Educational for Drone (eDrone)

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Educational for Drone
(eDrone)
Introduction to drones

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Università degli Studi del Sannio

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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

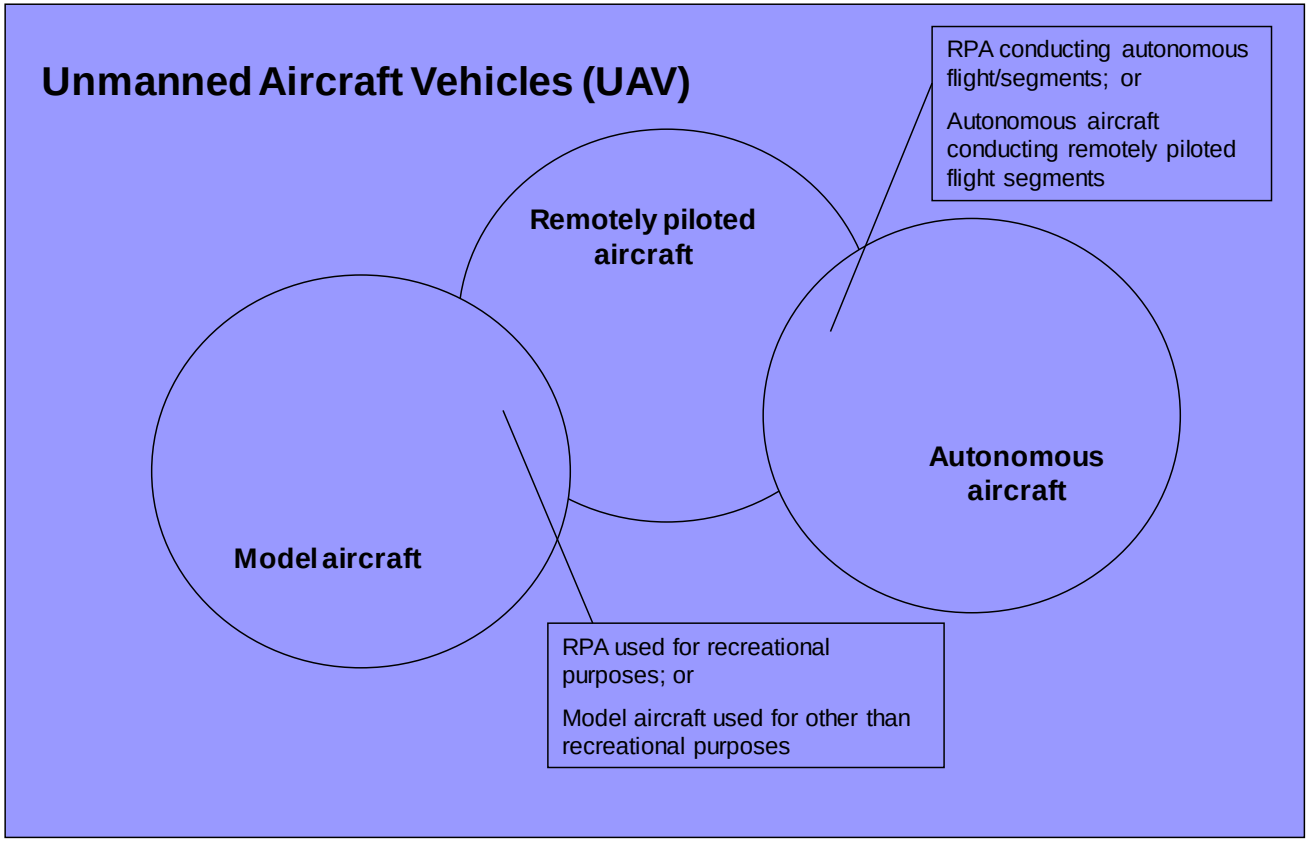
Remote pilot station: The station at which the remote pilot manages the flight of an unmanned aircraft

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?



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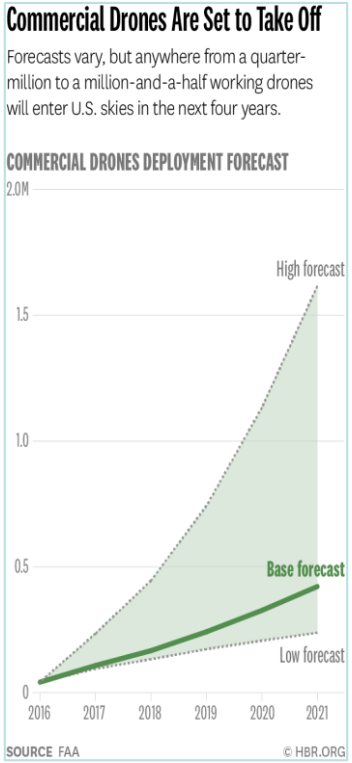
Why drones?


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
2.0M
1.5
1.0
0.5
0
High forecast
Base forecast
Low forecast
2016
2017
2018
2019
2020
2021
SOURCE FAA
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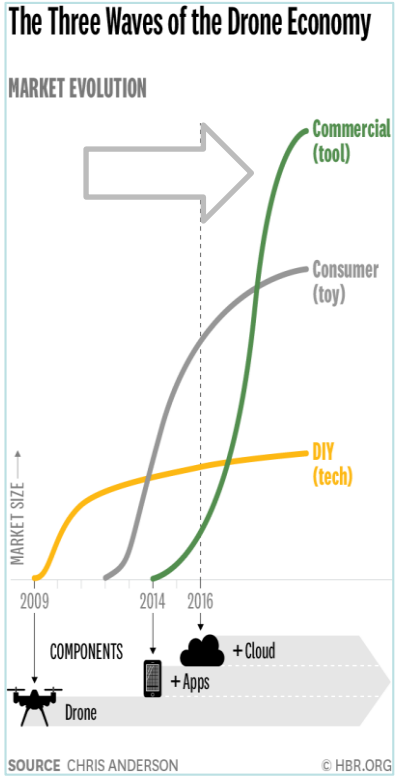
The Three Waves of the Drone Economy
MARKET EVOLUTION
Commercial (tool)
Consumer (toy)
DIY (tech)
MARKET SIZE
2009
2014
2016
COMPONENTS
+ Cloud
+ Apps
Drone
SOURCE CHRIS ANDERSON
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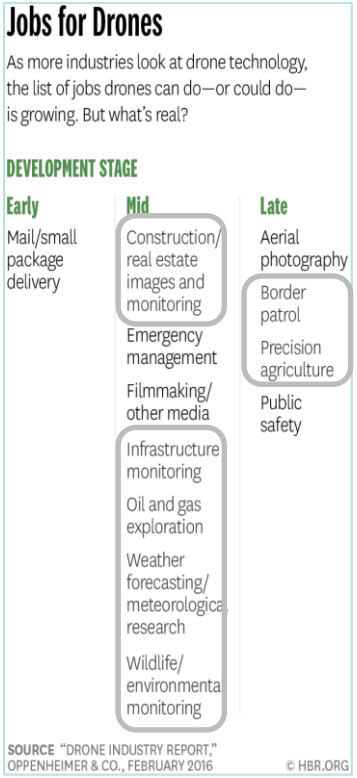
Jobs for Drones
As more industries look at drone technology, the list of jobs drones can do—or could do—is growing. But what's real?
DEVELOPMENT STAGE
Early
Mail/small package delivery
Mid
Construction/ real estate images and monitoring
Emergency management
Filmmaking/ other media
Infrastructure monitoring
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
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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.

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

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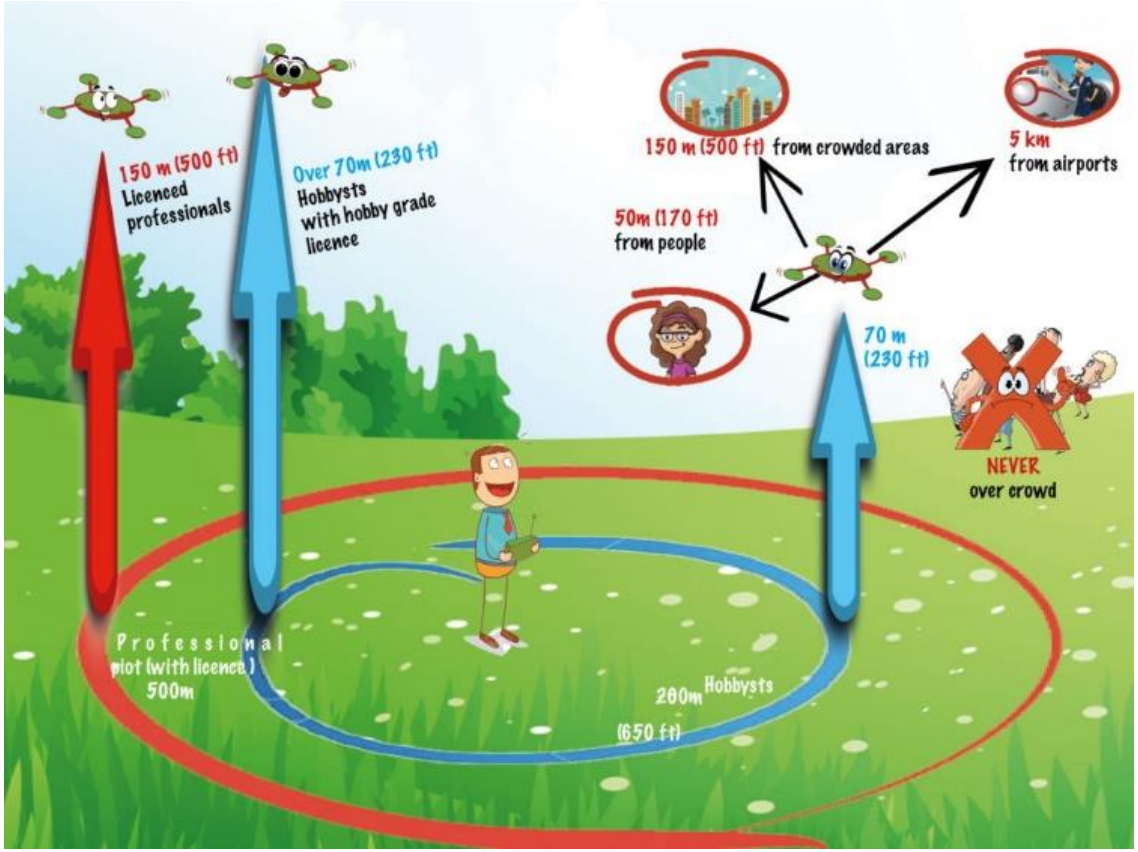
Drone regulations (in italy)



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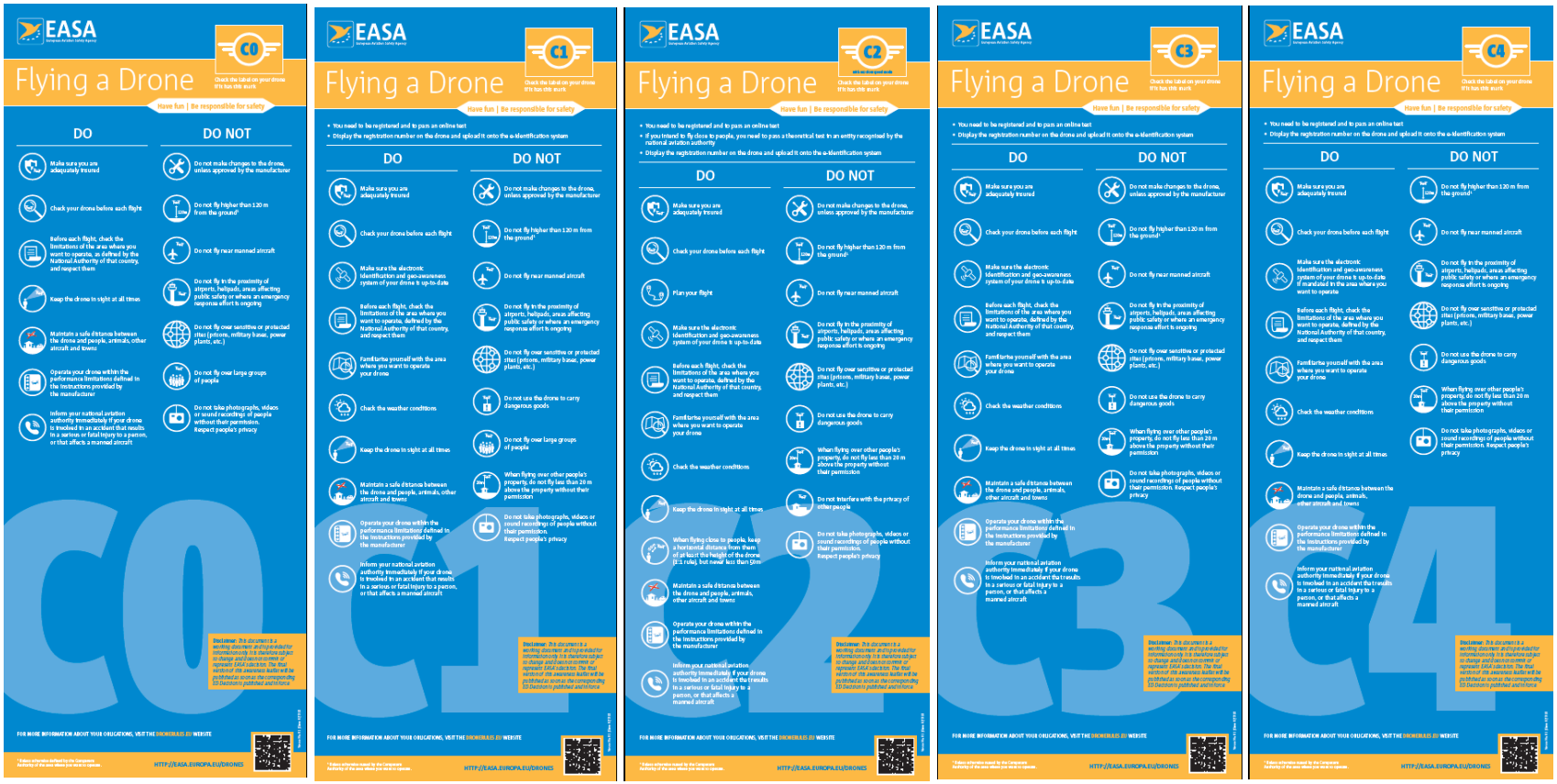
Drone regulations (in italy)

- 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
  - Bon–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		
		• Consumer info • online training • online test	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	• Consumer info • online training • online test • theoretical test in a centre recognised by the aviation authority	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: • fly in an area where it is reasonably expected that no uninvolved people will be endangered • keep a safety distance from congested areas	• Consumer info • online training • online test	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



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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

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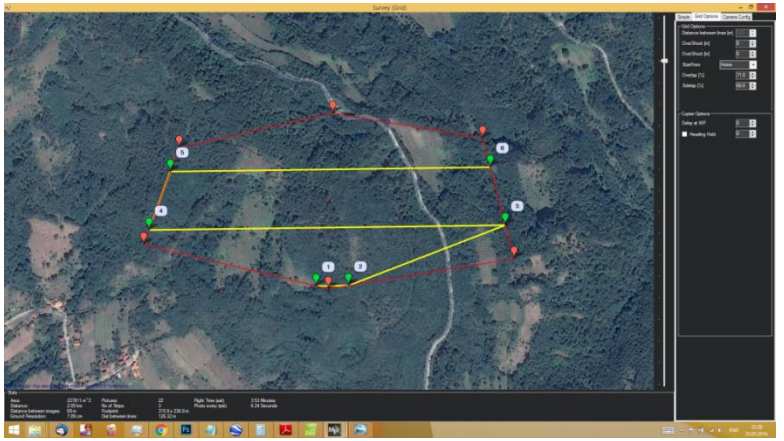
Didactic Module
2-8 July 2018

U-Space implementation

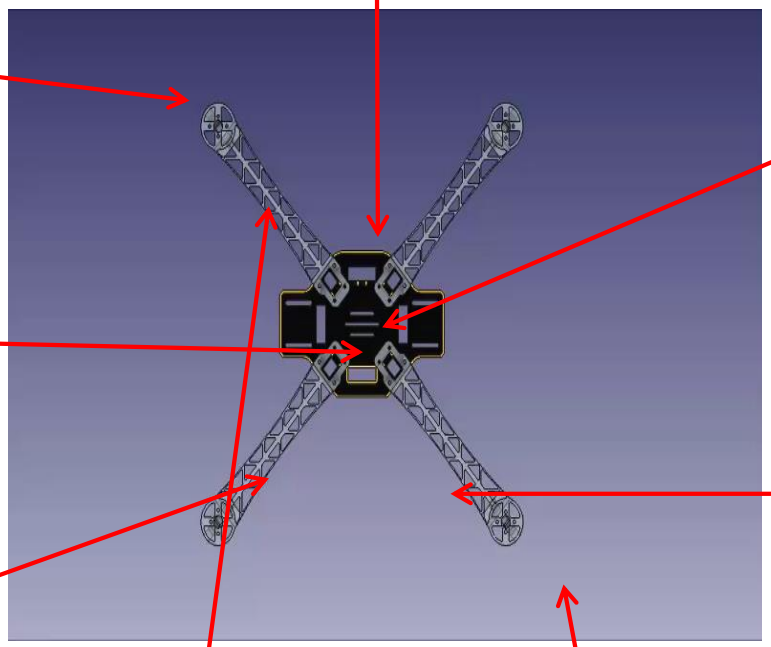
Drones we will refer to…

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



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Sensors of drones

Sensors for navigation

Sensors for mission

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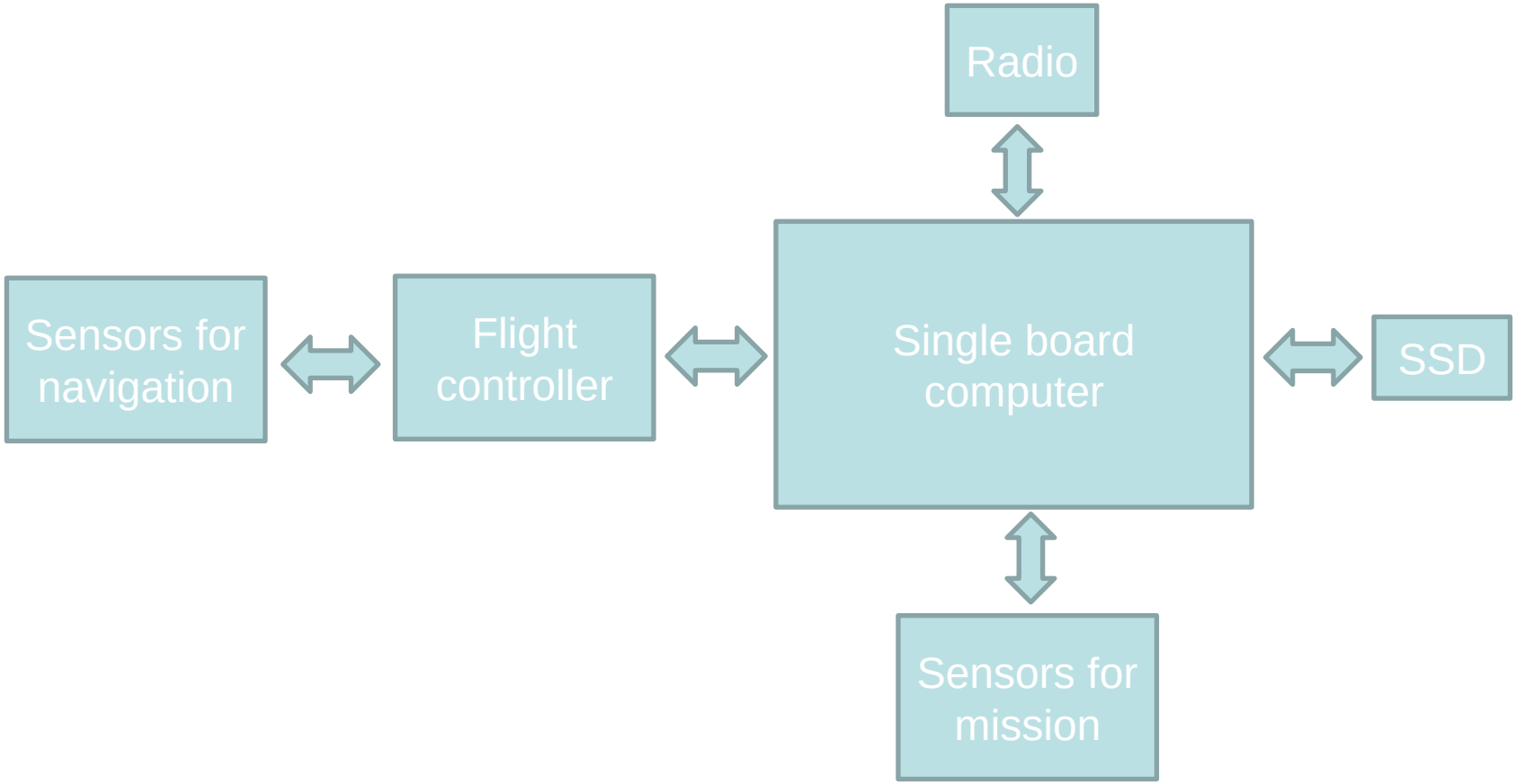
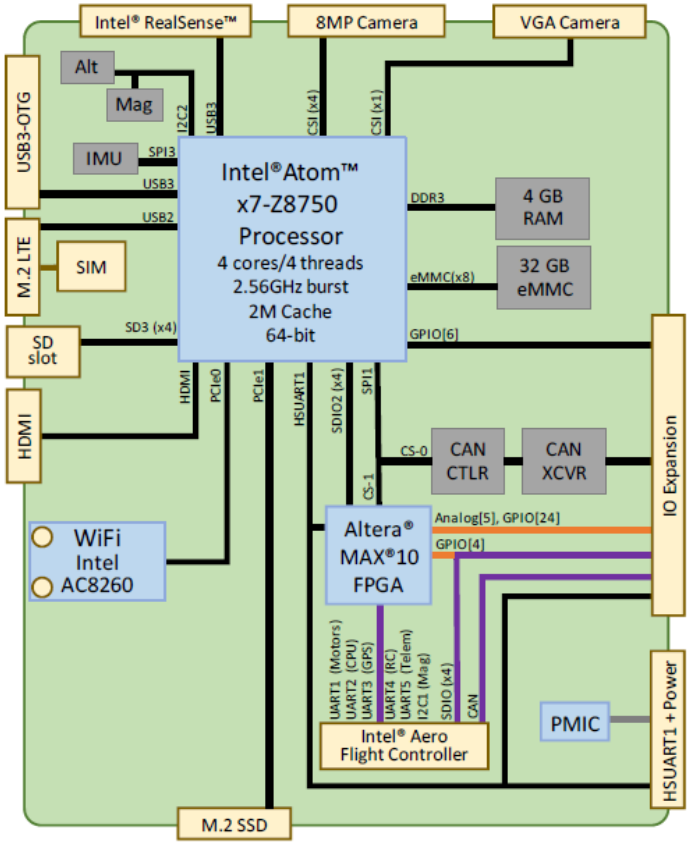
Drone electronics



Example: Intel Aero RTF



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