UAS in European Civil Airspace: USICO and SINUE Results

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UAS Integration in Civil Airspace

- Relay
- Comm delay
  - relay C³ link
- Avionics System (NAV / FMS / AFCS / FTS)
- C-UAS
- Other aircraft
- strobe lights
  - TCAS II
  - sense & avoid
- VHF COM
  - SSR transponder
- direct C³ link
- telephone
- UAS Control Station
- Air Traffic Control

Comm delay

DLR Deutsches Zentrum für Luft- und Raumfahrt e.V.
in der Helmholtz-Gemeinschaft
SESAR D1 Results

2005: 10.5 millions
SESAR D1 Results

2005: 10.5 millions

2010: 12.5 millions
SESAR D1 Results

- 2005: 10.5 millions
- 2010: 12.5 millions
- 2020: 17.2 millions
Current Situation above FL 360 in Europe
European Scale Research necessary

- **USICO**
  UAV Safety Issues for Civil Operations,
  European Commission 2002 – 2004

- **SINUE**
  Satellites enabling the Integration in Non-segregated airspace of UAS in Europe
  European Space Agency 2009 -2010
USICO Setup

Simulated MALE UAS
(Medium Altitude Long Endurance Unmanned Aerial Vehicle)

- Wing span (m) 22.6
- Length (m) 10.68
- Normal cruise (kcas) 110
- Max. ceiling (ft) 45000
Objectives of ATC/ATM Real Time Simulations

- Evaluation of the UAS integration concept:
  - Normal operations
    - Avoidance of severe weather
  - Emergency Operations:
    - Standard emergency procedures:
      - Comm Loss squawk 7600
      - Thrust Loss squawk 7700
    - UAS specific emergency procedures
      - (additional emergency codes)
  - Loss of separation

- Investigation of UAS specifics:
  - Communication delay for voice and data
Real Time Simulations

Mission Scenario:
- Surveillance Mission of a MALE UAS
- from regional airport Frankfurt-Hahn
- to mission area north of Bautzen

Scenario of Real Time Simulation:
- UAS crossing TMA Frankfurt on its outbound and inbound flight
- UAS emergencies within the TMA
Simulated Airspace

FIR Frankfurt: TMA Frankfurt & Sector West (modified)
Simulated Airspace

Background Traffic:
- Arrivals (26 – 38)
- Departures (0 – 13)
- Overflights (4 – 6)
Simulation Setup

Pseudo Pilots

UAS Pilot

Air Traffic Management and Operations Simulator
ATMOS
Simulation Setup

- **Communication**
  - Telephone communication between sector controller and arrival controller
  - Telephone communication between controller and UAS pilot if requested

- **Simulated Radio Telephony**
  - Radio telephony for the controller / pseudo pilot voice communication specially designed intercommunication device operation over wire link
  - Communication delay for satellite link is implemented:
    - 1.5 s
Workload of controllers

- UAS-pilot to ATCO interactions
- Instantaneous Self Assessment questionnaires
- NASA Task Load Index methodology
- Introduction of 1 UAS into airspace
- Introduction of 2 UAS into airspace
Workload of controllers

Week 1
2 UASs
Baseline
Week 2
A/C
Workload of controllers

- Workload increased slightly
- Due to unknown behaviour
- Later on workload got to normal
USICO Results (1)

• General
  No special problems with UAS in airspace
  Integration concept allows treatment of UAS like normal aircraft
• Emergency Codes

7600 for data link loss and comm loss appropriate
7700 for unpredictable emergency behaviour only
No other codes recommended
USICO Results (3)

- Work Load of Controllers

Workload increased slightly
Due to unknown behaviour
Later on workload got to normal
USICO Results (4)

• Communication

Telephone comm between controller and UAS pilot is a benefit compared to manned aircraft
USICO Results (5)

• Sense & Avoid

Sense/See & Avoid is still an issue to be solved with highest priority
SINUE Setup

Satellites enabling the Integration in Non-segregated airspace of UAS in Europe
State of the art UAS usage

Unmanned Aerial Systems (UAS)
in non-segregated airspace
through real-time simulation of
Beyond Line of Sight (BLOS) scenarios.
Airspace usage concept validation

The project SINUE investigates satellite aspects (BLOS operations)
Satellite Communication BLOS

- Within the simulation architecture, a satellite model is included

- In the underlying scenarios, several satellite issues will be covered:
  - temporary comm failure because of satellite constellation
  - total comm failure
  - C2 failure
  - time delay
  - bandwidth for real-time surveillance mission
  - cost benefit study
Simulation facilities NARSIM, MUST, GCS

Emergency procedures

ATC Interface

Separation
Architecture of communication

SINUE communication overview
Communication

- Communication
  - Telephone communication between controller and UAS pilot if requested

- Simulated Radio Telephony
  - Radio telephony for the controller / pseudo pilot voice communication
  - Specially designed intercommunication device operation over wire link
  - Satellite Model integrated
  - Communication delay for satellite link is implemented:
SINUE Results

- General
  No special problems with UAS in airspace
  Integration concept allows treatment of UAS like normal aircraft

- Demonstration mission planned a the Canary Islands or Baltic Sea 2011-2012
Conclusions

- Validation prior to real life operation.
- Simulation results are very realistic
- See/Sense & Avoid:
  further investigations ongoing