Drone Swarms summary

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Artificial Intelligence & Information Analysis Lab

Drone Swarms

- Drone swarm architectures
- Drone2drone communications
- Drone collision avoidance
- Drone migration
- Drone swarm localization and monitoring

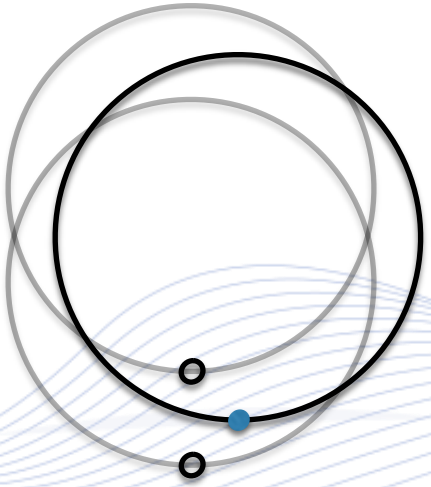
Drone swarms

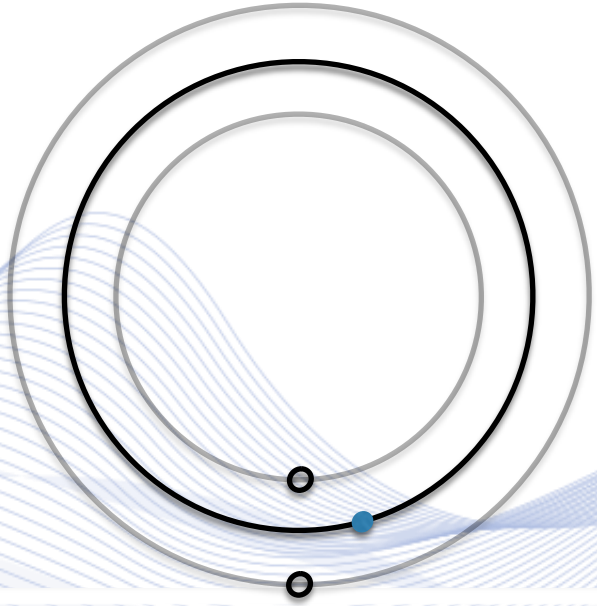
Drone swarm architectures

- All drones are equal in decision making.
- Leader-follower architecture.
- Ad hoc networking:
  - A control center creates the ad-hoc network, discovers the topology and manages the swarm.

Leader-following for drone formation control

- Main idea:
  Trailer-like behavior for the followers.



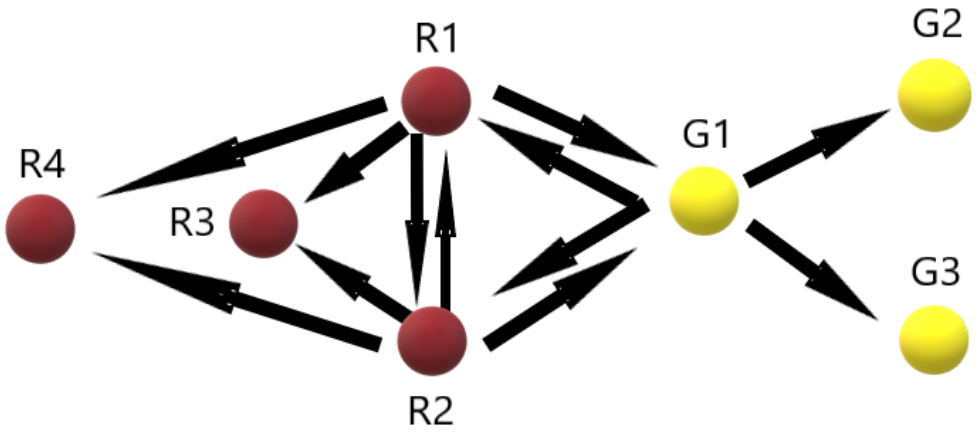


In inertial frame:
Translated identical paths

In trailer frame:
Different paths, no superposition

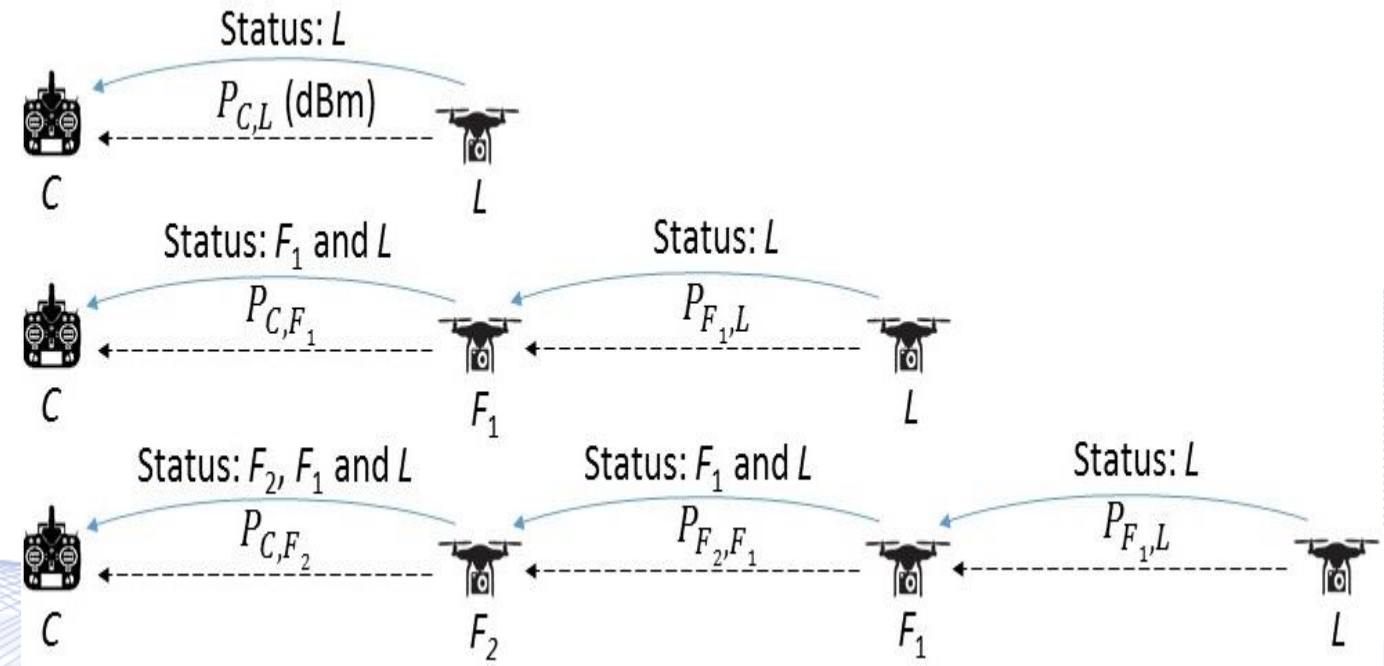
Drone2drone communications

Data dissemination scenario between two drone swarms (“Red”, “Green”).



Drone2drone communications

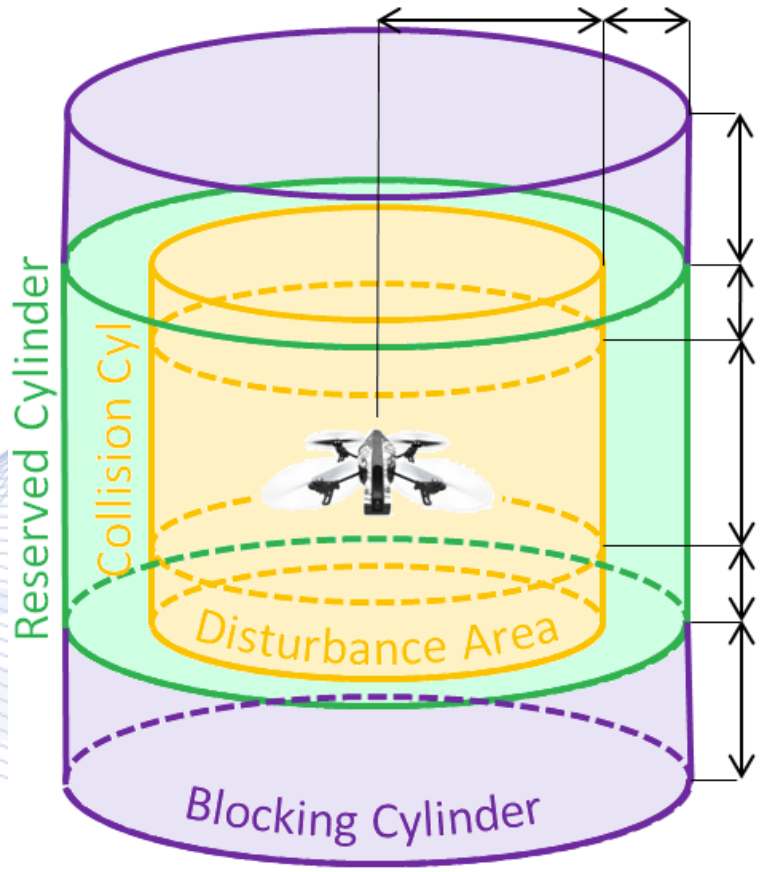
Depending on the leader position,
appropriate followers can take off, spreading the leader's message.



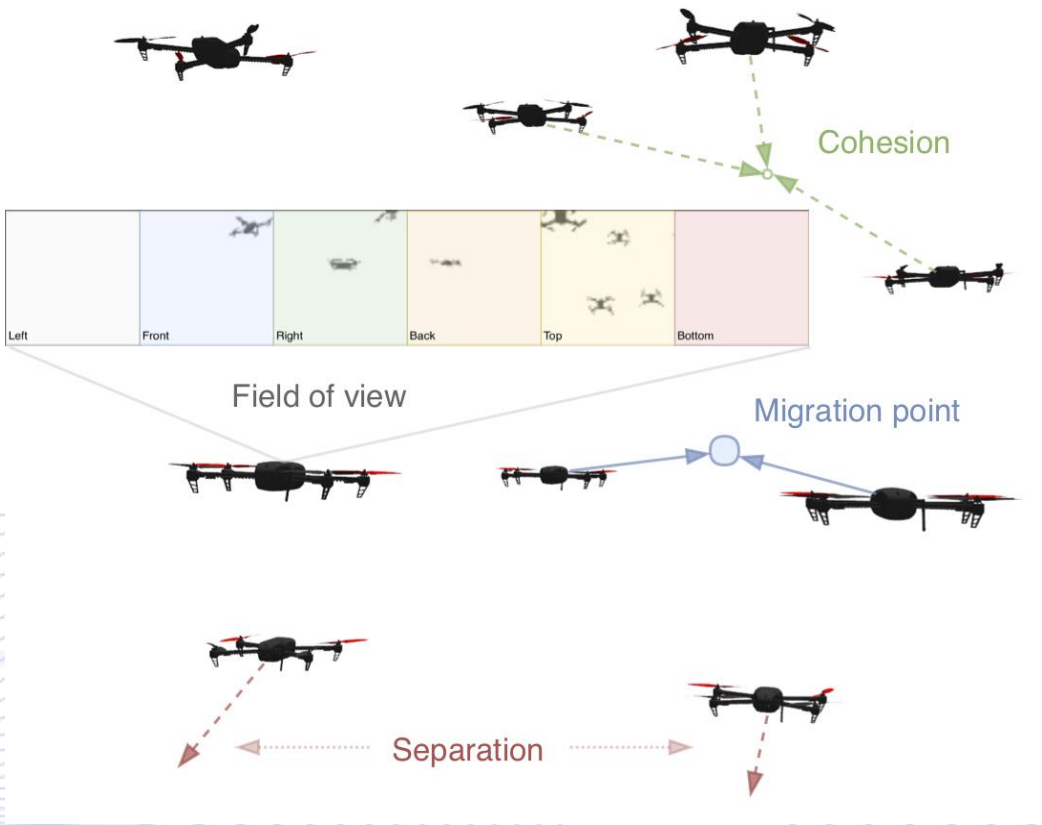
Reference: A new approach to realize drone swarm using ad-hoc Network. Omar Shrit, Steven Martin, Khaldoun Al Agha, Guy Pujolle

Drone collision avoidance

- Collision hull defined as a cylinder (yellow).
- Horizontal conflict when reserved cylinder (green) overlaps with others.
- Vertical conflict when blocking cylinder overlaps with others.
- Cylinders allow drones to brake on time and maneuver to avoid collision.



Visual data



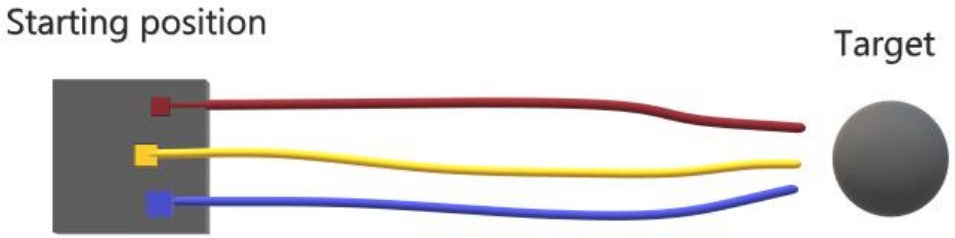
Reference: Learning Vision-based Cohesive Flight in Drone Swarms
Fabian Schilling, Julien Lecoeur, Fabrizio Schiano, and Dario Floreano

Drone migration

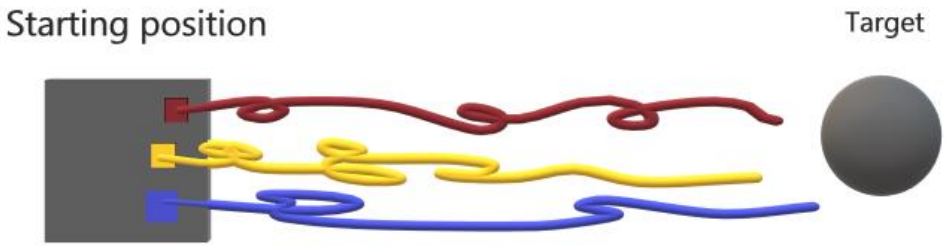
Drone migration information:

- The minimum distance to avoid collision
- The maximum distance helps deciding whether or not a swarm is coherent.

Drone migration goals



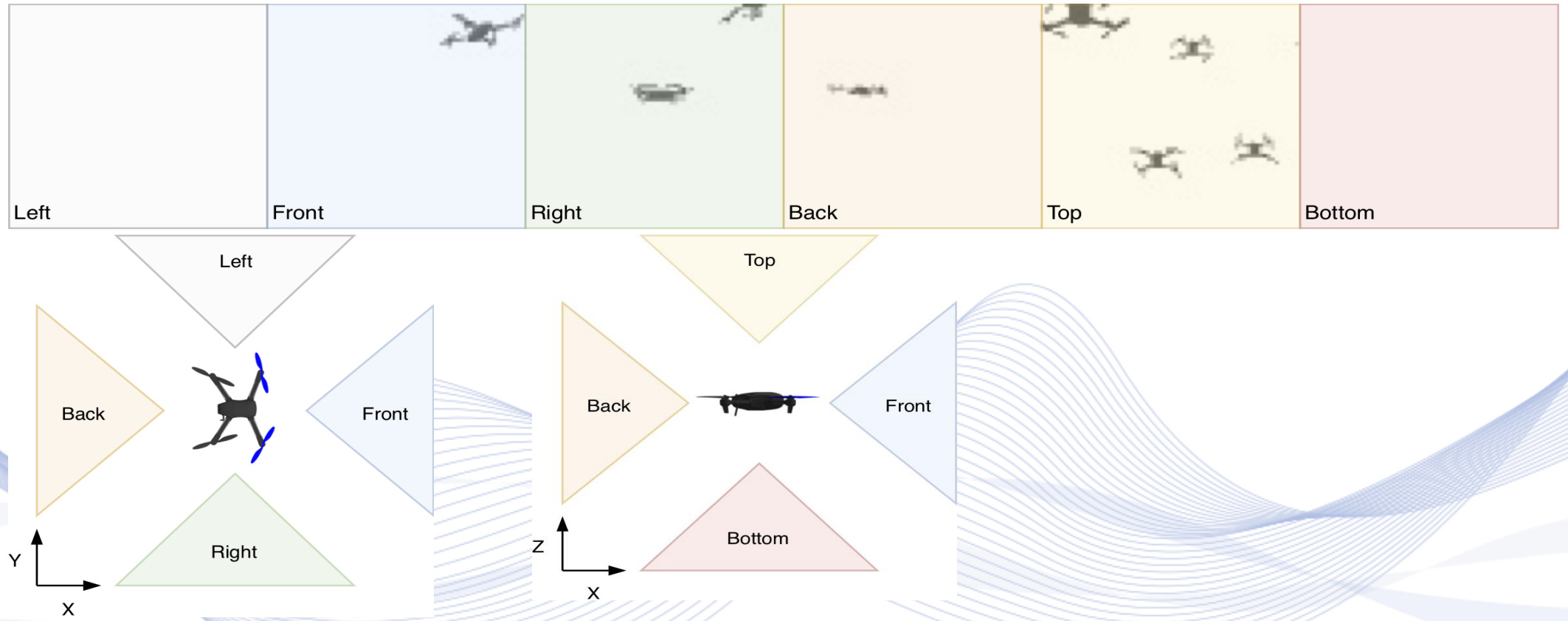
Concentration at a common migration target



Opposite migration targets

Colored squares= drones
Colored lines = paths of drones

Camera configuration and resulting visual drone input



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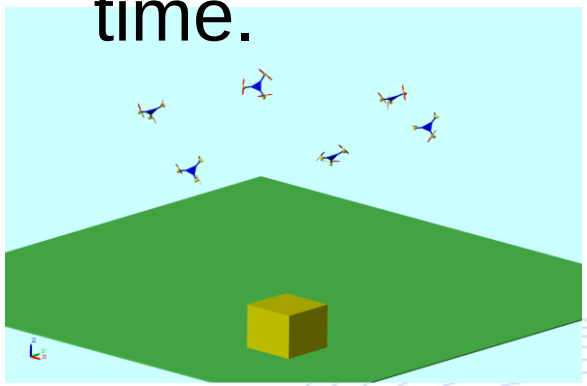
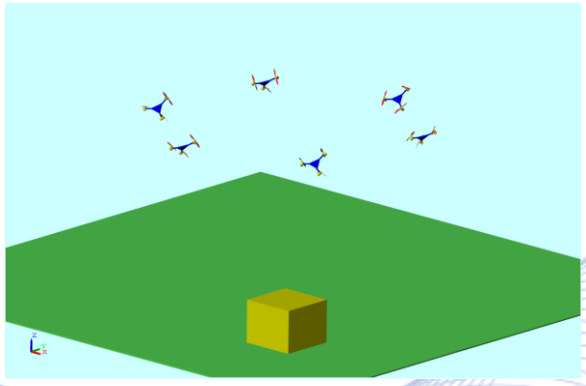
Drone swarm localization and monitoring

- Localization and monitoring of drone swarms flock over time.

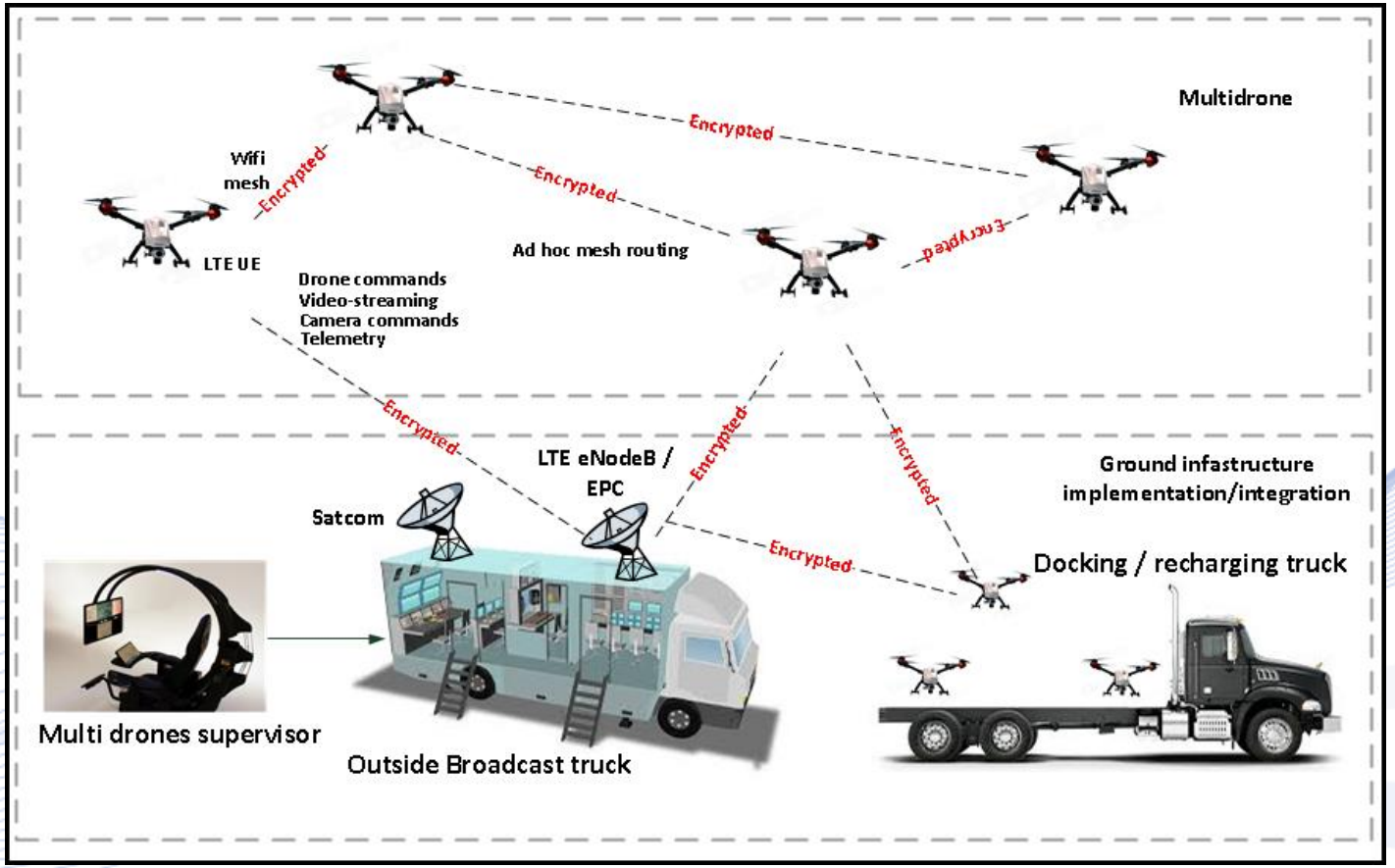




Reference: An Innovative Tri-rotor Drone and Associated Distributed Aerial Drone Swarm Control
Junyan Hu, Alexander Lanzon

Drone Swarm Communication infrastructure

- Drone2Drone Communication.
- Drone2Ground communication.
- Live broadcasting.



Bibliography

- Learning Vision-based Cohesive Flight in Drone Swarms, Fabian Schilling, Julien Lecoeur, Fabrizio Schiano, and Dario Floreano
- A new approach to realize drone swarm using ad-hoc network, Omar Shrit, Steven Martin, Khaldoun Al Agha, Guy Pujolle
- ADDSEN: Adaptive Data Processing and Dissemination for Drone Swarms in Urban Sensing, Di Wu, Member, IEEE, Dmitri I. Arkhipov, Minyoung Kim, Carolyn L. Talcott, Amelia C. Regan, Member, IEEE, Julie A. McCann, Member, IEEE, and Nalini Venkatasubramanian, Senior Member, IEEE
- An Innovative Tri-rotor Drone and Associated Distributed Aerial Drone Swarm Control Junyan Hu, Alexander Lanzon
- Swarm intelligence: from natural to artificial systems, Marco Dorigo

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Q & A

Thank you very much for your attention!

More material in
http://icarus.csd.auth.gr/cvml-web-lecture-series/

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