



eDrone

***Educational for Drone (eDrone)***  
***574090-EPP-1-2016-1-IT-EPPKA2-CBHE-JP***

# **Educational for Drone (eDrone)**

## **Introduction to drones**

**Prof. Francesco Lamonaca, Ph.D.**



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of the European Union



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## Definitions (ICAO)



**Aircraft:** Any machine that can derive support in the atmosphere from the reactions of the air other than the reactions of the air against the earth's surface

**Aircraft — category:** Classification of aircraft according to specified basic characteristics, e.g. airplane, helicopter, glider, free balloon

**Autonomous aircraft:** An unmanned aircraft that does not allow pilot intervention in the management of the flight

**Autonomous operation:** An operation during which a remotely-piloted aircraft is operating without pilot intervention in the management of the flight

**Commercial operation:** An aircraft operation conducted for business purposes (mapping, security surveillance, wildlife survey, aerial application, etc.) other than commercial air transport, for remuneration or hire

## Definitions (ICAO)



**Remote pilot:** The person who manipulates the flight controls of a remotely-piloted aircraft during flight time

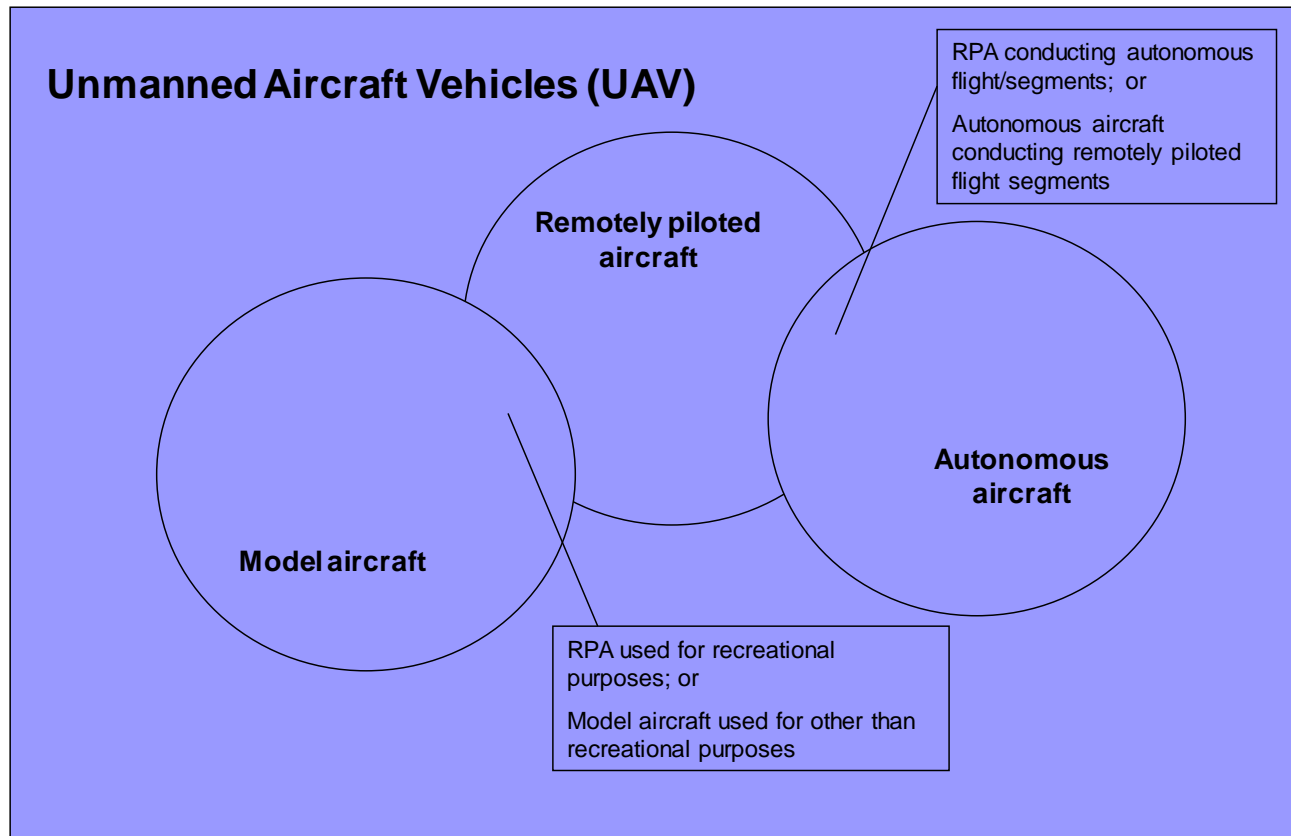
**Remote pilot station:** The station at which the remote pilot manages the flight of an unmanned aircraft

**Remotely-piloted:** Control of an aircraft from a pilot station which is not on board the aircraft

**Remotely-piloted aircraft:** An aircraft where the flying pilot is not on board the aircraft

**Remotely-piloted aircraft system:** A set of configurable elements consisting of a remotely-piloted aircraft, its associated remote pilot station(s), the required command and control links and any other system elements as may be required, at any point during flight operation.

# What is a drone?

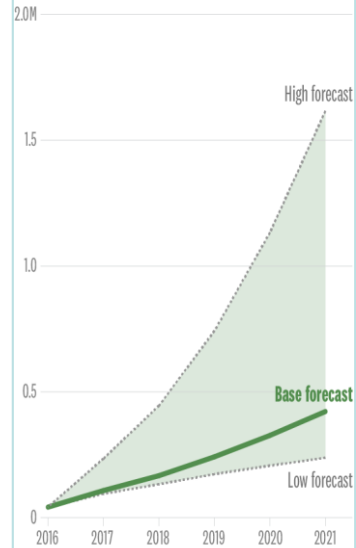


# Why drones?

## Commercial Drones Are Set to Take Off

Forecasts vary, but anywhere from a quarter-million to a million-and-a-half working drones will enter U.S. skies in the next four years.

### COMMERCIAL DRONES DEPLOYMENT FORECAST

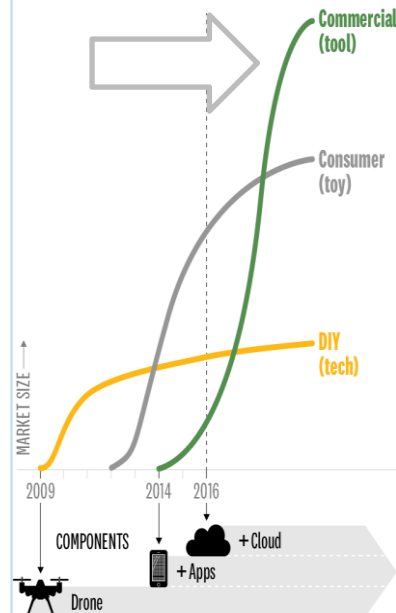


SOURCE FAA

© HBR.ORG

## The Three Waves of the Drone Economy

### MARKET EVOLUTION



SOURCE CHRIS ANDERSON

© HBR.ORG

## Jobs for Drones

As more industries look at drone technology, the list of jobs drones can do—or could do—is growing. But what's real?

### DEVELOPMENT STAGE

#### Early

Mail/small package delivery

#### Mid

Construction/real estate images and monitoring

Emergency management

Filmmaking/other media

Infrastructure monitoring  
Oil and gas exploration

Weather forecasting/meteorological research

Wildlife/environmental monitoring

#### Late

Aerial photography

Border patrol

Precision agriculture

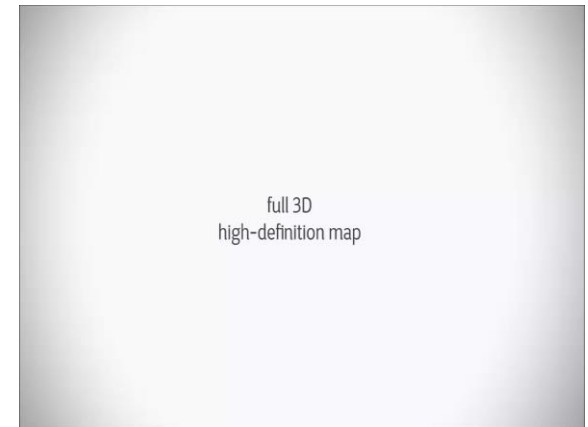
Public safety

SOURCE "DRONE INDUSTRY REPORT," OPPENHEIMER & CO., FEBRUARY 2016

© HBR.ORG

# Drones and measurements

- **“Reality capture”** is the process of digitizing the physical world by scanning it inside and out, from the ground and the air.
- Example:
- In Google Maps, data was captured by satellites, airplanes, and cars, and presented in 2-D and 3-D maps.
- Now that kind of mapping, initially designed for humans, is done at much higher resolution in preparation for the self-driving car.



# Drones and measurements

- Industries have long sought data from above, generally through satellites or planes, but drones are better “**sensors in the sky**” than both.
- They gather higher-resolution and more-frequent data than satellites (whose view is obscured by clouds over two-thirds of the planet at any time), and they’re cheaper, easier, and safer than planes.
- Drones can provide “anytime, anywhere” access to overhead views with an **accuracy** that rivals laser scanning.





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# Drone-based measurement instruments



“Sensors and sensing strategies enable an unmanned aircraft to sense, see, hear and understand the world around it”

- Valavanis et al.



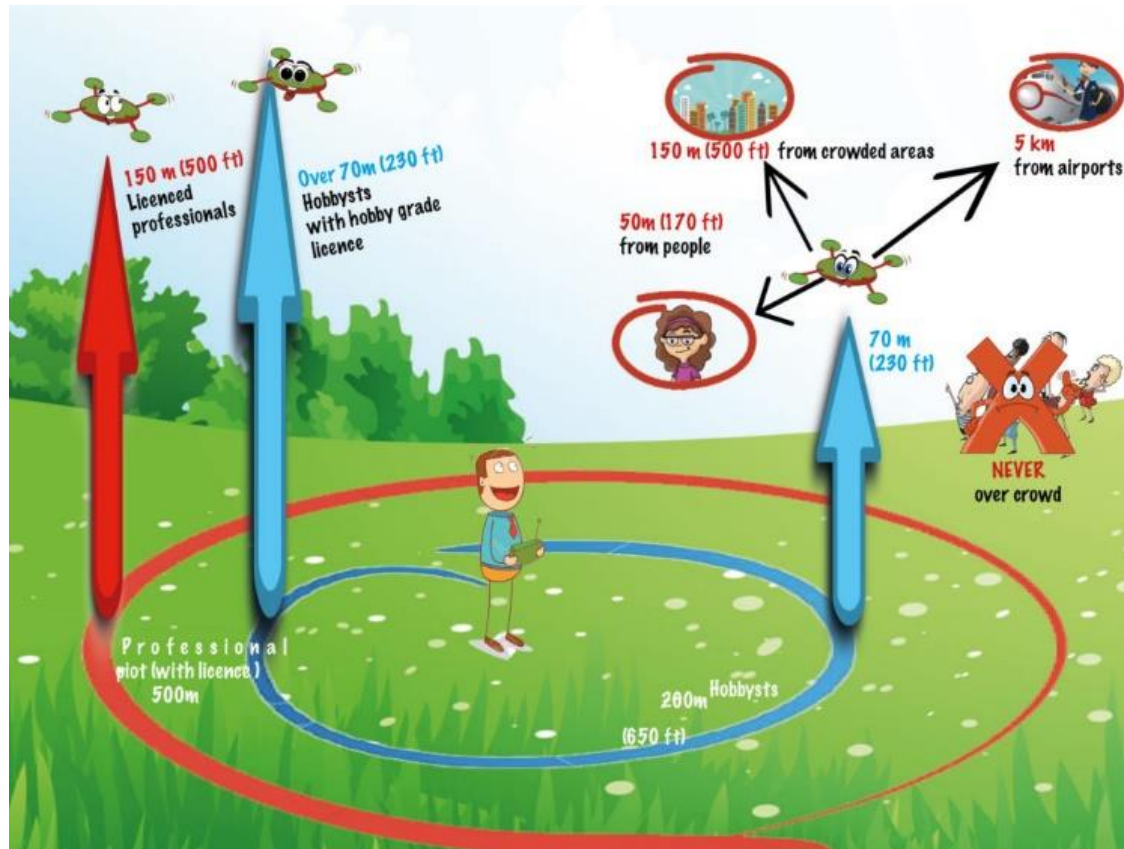
**Drones are mobile measurement platforms  
making measurements during flight**



# Airspace classification



# Drone regulations (in italy)



# Drone regulations (in Italy)



- Hobby and leisure use:
  - Weight < 25 kg and power < 15 kW
  - No professional use
  - Not beyond VLOS
  - Distance < 200 m, Altitude < 70 m
  - Not over people, houses, roads, railroads, ...
  - At least 5 km far from airports
  - No license or registration required
- Professional use:
  - Pilot Certificate for VLOS and < 25kg. [if < 0,3 kg, < 60km/h and rotors protection, no pilot certificate]. Otherwise Pilot License
  - Non-critical operations (not over congested area, gathering of persons, urban areas, critical infrastructures): > 150 meter from congested area, 50 meter from persons and property, in uncontrolled airspace, outside ATZ and > 5 km from airport
  - Critical operations: ENAC authorization required

# EASA proposed regulation

Operation		Remote pilot competency (age according to MS legislation)	UAS				UAS operator registration
Subcategory	Area of operation (far from aerodromes, maximum height 120 m)		class	MTOM/ Joule (J)	Main technical requirements (CE marking)	Electronic ID/ geo awareness	
A1 Fly over people	You can fly over uninvolved people (not over crowds)	Read consumer info	Privately built	< 250 g	N/a	No	no
			C0		Consumer information, Toy Directive or <19 m/s, no sharp edges, selectable height limit		
		<ul style="list-style-type: none"> <li>Consumer info</li> <li>online training</li> <li>online test</li> </ul>	C1	< 80 J or <900 g	Consumer information, <19m/s, kinetic energy, mechanical strength, lost-link management, no sharp edges, selectable height limit.		
A2 Fly close to people	You can fly at a safe distance from uninvolved people	<ul style="list-style-type: none"> <li>Consumer info</li> <li>online training</li> <li>online test</li> <li>theoretical test in a centre recognised by the aviation authority</li> </ul>	C2	< 4 kg	Consumer information, mechanical strength, no sharp edges, lost-link management, selectable height limit, low-speed mode.	Yes + unique SN for identification	yes
A3 Fly far from people	You should: <ul style="list-style-type: none"> <li>fly in an area where it is reasonably expected that no uninvolved people will be endangered</li> <li>keep a safety distance from congested areas</li> </ul>	<ul style="list-style-type: none"> <li>Consumer info</li> <li>online training</li> <li>online test</li> </ul>	C3	< 25 kg	Consumer information, lost-link management, selectable height limit.	if required by zone of operations	
			C4		Consumer information, no automatic flight		
			Privately built		N/a		

# EASA proposed regulation




## Flying a Drone

Check the label on your drone  
It's too old, sorry!

Have fun | Be responsible for safety

DO	DO NOT
 Make sure you are adequately insured	 Do not make changes to the drone, unless approved by the manufacturer
 Check your drone before each flight	 Do not fly higher than 120 m from the ground
 Before each flight, check the limitations of the area where you want to operate, as defined by the National Authority of that country, and respect them	 Do not fly near manned aircraft
 Keep the drone in sight at all times	 Do not fly in the proximity of airports, heliports, areas affecting public safety or where an emergency response effort is ongoing
 Maintain a safe distance between the drone and people, animals, other aircraft and boats	 Do not fly over sensitive or protected sites (patrons, military bases, power plants, etc.)
 Operate your drone within the performance limitations defined in the instructions provided by the manufacturer	 Do not fly over large groups of people
 Inform your national aviation authority immediately if your drone is involved in an accident that results in a serious or fatal injury to a person, or that affects a manned aircraft	 Do not take photographs, videos or record soundings of people without their permission. Respect people's privacy

**Disclaimer:** This document is a summary of the proposed regulatory framework. It is not intended to be a definitive guide. The final version of the regulation will be published in the Official Journal of the European Union.

FOR MORE INFORMATION ABOUT YOUR DRONE, VISIT THE [EASA WEBSITE](http://easa.europa.eu/drones)

[HTTP://EASA.EUROPA.EU/DRONES](http://easa.europa.eu/drones)




## Flying a Drone

Check the label on your drone  
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Have fun | Be responsible for safety

- You need to be registered and to pass an online test
- Display the registration number on the drone and upload it into the e-identification system

DO	DO NOT
 Make sure you are adequately insured	 Do not make changes to the drone, unless approved by the manufacturer
 Check your drone before each flight	 Do not fly higher than 120 m from the ground
 Make sure the electronic identification and geo-awareness system of your drone is up-to-date	 Do not fly near manned aircraft
 Before each flight, check the limitations of the area where you want to operate, as defined by the National Authority of that country, and respect them	 Do not fly in the proximity of airports, heliports, areas affecting public safety or where an emergency response effort is ongoing
 Familiarise yourself with the area where you want to operate your drone	 Do not fly over sensitive or protected sites (patrons, military bases, power plants, etc.)
 Check the weather conditions	 Do not use the drone to carry dangerous goods
 Keep the drone in sight at all times	 Do not fly over large groups of people
 Maintain a safe distance between the drone and people, animals, other aircraft and boats	 When flying over other people's property, do not fly less than 30 m above the property without their permission
 Operate your drone within the performance limitations defined in the instructions provided by the manufacturer	 Do not take photographs, videos or record soundings of people without their permission. Respect people's privacy
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- If you intend to fly close to people, you need to pass a theoretical test in an entity recognised by the national aviation authority
- Display the registration number on the drone and upload it into the e-identification system

DO	DO NOT
 Make sure you are adequately insured	 Do not make changes to the drone, unless approved by the manufacturer
 Check your drone before each flight	 Do not fly higher than 120 m from the ground
 Plan your flight	 Do not fly near manned aircraft
 Make sure the electronic identification and geo-awareness system of your drone is up-to-date	 Do not fly in the proximity of airports, heliports, areas affecting public safety or where an emergency response effort is ongoing
 Before each flight, check the limitations of the area where you want to operate, as defined by the National Authority of that country, and respect them	 Do not fly over sensitive or protected sites (patrons, military bases, power plants, etc.)
 Familiarise yourself with the area where you want to operate your drone	 Do not use the drone to carry dangerous goods
 Check the weather conditions	 When flying near other people's property, do not fly less than 30 m above the property without their permission
 Keep the drone in sight at all times	 Do not interfere with the privacy of other people
 When flying close to people, keep a theoretical distance of more than 30 m (or less than the height of the drone, if it is less than 30 m)	 Do not take photographs, videos or record soundings of people without their permission. Respect people's privacy
 Maintain a safe distance between the drone and people, animals, other aircraft and boats	 Do not take photographs, videos or record soundings of people without their permission. Respect people's privacy
 Operate your drone within the performance limitations defined in the instructions provided by the manufacturer	 Inform your national aviation authority immediately if your drone is involved in an accident that results in a serious or fatal injury to a person, or that affects a manned aircraft

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# EASA classes



C0	C1	C2	C3	C4
'Toy Aircraft'	Spark / Mavic	Phantom / Inspire	M210 / M600 / +Racing Quads	Model Aircraft
<250g	<900g	<4Kg	<25Kg	
Max Speed 19m/s		Low Speed mode Max 3m/s		No Autonomous Flight Modes
	Unique Serial Number Required			
Deviation Possible	Fire Retardant Placard Displaying Registration Information Required			Deviation Possible
	Max Sound Pressure 60dB(A) at 3m			
	E-Identification & Geoawareness Required			In Specific Areas
		Data Link Protection Required		
		Lighting Required (Different to Manned Aviation)		
	Registration Required (National Responsibility)			
Manufacturer must provide EASA Safety Leaflet with product				
Manufacturer must provide additional product information				



# U-Space



# U-Space implementation

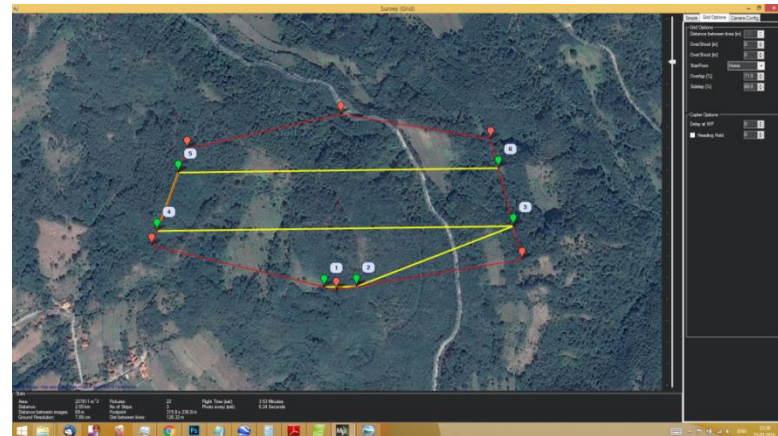




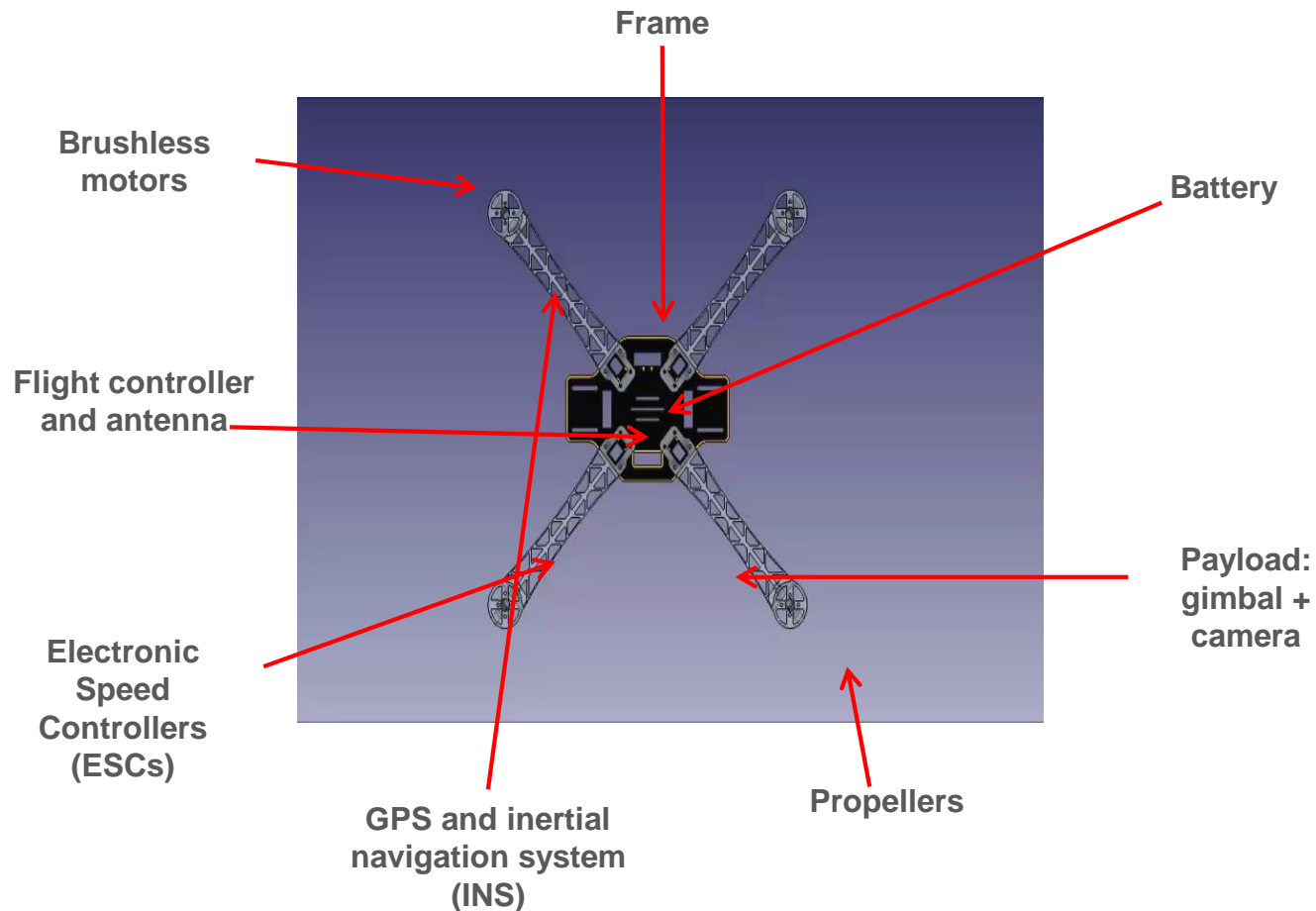
# Drones we will refer to...

## Specifications:

- MTOW < 13.5 kg;
- Vertical Take-Off Landing (VTOL);
- Very low altitude (VLA), 500 ft;
- Operations in line-of-sight (LOS) and beyond-line-of-sight (BLOS)
- Remotely operated (semi-autonomous): the drone can perform high-level commands (waypoints, objects tracking, etc.), and its performance is monitored by a trained operator.



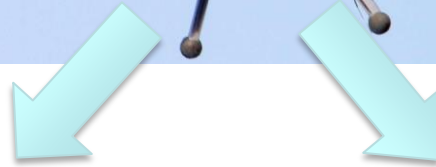
# General architecture of a drone



# Sensors of drones



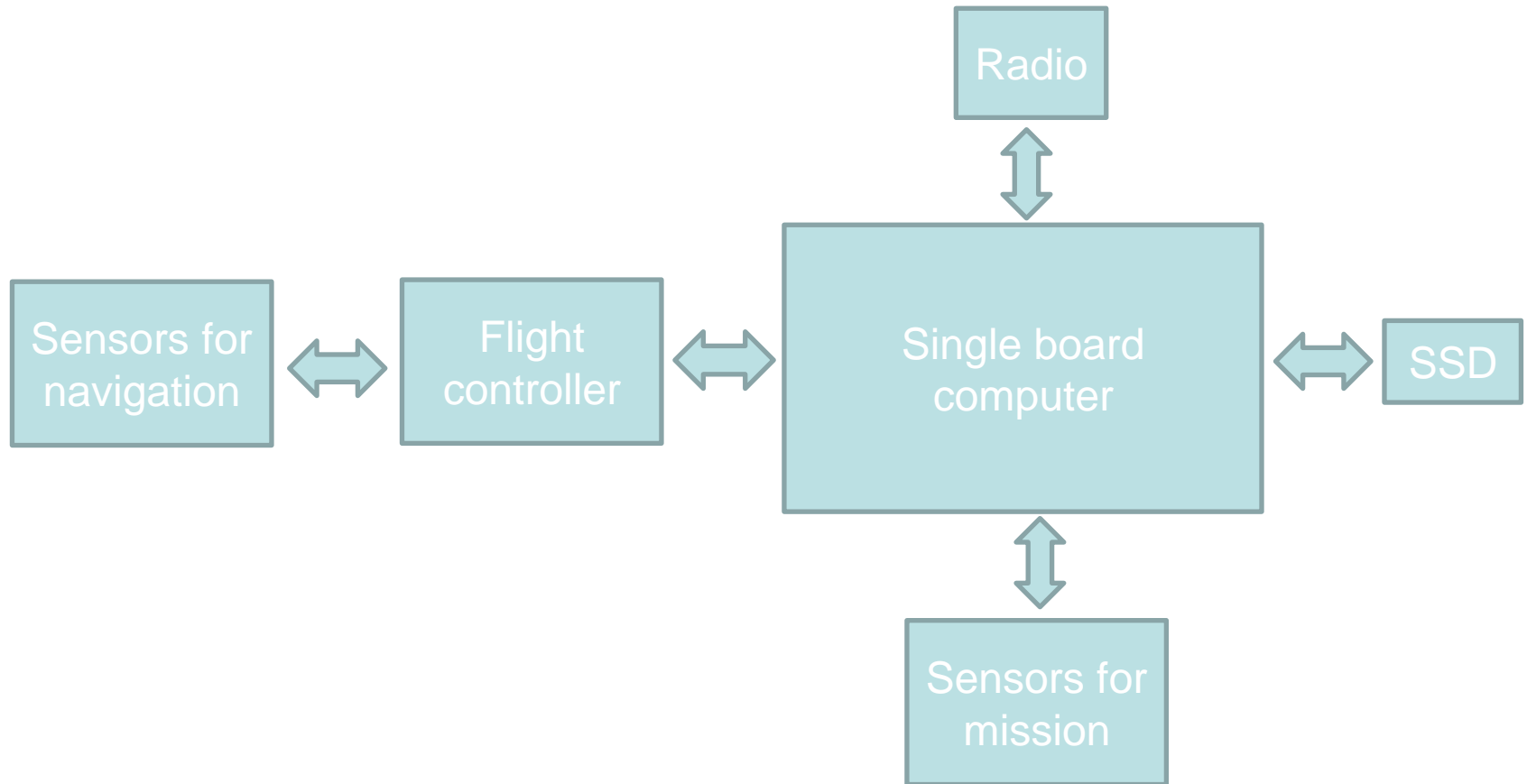
Sensors for navigation



Sensors for mission



# Drone electronics



# Example: Intel Aero RTF

