



# IDEAS

## Integrated Deployment of UAS in the European Airspace using Satellites

ESA/EDA Workshop  
May 11/12th, 2010 - Noordwijk

## Summary

- INTRODUCTION
- IDEAS INDUSTRIAL TEAM PRESENTATION
- IDEAS APPROACH - METHODOLOGY
- IDEAS DEMONSTRATION HIGHLIGHTS
- CONCLUSION
  
- DEMONSTRATION MISSION JUSTIFICATION

## Introduction (1/2)

- UAS demonstrates everyday (for the moment quite exclusively in the military domain), their interests as **complementary assets** to existing ones (satellites, Mission aircraft, ground Surveillance networks,...),
- Three points acting as a brake on UAS expansion:
  - **Proven Airworthiness/Safety/Security** (w.r.t. rules yet to be fixed)
  - **Integration into non-segregated airspace** / General Air Traffic (GAT)
  - **Proven cost-effectiveness** of the UAS Services (w.r.t. conventional means)
- Concerning integration into non-segregated airspace, EDA, within the **Air4All Roadmap** has identified technical challenges identified as enablers to "break through the barriers",
- Amongst which "**Secure and sustainable Communications for UAS Command & Control (C<sup>2</sup>)**" shall be addressed.

## Introduction (2/2)


- The return of (good and bad) experiences of the IDEAS Team in UAS (more than **25 years** including **10 years** of experience in UAS Satcoms) demonstrates the following:
  - Communication System in UAS design is **one of the most complex** topic to address, at least as complex as Air Vehicle and Sensors,
  - Communications on UAS is an endless challenge due to the **fast growing Operational Requirements and constraints** imposed by the Environment: more bandwidth, more availability, more liability, more security;.....less spectrum.....requested cheaper operating costs,
  - Satcom shall not be addressed as a "stand-alone topic" but as a **component of a Communication System**, itself part of a UAS System integrated into a System of Systems,
  - Military, State/Civil Security and Civil Missions and way to operate UAS are probably different. Nevertheless the **experience acquired on military UAS System could be useful** to avoid mistakes and speed up the process of integration of UAS into non-segregated airspace.

## IDEAS Industrial Team (1/2)

- To answer to EDA/ESA Request concerning the Satcom Feasibility Study, EADS has decided to **gather the experience and expertise** of UAS (and connected domains) experts in Europe:
  - To address both **Satellite** and **UAS** domains,
  - To address **Military, State/Civilian and Civil** UAS cases,
  - With a **System of Systems approach** considering the UAS System integrated in its environment: Command & Control and Air Traffic Control (current and future), Satellite Systems, Satellite Infrastructures,...
  - Encompassing every aspects to be taken into account: regulatory, operational, technical, technological, industrial, economic,
  - Based on **concrete experience** (not only theoretical) of designing and operating for years all kind of UAS (from 8 Kg up to 15 tons), as far as of design of Satellite System: Communications, Navigation, Earth Observation and Satcom airborne terminals,
  - UAS **Systems** and associated **Services**.



## IDEAS Industrial Team (2/2)

- An International Team: 
  - EADS Astrium (Fr+UK+Ger)
  - EADS DS Military Air Systems (Fr+Ger+Sp) with DFS (Ger) as Support
  - EADS DS Defence & Communications (UK)
  - QinetiQ (UK)
  - ISDEFE (Sp)
  - IABG (Ger)
- Involved in all UAS (and connect topics) related European/World working groups:
  - EUROCAE WG 73
  - NATO FINAS
  - ASTRAE
  - JARUS
  - ICAO UAS Working Group
  - EuroControl UAV-OAT Task Force
  - ASD UAS Working Group
  - SESAR JU
  - INOUI
  - ITU-R, CEPT
  - NATO STANAGs Communication Working Group,...

## IDEAS Approach – Methodology (1/2)

- Identification of potential **Stakeholders** for UAS Services: Military, State/Civilian and Civil,
- Identification of UAS Missions: Military, State/civilian and Civil,
- **Review of existing Studies**, Requirements related to the use of Satcom on UAS (for Air Vehicle and Mission C<sup>2</sup>): EDA, ESA, INOUI, ASTRAE, EUROCONTROL, EASA, SESAR, ICAO, FAA, EUROCAE WG 73, RTCA SC203 (US equivalent of EUROCAE WG 73),
- Capitalization of **actual IDEAS experience on airborne Satcoms** (not exclusively UAS experience),
- Weighting of the Demonstration criteria related to the **expected Quality of Service of the Satcom link**: range, coverage, availability, bit error rate, latency, authenticity, protection against interference/jamming, security,...
- Sorting and ranking of Missions w.r.t. pre-established selection criteria



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## IDEAS Approach – Methodology (2/2)

- Global Demonstration scenario description. Identification of the Satcom functions/performances which should be demonstrated to guarantee **safe operation of UAS via Satcom link(s)**,
- Preliminary assessment of the feasibility of such Demonstration Mission in **year 2011**:
  - Detailed list of topics which could be demonstrated during a Demonstration in flight,
  - Candidate UAS platform, requested infrastructure,
  - Requested Support (from UAS owners, from ATC, from national/European Administration,...).
- Preliminary description of generic Demonstration Mission,
- Refined/final description of the EDA/ESA selected Demonstration Mission,
- And in parallel, step by step:
  - **Viability Analysis**,
  - Technology Roadmap (what will be necessary beyond the Demonstration),
  - **UAS Services costs assessment**.



X Band Terminal



X / Ka Band Terminal



Ku Band Terminal



## IDEAS demonstration Highlights (1/2)

- On an **actual MALE UAS System**, fully qualified, flying daily in operation, type certification under process,
- Qualified (in France up to now) to **fly over populated area** in segregated airspace,
- With a **redundant Communication System**: Wideband Line of Sight (LOS) datalink, Wideband Satcom, Communication Server, ATC Radio, IFF, **fully mastered by the European Industry**. Today, the **only existing operational UAS wideband Satcom** in Europe,
- With the ability to **monitor in real-time the Quality of Service** of the Satcom link as seen by the UAS System itself and by the Satellite Service provider,
- Interfaceable with European military and civil ATCs,
- Interfaceable with Military and State/Civilian Command & Control Structures.



## IDEAS demonstration Highlights (2/2)

### SIDM/Harfang Characteristics:

- MTOW: 1.250 Kg
- Max Payload: 250 Kg
- Automatic Take-off and Landing
- High resolution SAR/TI and EO/IR/LD Sensors
- Communications:
  - V/UHF ATC Radio
  - IFF
  - Ku Band Line of Sight (LOS)
  - Ku Band Satcom
  - Communication Server
  - Rover Remote Video Terminal
  - Voice Interface with ATC through LOS and Satcom



## Conclusion

- A **multi-domain approach is mandatory** to address the Satcom topic based on careful analysis of the Stakeholders / End-Users UAS Requirements and their quick evolution for 10 years,
- Even if Military, State/Civilian and Civil Customers have (apparently) different Requirements and way to operate UAS, they could be **useful synergies** enabling to avoid to do again the same mistakes and to **shorten the loop** of integration of UAS into non-segregated airspace,
- IDEAS (and in particular EADS) is **ready to share its concrete and very pragmatical experience** with UAS potential Stakeholders / End-Users,
- Nevertheless, after 25 years of (sometimes painful) experience, there are still things to learn on this fast evolving UAS domain. **EADS as IDEAS Study leader, is fully open to new Partnership** for the Demonstration phase (and even beyond).

## Mission Selection Justification

## Mission Selection Justification (1/3)

- During the initial phase of the EDA/ESA Feasibility Study, IDEAS has selected two missions according to the selection process described here before:
  - Critical Infrastructure Surveillance (pipeline),
  - Border Control / Maritime Surveillance.
- Border Control / Maritime Surveillance Mission seems to be the most challenging case for the following reasons:
  - Adresses Military, Civilian/State and Civil/commercial issues,
  - More and more strong synergies between Military and Civil Security airborne Surveillance Requirements,
  - Similar trends:
    - Ten years ago: General Surveillance, Tactical Situation establishment, limited Reconnaissance and Identification,
    - Today: Detection, Reconnaissance and unambiguous Identification of "targets of interest", Multi-sensors Tactical Situation management,
    - Tomorrow: Understanding of the "targets" behaviour in advance in order to get sufficient notice to take the appropriate measures.

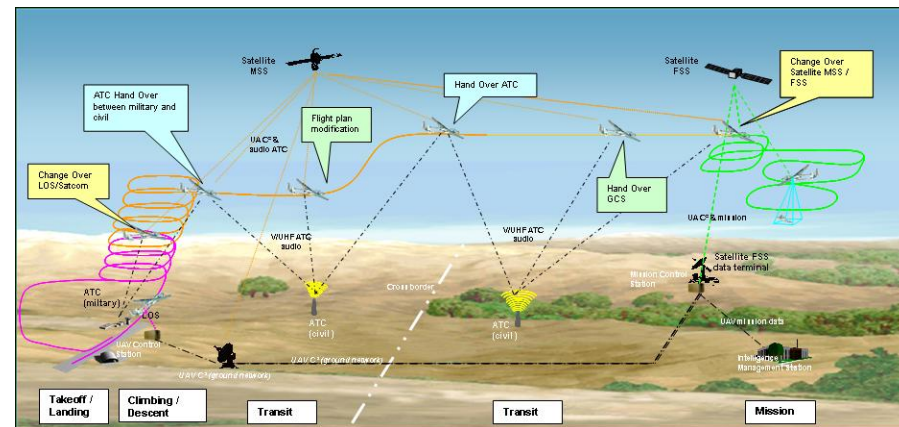
## Mission Selection Justification (2/3)

- The solution is probably in a **smart combined use of ground, space and airborne assets** involving efficient Communication networks (including Satcom(s),
- Border Security / Maritime Surveillance Mission is **very challenging** concerning UAS Communications:
  - Long range, persistent Missions,
  - Day/night, all weather,
  - Successively high and (very) low flight profiles,
  - Potentially **cross-border**,
  - Potentially in **successive segregated – non-segregated airspaces** due to unpredictable behaviour of the "target",
  - In a **dense electromagnetical environment** (coastal areas with harbours or airports) where RF interferences could jeopardize the Mission,
  - Mandatory **interoperability** (via Communications) with the involved participants: Surface, Ground, Airborne.

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## Mission Selection Justification (3/3)

- Border Security / Maritime Surveillance Mission is very challenging concerning UAS Communications (continued):
  - Highly demanding concerning **Quality of Service** due to real-time transmission of high resolution sensors images/video,
  - Frequent **change-over** (between LOS and Satcom) and **hand-over** (between Ground Control Stations),
  - Interface with **military and civil ATCs**,
  - Very demanding concerning **Information dissemination**: the right information (and only this one), to the right person, with the appropriate level of Quality of Service.



# Thank you for your attention!



<http://www.ideas-uas.eu>





Backup



## Non exhaustive list of UAS Missions / functions taken into account

- **Military (Navy, Army, Air Force, Joint Force, Intelligence, Special Operations...)**
  - Surveillance, reconnaissance and target acquisition (maritime)
  - Surveillance, reconnaissance and target acquisition (terrestrial)
  - Close Air Support
  - Communication relay
  - Imagery broadcasting
  - Personnel recovery
  - SIGINT and Jamming
  - Convoy Protection
  - Combat Search & Rescue (CSAR)
  - Antiballistic Detection & Tracking
  - Cargo Transport
- **State (Homeland Security, Customs, Police Forces, Coast Guards... )**
  - Border Surveillance (Smuggling, Illegal Immigration...)
  - Maritime Surveillance (ship tracking, fishery surveillance, anti-piracy...)
  - Law Enforcement
  - Event Monitoring
  - Anti-Terrorist Surveillance
  - Environmental Monitoring
  - National Infrastructure Monitoring
  - Emergency Response Support
  - Disaster Relief
  - Search and Rescue (SAR)
- **Civil (Commercial, NGO... )**
  - Weather Reconnaissance
  - Infrastructure Monitoring (e.g., energy networks – pipelines, power-grids, oilrigs...)
  - Aerial Surveys
  - Cargo Transport
  - Environmental Monitoring (e.g., accidental disasters, oil spills...)
  - Disaster Relief
  - Traffic Management