

# Eyes in the Sky

## Drones for Smarter Transportation Operations

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# Agenda

- The Vision
- The Journey: Research & Findings
- Concept to Application
- Bringing it to Life: Operational Use Cases
- Global Progress vs. U.S. Reality
- Next Steps
- PDH Questions
- Questions

# The Vision

# The Vision - 2020

You can see a lot more from here...



Source: A.Delbene

What if, with the push of a button, you could instantly see what's happening beyond the limits of your CCTV network...in real time?

# Legacy System Challenges

## Traditional CCTV Limitations

- Fixed location
- Gaps in Coverage (video, data)
- Blind Spots
- Camera Blockage
- High Capital Costs
- Lack of Coverage in Rural Areas



# The Idea

## The Flying CCTV

- Remote Beyond visual line of sight (BVLOS) untethered drone operations
- Supplement video and data gaps with drones
- Operate drones remotely from the Traffic Management Center (TMC) with the touch of a button
- Integrate with existing system and TMC operations seamlessly
- Enhance TMC operations by providing additional situational awareness from supplemental data
- Launch Drones from roadside mounted enclosures
- Utilize existing infrastructure to minimize cost and environmental impact



# The Journey: Research & Findings

# Research

## Feasibility of Drones for Traffic Management

### Preliminary Research (Internal to Arup)

- FAA Rules/Regulations/Exemptions for BVLOS
- Market Assessment
- Existing Drone Technology (hardware/software)
- Communications Design Concept
- Drone Enclosure Design Inquiry
- Existing use cases

### Continued Research (WSDOT Drone Research)

- FAA Part 108 Rule (BVLOS Enabling Legislation)
- Vendor Engagement
- Stakeholder Engagement
- Cost Benefit Assessment
- Pilot Deployment Plan
- Concept of Operations
- Testing

### Pilot Deployment (WSDOT)

- Seamless integration of drones (existing TMC operations, ITS network)
- Training
- Deployment
- Remote operations of untethered drones from TMC

# Key Findings and Feasibility

- BVLOS Drone deployment by a public agency is feasible
- Hardware and software solutions are mature and commercially available
- Many agencies are using drones today for non-traffic tasks
- Limited Examples of BVLOS operations at DOTs
  - ADOT (Alaska)
- FAA regulations are evolving and are becoming more permissive for remote operations



# Concept to Application

# WSDOT BVLOS Drone Research

ARUP

## Concept to Application

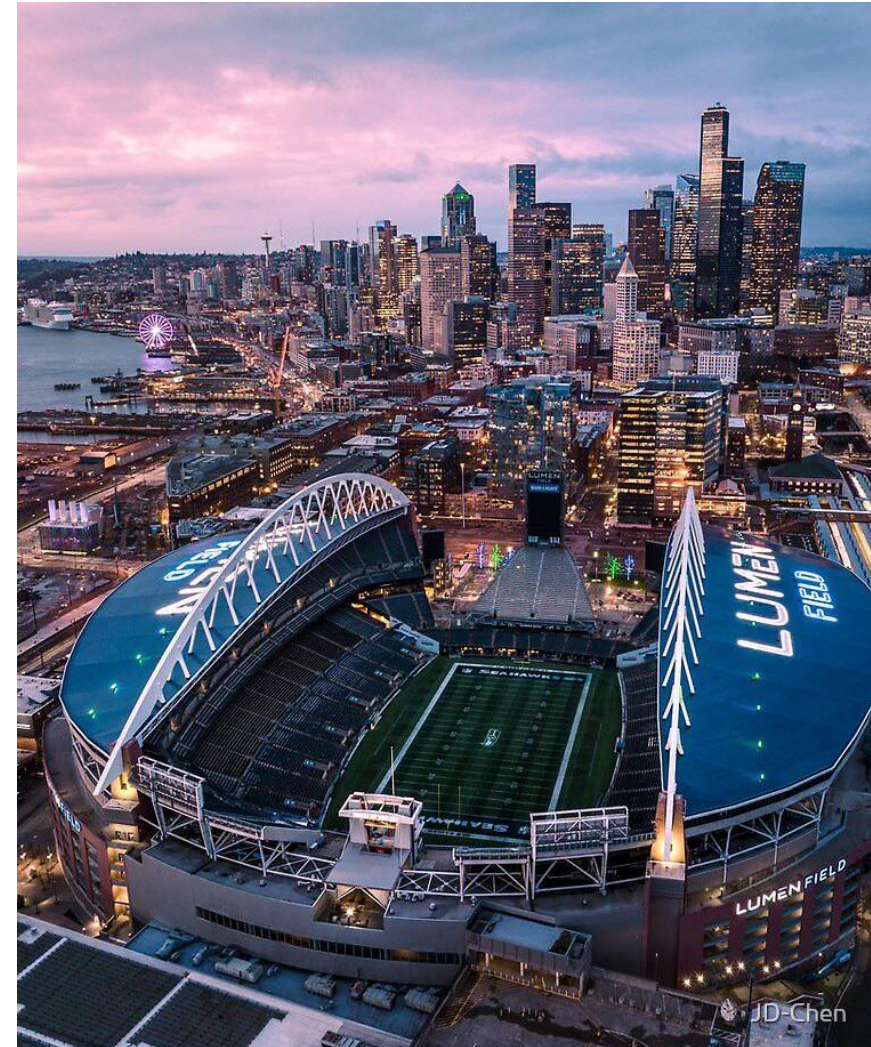
**Phase 1** – Research and Testing (Ongoing)

**Phase 2** – Pilot (TBD)

**Phase 3** – Scaled Deployment (TBD)

### Phase 1 Scope:

- Research FAA Rules/Regulations
- Stakeholder Engagement
- Feasibility & Operations Study
- Concept of Operations
- Cost Benefit Assessment
- Risk Assessment
- Pilot Deployment Plan



# WSDOT Drone Research

## Existing Use Cases

- Graffiti Removal
- Avalanche and Rockslide inspection and detonation
- Slope surveys
- Vegetation/Herbicide spraying
- Inspections



Source: WSDOT

# Bringing it to Life: Operational Use Cases

# Use Case 1

## Day to Day Operations - AM/PM Peak

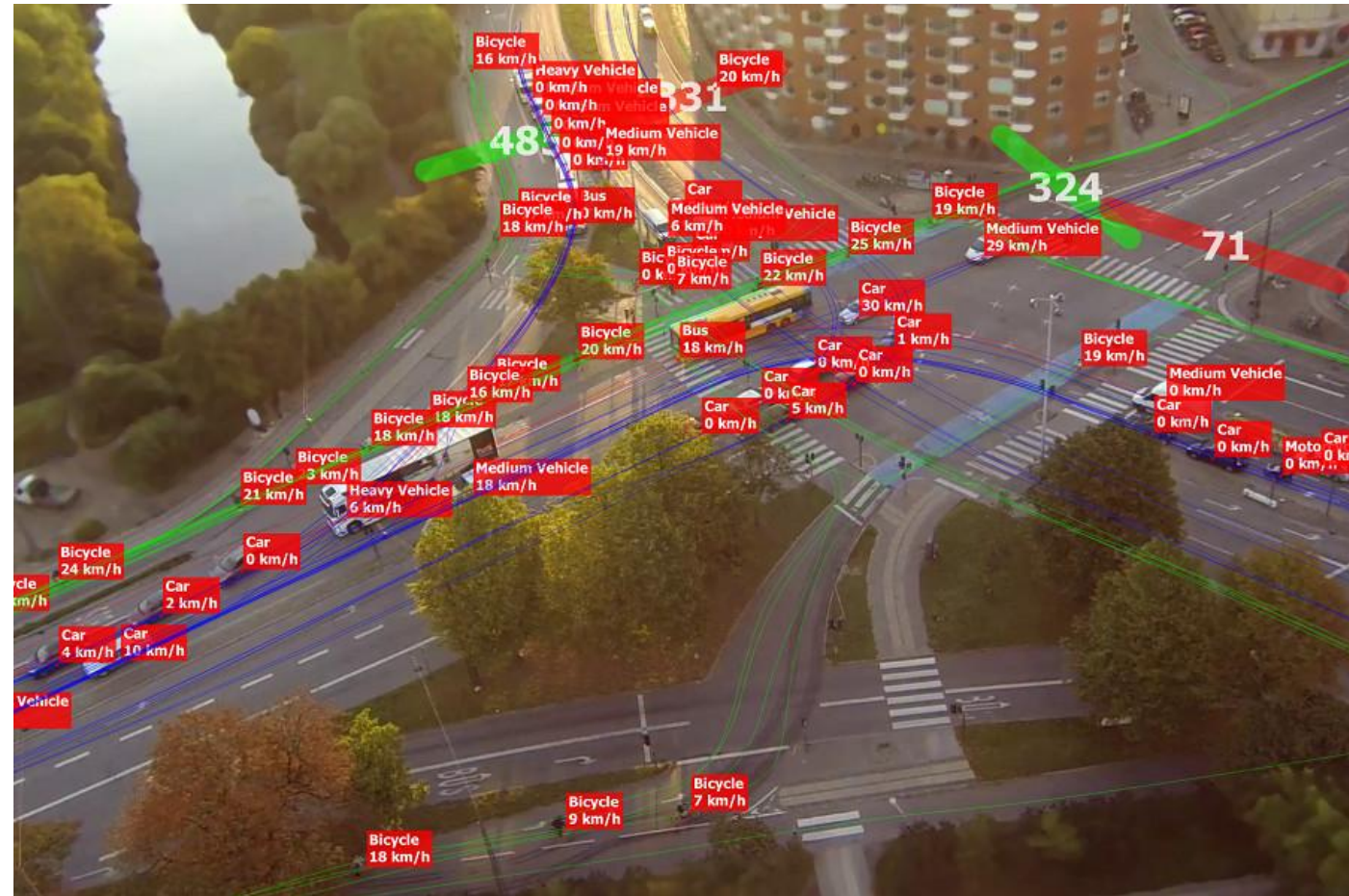
**Objective:** Utilize drone for day-to-day TMC operations

**Key data** collected by drones to support operational response:

- Traffic data (Speeds, Volumes, Queuing, etc.)
- Upstream and Downstream congestion

### Operations Optimization:

- Improve situational awareness
- Improve TIM response
- Enhanced incident and traffic demand management systems
  - Reoccurring Congestion
  - Unplanned Incidents
  - Planned Incidents
  - Special Events



# Use Case 2

## Incident Response on Highways

**Scenario:** Incident occurs on a segment without CCTV coverage.

**Goal:** Enhance incident response, safety, and TMC operations using real-time video and analytics.

**Method:** Deploy drone to capture and deliver:

- Live video of the scene
- Traffic data (speeds, volume, queuing)
- Upstream/downstream congestion data

**Outcome:** Improved situational awareness, faster response times, and better-informed decision-making for TMCs.



Source: UDOT

# Use Case 3

## Asset Management - Remote Traffic Signal Diagnostics

**Scenario:** A Traffic signal appears to be offline, and the operator can not verify the cause of the disruption due to lack of video coverage or communication with the intersection.

**Goal:** Diagnose potential equipment failure remotely without dispatching maintenance staff

**Method:** Deploy a drone to the field following a pre-planned route to locate the affected traffic signal. The drone provides real-time visual and diagnostic data to:

- Identify the exact location and status of the asset
- Observe any visible signs of equipment malfunction
- Determine the likely cause of the failure

**Outcome:** The drone confirms the cause of the outage, allowing the TMC operator to verify the issue and dispatch maintenance if needed.



Source: NJDEP

# Global Progress vs. U.S. Reality

# U.S. Drone Deployments

- Los Angeles DOT Urban Air Mobility Policy Framework and Guidelines
- Designed small scale delivery drone station for landing and transfer of good for drones (Confidential Client) USA
- Designed multi drone charging and landing pad for fleet of delivery drones (Confidential Client) USA
- Noise study on the Impact of delivery drones (Confidential Client) USA
- Eglinton Crosstown Light Rail Corridor, Canada
- Confidential NYC Airport EVTOL Vertiport Study
- Confidential West Coast Airport EVOTL Terminal Study



# Global Drone Deployments

## Europe/UK

- Drone Driving Distraction Study – National Highways England
- Highways England Drone Operation Policy and Standards
- Highways England Drone operations capacity development
- National Health Service Scotland Drone Medical Delivery Noise Study
- Loupe 360 Tunnel inspection tool

## Asia

- Automated Building Façade Inspection program- Singapore
- Hong Kong Cross Boundary Logistics
- Arup Case Study - Hangzhou Ningbo Smart Motorway – Drone traffic safety



# Introducing Loupe360

T1: (T0 + 324 days)  
15-10-2020 (15:10:55)  
RN 135

Water Ingress | Confidence: 99

135

RN 136  
ground mADO 11.2  
tunnel mADO -5.075  
total ML 2  
ML ID's ID44 ID46

Electric cables

67 68 69

Pipeline

Defects

Inventory

| Ring no. ↕ | Water ingress | Cracks | Spalling | Notes |
|------------|---------------|--------|----------|-------|
| 135        | Danger        | Normal |          |       |
| 136        | Danger        | Normal |          |       |
| 137        | Medium        | Normal |          |       |

Defects

Inventory

Ring no. ↕

Pipeline

Electric cables

Light

U-bolt

|    |        |        |   |   |
|----|--------|--------|---|---|
| 67 | 120 cm | 120 cm | 0 | 4 |
| 68 | 120 cm | 120 cm | 0 | 4 |
| 69 | 120 cm | 120 cm | 0 | 4 |

# Automated Tunnel asset inspection workflow

Loupe 360

## Data capture

360 degree photographic imagery, as good as or better than manual inspection

## Data analysis & machine learning

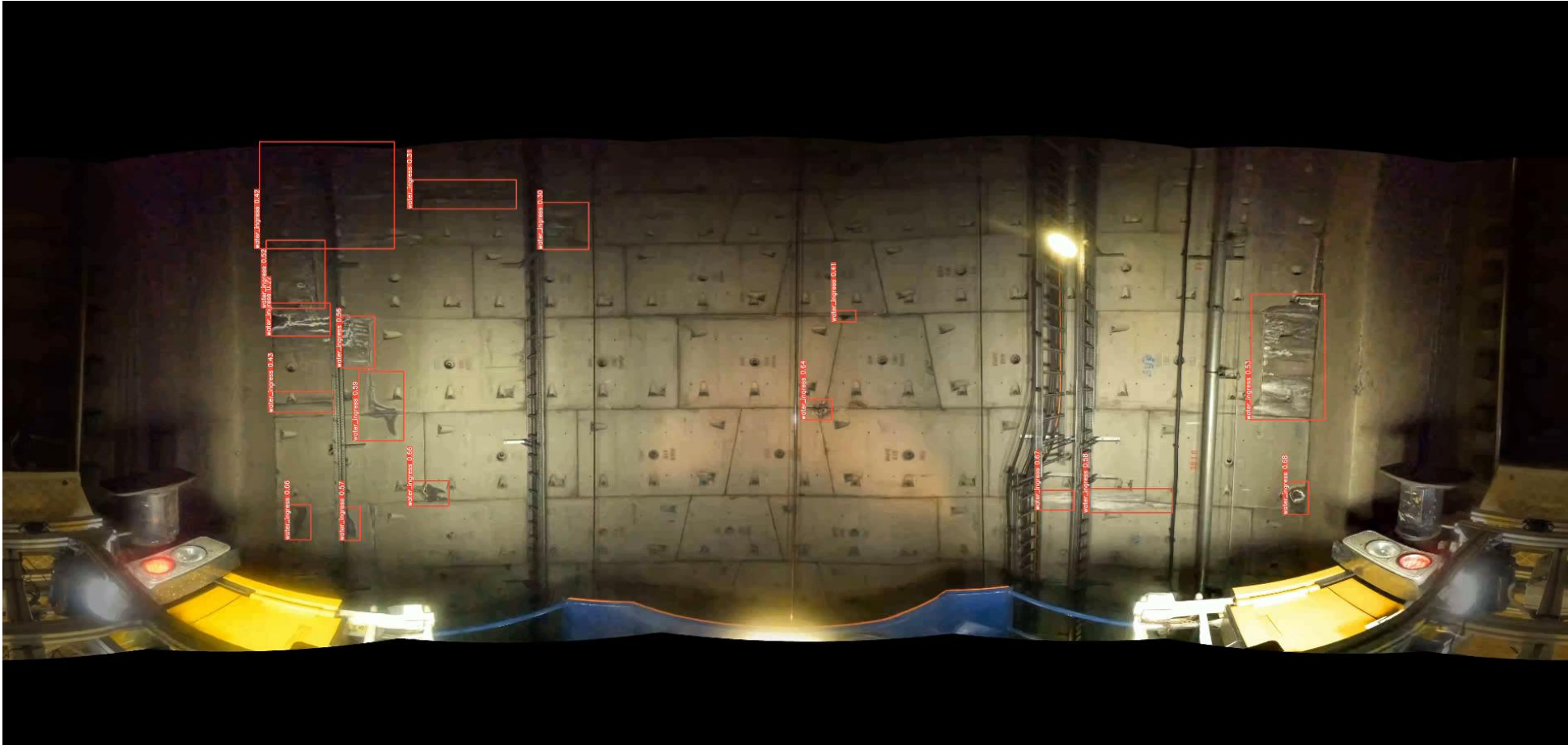
ML algorithm to identify features such as water ingress, cracks, lineside equipment etc

## Data visualisation & dashboard

Web-based 360-viewer, maps, compatible with existing asset management software

# Data analysis & machine learning

Introducing Loupe360



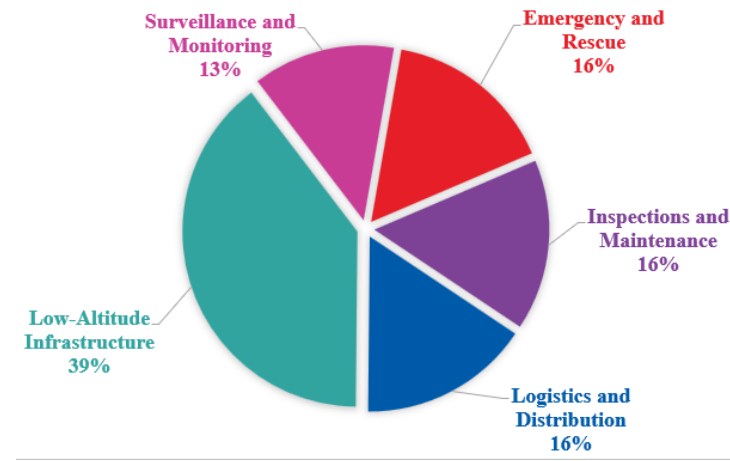
# Zhuhai-Hong Kong Cross-boundary Logistics



## Collaboration with the HK Civil Air Authority

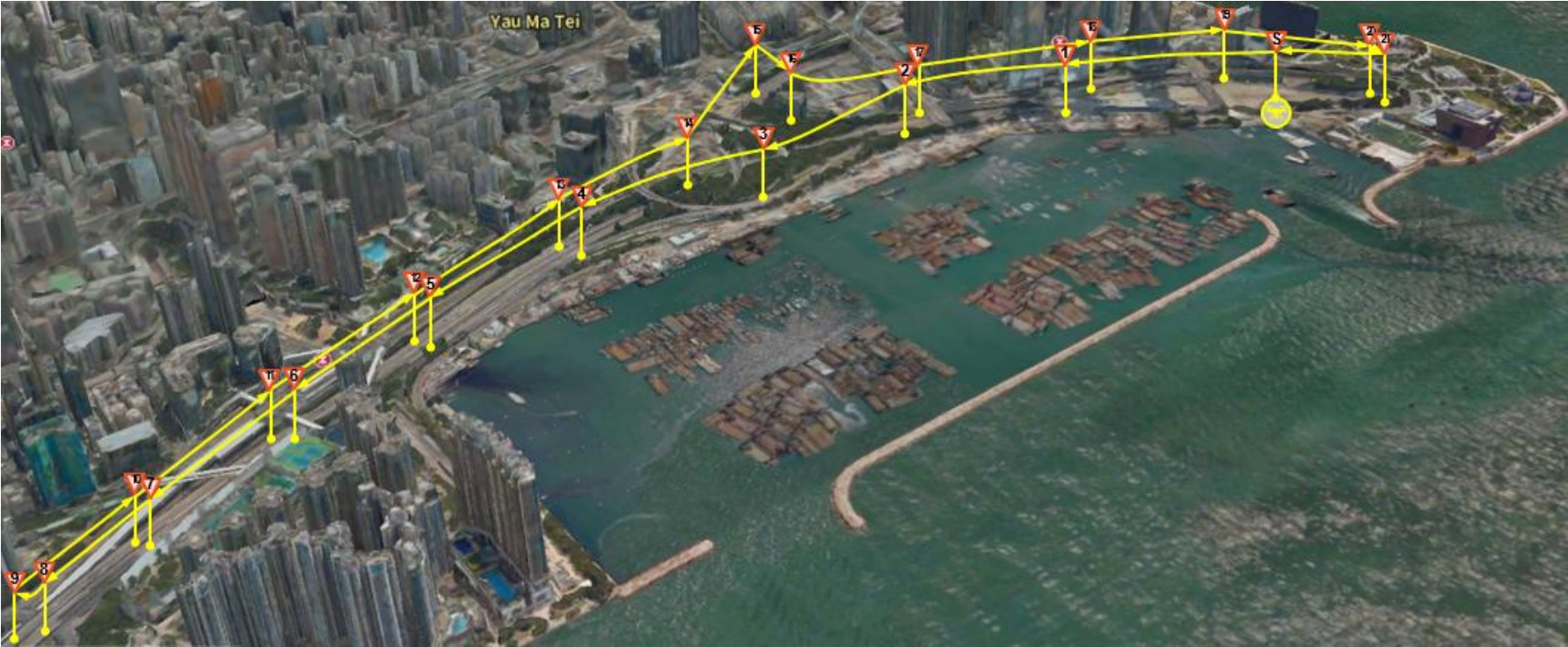


- Arup partnering with Low Altitude Economy industry leaders to submit application.
- Trials on cross-boundary logistics delivery with drones between HK and Zhuhai, in an 80 million people metro area
- Strengthening the strategic logistics corridor between Guangdong West and HK Northern Metropolis.



# Patrol and Management of Smart Motorways

Mainland China



|                    |                                                                                                                                   |
|--------------------|-----------------------------------------------------------------------------------------------------------------------------------|
| Daily Patrol       | <ul style="list-style-type: none"><li>•Traffic Condition</li><li>•Conditions of pavement, road furniture, devices, etc.</li></ul> |
| Incident Detection | <ul style="list-style-type: none"><li>•Severity</li><li>•Casualties</li><li>•Congestions</li></ul>                                |
| Incident Recovery  | <ul style="list-style-type: none"><li>•Guidance to motorists via loudspeaker</li><li>•Warning to downstream vehicles</li></ul>    |

## Successful application on Hangzhou-Shaoxing-Ningbo Expressway in Mainland China

Performance highlights in 2024:

- ✓ Proactive accident detection: **100%**
- ✓ Average handling time: 9 min → **3 min**
- ✓ Annual fatal accidents: ↓ **55 %**
- ✓ Secondary accident rate: 23 % → **4 %**
- ✓ Overall accident incidence: ↓ **35 %**



# 连处三起事故

24年10月2日，杭甬高速无人机连续处置3起事故，高效率。

# Next Steps

# PDH Questions

# What is BVLOS?

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- B. Beyond Visual Line of Sight
- C. Beyond Visual Level of Service
- D. Bad Vibes in Los Angeles

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C. Vegetation/Herbicide Spraying

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D. 40 minutes

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# ARUP

