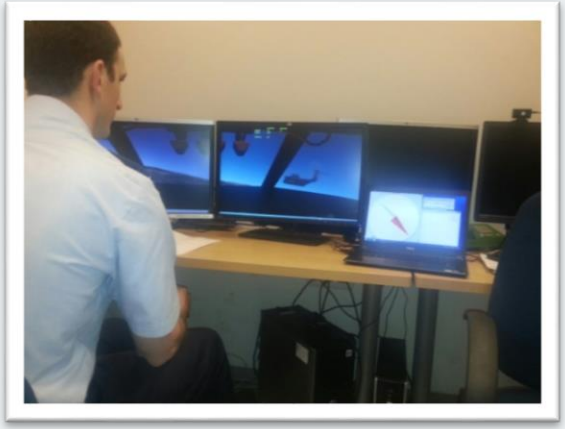
Deconfliction & Separation Management

Air Traffic Separation and Collision Avoidance

Ciconia

Safe separation for the UTM

Ciconia deals with Deconfliction & Safe Separation for “low & slow” since 2011 with the C&CAS: “Control & Collision Avoidance System”



Safe separation for the UTM - New standards & terminology required:

Examples:

- ‘Street roof’ altitude
- Max speed between buildings: horizontal, vertical
- Maximum density of air traffic in a given volume
- Minimum DbP (Distance between Platforms)
- Minimum TtC (Time to Collision) between platforms
- Speed control

New standards & terminology required:

‘Street Roof’ Altitude:

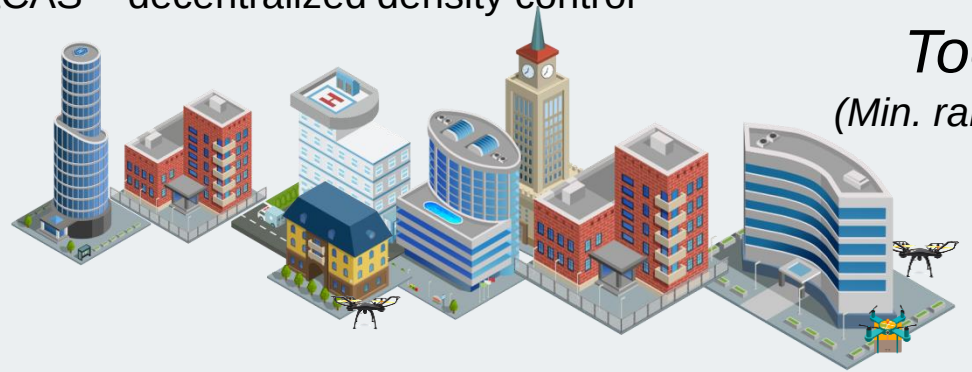
- Only vertical speed below street roof?
- Stop before climbing over street roof?

- Setting ‘street roof’:

New standards & terminology required:

‘Density limit’ - Maximum platforms in a given air volume:

- Set by regulator
- Enforced by:
  - Strategic level while allocating air space to users
  - C&CAS – decentralized density control



Too crowded!

(Min. range limit maintained)

New standards & terminology required:

Separation between platforms:

- Minimum DbP (Distance between Platforms)

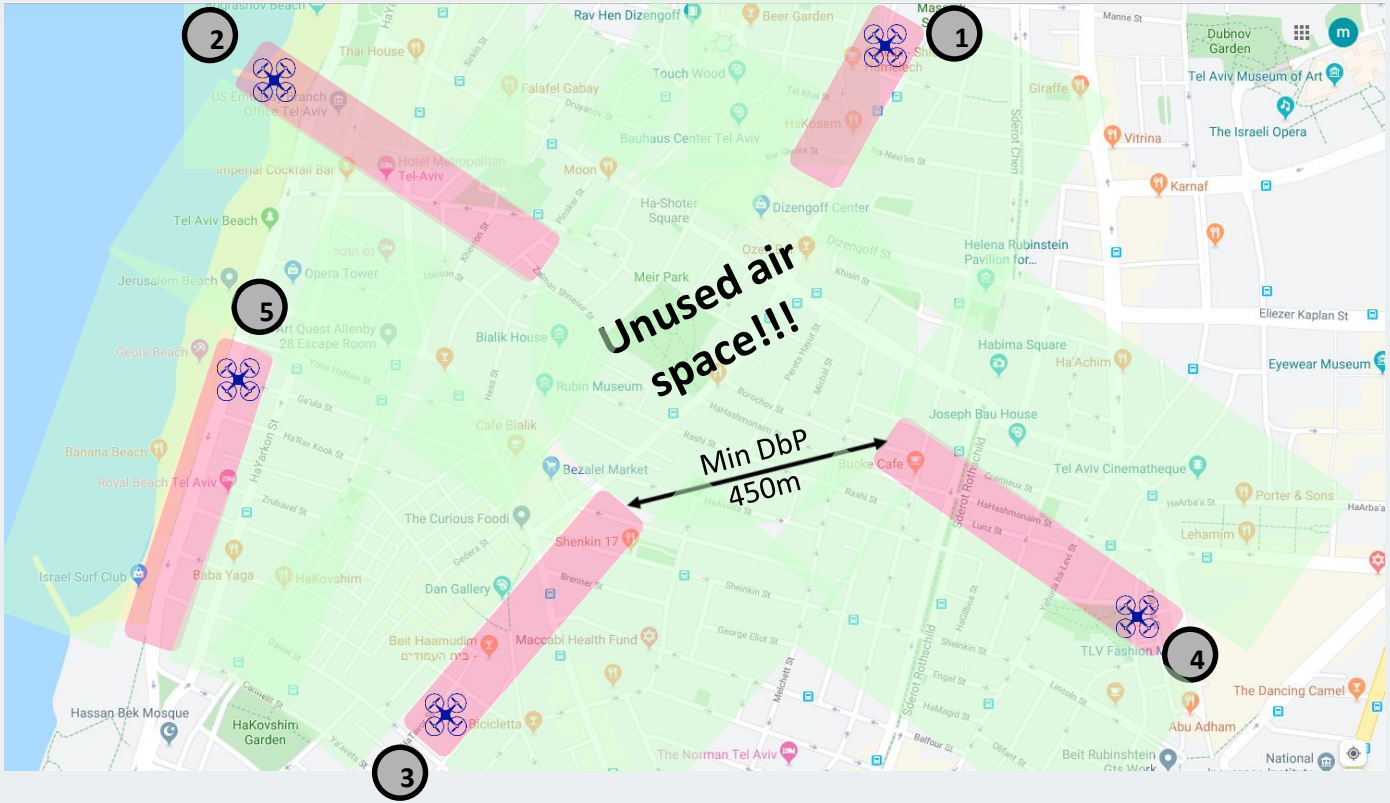
- Minimum TtC (Time to Collision) between platforms

Drone 1
max speed = 15m/s → TtC = 15sec. ← Drone 2
max speed = 15m/s

$$\frac{45\text{m}}{(15\text{m/s} + 15\text{m/s})} = 15\text{sec.}$$

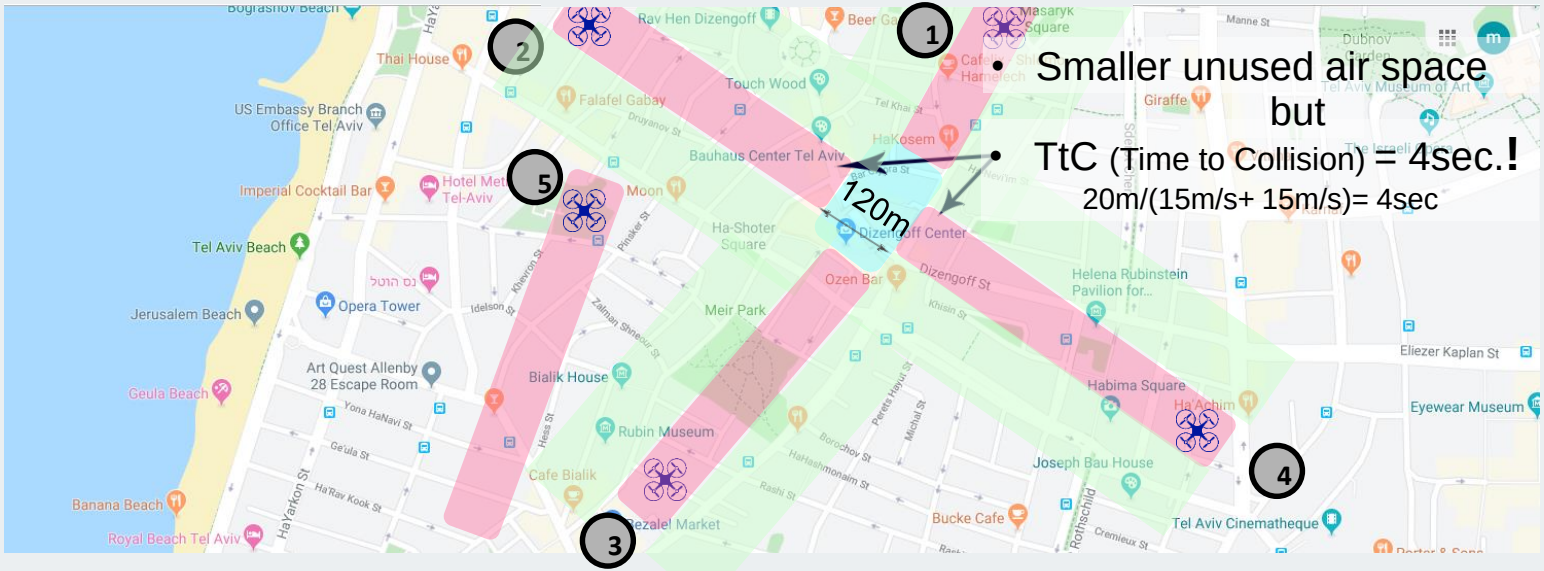
Test case 1:

5 drones operating in 5 areas
Min DbP (Distance between Platforms) > 450m
Min TtC (time to Collision) >= 15 sec.



Test case 2:

5 drones operating in 5 areas
Min DbP (Distance between Platforms) > 120m
Min TtC (time to Collision) >= 15 sec.



To maintain TtC>= 15sec.,
Drones 2 & 4 must slow to 4m/sec
[120m/(4m/s+4m/s)=15sec]

Test case 2:

5 drones operating in 5 areas
Min DbP (Distance between Platforms) > 120m
Min TtC (time to Collision) >= 15 sec.

Who will slow the drones in real time?

C&CAS – decentralized density control

Safe separation for the UTM – new standards & terminology required:

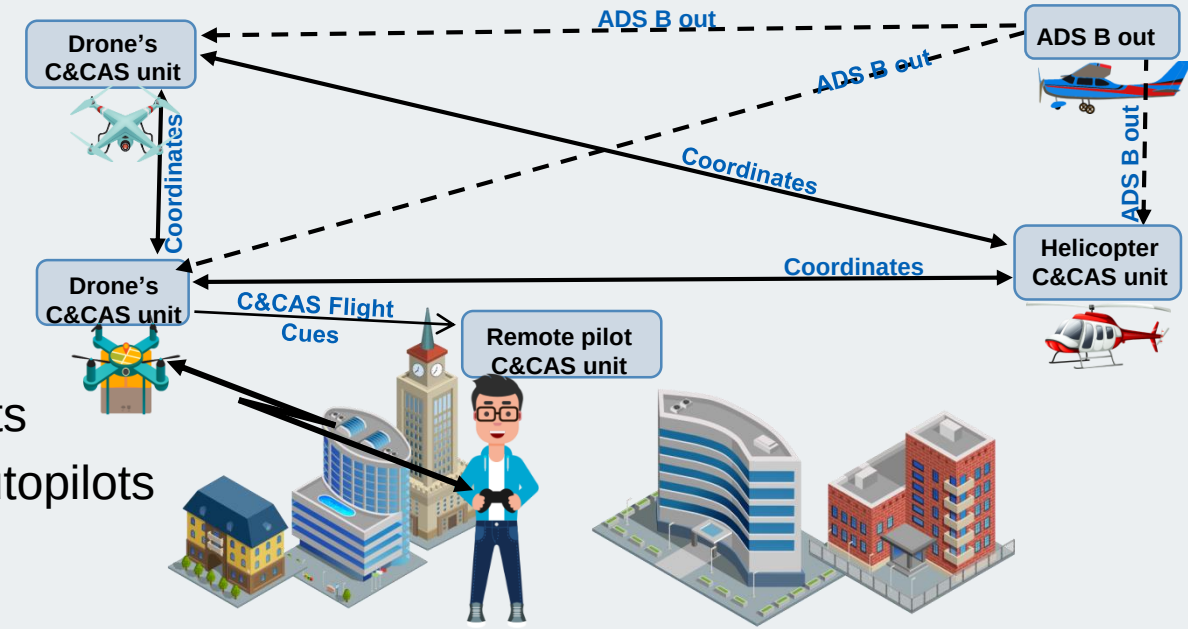
Ciconia decentralized C&CAS:

- Monitors constantly at the vehicle level:
  - DbP (Distance between Platforms)
  - TtC (Time to Collision)
  - RoC (Rate of Closure)
  - Traffic density
- Informs operators of potential separation violation
- Displays steering commands to pilots; onboard & remote
- Takes control over autopilot to avoid separation violation

Enforcement of separation limits

Ciconia's decentralized C&CAS (Control & Collision Avoidance)

- A V2V network (remote ID?)
- ADS-B In data



C&CAS introduces:

- Flight cues to human pilots
- Steering commands to autopilots

Conclusion

- New terminology & limits required (‘street roof’, ‘traffic density’, etc.)
- As sophisticated as the ATM may be, there will be midair traffic conflicts!
- Decentralized monitoring & enforcement is the only way to ensure safety of flight and efficient use of airspace

Conclusion (Cont.)

Ciconia’s C&CAS has been proven in flight tests

Decentralized C&CAS will allow **more traffic** while keeping highest **safety** standards

Thank you!