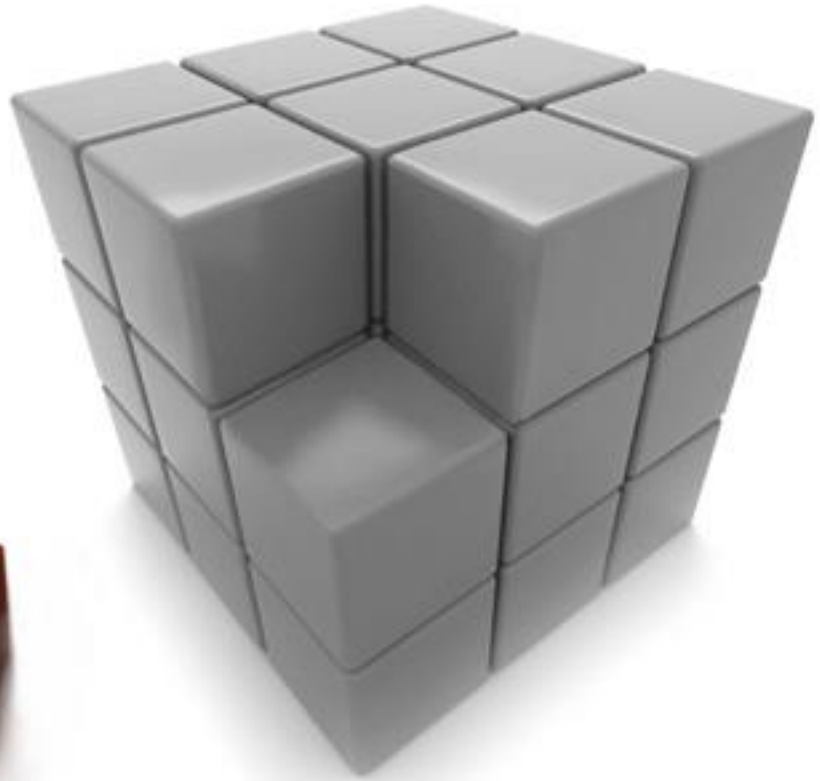
Using drone technology, today and tomorrow.



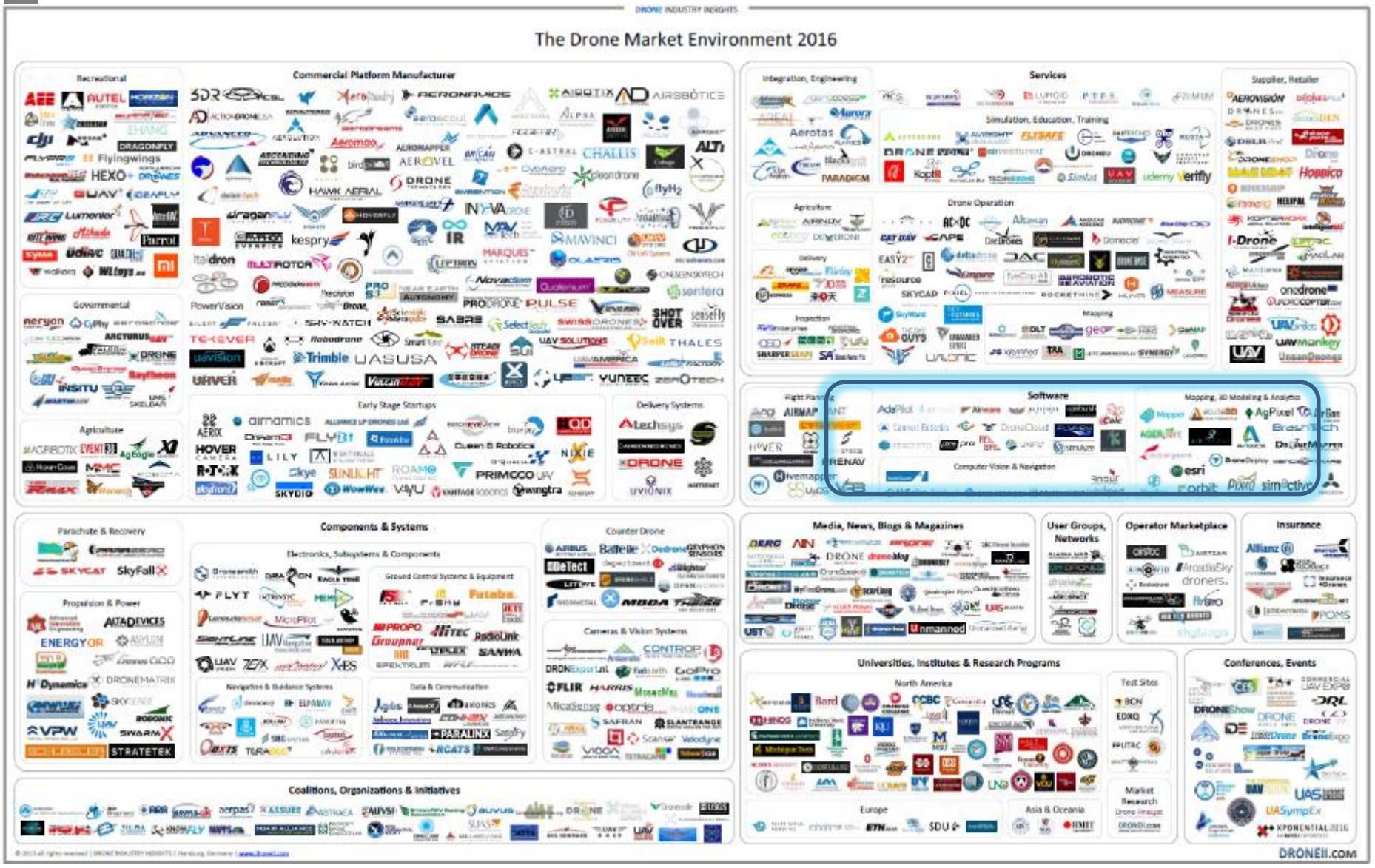
Tihomir Šašić

Voditelj programa, poslovna rješenja s bespilotnim letjelicama

HrOUG 2016, 20.10.2016., Rovinj

Što je novo u svijetu dronova?

Tržište dronova 2016.

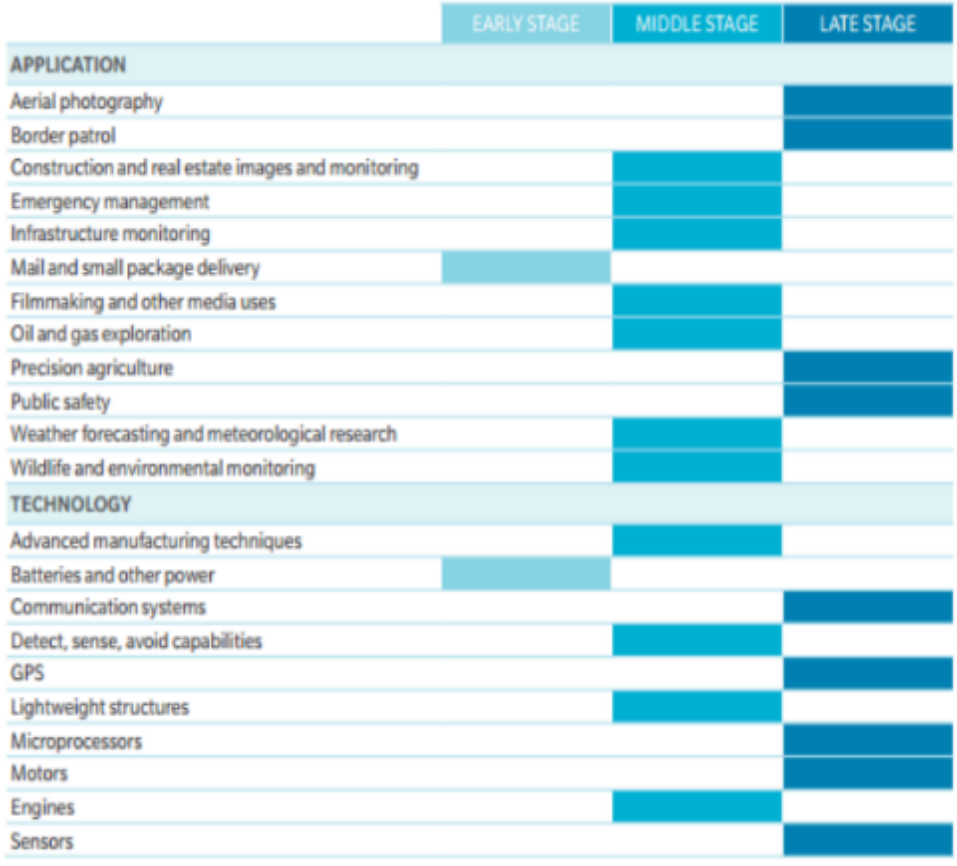


Kategorije letjelica

	 	 	 
Kategorija	**Microdrone/Igračke**	**Prosumer**	**Profesionalna/komercijalna**
Proizvođači	Parrot, Cheerson CX-10	DJI, Yuneec	Sensefly, DJI
Godišnja isporuka	> 10 M letjelica	do 1M letjelica	<10.000 letjelica
Cijena	<700 USD	<3.000 USD	>3.000 USD
Mogućnosti	HD/FHD video	Gimbal, FHD/UHD, senzori za udaljenost	Veća nosivost, veći domet i autonomija, napredni senzori

Source: Company reports, Oppenheimer & Co. Inc.

Zrelost platforme i vrijednost tržišta

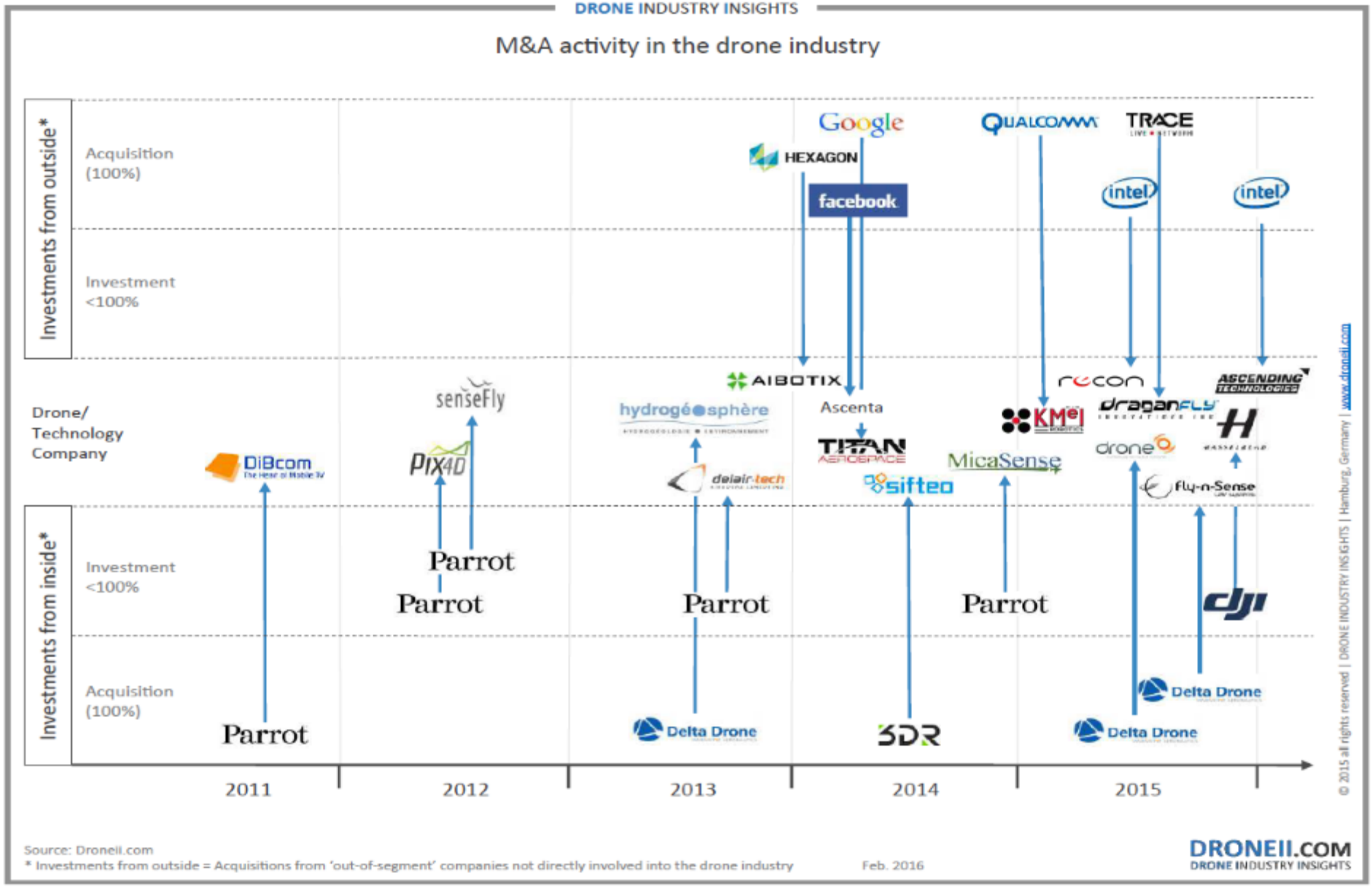


Source: Oliver Wyman, Oppenheimer & Co. Inc.

Drone Market Scope	Market Size	Time Horizon	Source
Esimates by sales			
Consumer	$1.7B (4.3M units)	2015	KPMG
US civil and commercial	$125M	2015	IBISWorld
US consumer	$1B	2018	Consumer Electronics Association
Commercial small	$5.1B	2019	ABI Research
Prosumer and hobby small	$1.1B	2019	ABI Research
Small UAS	$1.9B	2020	Markets and Markets
Worldwide commercial	$2.07B	2020	Grand View Research
Worldwide hobby	$4.4B	2020	Frost & Sullivan
Worldwide commercial	$6.4B	2020	Frost & Sullivan
Global aerial drone	>$3B	2024	Business Insider Intelligence
Commercial	$1.7B	2025	Lux Research
Worldwide production	$14B	2025	Congressional Research Service
Esimates by unit shipment			
Non-military ($200+)	1M+ units	2015	Deloitte
Small UAV intended as model aircraft	1.6M units	2015	FAA
Small UAV intended as model aircraft	1.9M units	2016	FAA
Small UAV intended for commercial purposes	600,000+ units	2016	FAA
China camera drone	3M units	2019	IDC
Small UAV intended for commercial purposes	11M units	2020	FAA

Source: KPMG, IBISWorld, CEA, ABI Research, Markets and Markets, Grand View Research, Frost & Sullivan, Business Insider, Lux Research, Congressional Research Service, Deloitte, FAA, IDC, Oppenheimer & Co. Inc.

Udruživanja, spajanja i kupovine!



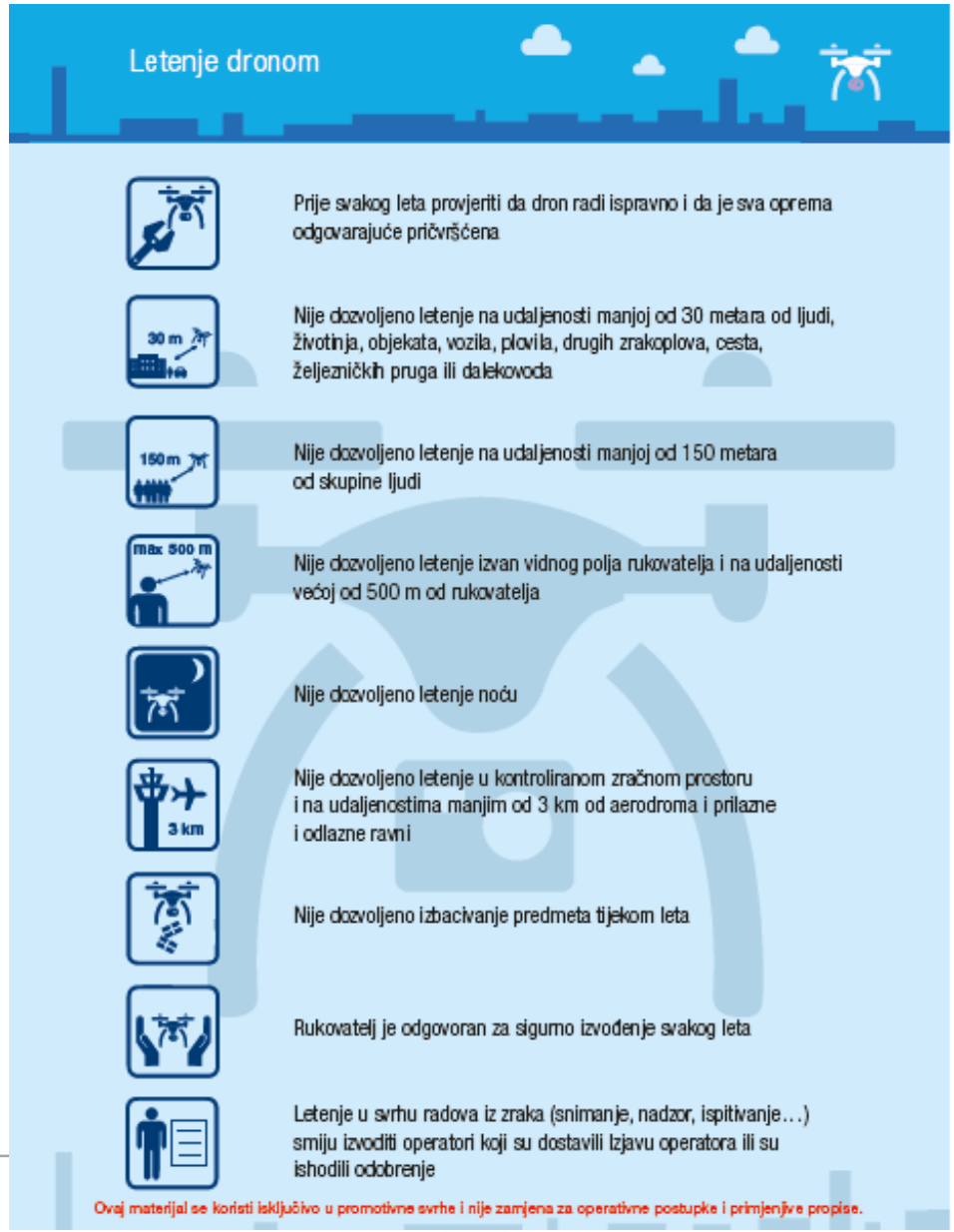
Regulatorni okvir

Država	Mogućnost komercijalnih letova	Potrebna licenca za let	Mogućnost izvođenja BVLOS* letova	Potrebna dozvola za BVLOS* letove	Potrebno osiguranje letjelice za komercijalne letove	Potreban trening za dobivanje pilotske dozvole
SAD	√	√	X	X	X	√
UK	√	√	√	√	√	√
Njemačka	√	√	X	X	√	√
Kanada	√	√	√	X	√	X
Francuska	√	√	√	X	X	√
Kina	√	√	√	√	X	√
Meksiko	√	√	X	X	X	√
Japan	√	X	X	X	X	X
Rusija	X	X	X	X	X	√
Hrvatska	√	√	X	X	?	√ (C i D kategorija)

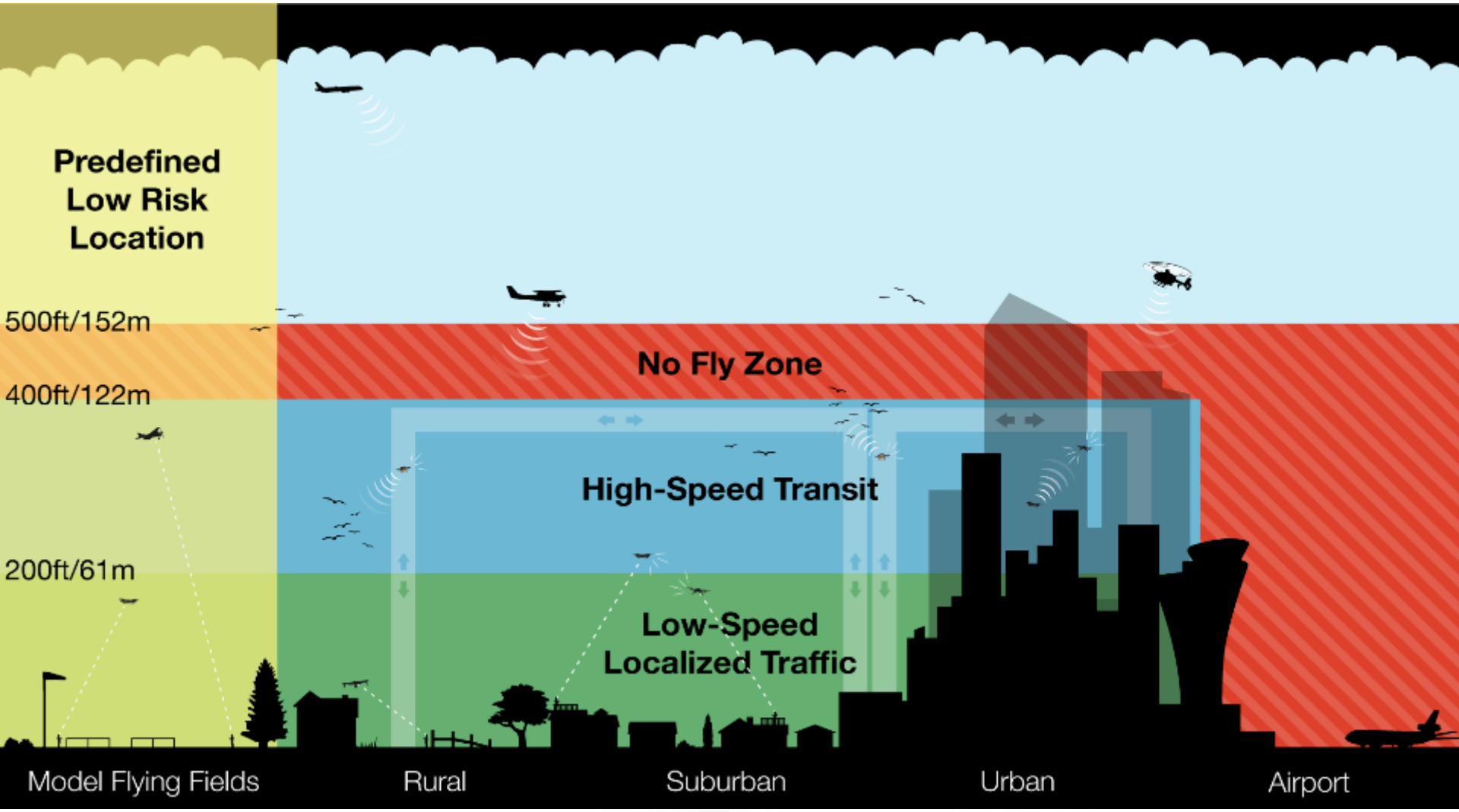
www.ccaa.hr – Hrvatska agencija za civilno zrakoplovstvo

**BVLOS – beyond visual line of sight*

Upute za letenje dronom



Budućnost zračnog prostora - prijedlog Amazona



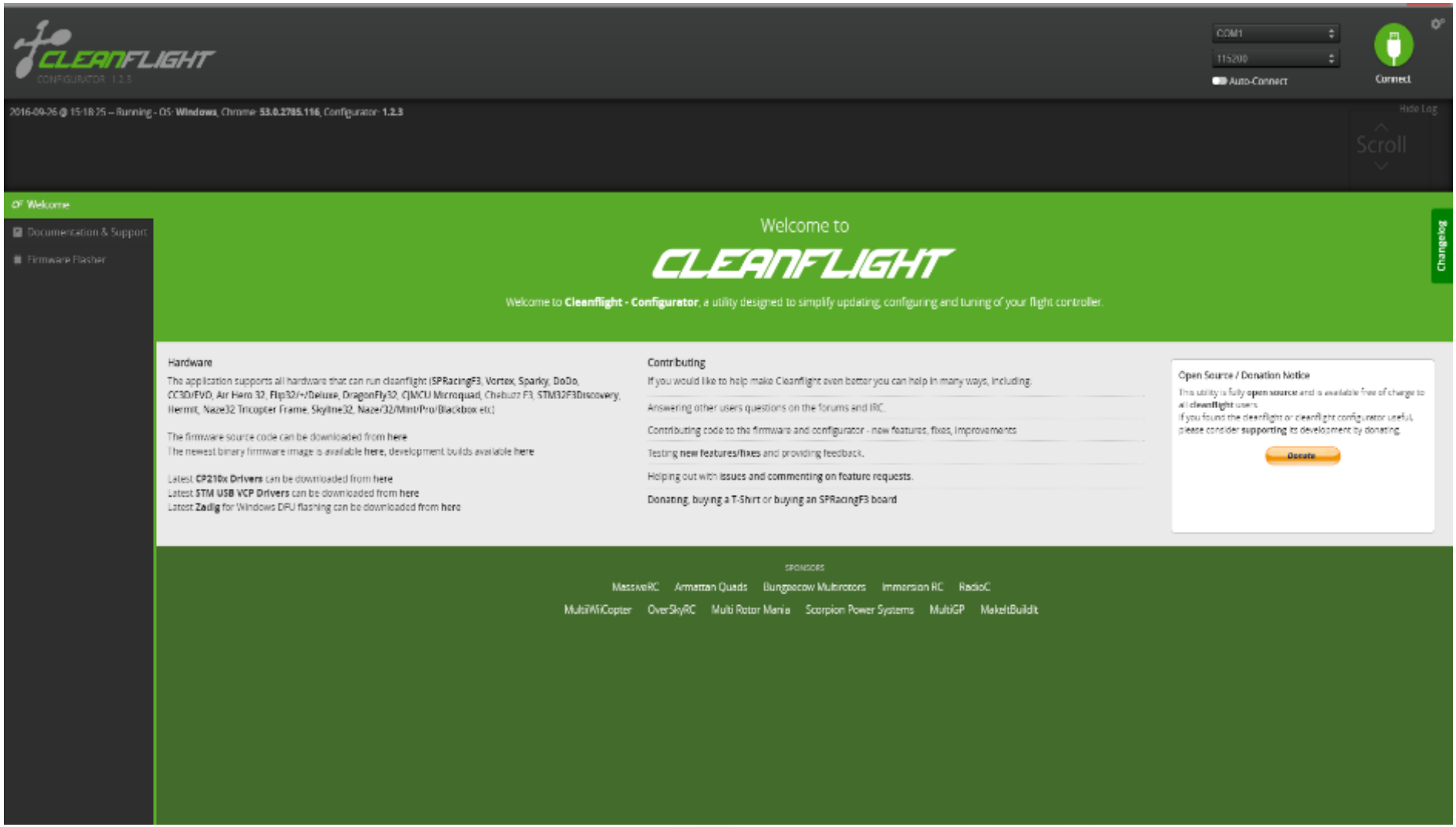
Odabir letjelice – letačke operacije

Vrsta letjelice (*multirotor ili fixed wing*)	Samogradnja letjelice	Kupovina letjelice
Mogućnost nadogradnje	Da	Ograničeno
Potrebo modelarsko znanje	Da	Ne
Povoljna cijena komponenti	Da	Ne
Potrebno znanje programiranja uređaja	Da	Ovisno o scenariju
Dodatne aplikacije/Open source podrška (misson planner, itd….)	Da	Ograničeno „Standardizirano" od strane proizvođača
Potrebno izraditi letački priručnik	Da	Ne
Laka prilagodba specifičnim scenarijima	Da	Ograničeno
(Pre)definirani scenariji korištenja	Ne	Da
Odobrenje HACZ/atest	?	Da
Jamstvo na uređaj	?	Da

Popularne platforme za kontrolu letjelica

Letačka platforma	Cijena	Vrsta letačke operacije
Flyduino KISS	$45	Utrke & rekreativan let
Lumenier LUX	$40	Utrke & rekreativan let
SP Racing™ F3 flight controller	$70	Profesionalne utrke
3DR PixHawk	$250	Samogradnja & autonoman let
DJI NAZA-M V2	$300	Autonoman let & snimanje iz zraka
DJI A3	$900	Profesionalno snimanje iz zraka
????	????	?????

Konfiguriranje i podešavanje kontrolera



Intel® Aero platforma

- Equipped with Intel® RealSense™ technology
- Runs on open-source Linux* operating system
- Pre-programmed flight controller with Dronecode PX4* software
- Support for AirMap* SDK for airspace services

Intel® Aero Ready-to-Fly Drone

Intel® Aero Compute Board

Intel® Aero Vision Accessory Kit

PX4 - platforma

- **Microprocessor:**
  32-bit STM32F427 Cortex M4 core with FPU
  168 MHz/256 KB RAM/2 MB Flash
  32 bit STM32F103 failsafe co-processor
- **Sensors:**
  ST Micro L3GD20 3-axis 16-bit gyroscope
  ST Micro LSM303D 3-axis 14-bit accelerometer / magnetometer
  Invensense MPU 6000 3-axis accelerometer/gyroscope
  MEAS MS5611 barometer
- **Interfaces:**
  5x UART (serial ports),2x with HW flow control
  2x CAN
  Spektrum DSM / DSM2 / DSM-X® Satellite compatible input
  Futaba S.BUS® compatible input and output PPM sum signal
  RSSI (PWM or voltage) input
  External microUSB port
- **The Dronecode Project** is an open source, collaborative project that brings together existing and future open source drone projects under a nonprofit structure governed by The Linux Foundation. The result will be a common, shared open source platform for Unmanned Aerial Vehicles (UAVs).

DJI platforma

A3

A2

WooKong-M

Naza-M V2

Naza-M Lite

Naza-M

iOS i Android platforma

https://developer.dji.com/mobile-sdk/documentation/introduction/index.html

DJI Dev Brief Overview

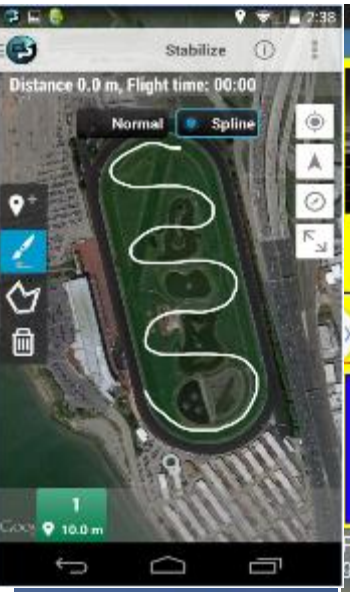
- Tri različita SDK
  - Mobile SDK
  - Onboard SDK
  - Guidance SDK
- Mobile SDK
  - High level kontrola leta (idi na tu i tu koordinatu na toj visini)
  - Low level kontrola leta (ili X,Y,Z brzina, ili yaw/pitch/roll nagib)
  - Realtime telemetrija (pozicija, brzina, visina, stanje baterija…)
  - Sustav za automatsko izbjegavanje prepreka (na podržanim letjelicama)
  - Kontrola kamere, live video feed s kamere, pristup zapisima na memorijskoj kartici kamere, upravljanje kontrolerom itd…

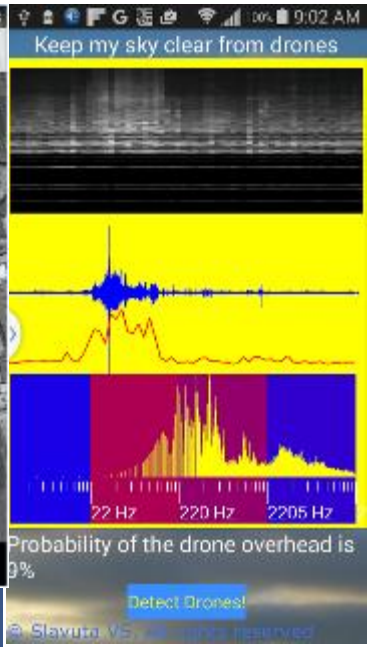
DJI Dev Brief Overview – DJI Mobile SDK

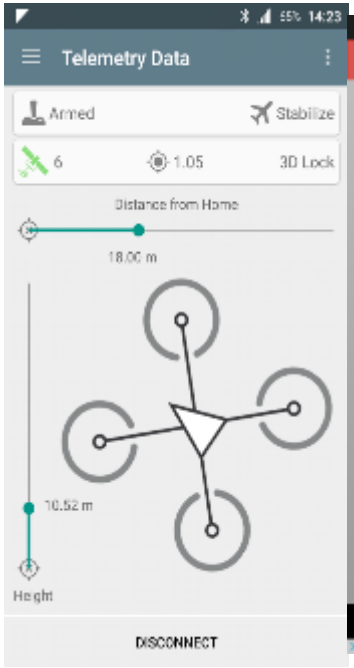
- Potrebno
  - Dron
  - Računalo s instaliranim simulatorom (DJI ga nudi besplatno)
  - Registrirati se na https://developer.dji.com/
  - Pokupiti API key za svaku aplikaciju
  - Skinuti SDK sa https://developer.dji.com/mobile-sdk/
  - Razvojno okruženje

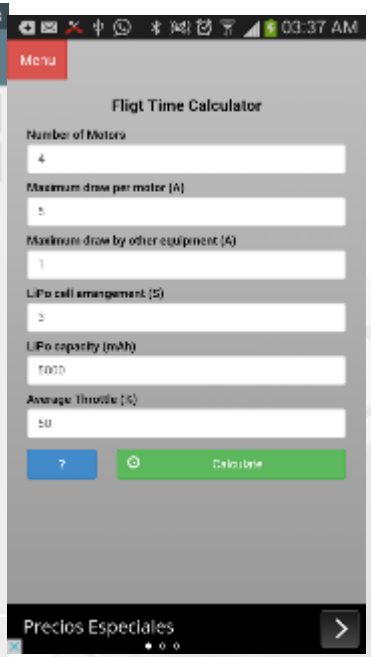
DJI simulator leta

Mobilne aplikacije





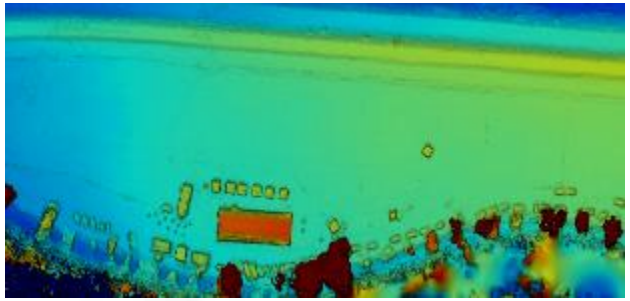




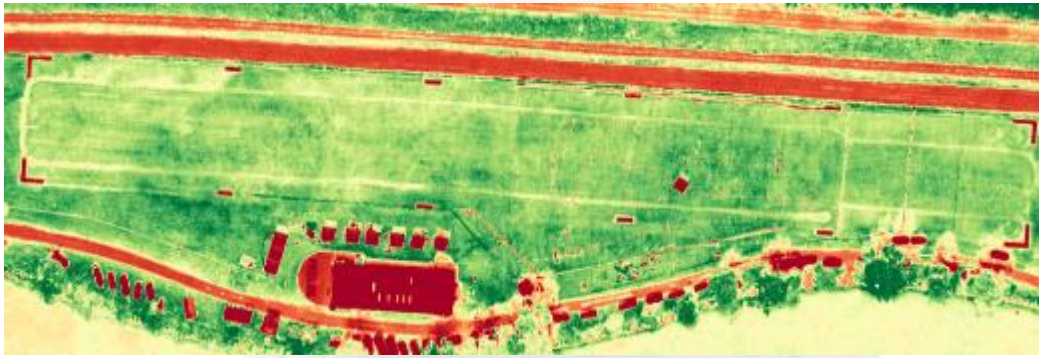
200njak aplikacija u *Google store* od toga 90% razne igrice i simulatori.

Alati za analizu snimaka

- Ortofoto karta
- Digitalni reljef terena
- 3D modeli

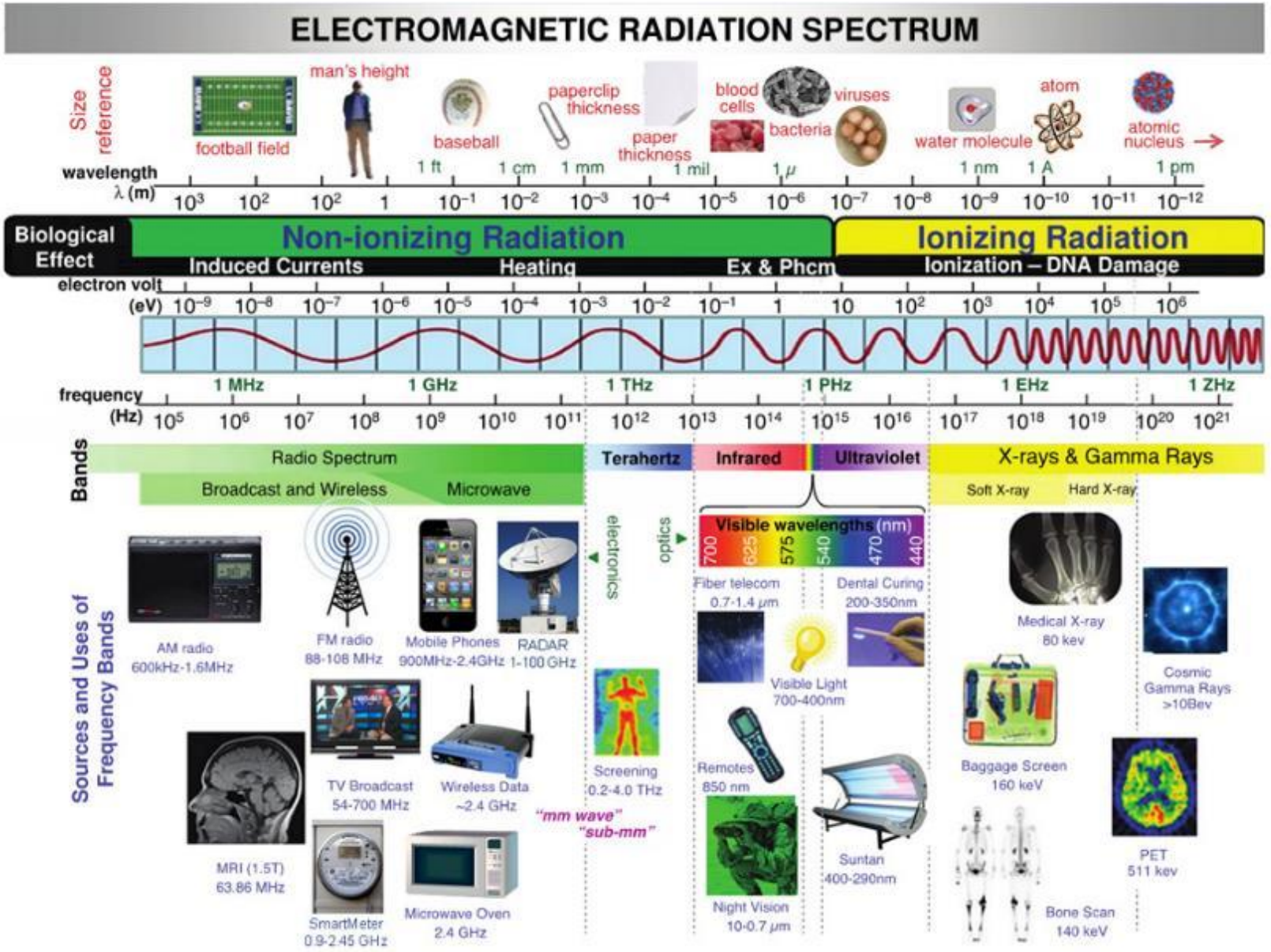


Mogućnosti
- Mjerenje volumena
- Izmjere terena
- Vegetacijski indeks, stanje tla

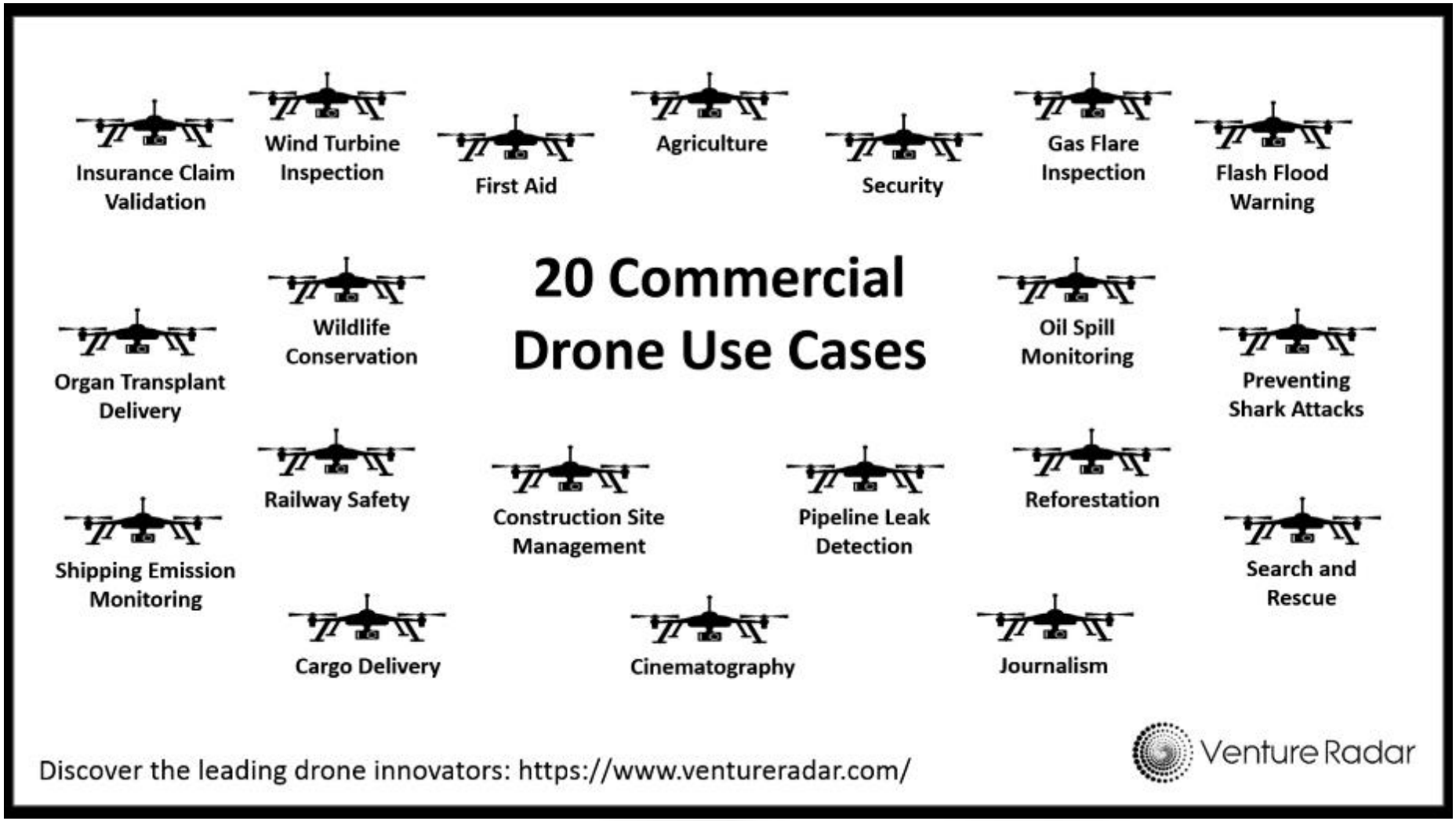


2-5GB podataka po misiji
na 40tak hektara (bez telemetrije)

Senzori


ELECTROMAGNETIC RADIATION SPECTRUM
Size reference
football field
man's height
baseball
paperclip thickness
paper thickness
blood cells
bacteria
viruses
water molecule
atom
atomic nucleus
wavelength λ (m)
1 ft
1 cm
1 mm
1 mil
1 μ
1 nm
1 A
1 pm
Biological Effect
Non-ionizing Radiation
Induced Currents
Heating
Ex & Phcm
Ionizing Radiation
Ionization – DNA Damage
electron volt (eV)
frequency (Hz)
1 MHz
1 GHz
1 THz
1 PHz
1 EHz
1 ZHz
Bands
Radio Spectrum
Broadcast and Wireless
Microwave
Terahertz
Infrared
Ultraviolet
X-rays & Gamma Rays
Soft X-ray
Hard X-ray
Visible wavelengths (nm)
700
625
575
540
470
440
electronics
optics
Sources and Uses of Frequency Bands
AM radio
600kHz-1.6MHz
FM radio
88-108 MHz
Mobile Phones
900MHz-2.4GHz
RADAR
1-100 GHz
Fiber telecom
0.7-1.4 μm
Dental Curing
200-350nm
Medical X-ray
80 kev
Cosmic Gamma Rays
>10Bev
Visible Light
700-400nm
TV Broadcast
54-700 MHz
Wireless Data
~2.4 GHz
Screening
0.2-4.0 THz
"mm wave"
"sub-mm"
Remotes
850 nm
Baggage Screen
160 keV
MRI (1.5T)
63.86 MHz
SmartMeter
0.9-2.45 GHz
Microwave Oven
2.4 GHz
Night Vision
10-0.7 μm
Suntan
400-290nm
PET
511 kev
Bone Scan
140 keV

Scenariji uporabe dronova

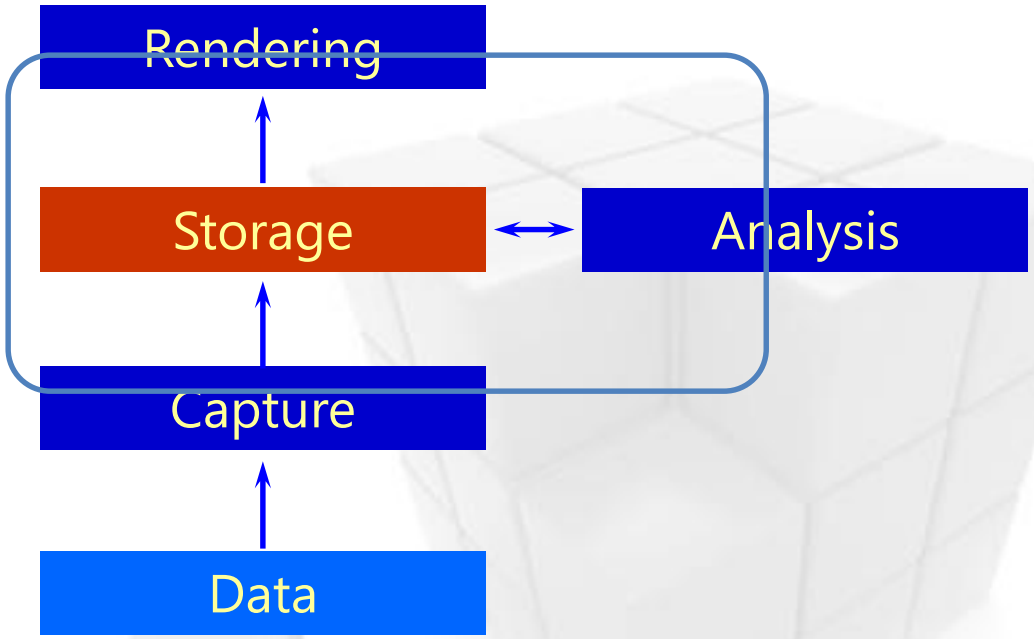


Gdje je tu Oracle?

- Oracle Big Data Cloud Services
- Oracle Cloud Platform
- Oracle Java
- Oracle IoT Cloud Services
- Oracle Database 12c Enterprise Edition
- Oracle Spatial & Maps (Enterprise Edition DB)

Where does Oracle fit in a Spatial/GIS System

ORACLE

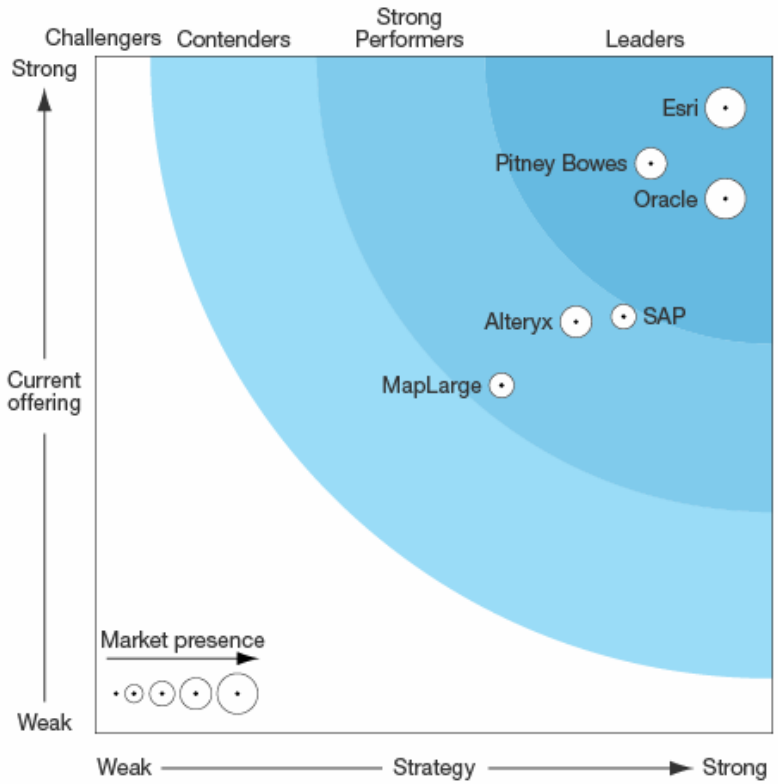


The Forrester Wave™: Geospatial Analytics Tools And Platforms, Q3 2016 - The Six Providers That Matter Most

VENDOR PROFILES

This evaluation of the geospatial analytics platforms market is intended to be a starting point only. We encourage clients to view the detailed product evaluations and adapt the criteria weightings to fit their individual needs through the Forrester Wave Excel-based vendor comparison tool (see Figure 3).

Figure 3: The Forrester Wave™: Geospatial Analytics Tools And Platforms, Q3 '16



Oracle Database 12*c* Location & Spatial Features

- **Vector Performance Acceleration**: Substantially faster querying and more efficient use of CPU, memory, and partitioning
- **Parametric Curves (NURBs)**: mathematically precise representation of free form curves and reproduced exactly for 2D and 3D data.
- **GeoRaster virtual mosaic**: a large collection of GeoRaster objects, rectified or not, from one or more GeoRaster tables
- **GeoRaster raster algebra**: new analytical algorithms and faster, parallel raster operations
- **GeoRaster image processing:** More processing capabilities, more server-side and parallel processing
- **GeoRaster Java APIs**: more APIs that were previously supported only in the PL/SQL API
- **3D**: accounts for height when calculating distance between two 3D points
- **3D:** metadata views for 3D themes, scenes, and viewframes for visualization and analytics
- **3D:** pyramiding is supported for Point clouds and TINS
- **3D**: Contour lines can be generated from point clouds
- **3D**: geodetic data supported in Linear Referencing System functions
- **Geocoding**: supports point address geocoding for countries that don't have address ranges and language support for countries that have addresses in multiple languages.
- **Routing engine:** advanced routing restrictions and conditions, such as truck-specific routes
- **Spatial Web Services:** A Web-based Administrative Console for Web Feature Server 1.1

Budućnost – iznimna brzina inoviranja

#1 Podaci – kako upravljati, razmjenjivati i analizirati podatke.

#2 GIS – integracija s GIS sustavima

#3 Senzori – povezivanje i interpretacija podataka

#4 *UTM* – integracija autonomnih sustava u postojeće sustave

#5 *Sense & Avoid* sustavi – nova rješenja i scenariji

#6 *BVLOS* – letačke operacije na daljinu >100km

#7 Sigurnost i privatnost – zaštita sustava

#8 Sustavi za detekciju i ometanje dronova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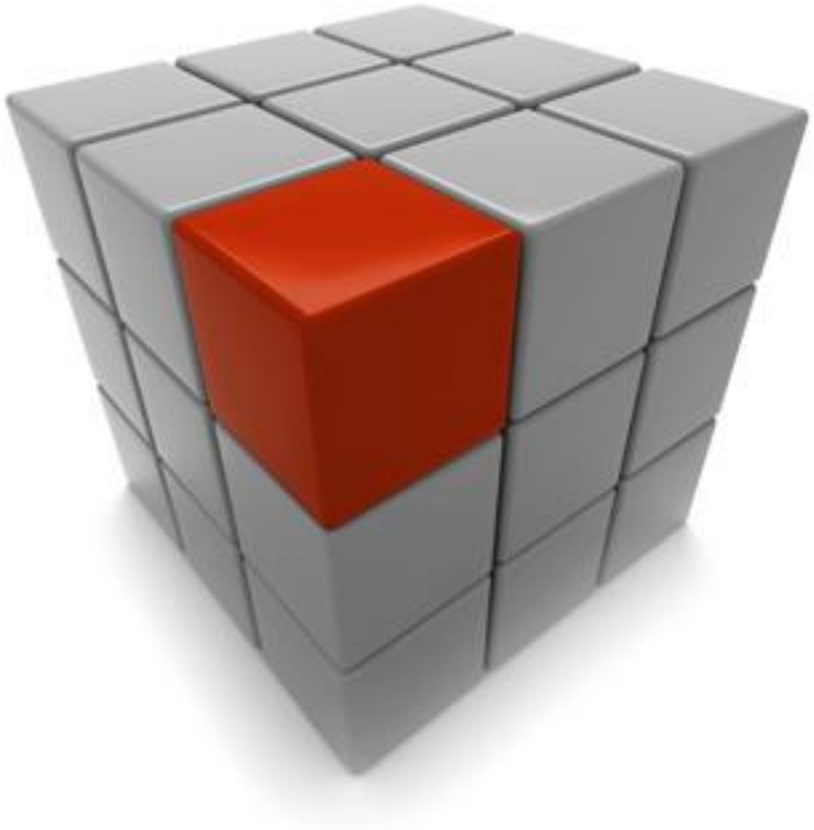

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