

Smart Cities & Research

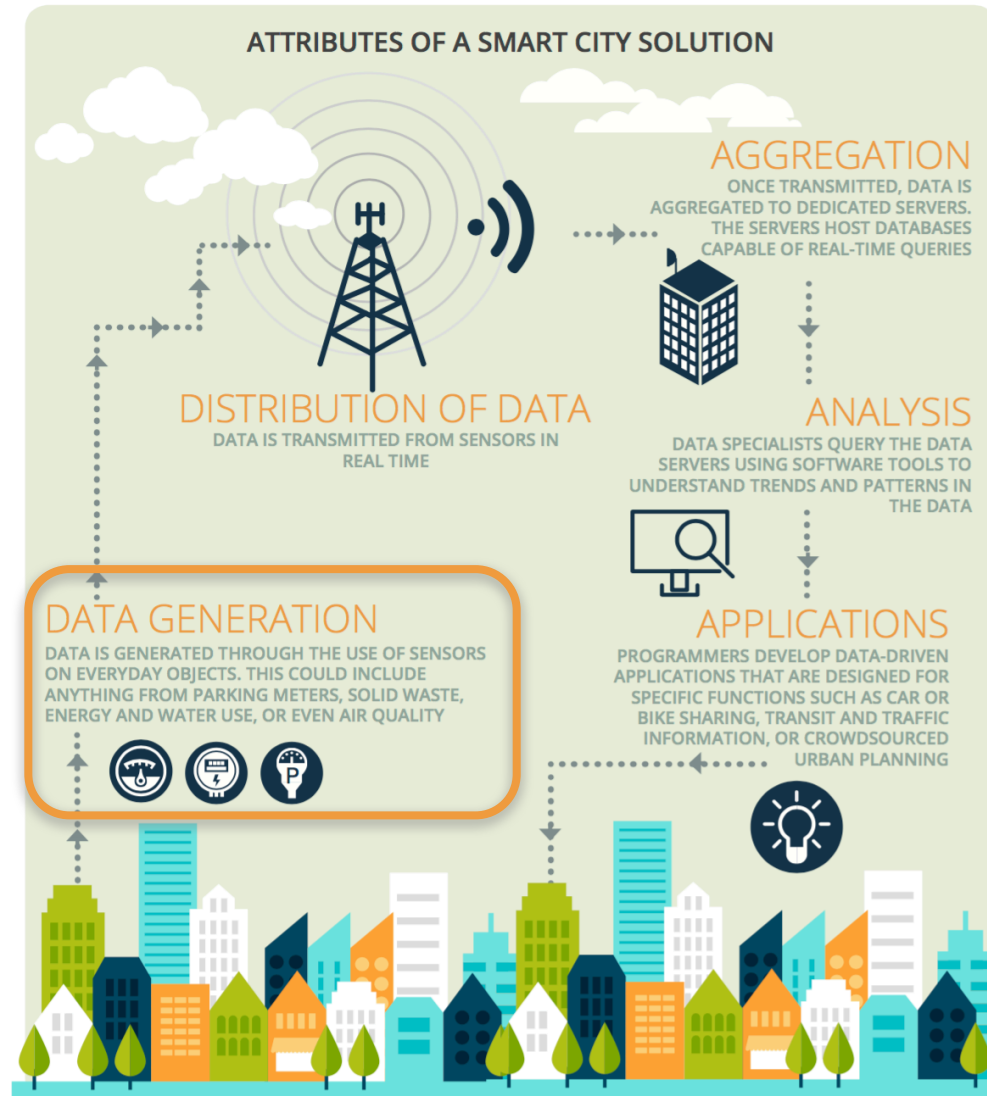
World Standards Day

Dr. Grégoire Danoy

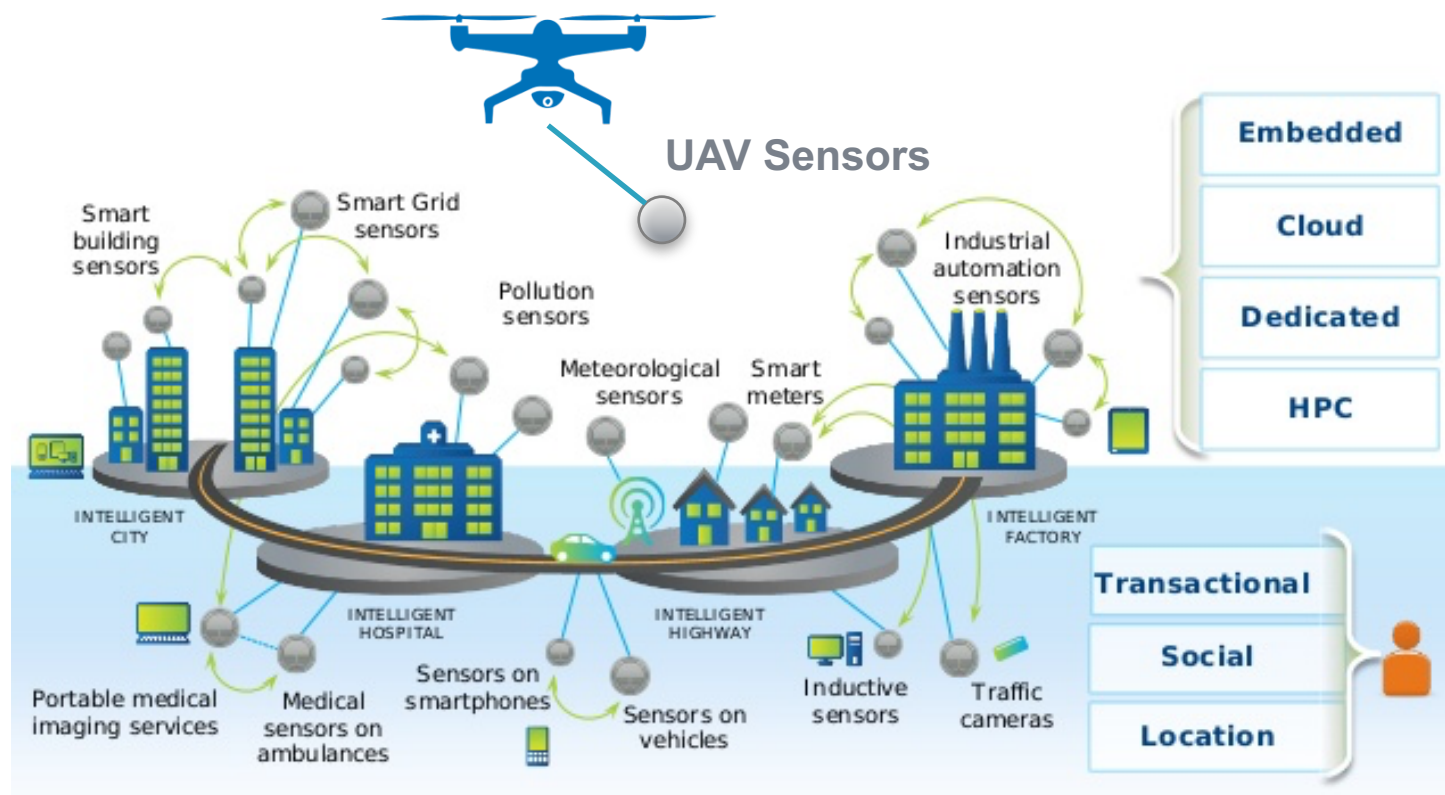
Research Scientist- Parallel Computing and Optimisation Group (PCOG)



Smart City – What?



Smart City Sensors



Source: Intel

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



Source: Purdue University

■ Well-known commercial UAV example

Parrot AR Drone 2.0

Controlled by an iPad or iPhone

A WiFi
connection

Flying camera

Video drones come in all shapes, sizes and levels of sophistication. This one, the AR.Drone 2.0, is a low-cost, easy-to-use flying camera that can be operated from a smartphone or tablet application, from as far away as 165 feet.

The view on the screen lags slightly behind real time.

Forward camera
The forward-pointing camera has a 92-degree, wide-angle lens with a resolution of 1280 x 720 pixels.

Stabilizers
An ultrasonic altimeter provides vertical stabilization up to 19 feet, 8 inches and assists in landing the vehicle.

Vertical camera
64-degree, wide-angle lens with lower resolution. Live-stream feed to smartphone or tablet can toggle between forward and vertical cameras.

Computer
The on-board computer responds to turn signals sent by the operator. It controls the speed of each rotor to effect the required movement.

Weight
380 grams (Less than 1 pound).

Construction
Styrofoam hull, nylon and carbon fiber tubing.

Rotors
Each rotor is spun by gears run by a small electric motor. Each motor is controlled by a circuit board receiving signals from the main on-board computer.

Dimensions
20 x 20 inches

Battery
The lithium polymer battery takes about 1.5 hours to charge and allows for a flight time of 12 minutes.

Two thumbs pilot, one guides it up and down and rotates the drone left and right, while the other moves it forward and backward, left and right.

Drone must fly lower than 400 feet and at least five miles from an airport.

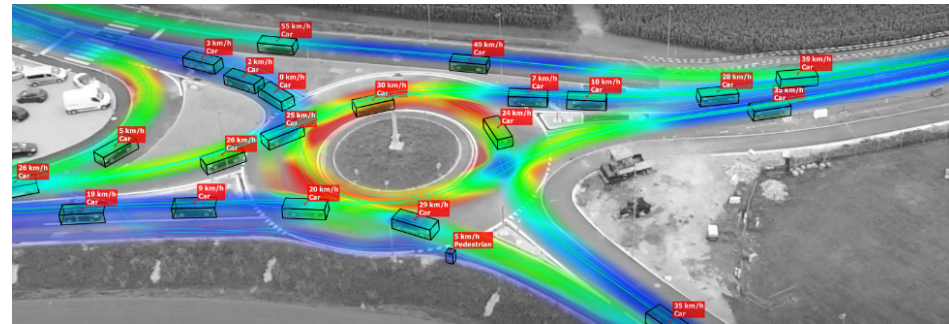
Source: dronesmisc.com

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

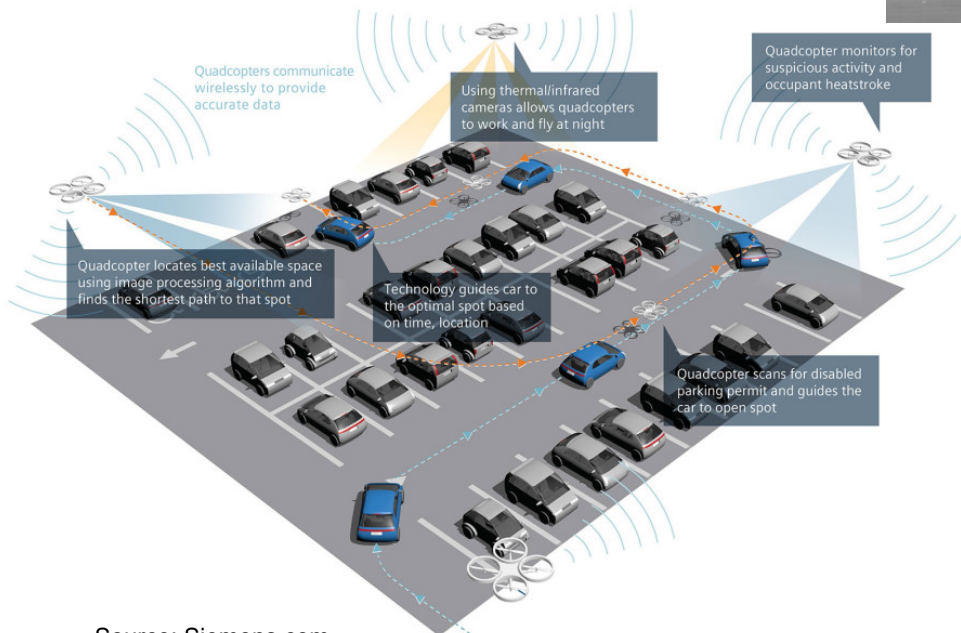
UAVs for Smart Cities (1)

■ Traffic and crowd management

- Vehicular traffic monitoring
- Crowd monitoring
- Smart parking



Source: Datafromsky



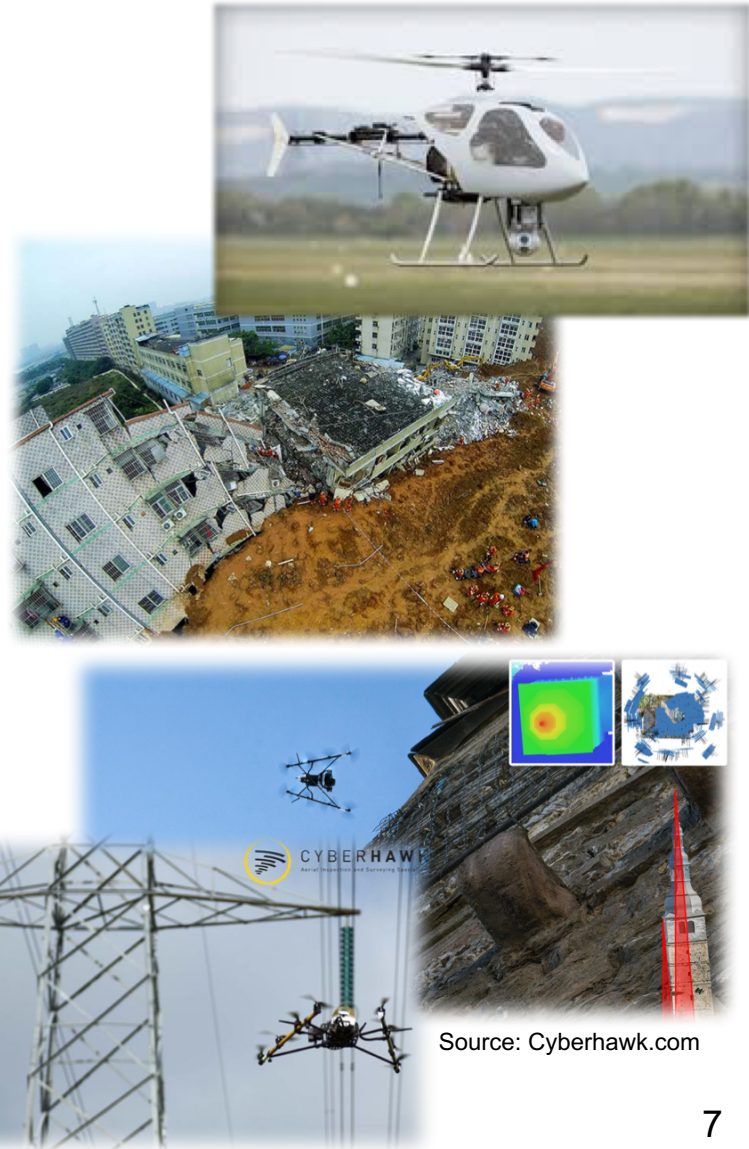
Source: Siemens.com



Source: Telegraph.co.uk

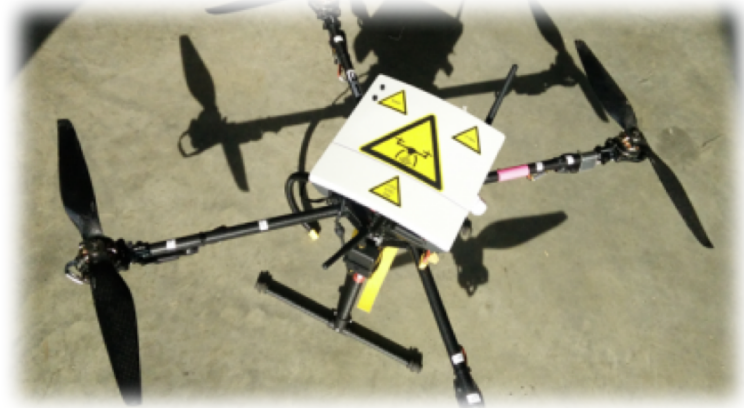
UAVs for Smart Cities (2)

- **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.



Source: Cyberhawk.com

- **Environment monitoring**
 - Air quality monitoring (CO₂, NO_x, radiation levels, etc.)
 - Harmful substances monitoring next to oil/gas facilities



Source: aretasaerial.com

UAVs for Smart Cities (4)

- **Search and Rescue**

- Avalanche survivors search
- Defibrillator



Source: dronehebdo.com

- **Delivery**

- Amazon Prime Air



Source: Amazon.com

Source: sustainableurbandelta.com

■ **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
- 15 participating countries and 4 observers (incl. Luxembourg)
- 4 standards under development

- **ISO/IEC JTC1/ SC 17 - Cards and personal identification**

- Drone Identify Module and Drone License (ISO/IEC AWI 22460)



- **Committee F38 on Unmanned Aircraft Systems**

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



- **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

- **Huge potential of UAVs in smart cities**
- **BUT**
- **Requires standards and regulations to permit to develop this market**

■ Autonomous UAVs swarms

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

■ Research challenges

- New mobility models for autonomous UAV swarms

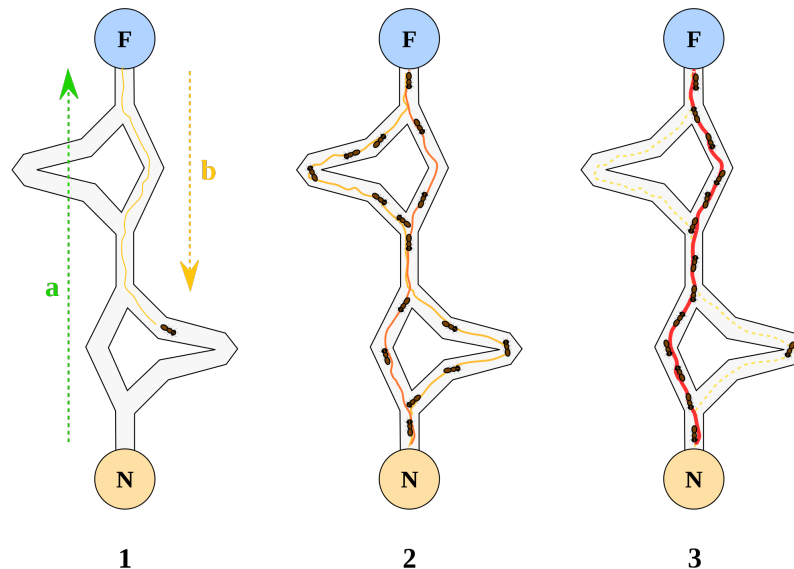


Nature Inspired Techniques



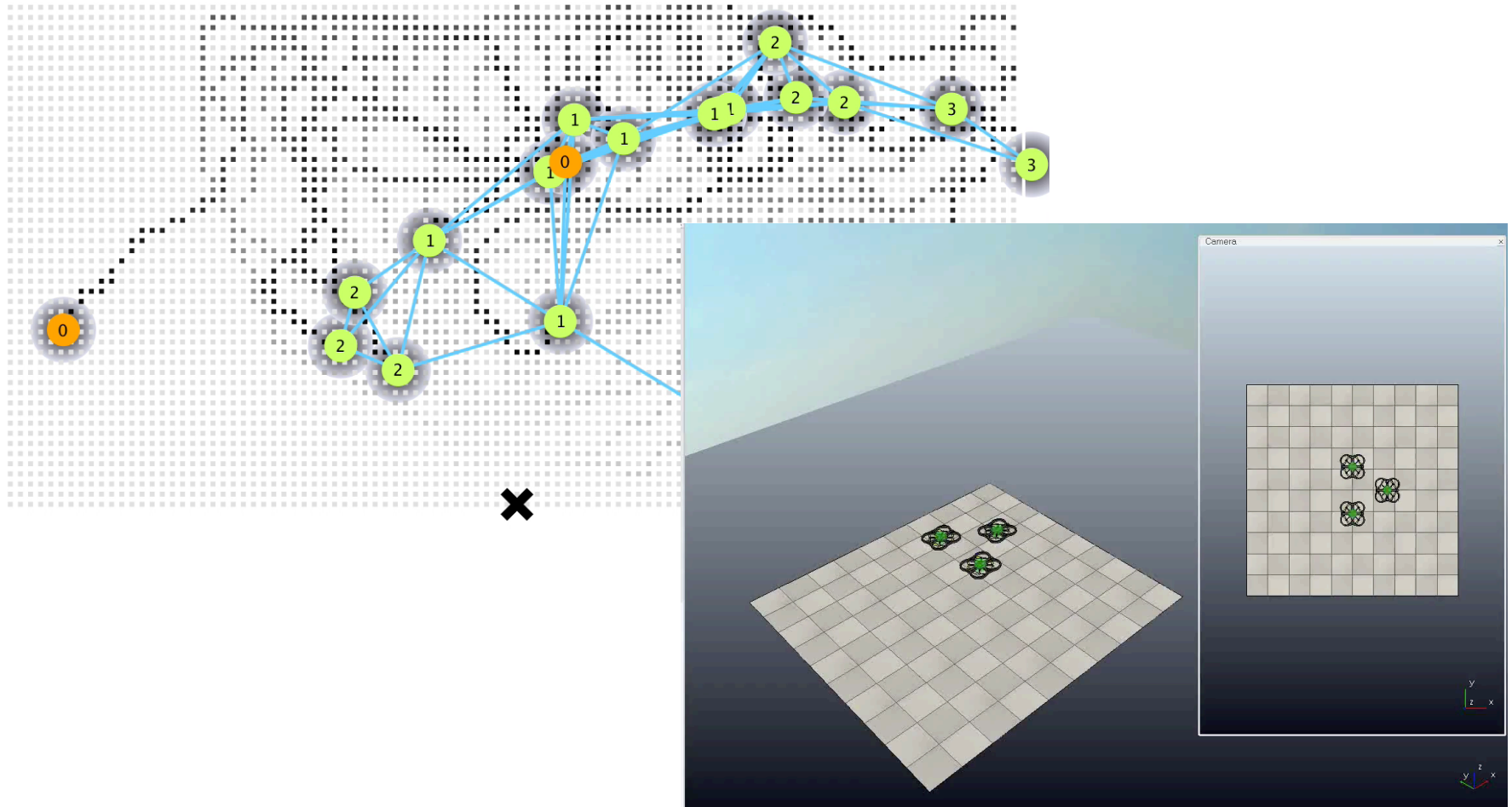
Ant Colony Optimization (ACO)

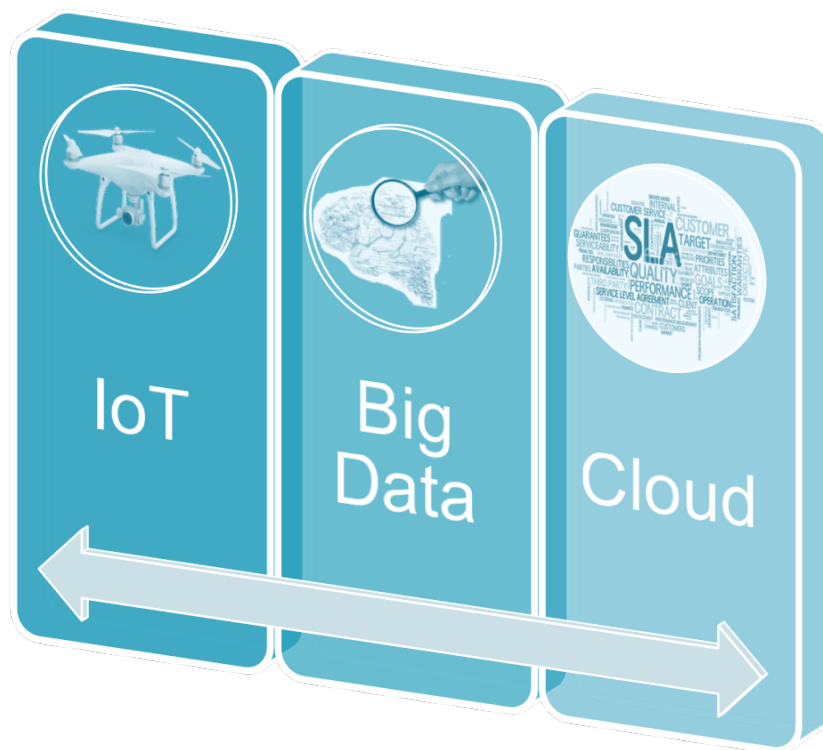
- **Able to find shortest route from nest to source**
- **Stigmergy: ants are unsophisticated, but collectively they can perform complex tasks**
 - They communicate using pheromones



UAV Swarm Mobility Models

Theoretical and realistic simulations





Digital Trust

Thank you for your attention

Questions?

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Dr. Grégoire Danoy
gregoire.danoy@uni.lu
Office 4.45.050
Maison du Nombre
Belval Campus
L-1359 Luxembourg
T. +352 46 66 46 – 5306

<http://pcog.uni.lu>