"

- Pilotless Aircraft: Article 8 Chicago Convention (1944)

No aircraft capable of being flown without a pilot shall be flown without a pilot over the territory of a contracting State...
Each contracting State undertakes to insure ... to obviate danger to civil aircraft.


- §1 Luftverkehrsgesetz: Unbemannte Luftfahrtsysteme
Definition of Unmanned Aircraft

- Full autonomous UAS*** instead of RPAS
  → System Manager at Ground

- RPAS** → Pilot at Ground

- Manned Aircraft
  - Single Pilot Cockpitt/OPV*
  - Pilot as System Supervisor/-Manager

* Optionally Piloted Vehicle  ** Remotely Piloted Aircraft System  *** Unmanned Aircraft System
Concept of Integration

Relay

Comm delay

relay C³ link

Avionics System (NAV, FMS, AFCS, FTS, MMS)

strobe lights

ACAS sense & avoid

RPA

direct C³ link

VHF COM SSR transponder

Follow ATC advisories, select COM frequ. & XPR code

Remote Pilot Station RPS

Air Traffic Control

Other aircraft

Radar Display with a/c labels & RPAS identifier

telephone
RPAS fully equivalent to Manned Aircraft

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Adapted Procedures

Topics

- Procedural
- ATC
- TCAS
- Detect & Avoid

Restricted Areas

- Procedural
- mod ATC
- mod TCAS

Risk Assessment
Off-Route
Higher Sep.-Minima
Earlier TCAS Advisory

Equivalent Level of Safety $1.5 \times 10^{-8}$
Sectorless ATM: RPAS Working Position

Specialist for RPAS-Traffic

"normal" Traffic

RPAS-specific separation Minima:
e.g. 9 NM / 2000 ft
RPAS must deviate
S&A requirements reduced
Simpler Communication

- Relay
- Remote Pilot Station RPS
- Telephone
- Air Traffic Control
- Other aircraft
  - sense & avoid
  - Possibly by using double separation minima
  - RPA

Diagram:
- Satellite
- Airplane
- Telephone
- Control Center
But what is with Spacecraft?

• Lynx Suborbital Vehicle, XCOR Aerospace
Differences in handling aircraft vs. spacecraft in ATM

Space Vehicles - current situation

- do not file a flight plan,
- trajectories are predictable but far away from 4D-contracts,
- provide limited capabilities to avoid other traffic, therefore have to be prioritized, therefore need restricted airspace,
- often have to delay launch / landing operations,
- will operate internationally - e.g. launch at KSC and land in Europe,

are not (yet) fully integrated into ATS!

International Intraoperability is required!
SESAR Requirements

Single European Sky ATM Research Programme SESAR

• From Business trajectory to Performance based trajectory

• System Wide Information Management SWIM
  • Integration also Controller-Pilot Data Link Communication (CPDLC)
  • Pilots, Airport Operations Centers, Airline Operations Centers, Air Navigation Service Providers, Meteorology Service Providers, Military Operations Centers
SWIM in SESAR

From Planning to Sharing to Execution
- Business Development Trajectory BDT
- Shared Business Trajectory SBT
- Reference Business Trajectory
SWIM SpaceCraftEmergencyInformationServer

Diagram showing the flow of information and interactions between different components such as Digital NOTAM, Other Users (Ground), EFB Support, AMQP Publish, and Chart Web & AMQP/WFS Gateway Server. The interactions include WMS Request/Reply, WFS Request/Reply, and http Request/Reply. The diagram also highlights the SpacecraftEmergencyInformationServer and its connection to GeoServer (WFS/WMS), PostGIS Database, and Simulation Based Forecast Data.
Spacecraft Flight Planning and Execution

1. Checking potential hazard areas by making the IFPS Validation System a SpaceCraftEmergencyInformationService consumer

2. Air traffic controller surveillance assistant tools consume the SpaceCraftEmergencyInformationService Issuing associated voice commands to other aircraft

3. Standard http requests for pre-formatted web charts to a chart web server

4. EFB software as an AMQP subscriber to the gate way server AMQP
The future is coming

- SESAR and NextGen are coming

- RPAS to be integrated in SESAR. New concepts can help to integrate faster.

- Spacecraft are another new type to be dealt with. Special emergency service to be implemented.
Thank you very much for your attention!