Industria, Innovazione e Ricerca:

Le nuove frontiere del volo a pilotaggio remoto

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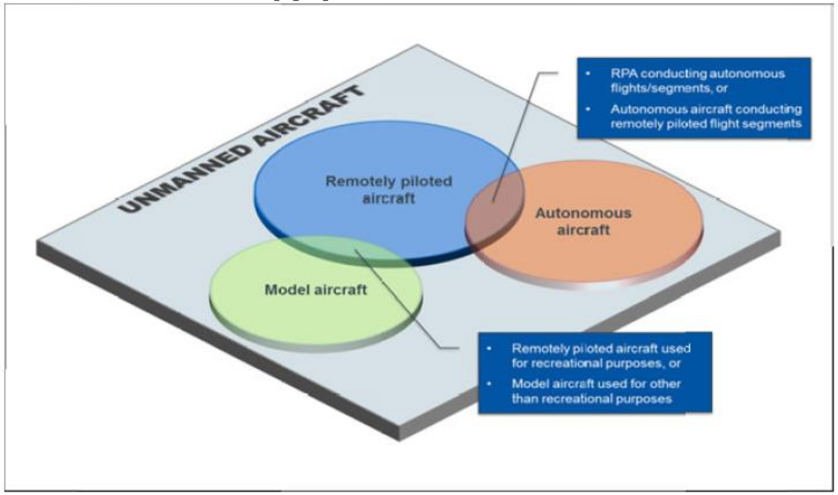
University of Naples Federico II, June, 12th, 2015

Fundamental Principle

- **Unmanned Aircraft** is a powered, aerial vehicle that does not carry a human operator, can fly **autonomously** or be **piloted remotely**.

- **Remotely Piloted Aircraft System (RPAS)** is a type of UAS and is the only one in the rulemaking process ICAO for civil integration.



- **RPAS** or fully autonomous or combination are subject to art. 8 ICAO
*"No aircraft capable of being flown without a pilot shall be flown **without a pilot** over the territory of a contracting State without **special authorization** by that State and in accordance with the terms of such authorization. Each contracting State undertakes to insure that the flight of such aircraft without a pilot in regions open to civil aircraft **shall be so controlled** as to obviate danger to civil aircraft."*

RPAS as a System

- RPAS is a system composed by:
  - A Remotely Piloted Aircraft (RPA).
  - A Remote Pilot Station(s) (RPS).
  - Command&Control (C2) Link.

C2 Link

RPA

RPS

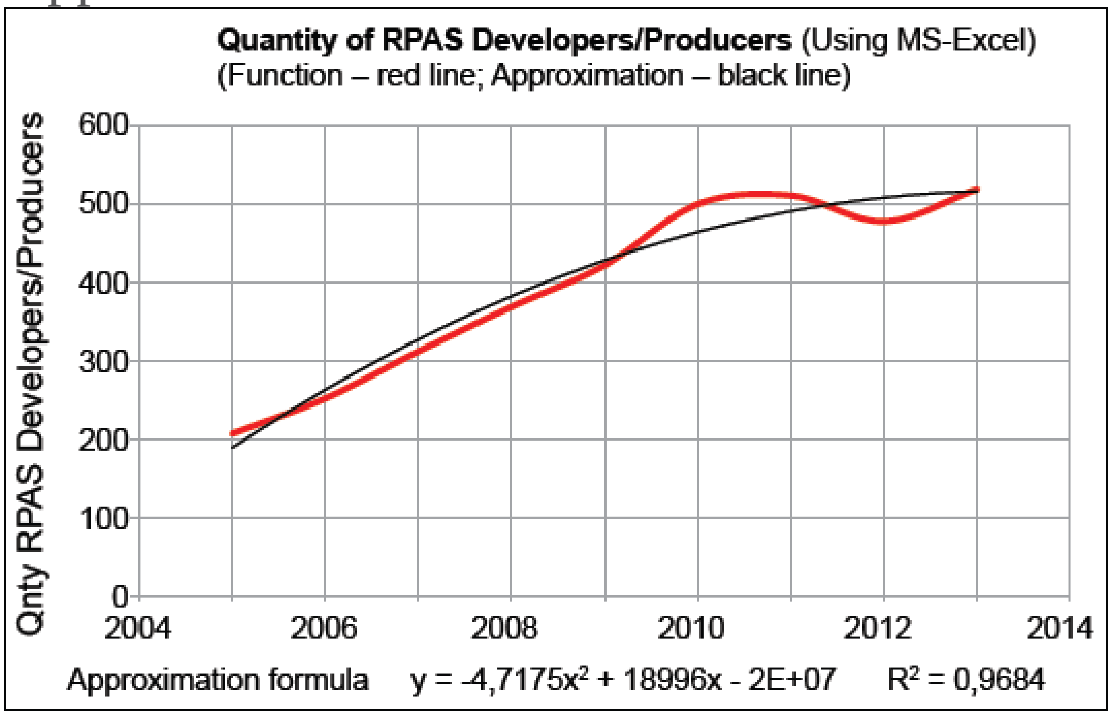
Authorization Effort based on ConOPS and MTOM

Where the EU is Going

RPAS									
	COMMERCIAL & NON-COMMERCIAL OPERATIONS								
	RPAS Operator Certificate Obligatory								
RPA MTOM	< 150 kg				> 150 kg				
Flight Altitude	Very Low Level < 500 ft				Above > 500 ft AGL				
						VFR		IFR	
Flight / Density Population	Teth	VLOS	E VLOS	B VLOS	Teth	EVLOS	BVLOS	RLOS	BRLOS
Unpopulated *(remonte agricultural, over sea, or fenced off)* Lightly Populated Highly Populated	Declaration signed by RPAS Operator, RPAS Safety Assessment, Pilot Approval by accredited **Qualified Entity** *(contracted by the Operator)*			Type Certicate based on « Common Rules » but issued by NAAs: • Language • Proximity • Fees Proportionate Rules			ICAO scope International Flights Type Certificate Issued by EASA		
	JARUS (CS-LURS, 1309, ORG etc.)								

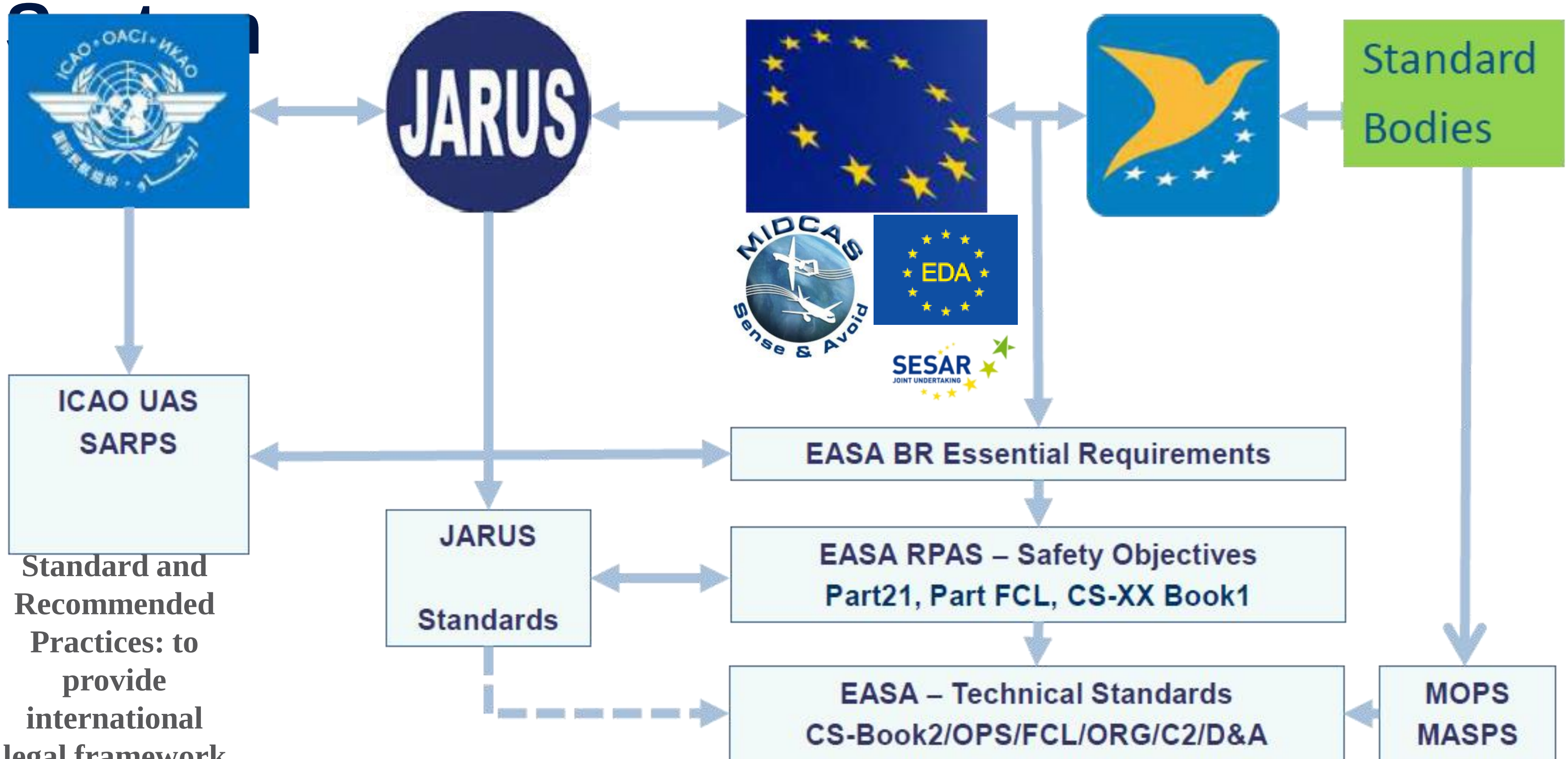
VLL Developing Activities

- Fast developing activity in particular for VLL < 150 Kg with multiple applications.

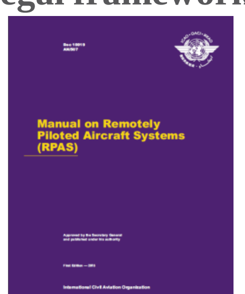


- In EASA Countries:
  - 2495 operators, 114 RPAS manufacturers. Very small to small RPAS with a maximum take-off mass below 150kg.
  - 16 Countries have national rules, 11 are preparing rules but they are not harmonised.

Europe stakeholder and Regulatory System



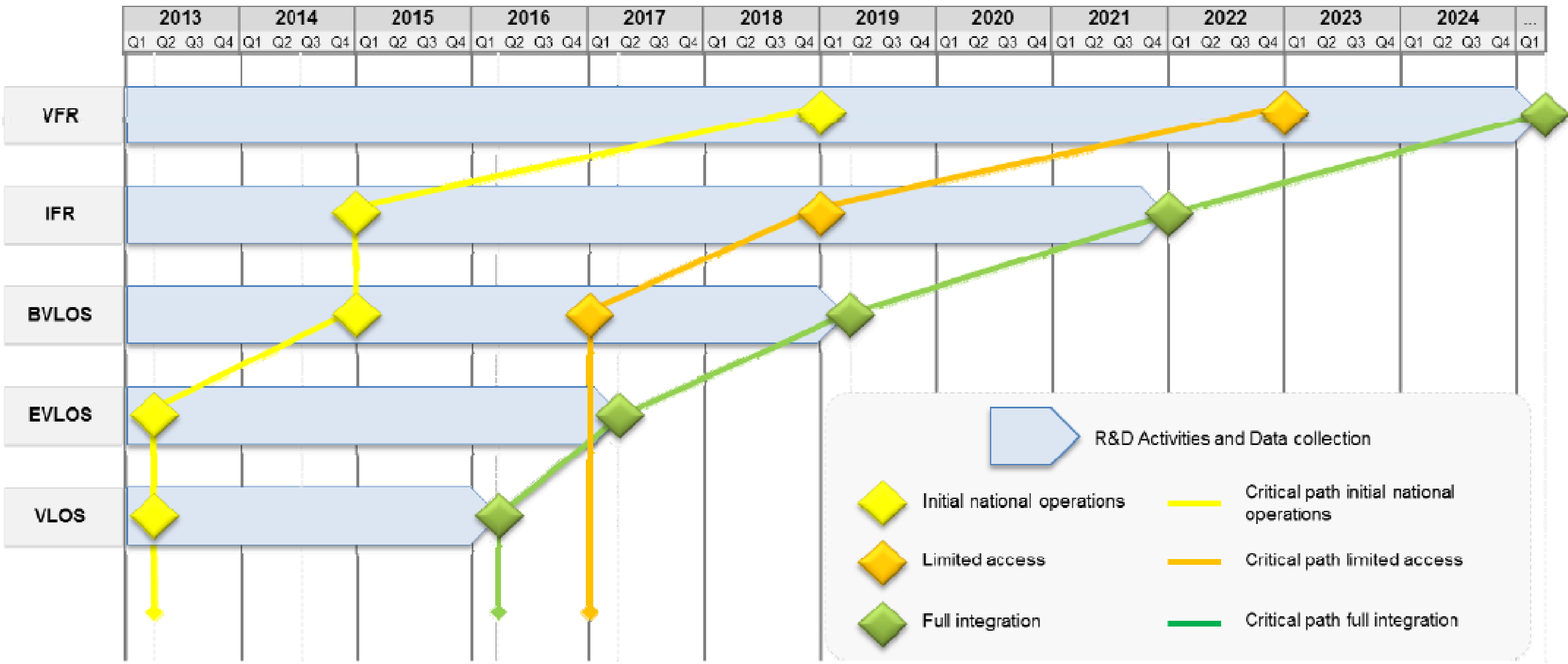
Standard and Recommended Practices: to provide international legal framework



MOPS: Minimum Operational Performance Standards
MASPS: Minimum Aviation System Performance Standards

ERSG Roadmap

- ERSG (European RPAS Steering Group) aims at developing a European civil RPAS integration Roadmap (Regulatory, R&D, Complementary).

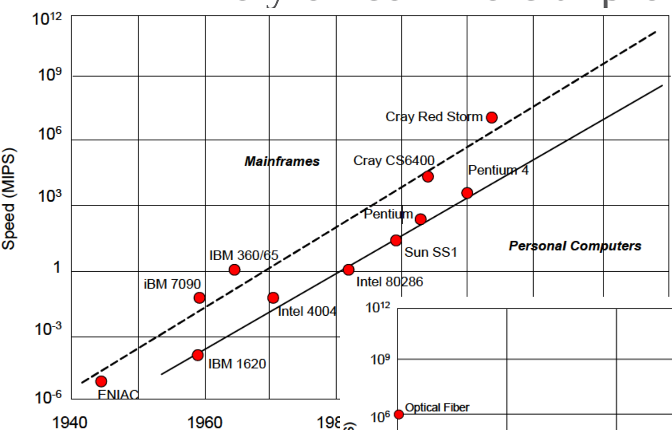


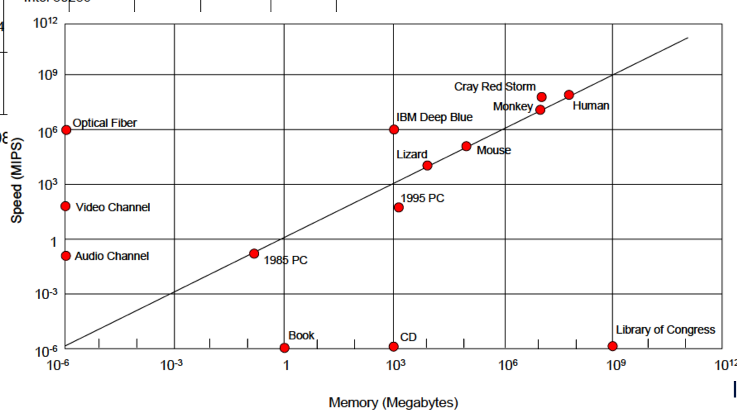
Technologies for RPAS

- To compensate for the absence of an onboard pilot enabling unmanned flight, the basic approaches to implementing unmanned flight (autonomy and pilot-in-the-loop) rely predominantly on:
  - Processor Technologies.
  - Communication Technologies.
  - Detect&Avoid.
- Other technologies to develop for future RPAS are:
  - Platform Technologies.
  - Payload Technologies.

Processor Technology

- RPAS, due to the high level of functionalities required (e.g. ATOL, Traffic and Ground Collision Avoidance etc.), need to use a Vehicle Control Management System (VCMS) instead of a “limited” Flight Control Computer (FCC).
- To enhance autonomous capability of RPAS, computer’s processors technology allowing faster computations, higher memory capacity, and safe responses (algorithms) are needed.
- Most of processing activities are onboard, so computers’ size, weight, reliability, integrity and dissimilarity for high level of safety are critical issues.
- Rely on commercial processor driven by safety-critical aeronautical specification.

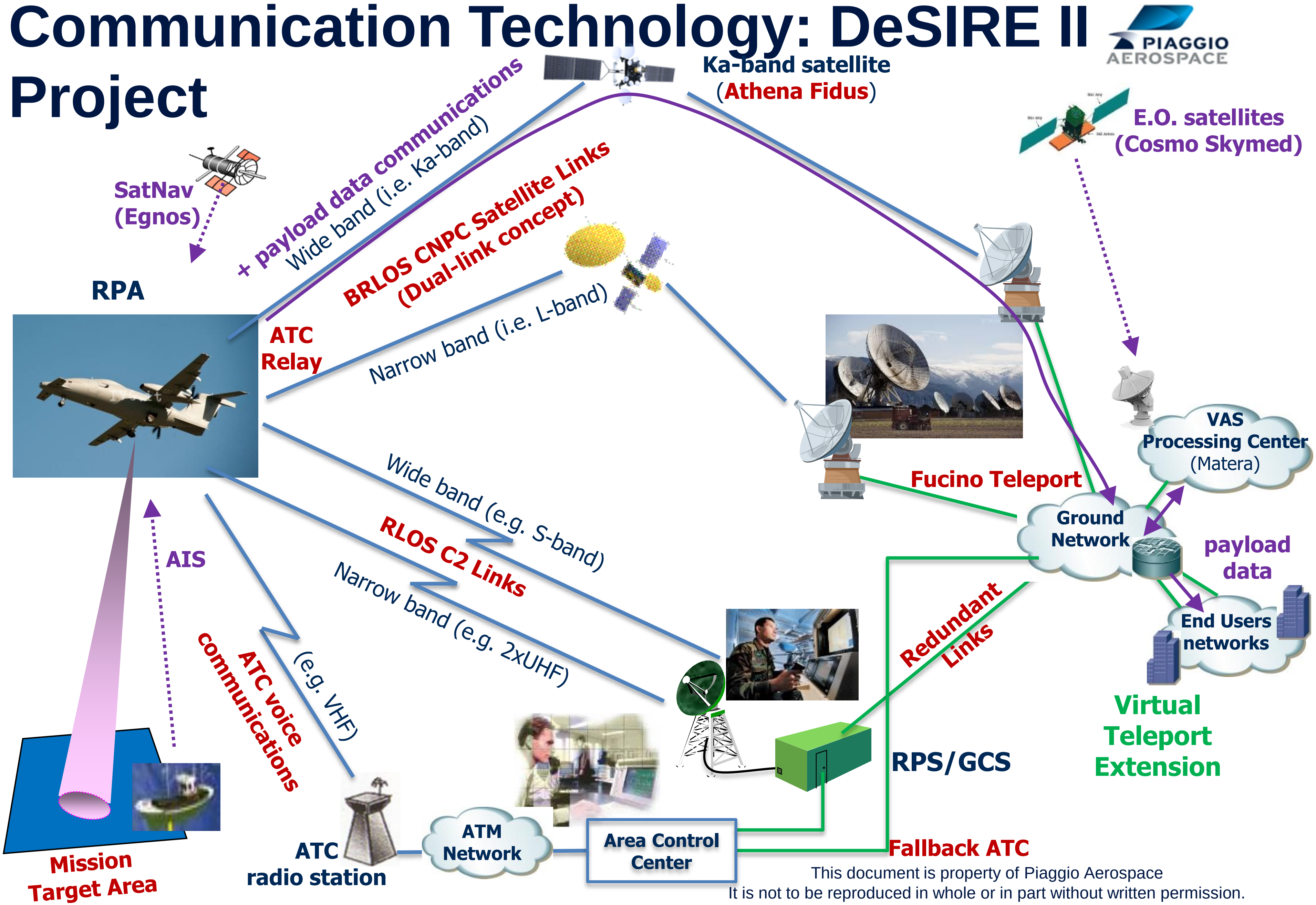




Communication Technology

- Airborne data link rates and processor speeds are in a race to enable future RPAS capabilities.
- Data rates are limited by usable spectrum and by the requirement to minimize airborne system size, weight, and power (SWAP).
- Congestion of S, C and L bands: 1.5 bps/Hz, close to theoretical maximum of 1.92.
- Rely on commercial markets (wireless communications, airliner links, finance) to drive link modulation methods technology, increasing the power of higher frequency (Ka), thus decreasing size, and weight.

Communication Technology: DeSIRE II Project

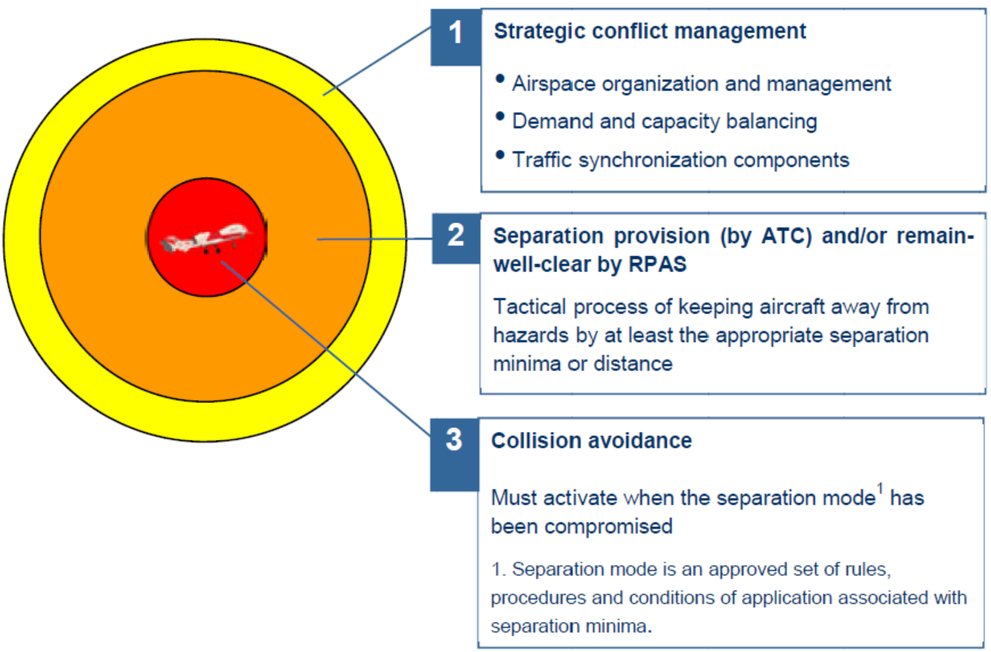


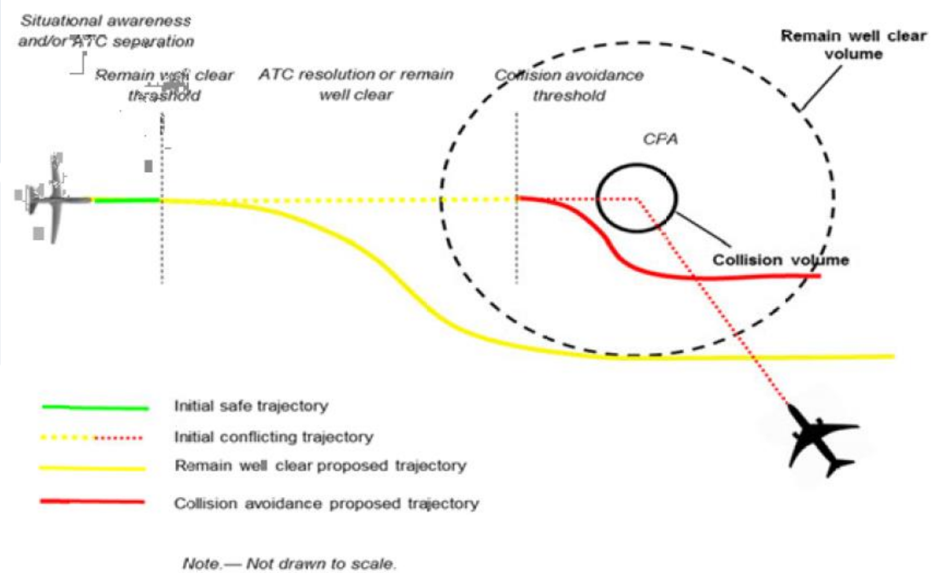
Detect&Avoid (DAA)

- DAA is "*the capability to see, sense or detect conflicting traffic or other hazard and take appropriate action*".
- This capability aims to ensure a safe integration of RPAS flight and enable full integration in all airspace classes.
- DAA capabilities are required for RPAS to limit risks of following hazards:
  - Conflicting traffic.
  - Terrain and obstacles.
  - Hazardous meteorological conditions.
  - Ground operations.
  - Other airborne hazards, including wake turbulence, wind shear etc..
- Major challenge for RPAS, due to the fact that current DAA systems and procedures of manned aviation cannot be used for RPAS (TCAS, Weather Radar, TAWS etc.).

Detect&Avoid: Conflict Traffic

- Three layers for conflict management approach (as manned):
  - Strategic conflict management.
  - Separation provision (by ATC, Remain Well Clear –RWC–).
  - Collision Avoidance: maneuver execution to resolve conflicts.





Detect&Avoid: MIDCAS Project

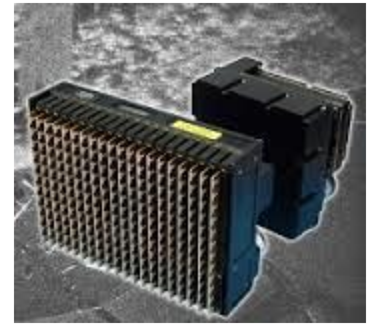
- The system is composed by cooperative and not-cooperative mid-air collision avoidance system made up of:
  - Cooperative sensors:
    - 3 EO (Electro-Optical) and 4 IR (Infra-Red) sensors.
    - Electrical Scan Radar (Ku band, >0.5Hz refresh rate).
  - Non-Cooperative sensors:
    - ADS-B receiver.
    - IFF transponder.

Platform Technology

- The need to allow extended mission capability of RPA requires:
  - A reduction of airframe structural weight.
  - Increased reliability.
  - Higher electrical power availability.
  - Increased endurance.
- Key enabling technologies are:
  - Composite: OOA (Out-Of-Autoclave) and ATL (Automatic Tape Layer).
  - Electro-mechanical actuators: High Reliable EMA.
  - Electric System: high voltage electrical power generation and modular distribution.
  - Propulsion System: high efficiency for long endurance, high altitude RPA.

Payload Technology

- Electro-optical sensors.
- Surveillance radar.
- Electronic surveillance sensors.
- Hyper-spectral sensors.



Conclusions

- RPAS are a **new component** of aviation system and are based on cutting-edge development in aerospace technologies.
- The **integration** of RPAS into **non-segregated airspace** is a **long-term activity**, requiring advanced technology for DAA, C2 BRLOS as well as robust regulatory framework.
- Italy can play an important role in the **European technology non-dependence.**
- Piaggio Aerospace participation inside European Project (e.g. DeSIRE II) is contributing to a truly **European flagship** technology initiative on Air Traffic Insertion of RPAS.


Thank you for your attention!
Any question?