



Cloud-Native Automated Drone Systems for Grid Inspections

Dr. Yang Wang, CEO of D.Y. Innovations



| About the speaker Dr. Yang Wang, CEO of D. Y. Innovations

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- 2015-present, D. Y. Innovations, founder & CEO, Shenzhen, China
- 2020-present, Industrial Advisor, Zhejiang University, China
- 2011-2015, United Technologies Research Center, Senior Research Engineer/Scientist, Hartford CT, USA
- 2007-2011, Ph.D. & M.S., University of Wisconsin - Madison, Madison WI, USA
- 2003-2007, B.S., Zhejiang University, China
- Used to serve as Vice Chair of IEEE ECCE, as well as Tech Committee Member of IEEE IAS and PELS

About D. Y. Innovations

D. Y. Innovations is a leading provider of automated drone systems in China. Its turnkey solution for grid inspection has been widely adopted by the State Grid and the Southern Grid in China.

| Introduction Drone tech for grid inspections

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**Remote-Piloted
Operations with some
automation**



**Automated
Operations**



**Cloud-Native
Operations**

Introduction Fault analysis

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**Onsite analysis by
human eyes**



**Offsite analysis by
human eyes**



**Cloud-edge AI
analysis**

Outline

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01 Introduction

02 Remote-Piloted Operations

03 Automated Operations

04 Cloud-Native Operations

05 Fault Diagnosis

06 Future



D. Y. Innovations
Extensions of Man

| There used to be zero SOP for drone inspections...

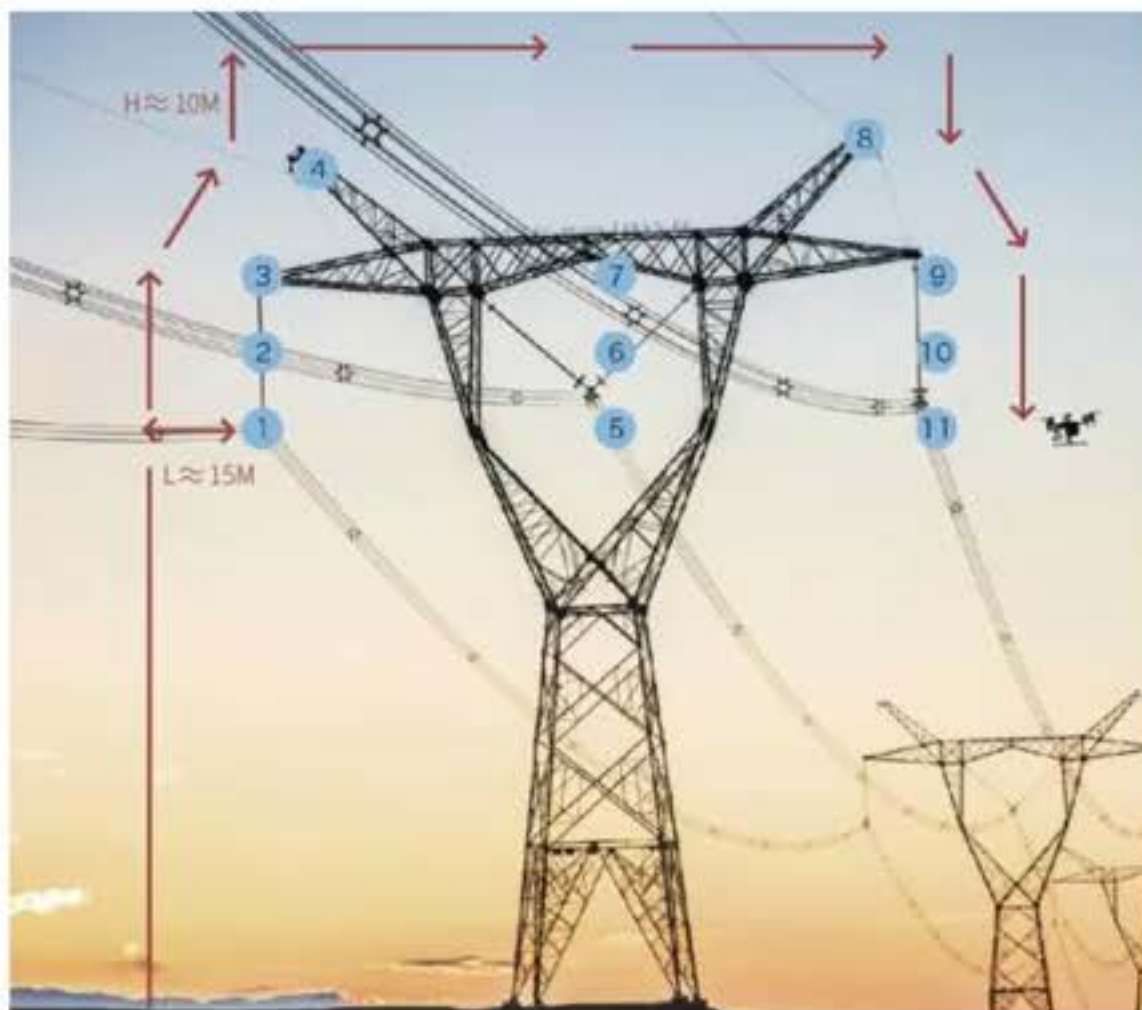
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- To be fair, drones have proven to be of great help. However...
- What should be captured? What are the objects of interest?
- How should they be captured? Distance, angle, FOV, focal length, exposure, sequence, ...
- Which actions are considered safe and which should be prohibited?
- What is considered fault and what is not? Remember, fault analysis used to be done onsite by looking at an iPhone-size screen...
- ...
- The lack of SOP made it impossible to mass-reproduce successful experience throughout the whole country.
- Moreover, due to the lack to SOP, data collected at that time were far from algorithm-friendly...



| SOP is ready, but...

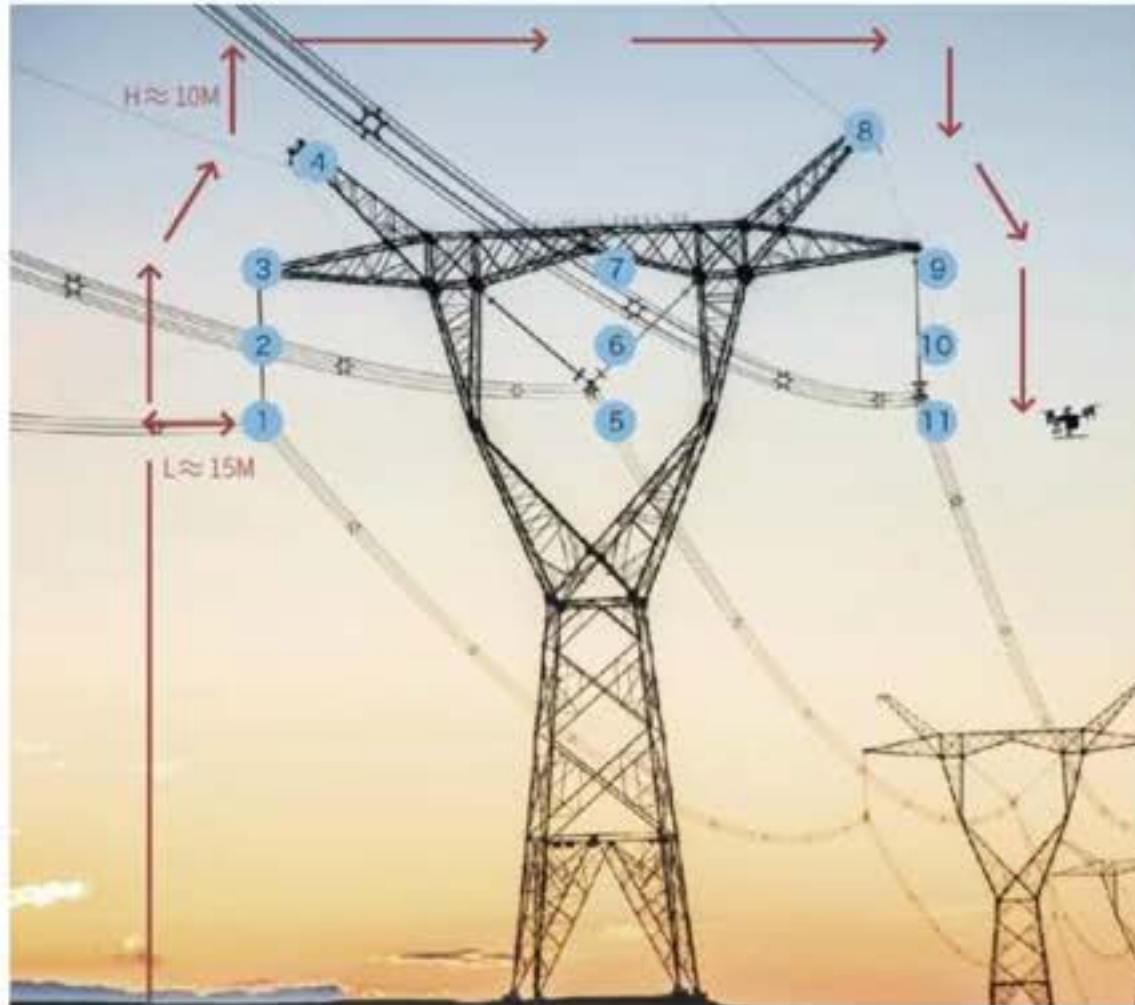
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- SOP is in position! Awesome, let's change the industry!
- Wait... We don't have enough pilots! Let's train more! However...
- First, training is time and money consuming.
- Second, to human pilots, the SOP is not that easy to conduct even after training, e.g. how does one determine the distance between the camera and the object?
- As a result, the improvement in efficiency is limited.
- Please, less training, more automation...

Let's add some automation to it!

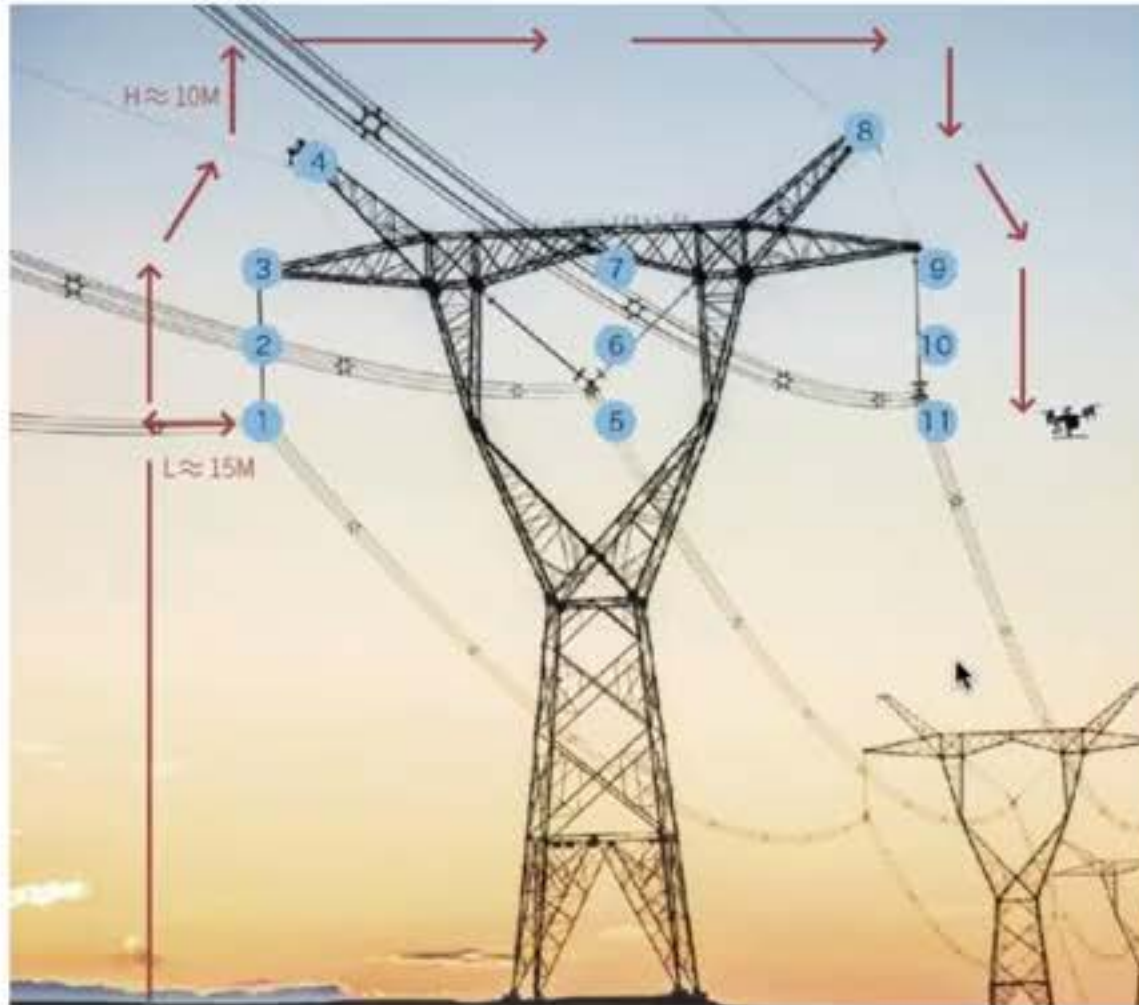
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- The mission is pre-programmed, and the drone runs the mission by itself with the help of RTK positioning system.
- Pilots do three things: (1) deploy and retrieve drones; (2) assist camera focusing; (3) failsafe intervention.
- There are mainly two ways to pre-program the mission: (1) record & replay; (2) reconstruct (with Lidar or camera) & calculate. The first is easier and safer, yet the second will prevail in the long run due to significantly better efficiency.
- D. Y. innovations offers such software package.

Let's add some automation to it!

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| Automated operations Achieving 4x efficiency

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Drone Base (w/ 1 drone)

Fully automated
operation

Cloud-edge
operating system

Auto battery-
swapping

Industrial grade
protections



Drone Carrier (w/ 4 drones)

Multi-drone
coordination

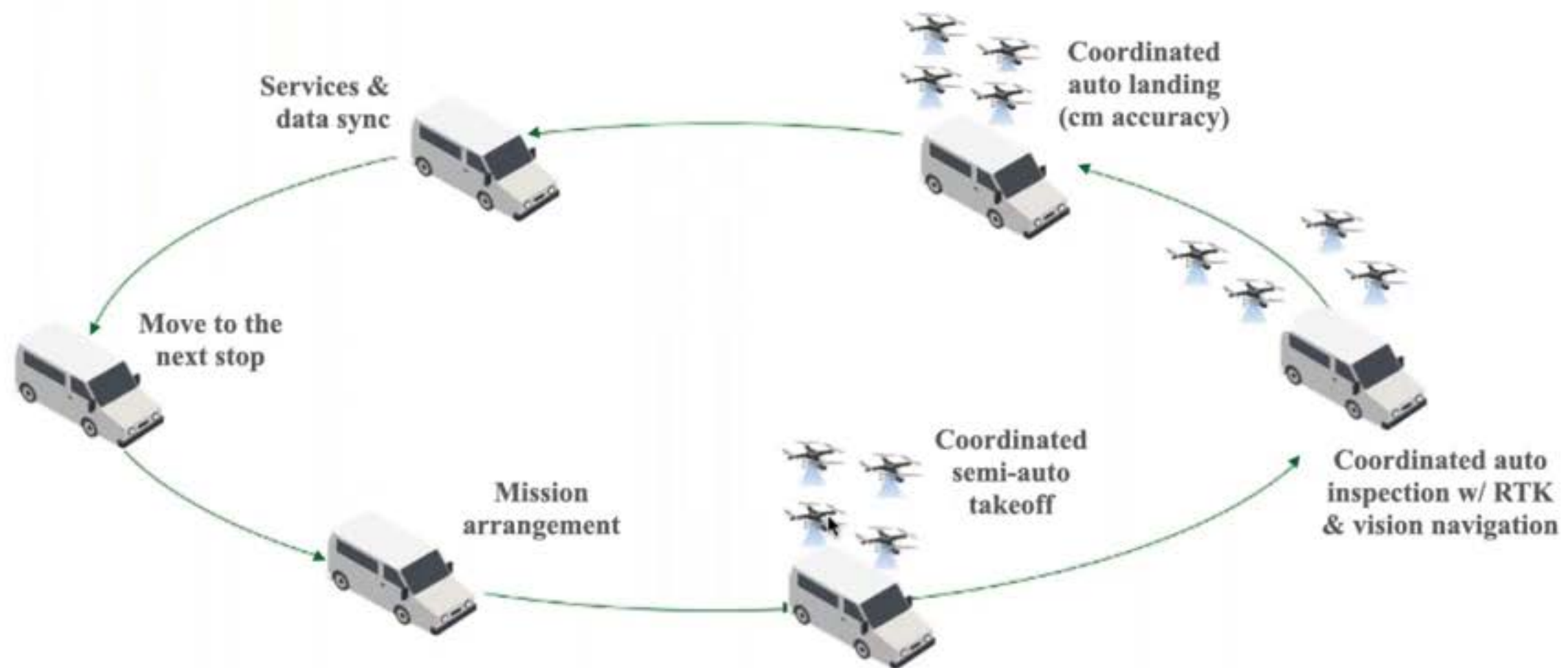
Cloud-edge
operating system

Onsite-offsite
coordination

Energy storage &
supply

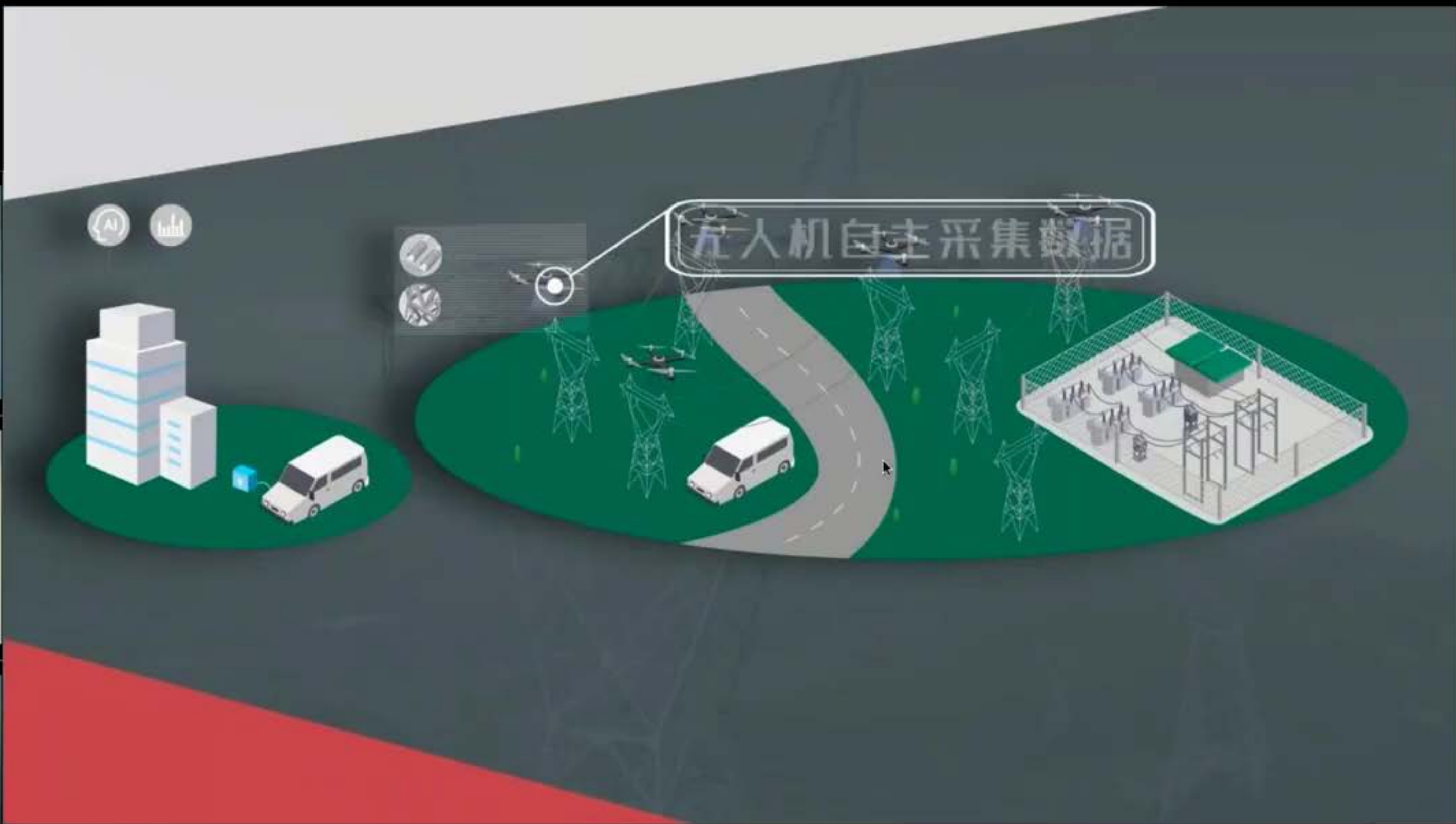
| How do they work Drone carrier

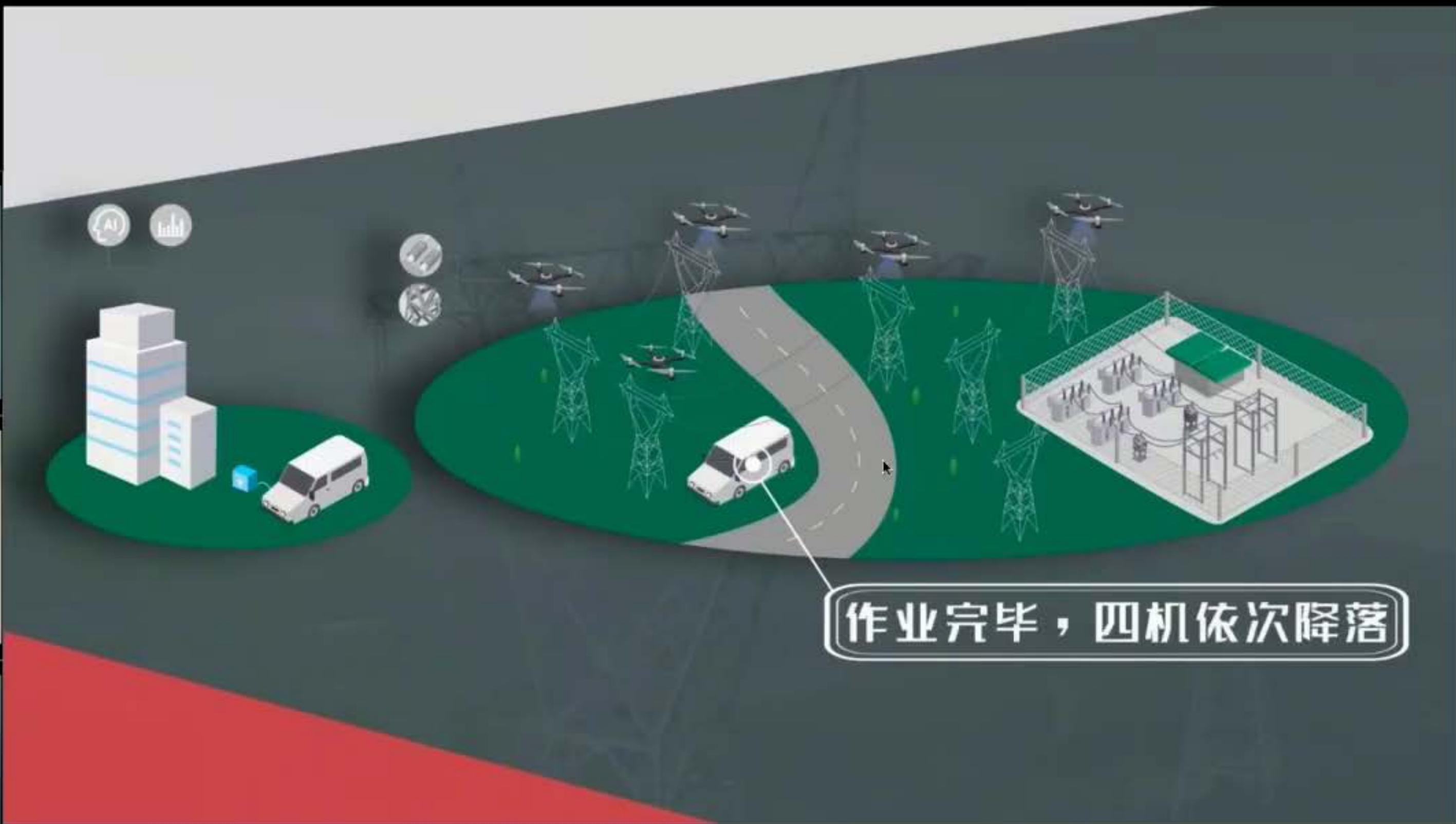
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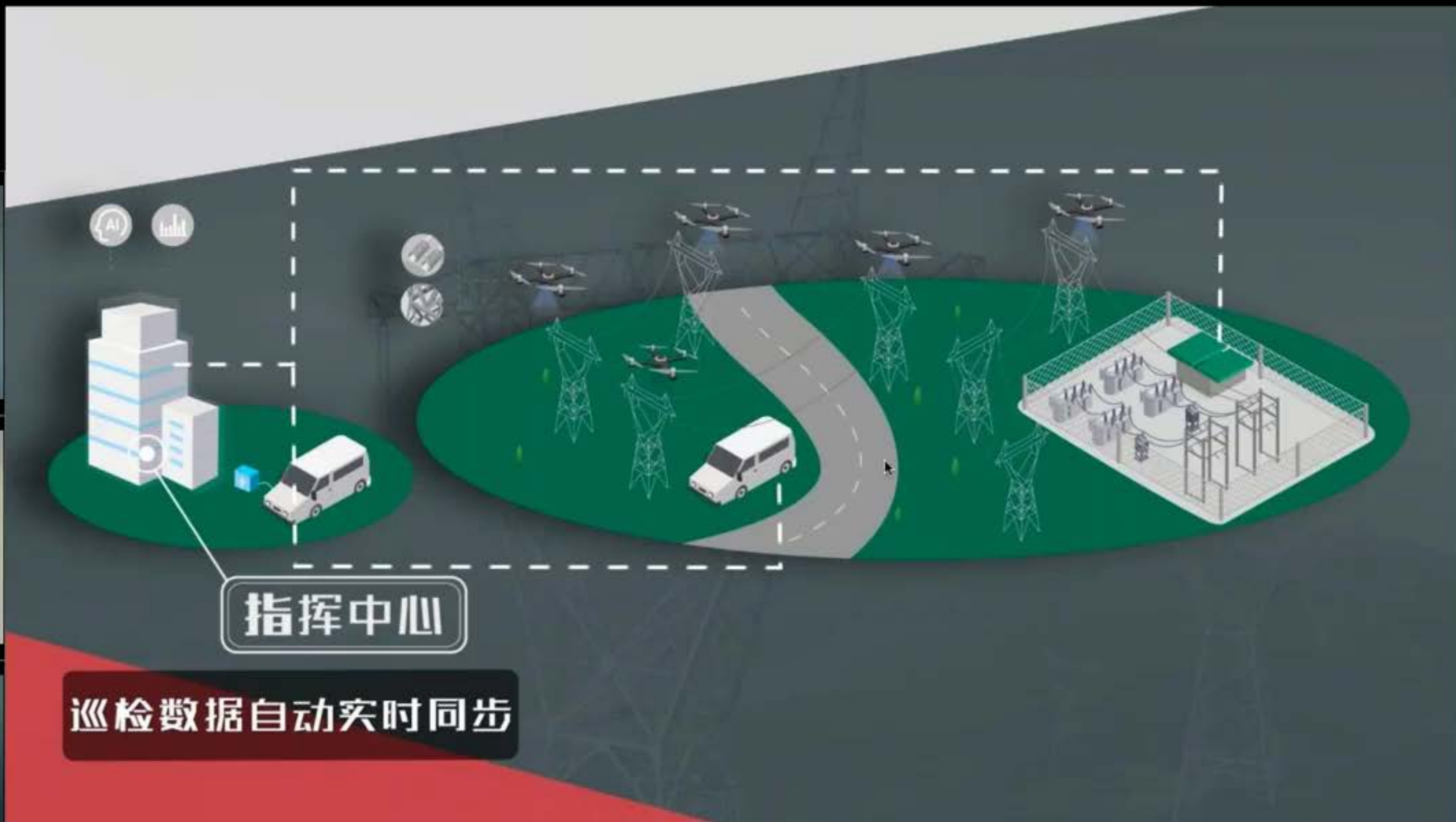


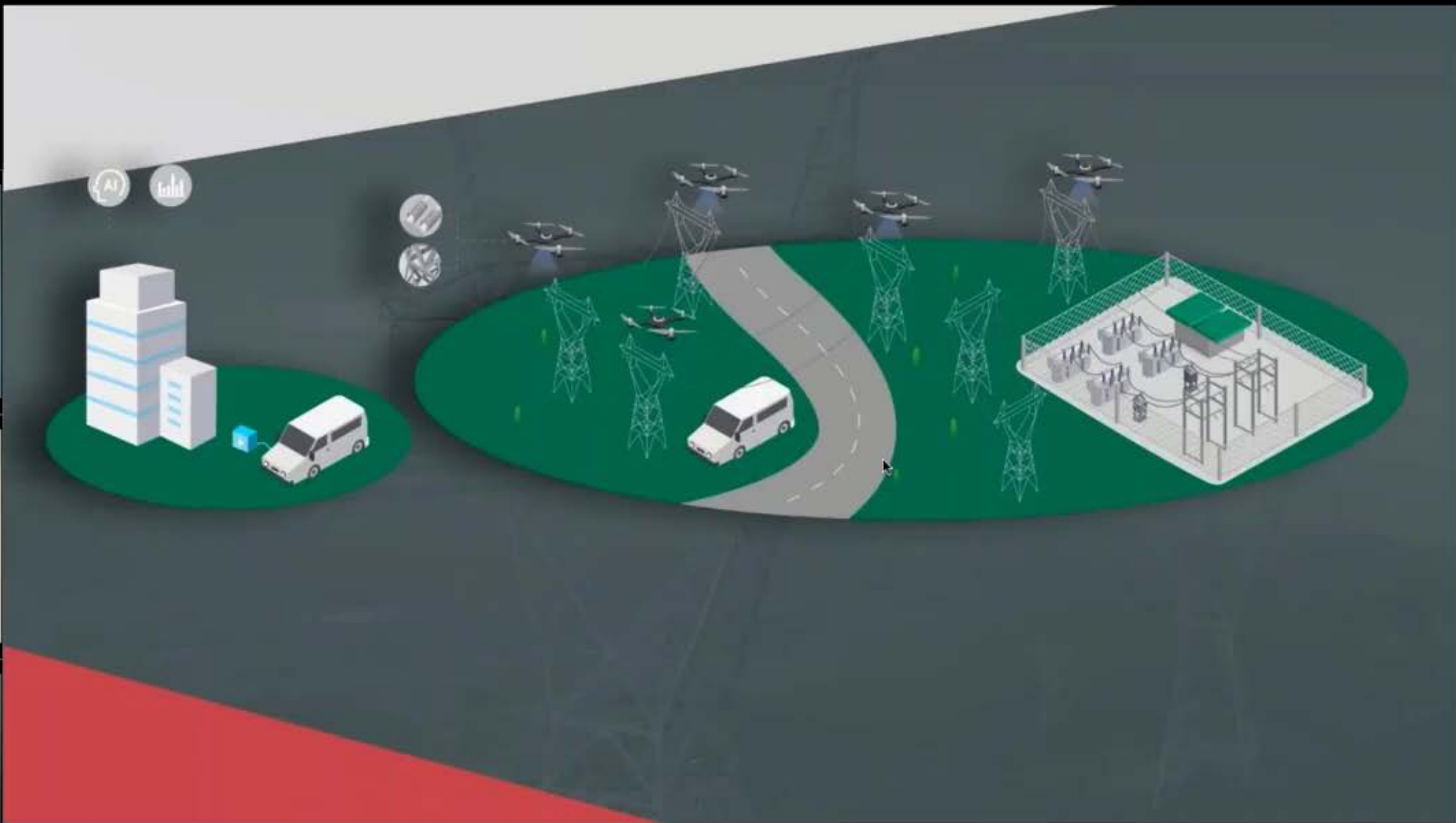


四机依次起飞
协同高效巡检









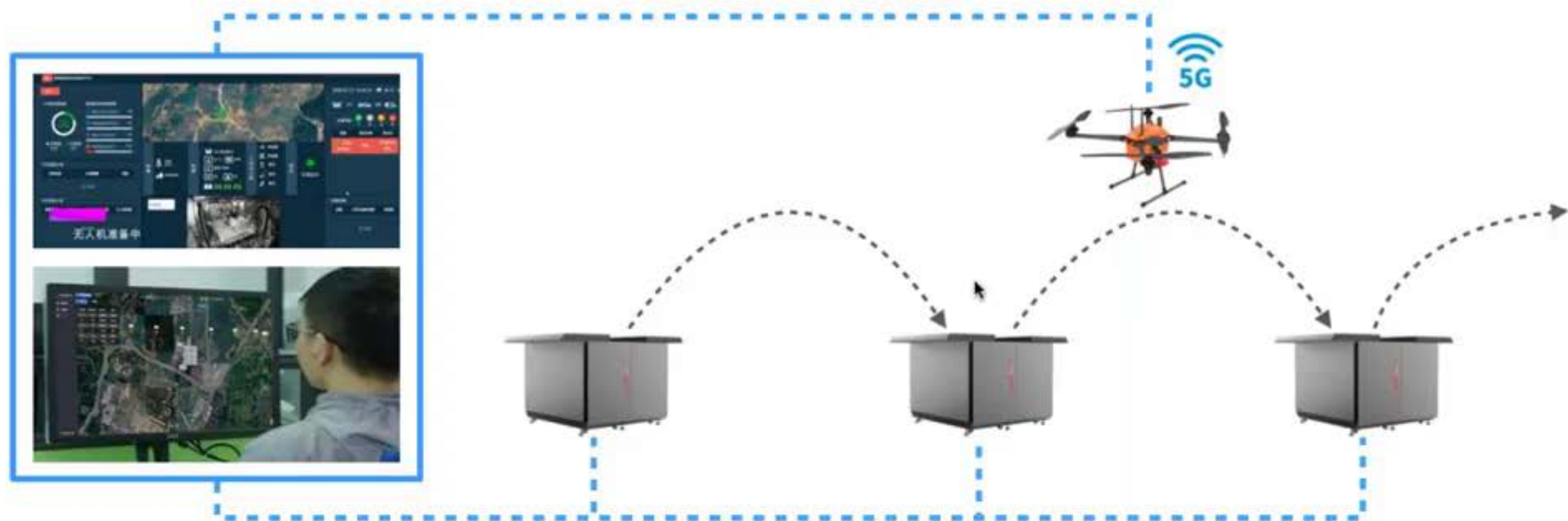
| Automated operation is awesome, but...

- With the help of drone bases and carriers, ~4x efficiency is achieved! And the drone base is totally unmanned, which is more desirable!
- Yet, we came across some obvious challenges...
 - Failsafe mechanism during automated operations
 - Communication range
 - Flight range
 - Price
 - Maintenance requirements
 - ...
- The “cloud-native” concept unveils itself quite naturally.



Gentlemen, this is absolutely what we desire!

Cloud-native drones



Hopping from base to base

| Cloud-native grid inspection

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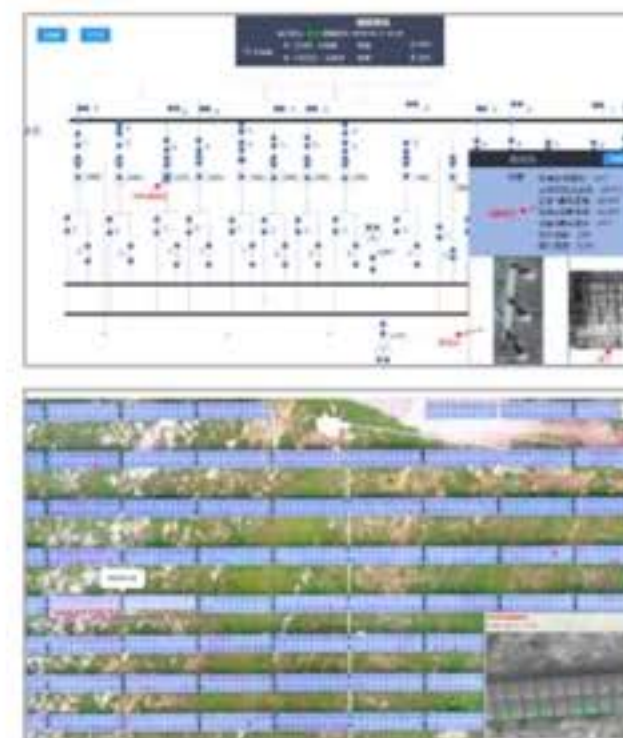
Cloud-native automated
drone systems



Cloud operating
system



Application software
package



Cloud operating system

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DY-OSS data storage


API available


Dispatching & monitoring


Airspace management


Remote intervention


OTA


Lifecycle management


Video streaming

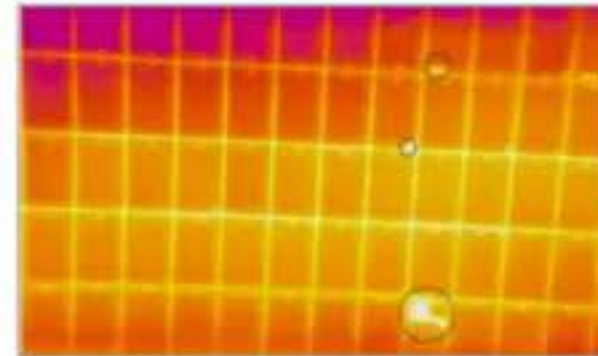
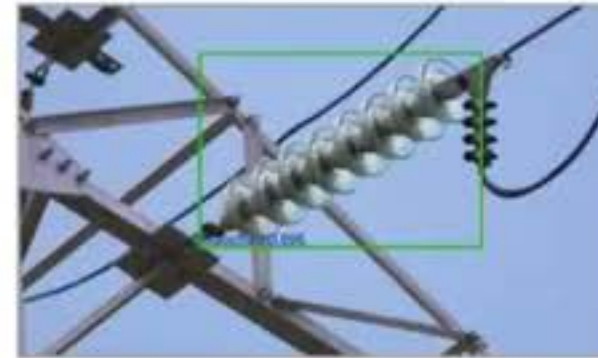
Application software package

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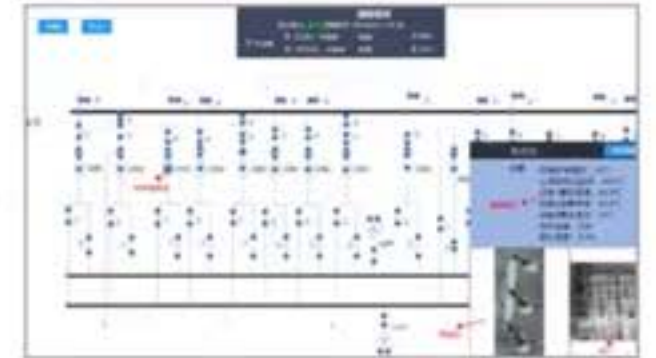
Autonomous data collection



AI-assisted data processing



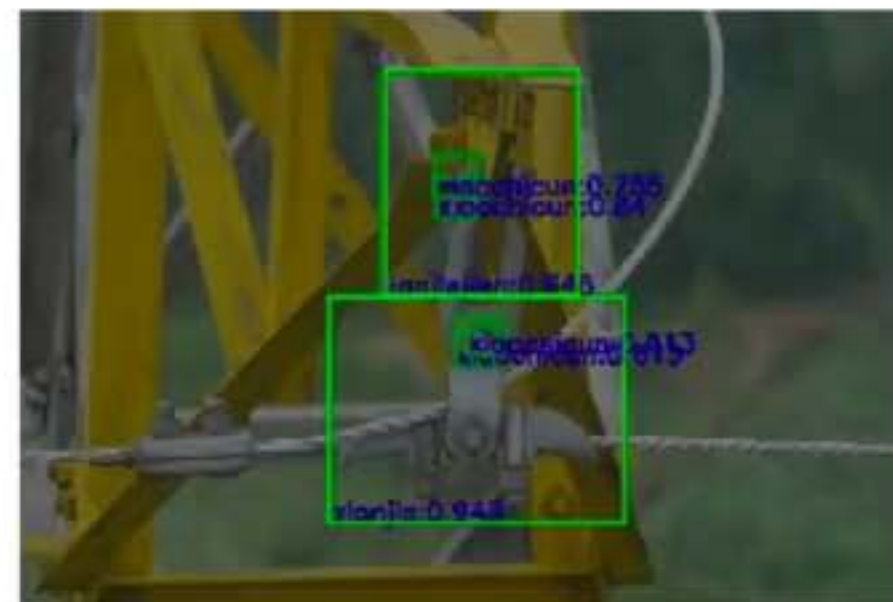
Visualization and API



| Can we have some magical help from AI please...

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- The industry started off with the hope of a full AI solution for fault analysis, only to realize pretty soon that there was a LONG way to go...
- Why?
 - Too few effective data
 - Too many kinds of faults
 - Too small objects
 - ...





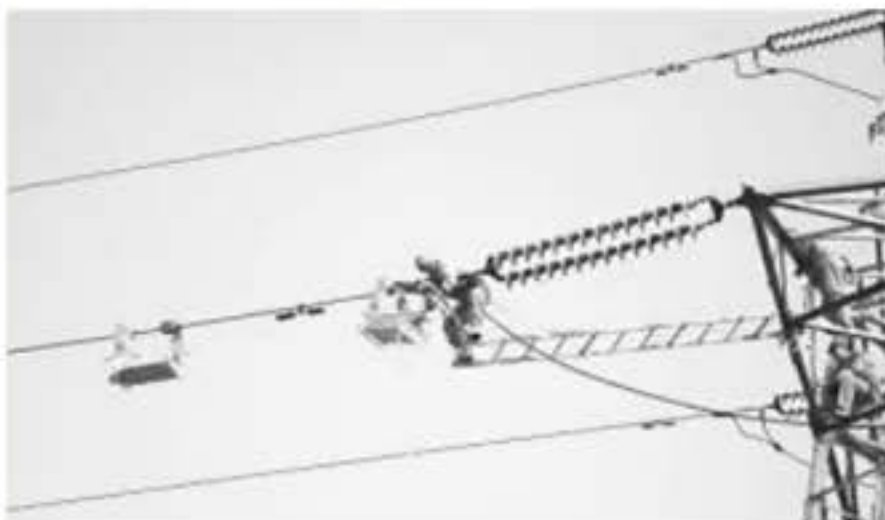
| What's the alternative? Is it going to work?

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- The industry soon started implementing an alternative approach: use AI to screen out the normal pictures, leaving the “could-be-fault” pictures to human diagnosis.
- It saves significant human labor!
- Still, it is quite challenging...
 - Too few data
 - Too many kinds of faults
 - Too small objects
 - ...

Competing/Complementary technologies will continue to exist

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Robots

- Good in battery life (compared to drones)
- Suitable for no-flight zones
- Poor in reliability and maintenance
- Limited sight



Cameras

- Online 24-7
- Affordable
- Very limited sight and imaging quality
- Still requires some maintenance

| And, D. Y. has started working on the next generation

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Previous generation

Off-shelf drone
4G control
Automated flight



Current generation

Customized drone
Cloud-native
Fully automated



Next generation

Autonomous air-
ground joint force



D. Y. Innovations • Extensions of Man



王洋 - 多翼

Q & A

Cloud-Native Automated Drone Systems for Grid Inspections

