

Internet of Things

Research & Standardization

ILNAS Breakfast

“Digital Trust in Internet of Things”

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What is a UAV?

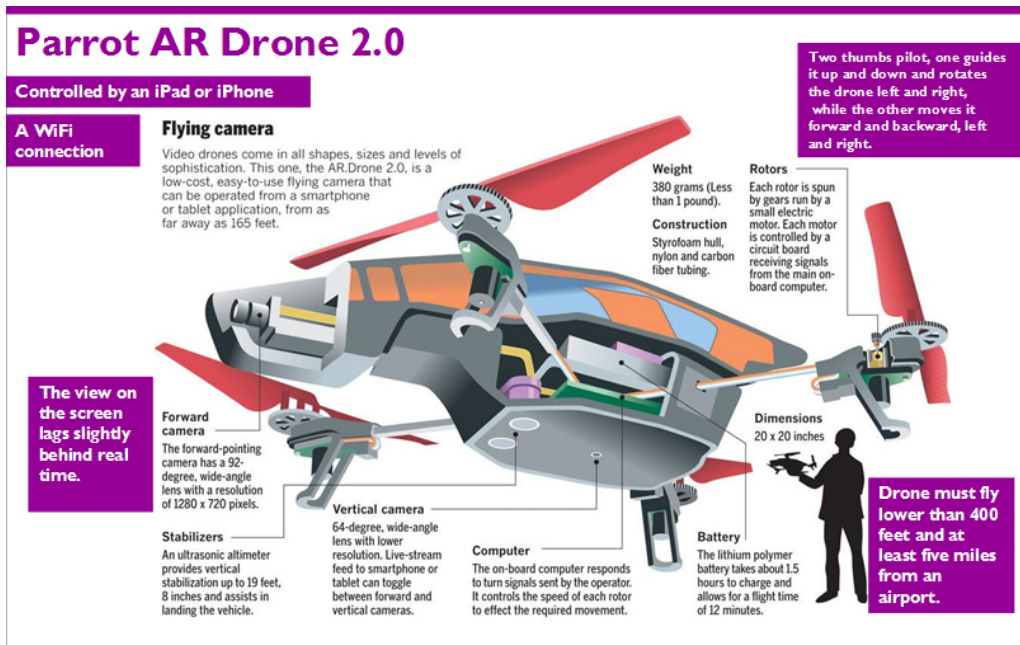
- **Unmanned Aerial Vehicle**
 - Also referred to as drone or unmanned aircraft system (UAS)
 - Aircraft with no pilot on board
- **Control**
 - Remotely by an operator
 - Autonomous
- **Different types of UAVs**
 - Fixed-wing UAV
 - Rotary wing UAV



ERMP Warrior



Well-known commercial UAV example

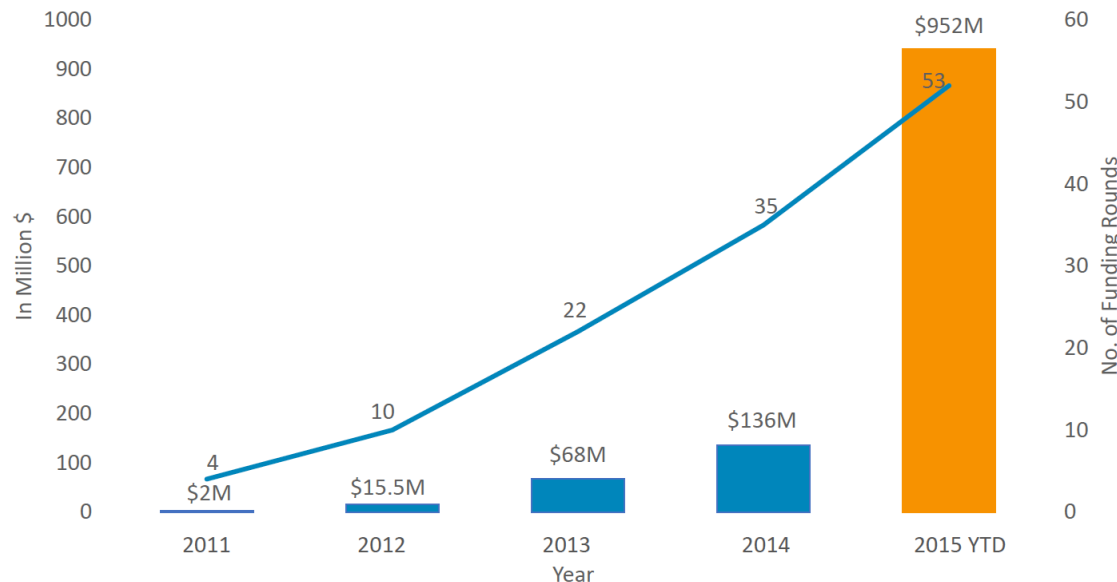


- UAVs are:
 - Connected
 - Mobile
 - Controllable
 - Flexible

UAV Market

- Over 1.1B\$ invested in commercial drones in the last 5 years
 - 80% spent in 2015 alone

Cumulative Funding Growth Year-on-Year (2011-15)



DJI Phantom 4
Source: DJI.com



3DR Solo
Source: 3DR.com

Notable Funding	CyPhy Works \$1.2M	Prioria Robotics \$5.5M 3D Robotics \$5M	3D Robotics \$30M Airware \$12.2M	DJI \$30M Airware \$25M	DJI \$575M 3D Robotics \$64M
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Source: Tracxn

■ Military:

- Border control
- Critical infrastructure surveillance
- War zone combat



Source: WICST

■ Civilian:

- Agriculture
- Search & rescue
- Fire and pollution detection
- Public safety
- Environmental protection



Source: WWF

Civilian applications examples

■ Environmental protection

- Wildlife protection in Nepal (WWF)
- Monitoring Amazonian forest
- Monitoring illegal whaling



Source: he Guardian

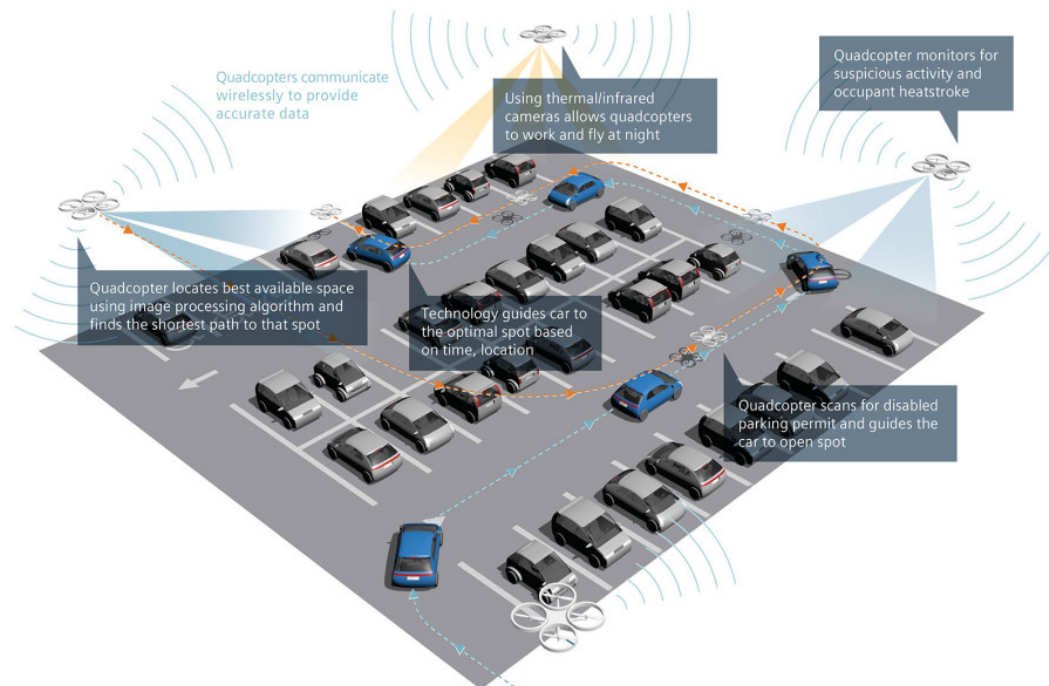
■ Agriculture

- Crop monitoring
- Pesticide spraying



Source: Agriboitix

- **Traffic and crowd management**
 - Vehicular traffic monitoring
 - Crowd monitoring
 - Smart parking



UAVs for Smart Cities (2)

- **Natural disaster control and monitoring**
 - Disaster zones analysis
 - Act as 3G/4G towers when Internet has become unavailable
- **Infrastructure inspection**
 - Ecological footprint monitoring
 - Monitoring of buildings/tunnels/bridges, etc.



■ **Business challenges**

- Ethics and Privacy
- Cost
- Licensing, legislations and normalisation

■ **Technical challenges**

- Increase flight time
- Decrease weather conditions sensitivity
- Development of fail-safe systems
- Development of sense and avoid mechanisms



- **ISO/ TC 20/ SC 16 – Unmanned aircraft system**
 - Created June 2015
 - WG1: General requirements for UAS for civil and commercial applications
 - WG2: Product manufacturing and maintenance
 - WG3: Operations and procedures
 - 13 participating countries and 5 observers (incl. Luxembourg)
 - 4 standards under development

- **ISO/IEC JTC1/ SC 17 - Cards and personal identification**
 - Drone Identify Module and Drone License (proposal status)

- **Committee F38 on Unmanned Aircraft Systems**

- Scope: development of standards and guidance materials for unmanned aircraft systems

- **IEEE DWG - Drones Working Group (10/2015)**

- P2025.1 Standard for Consumer Drones: Taxonomy and Definitions
- P2025.2 Standard for Consumer Drones: Privacy and Security



- **Current research: Autonomous UAVs swarms**

- Embedding wireless communication interface
- Form Flying Ad Hoc Networks (FANETs)

- **Existing work limitations**

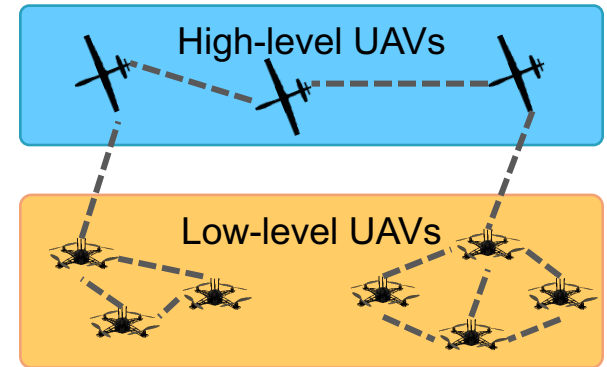
- Limited to homogeneous swarms

- **Objective: (multi-level) heterogeneous swarms**

- Combining low- and high-level UAV swarms

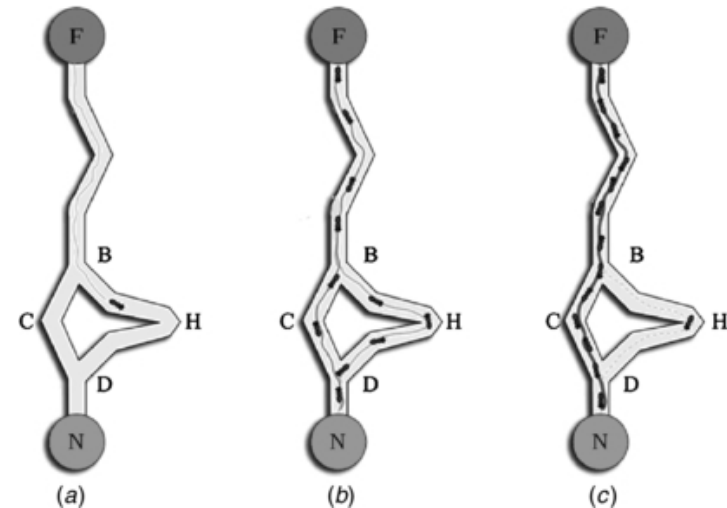
- **Research challenges**

- How to efficiently manage the mobility of (multi-level) UAV swarms for surveillance/tracking?



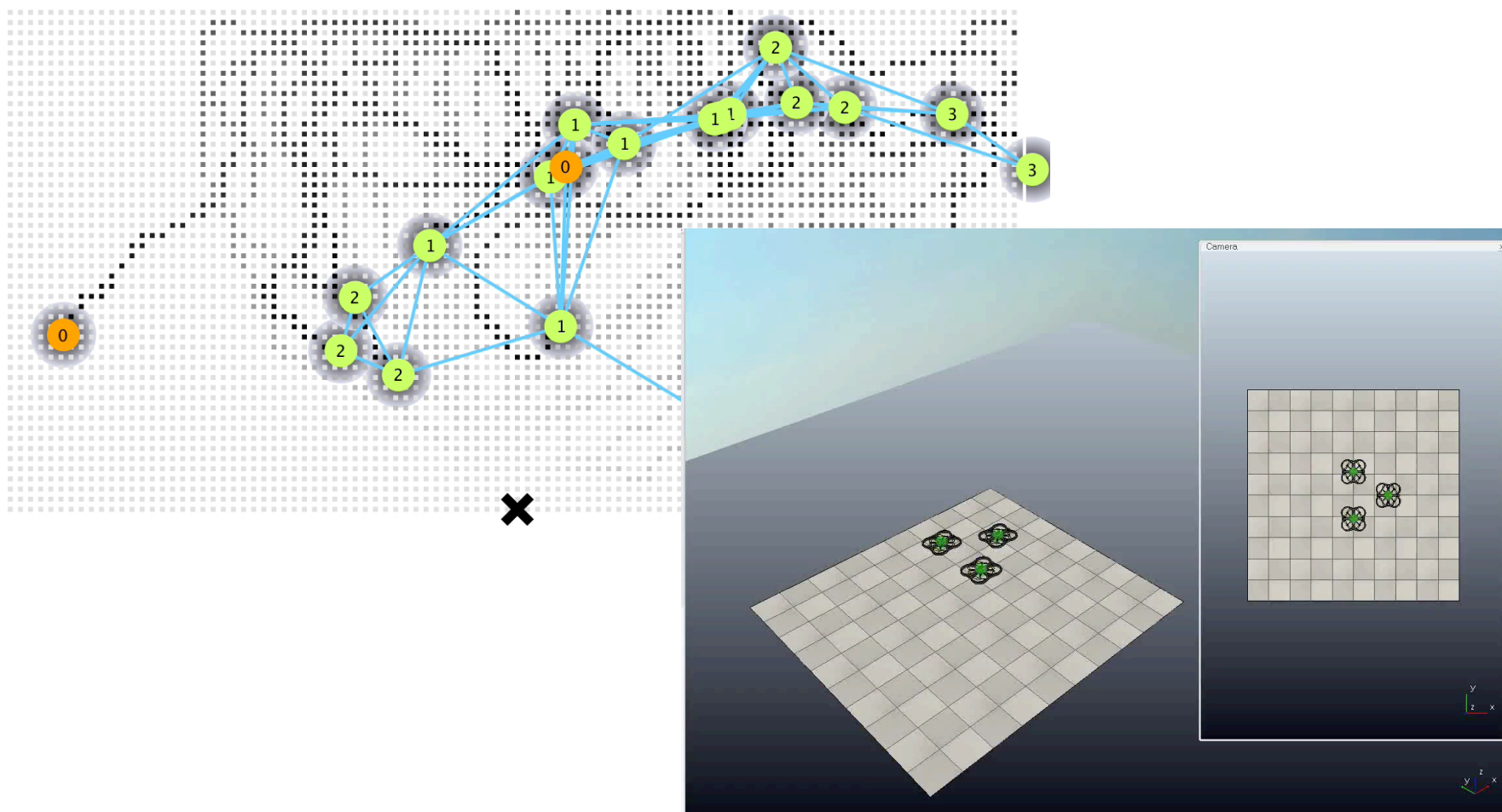
Ant Colony Optimization (ACO)

- **Nature-inspired technique – based on ants**
- **Able to find shortest route from nest to source**
- **Stigmergy: ants are unsophisticated, but collectively they can perform complex tasks**
 - They communicate using pheromones
 - They lay trails of pheromone

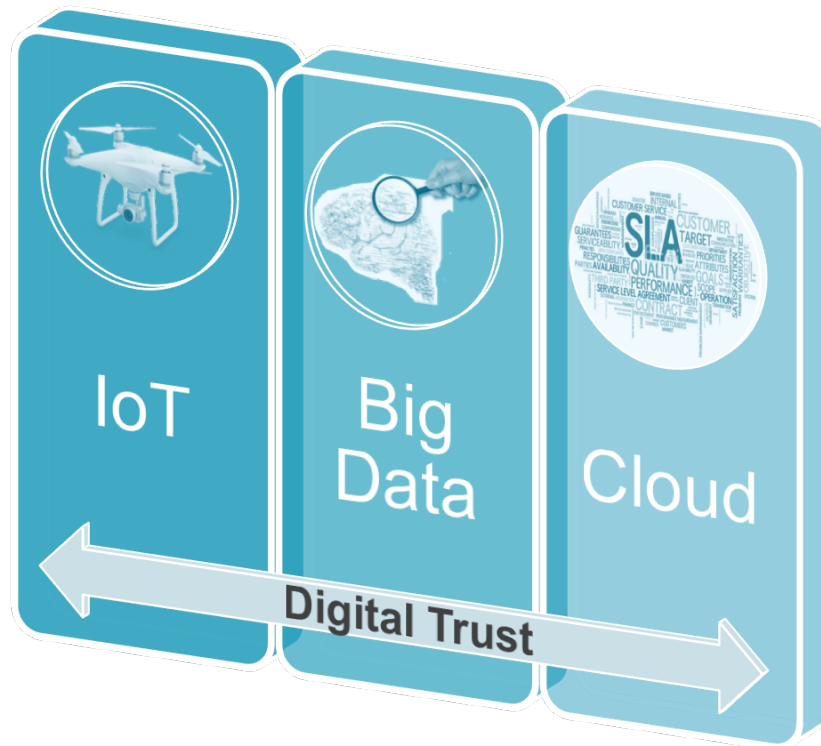


Area Surveillance

Theoretical and realistic simulations



- 4 years research project co-funded by ILNAS - UL/SnT
- 3 PhD students + 1 Postdoc dedicated to the project
- ILNAS/ANEC/UL personnel will also participate



■ UAVs Swarms

- Multi-fleet of multi-rotors and fixed wings UAVs
- Trusted and secure communication protocols
- Optimized mobility models and connection to the ground
- UAVs autonomy and other constraints

Thank you for your attention

Questions?
