



Thursday 27<sup>th</sup> April, 2017

In a historical location: The Junglinster Longwave transmitter

LUXEMBOURG  
INSTITUTE OF SCIENCE  
AND TECHNOLOGY



Take a fresh look at your water body: using flying wings to monitor the water quality of lakes

HM Cauchie & C Penny

[henry-michel.cauchie@list.lu](mailto:henry-michel.cauchie@list.lu)



# Context

- Increase in frequency and intensity of algal blooms as a result of global changes (climate, land use, urbanisation)
- Ecological triggers of algal blooms are not known in details



Lake Erie – June 2014: more than 400,000 people were left without safe drinking water in Ohio and Michigan (Hiffington Post)

J.A. Elliott (2012) Is the future blue-green: a review of the current model predictions of how climate change could affect pelagic freshwater cyanobacteria. *Water Res.*, 46: 1364–1371.

# Upper-Sûre Reservoir

Luxembourg's drinking water reservoir



*Lac de barrage situé au Luxembourg.*

- ✓ *Surface 3.2 km<sup>2</sup>*
- ✓ *Volume 55 · 10<sup>6</sup> m<sup>3</sup>*
- ✓ *Drinking water production ± 50,000 m<sup>3</sup> / day*
- ✓ *Consumption by 400,000 people*
- ✓ *Important recreational area (May – Aug.)*



# Toxic cyanobacteria

## Yearly bloom development



- 🔴 *Efflorescences observées généralement d'août à novembre*
- 🔴 *Développement maximal observé dans la partie amont du lac*
- 🔴 *Concentrations en microcystines dans l'eau utilisée pour la production d'eau potable lors des efflorescences = 5 – 30 ng.L<sup>-1</sup>*
- 🔴 *Limite maximale tolérable proposée par l'OMS = 1 µg.L<sup>-1</sup>*



# Cyanobacteria development in Esch-Sauer reservoir in 2016

End of August → mid-november

Le  
**Quotidien**  
INDÉPENDANT LUXEMBOURGEOIS

## Lac de la Haute-Sûre : les « algues bleues » décryptées

Dans Au Nord et à l'Est, Luxembourg Mis à jour le 02/09/16 17:03 | Publié le 02/09/16 17:03



Ces algues bleues, de couleur plutôt verdâtre, sont des bactéries qui produisent des toxines dangereuses pour l'homme et les animaux. (illustration DR)

On en sait un peu plus au sujet des algues toxiques repérées dans le lac de la Haute-Sûre. Il s'agit en réalité de bactéries.

Depuis mardi et jusqu'à nouvel ordre, [la baignade est «déconseillée» dans le lac de la Haute-Sûre](#). La faute «aux récentes apparitions massives de cyanobactéries, encore appelées algues bleues», indique le Luxembourg Institute of Science and Technology (LIST), chargé des analyses.



Wéinst den Algen am Stau

## Aus dem Éisleker Triathlon gött en Duathlon

D'Bakterien am Stau kéinten d'Nerven, d'Liewer an d'Haut ugräifen an och Verdauungsproblemer provozéieren.

## Lac de la Haute-Sûre : la baignade reste proscrite

Dans Au Nord et à l'Est, Luxembourg Mis à jour le 13/09/16 17:34 | Publié le 13/09/16 17:34



## Luxemburger Wort

Blaualgen im Stausee

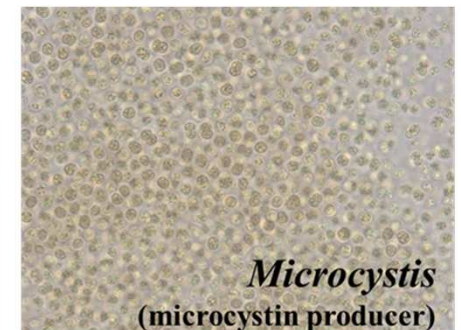
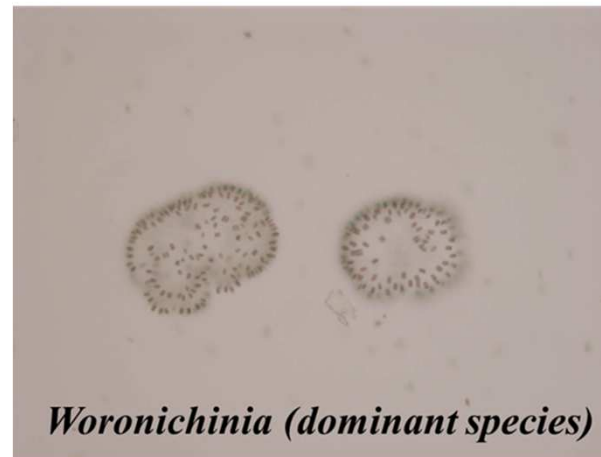
### Kein Problem für das Trinkwasser





# Characteristics of the algal blooms

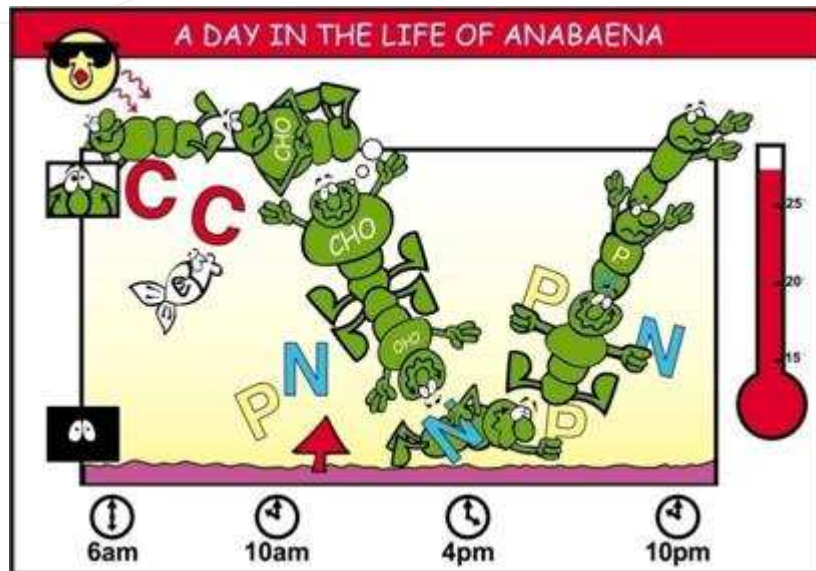
- Composed of cyanobacteria that
  - produced toxins (impairing the ability of the water to be used for producing drinking water)
  - forms thick floating mats (clogging filters of water consuming factories)



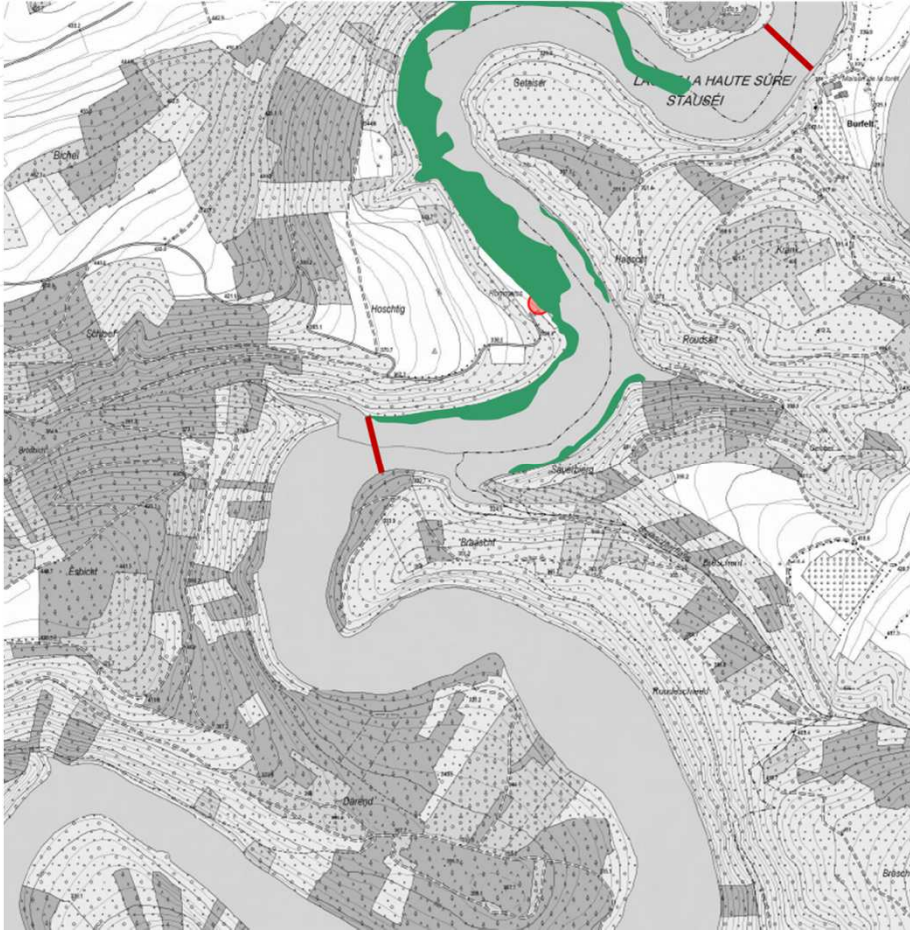
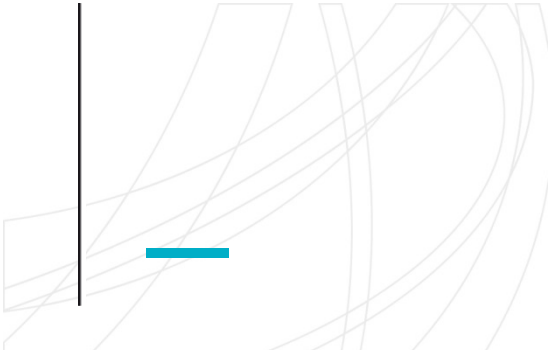


# Characteristics of the algal blooms

- Very heterogeneous spatial distribution, changing very rapidly as a function of the wind and the own motility of the algae









# Monitoring needs

- Real-time
  - Autonomous
  - Practical for water managers
- 
- Why locating cyanobacteria?
    - To correctly assess the risk
    - To apply *in situ* treatment at the right place

# RDI objectives



- **Setting up spatial «Drone» Mapping workflow**

## **From the flight planning to the cartographic products delivery**

- Image processing: spatial and multi-temporal analysis
  - Observation and monitoring of different central indices
  - Imagery classification (semi-automated or object-based approach) and segmentation
  - Altimetry data processing
- Geospatial data analysis
  - Using Geographic Information System
  - Validation based on *in-situ* data or ground control points
- Data visualization
- Final product
  - Provide easy-to-read map of potential areas affected by the event

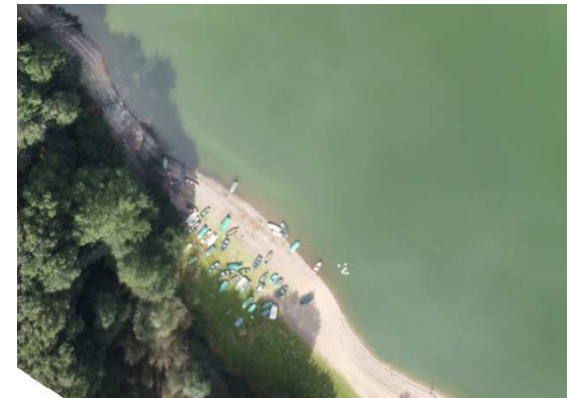


- Water quality - cyanobacteria

- Harmful algal blooms
- Cartography



LUXEMBOURG  
INSTITUTE OF SCIENCE  
AND TECHNOLOGY



# Equipment needs and operation

- Water quality (Luxembourg / France)

- Flying wing

- Sensors

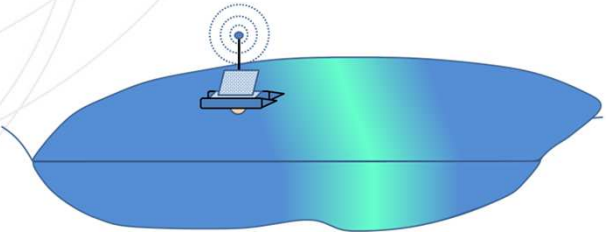
- RGB
- Hyperspectral
- Multispectral (real with 1 nm band or 4 fixed wavelengths)
- Thermal camera



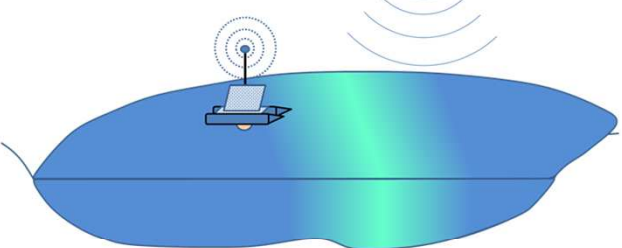


# Typical integrated risk assessment/management product

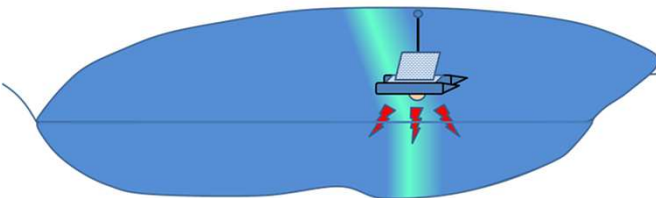
1 Continuous on-site monitoring for HAB prediction and observation



2 Airborne localisation of HAB during alerts



3 Targeted waterborne treatment



Aquatic drone in "sensing" mode



Air drone bearing hyperspectral cameras



Aquatic drone in "treatment" mode



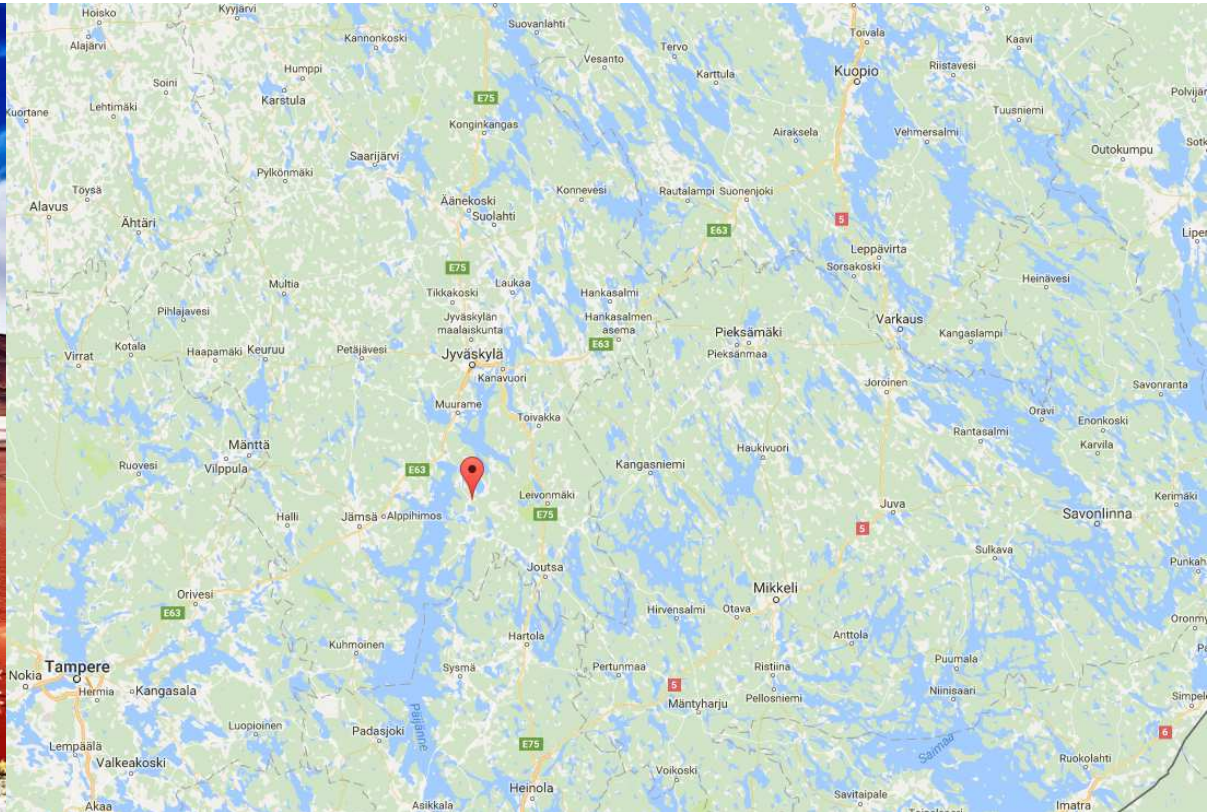
Integrated management system



Decision-support

# Perspectives of this integrated product

- Contact with large companies for drinking-water reservoirs or recreative lakes
- Extra-European projects (drinking water, red tides)





# ALLEN & OVERY



*Amcham*

*Drones - For Good and Evil*

Gary Cywie – Legal aspects: civil and leisure use of drones

27 April 2017

# Who are they?





**Do they bite?**





# Legislation

<http://www.dac.public.lu>

Know the  
rules



# Insurance



# Data protection







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Bridging the gap between manned and unmanned aviation





Improve aviation safety by making it possible for manned and unmanned aircraft to share the same airspace in a safe manner.

# Are drones a real threat?

**Stansted Airport: Drone 'serious crash risk' to Boeing 737**

🕒 25 July 2016 | Essex

 Share

MIDDLE EAST

**Drone closes busy Dubai International Airport for an hour**

Published June 11, 2016 · Associated Press



**Drone and plane in 'near miss' close to Newquay airport**

Police are investigating reports of a drone flying close to a passenger plane with 62 people onboard



# MANNED vs UNMANNED



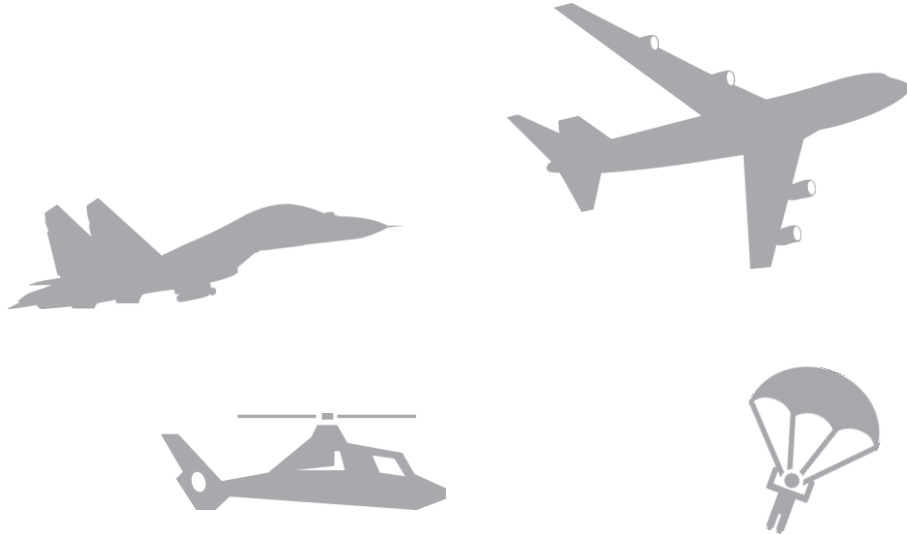
- + 362,000 aircraft
- 23,000 airliners
- Growth of 750 /year



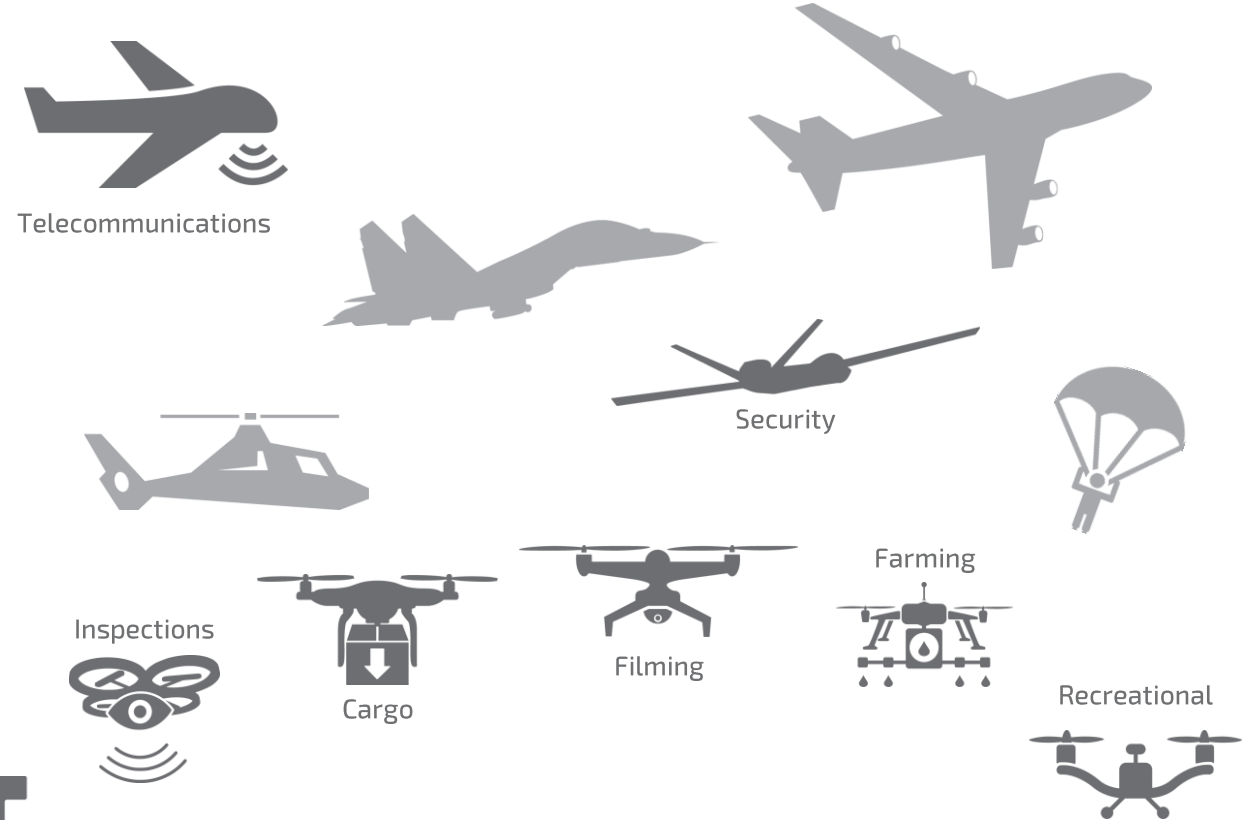
- + 4,000,000 drones
- Expected 400k commercial
- Growth of 150,000 /year

# FROM ATM TO UTM

In 2016 airspace is occupied mainly by manned vehicles.



By 2030 there will be 10x more traffic, mostly unmanned (drones).



Regulatory authorities & pilots keep airspace safe with the use of an air traffic management system.

Unify UTM platform will have tools for all; drone users & regulators of airspace will cooperate and provide security & safety for manned & unmanned air traffic.



# PROBLEM STATEMENT

MANNED



Reliable aircraft  
strict standards



Formal  
procedures



Extensive  
training



Comprehensive  
ATC

UNMANNED



Few standards in  
place yet



Creation of  
procedures



Short training  
Approx. 7 days



ATC not  
Drone focussed



# PROBLEM STATEMENT

Who's doing the inspections?





# STAKEHOLDERS



Drone Operators  
& Pilots



Police & Emergency  
Services



Air Traffic Control,  
CAA & Airports



Manufacturers  
& OEM

**WHERE AM I ALLOWED TO FLY?  
WHERE CAN I FLY?  
HOW DO I MANAGE MY FLIGHTS?**

# STAKEHOLDERS



Drone Operators  
& Pilots



Police & Emergency  
Services



Air Traffic Control,  
CAA & Airports



Manufacturers  
& OEM

**WHERE IS HE FLYING?  
IS HE ALLOWED TO FLY?  
HOW DO I ALLOW FLIGHTS?**



# STAKEHOLDERS



Drone Operators  
& Pilots



Police & Emergency  
Services



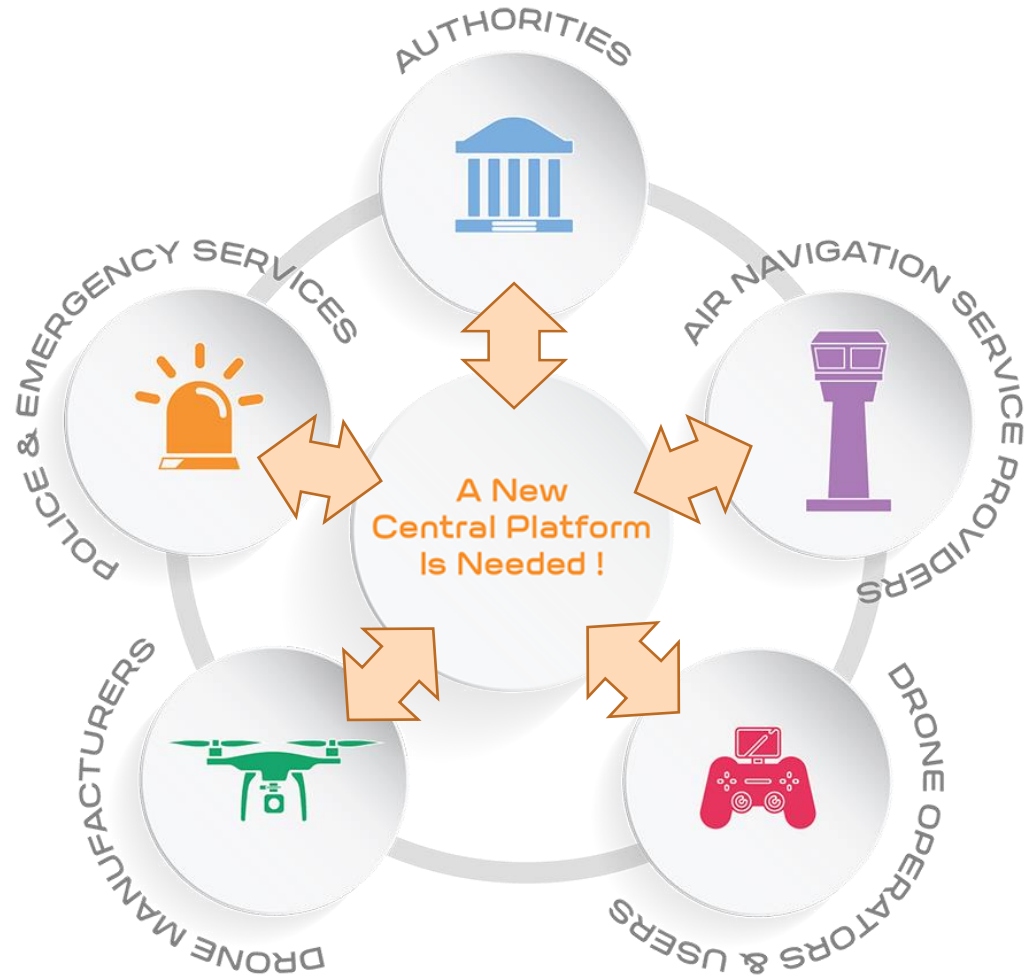
Air Traffic Control,  
CAA & Airports



Manufacturers  
& OEM

**HOW DO I CONNECT WITH THE  
DRONE COMMUNITY?**

# CONNECTING THE STAKEHOLDERS





# CONNECTING THE STAKEHOLDERS



- **Airspace data & regulatory rule engine inside**
- Cloud-based software platform
  - Fault tolerant
  - High availability
  - Scalable
- Intuitive user interface
  - Little or no training required
  - Easy access to aviation related data
  - Wide user acceptance
- Connects to existing ATM systems
- Open API & SDK available

# UNIFLY – USERS & APPLICATIONS



# TWO DISTINCT PILOTS

THE RECREATIONAL USER / HOBBYIST



THE PROFESSIONAL PILOT





# THE RECREATIONAL USER / HOBBYIST



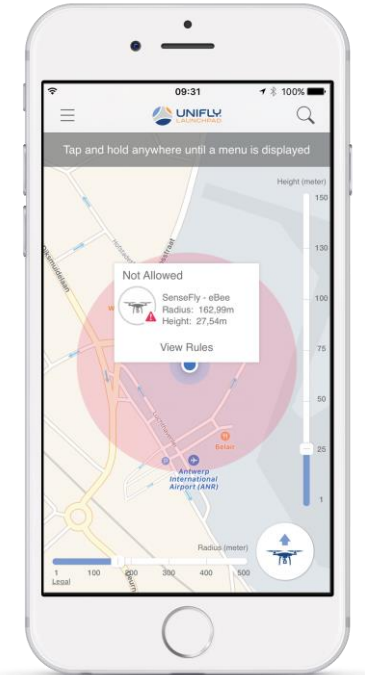
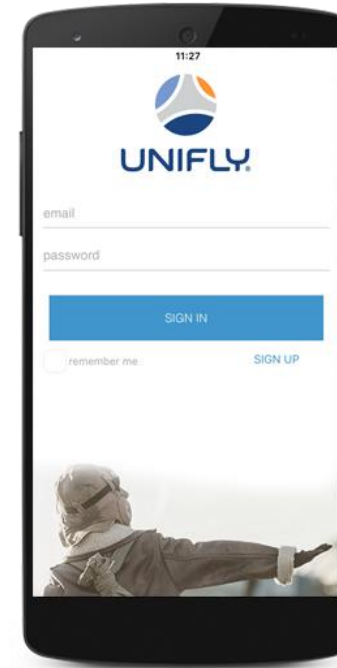
- Enthusiasts
- Impulsive behaviour
- 'Toys for boys' ?

**NOT RISK AWARE**

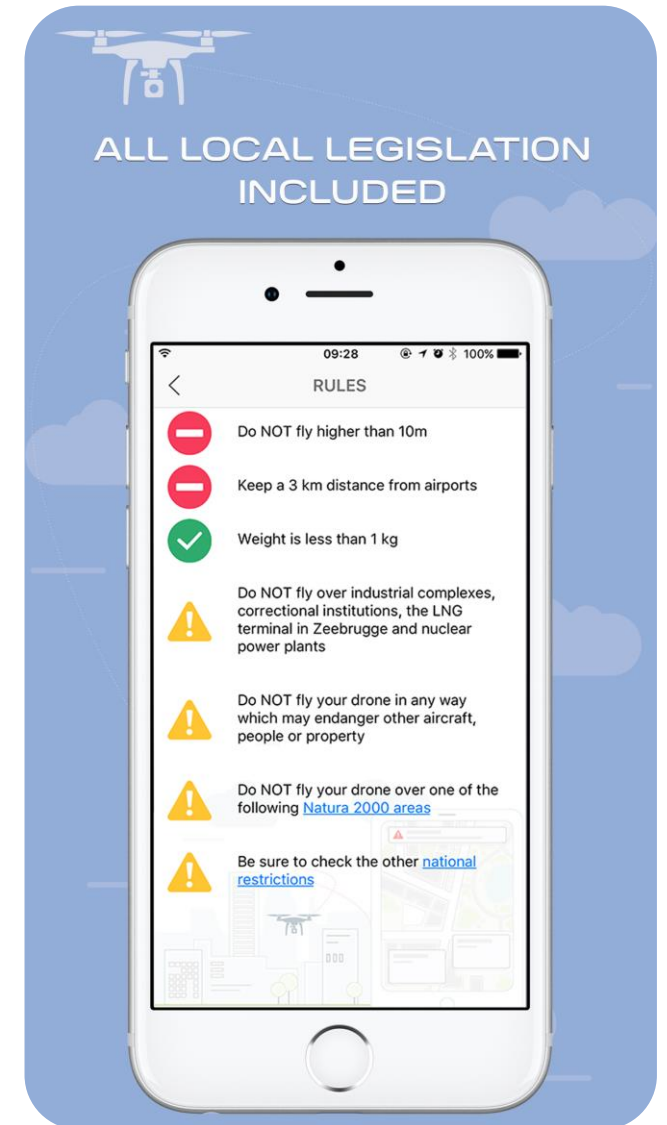
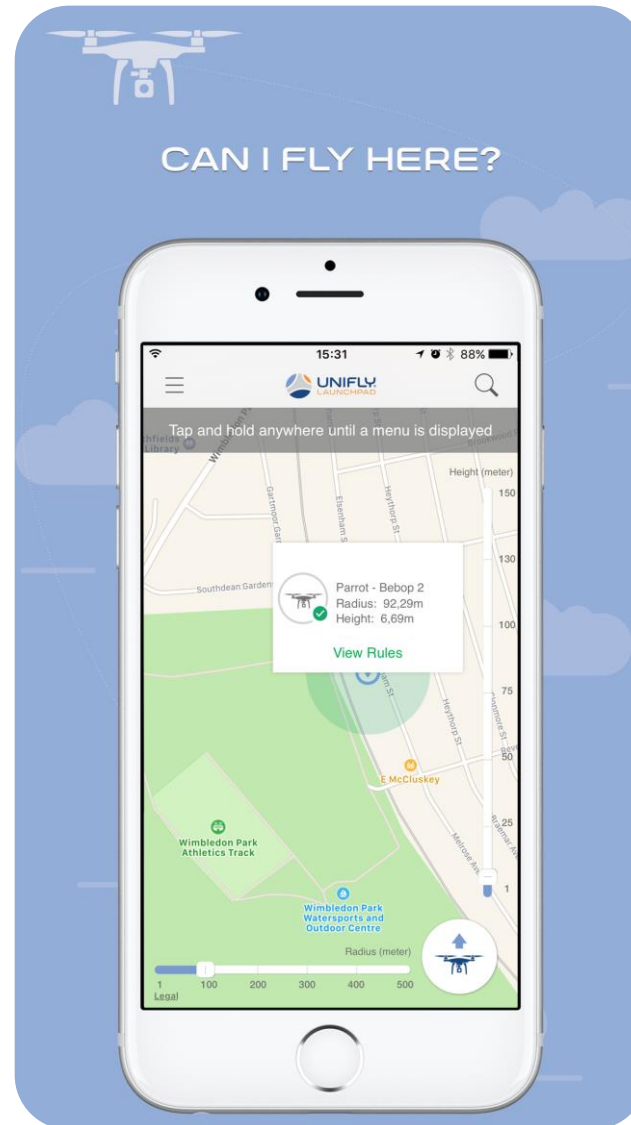
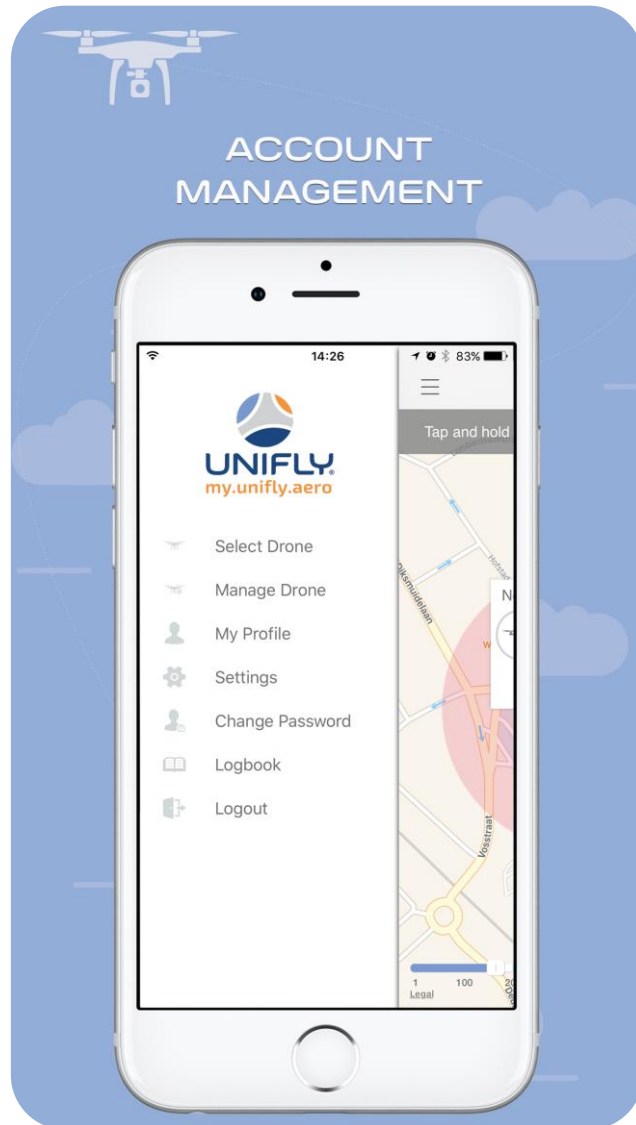
# UNIFLY – LAUNCHPAD



CAN I FLY  
HERE?



# UNIFLY – LAUNCHPAD

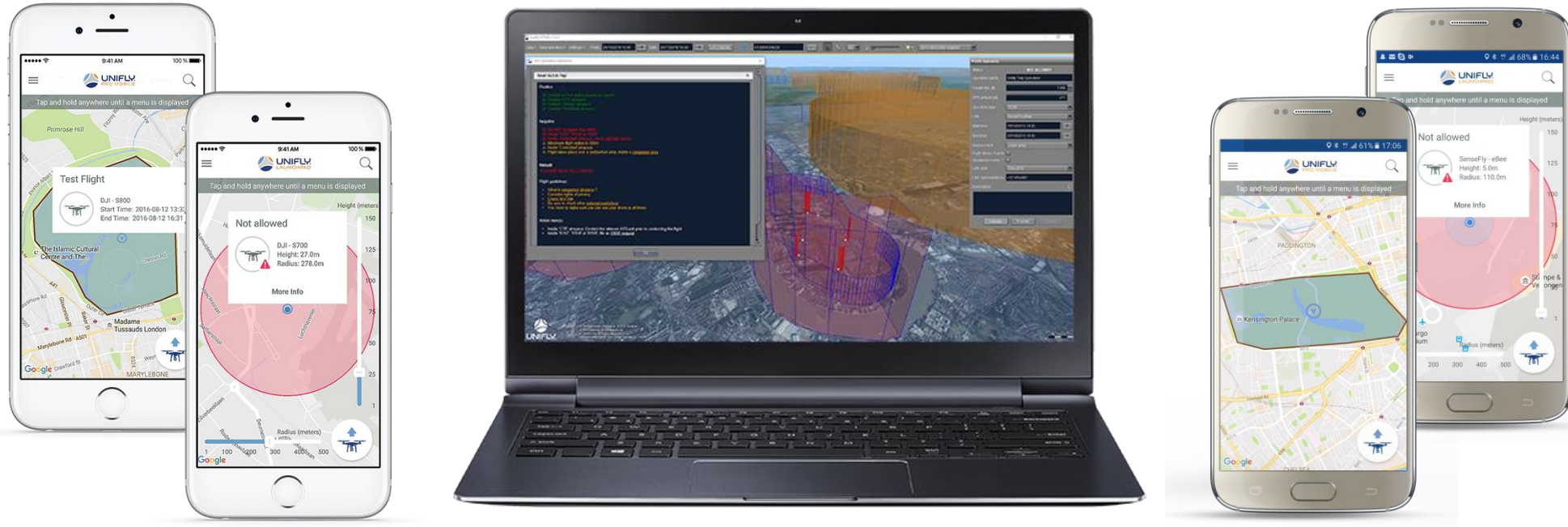




# THE PROFESSIONAL PILOT



# UNIFLY – PRO SERIES



## ALL-IN ONE SOLUTION

- 4D airspace & no-drone zone visualization
- All local aviation legislation
- Plan & validate drone flights
- Limited aviation knowledge required
- Automated pilot & drone logbook
- Fleet- and document management capabilities

# UNIFLY – USERS & APPLICATIONS

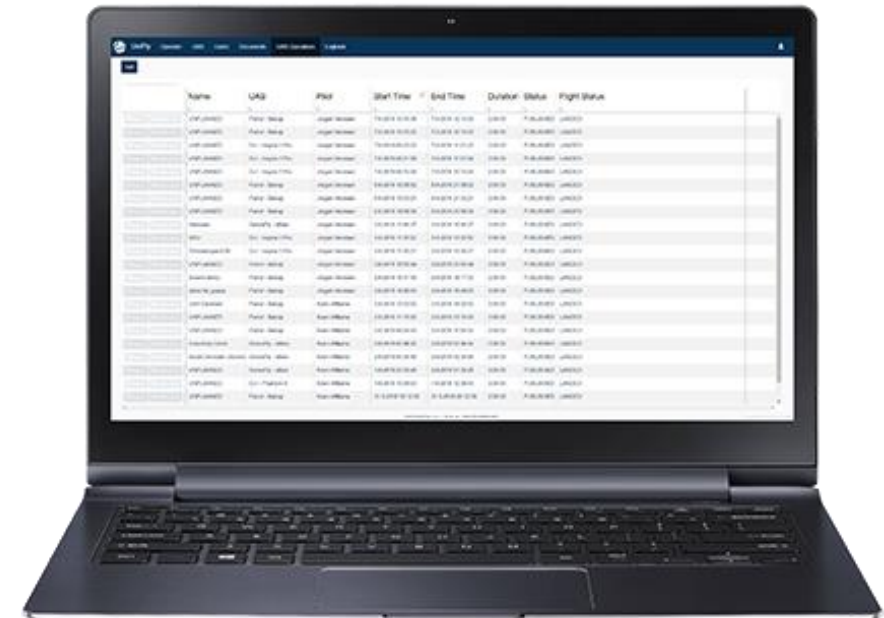




# UNIFLY - SENTRY



- Manage drone & pilot registration
- Monitor status of drone flights: pre/during/post flight
- Approve or even deny flight requests
- Allow flights in controlled airspace



# UNIFLY - SENTRY



- Overall airspace management system for manned & unmanned activities
- Connection to ATM possible
- Create & communicate no-drone zones
- Police services verification:
  - Identify pilot & drone
  - Create/request temporary no-drone zones above incident sites
- Rescue services:
  - Create/request temporary no-drone zones above incident sites

# UNIFLY - SENTRY



- Overall airspace management system for manned & unmanned activities
- All aerial activities can be implemented via digital NOTAM (AIS/AIM)
- Connection to ATM possible
- Create & communicate no-drone zones





# UNIFLY – USERS & APPLICATIONS



Drone Operators  
& Pilots



Police & Emergency  
Services



Air Traffic Control,  
CAA & Airports



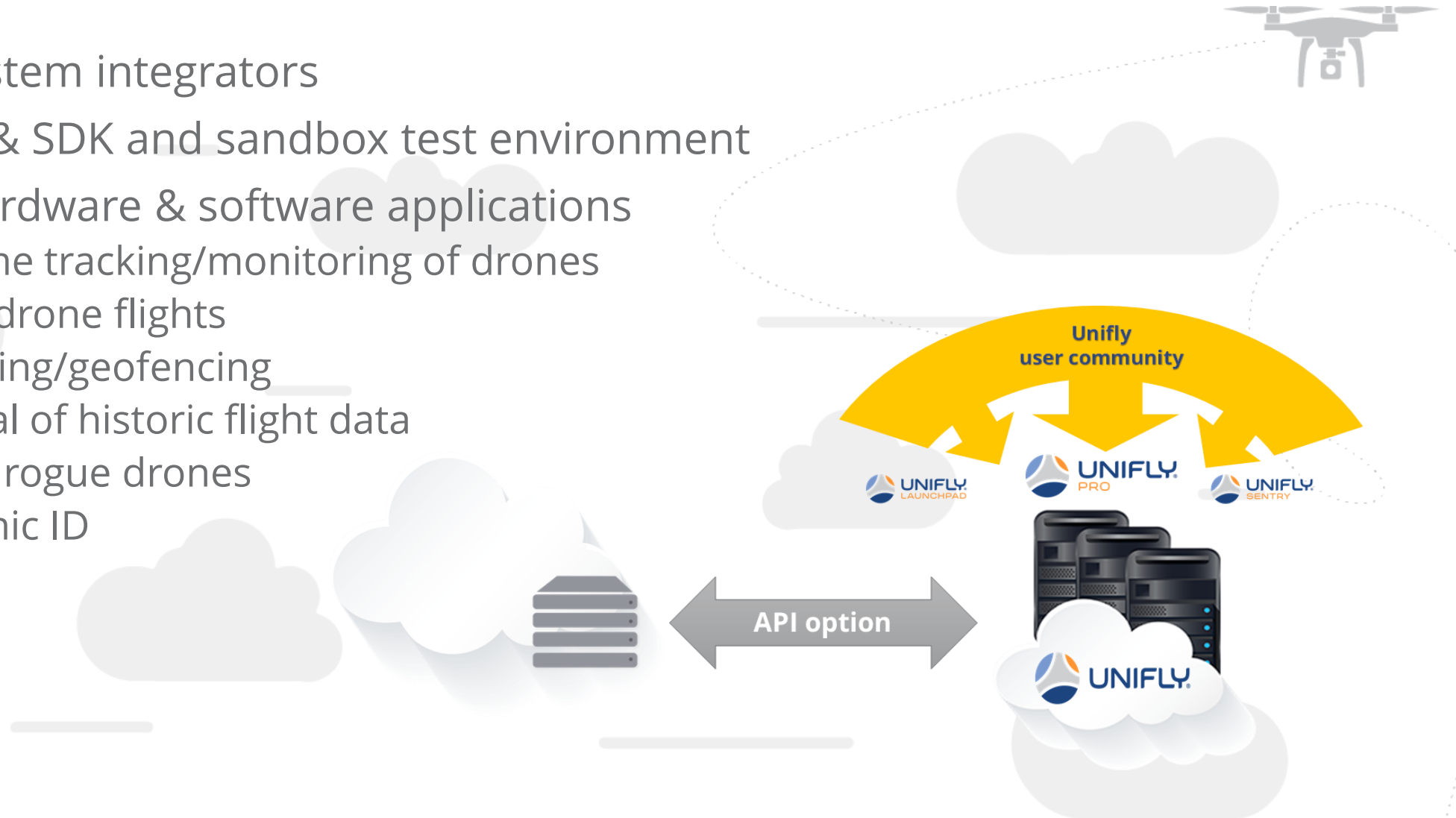
Manufacturers  
& OEM



# UNIFLY CONNECT



- OEM & system integrators
- Open API & SDK and sandbox test environment
- Type of hardware & software applications
  - Real-time tracking/monitoring of drones
  - Replay drone flights
  - Geocaging/geofencing
  - Retrieval of historic flight data
  - Display rogue drones
  - Electronic ID

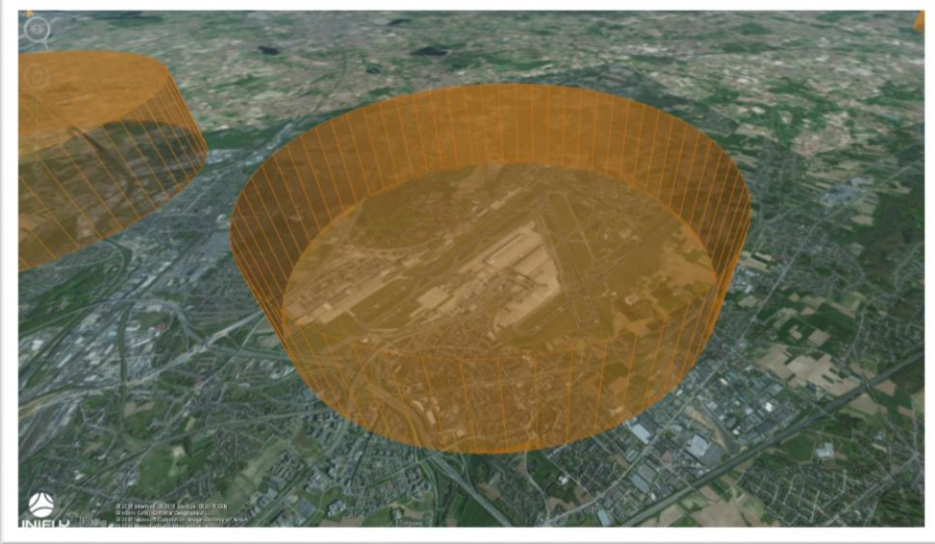


# UNIFLY CONNECT - EXAMPLE





# SECURITY SOLUTIONS NEEDED





QUESTIONS..?



**CHAQWA™**







CHAQWA™

The logo for CHAQWA, featuring the brand name in a white, bold, sans-serif font. The letter 'Q' is stylized with a red dot above it. A registered trademark symbol (®) is located to the upper right of the 'A'. The background of the top section is a dark wooden surface with coffee beans and chocolate pieces.A white home icon inside a circular frame, positioned in the top right corner of the image.

CHAQWA<sup>®</sup>

UN ASSORTIMENT COMPLET  
DE CAFÉ, THÉ ET CHOCOLAT CHAUD



CAFÉ



THÉ



CHOCOLAT  
CHAUD





# CHAQWA

apporte

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DÉLICIEUX



**QUALITÉ**  
SUPÉRIEURE



**EXPÉRIENCE**  
UNIQUE

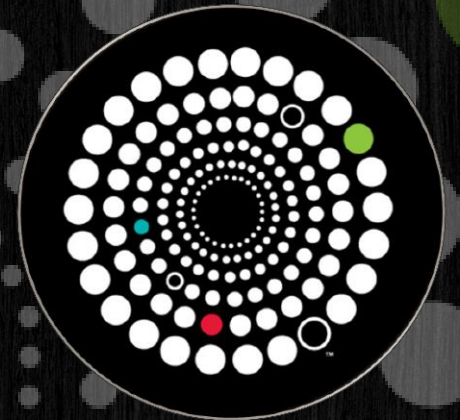


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# Plus d'informations ?

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