Enhancing Disaster Response with sUAS and

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CGA Energy Nexus & Annual Technical Conference 2025

About Me…

- Certified IT Operations Specialist
- 30+ years of Professional IT experience
- 20+ years of Gas industry experience
- FAA Certified Remote Pilot
- 60+ AMR system deployments
- Managing Director of Space Coast Helpdesk
- Co-Founder of both FlexMQ and Space Coast Imaging

Overcoming Response Challenges in the Gas Industry






UAS in Disaster Response

Hurricane Harvey, August 2017



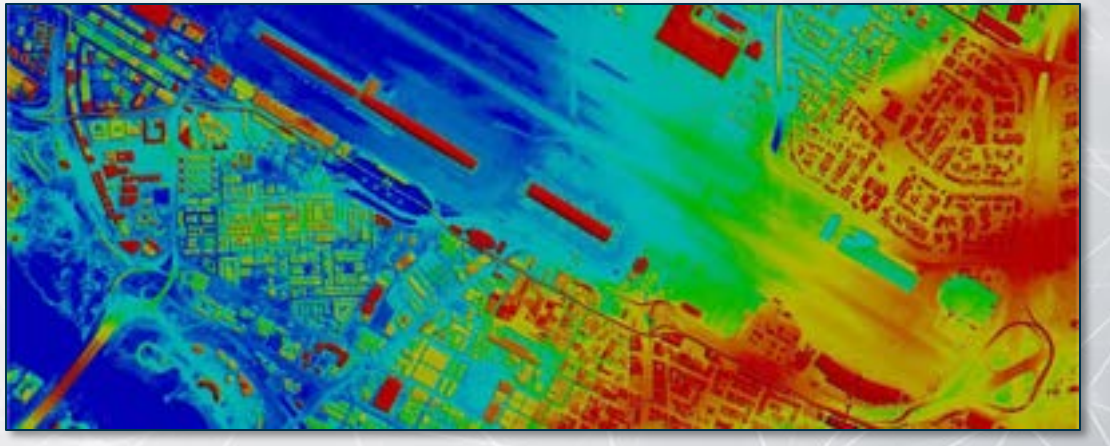



UAS in Disaster Response

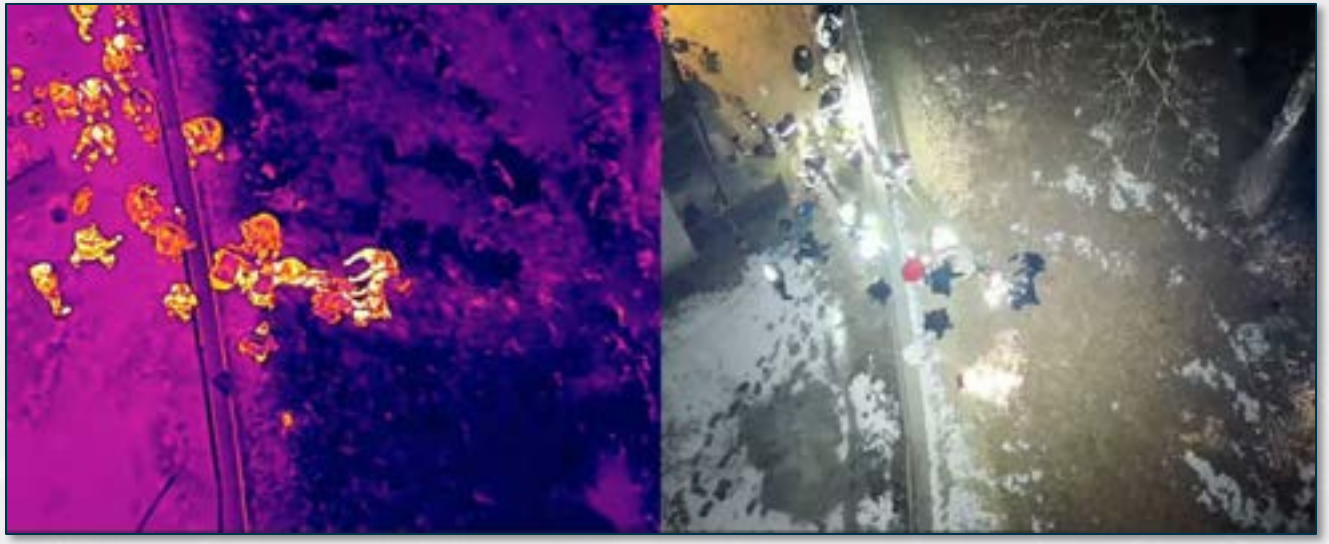
- **Remote Infrastructure Assessment:** Drones stationed at substations and transmission lines were launched remotely to assess damage before crews were dispatched.
- **Optimized Routing:** UAVs helped identify safe paths for repair teams, avoiding flooded zones and debris.
- **Accelerated Restoration:** By providing real-time visuals and thermal scans, drones reduced downtime and minimized customer minutes interrupted (CMI), saving utilities millions of dollars .

Applications – Rapid Damage Assessment

UAS can quickly map affected zones, enabling responders to prioritize resources and plan evacuation routes.



Applications – Search and Security Operations



Equipped with thermal infrared (IR) cameras, drones can detect heat signatures and structural anomalies—even in low-visibility conditions

Applications – Infrastructure Inspection

Drones can safely inspect bridges, power lines, and gas pipelines using electro-optical sensors, which capture visible light images. InfraRed sensors and multispectral imaging further enhance inspections while reducing risk to humans.

Applications – Communication Restoration

High-altitude platforms can act as temporary communication relays, providing mesh network connectivity in blackout zones.

Applications – Flood Management

During a flood, drones can provide gas utilities with:

- Rapid aerial assessments of submerged infrastructure
- Identify access routes for crews
- Detect potential gas leaks or pipeline damage using onboard sensor payloads

Applications – Flood Management

A drone was used to drop a flotation device to a mother and her two children caught in a rip current at a New Jersey beach.

Fire Management

Drones have become an essential tool in wildfire management, evolving from their initial use in photography to monitoring wildfires and collecting real-time data on fire spread.

This advancement has greatly enhanced situational awareness and transformed wildfire management

Avalanche Management

Drones offer a safer, more cost-effective alternative that minimizes human exposure and operational overhead.

This marks a major shift from traditional methods offering emergency teams a safer, more efficient approach to hazard mitigation.

Drone Accessories for Emergency Operations

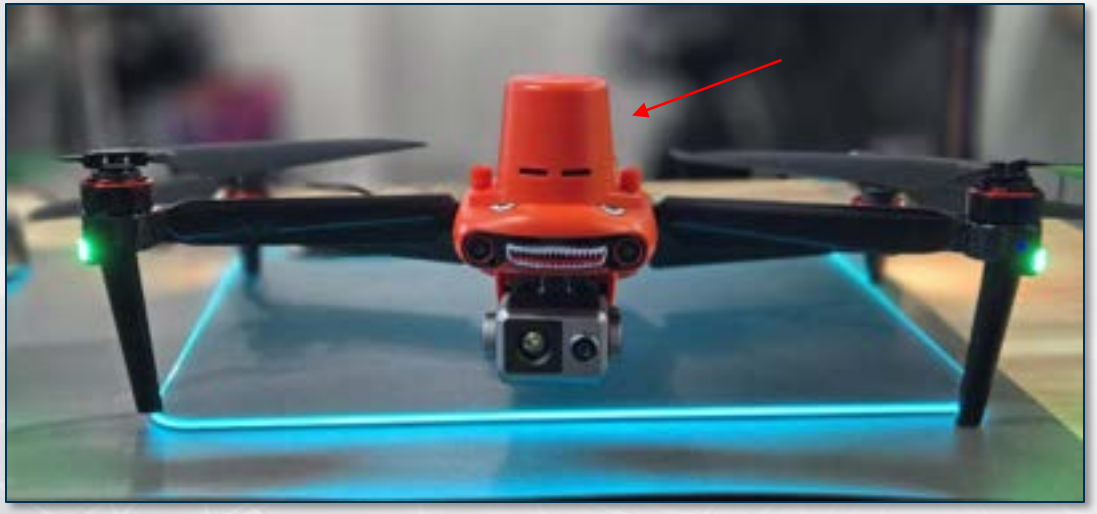
Accessories – EO Sensors and telephoto

An **Electro-Optical** (EO) sensor on a drone captures high-resolution visual data using visible light.

When paired with a **telephoto** lens, the sensor can zoom in on distant assets such as:

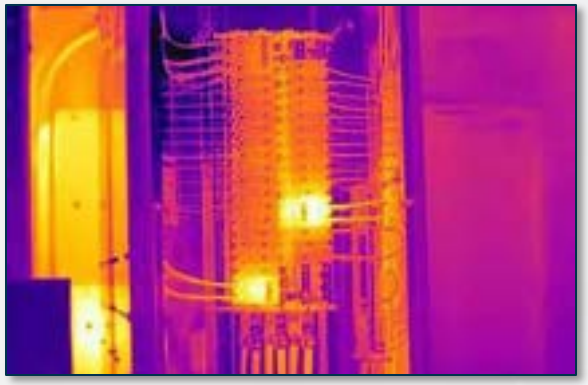
- Gas Meters
- Pipeline Valves
- Flare Stacks

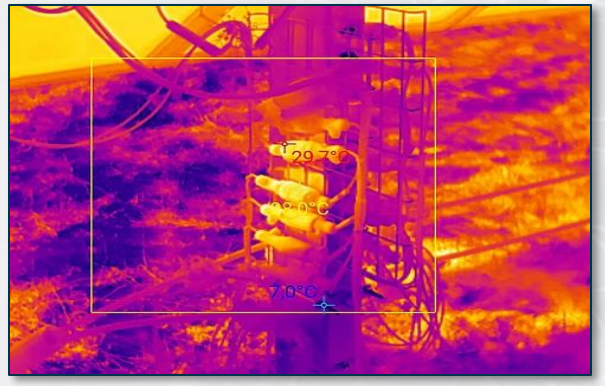
Accessories - Real-Time Kinematic Devices (RTK) and Base Stations

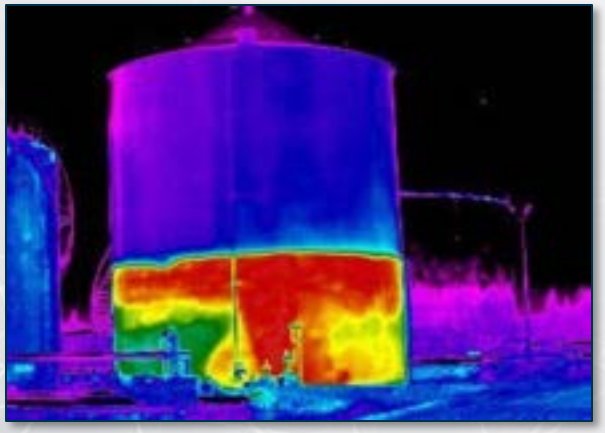


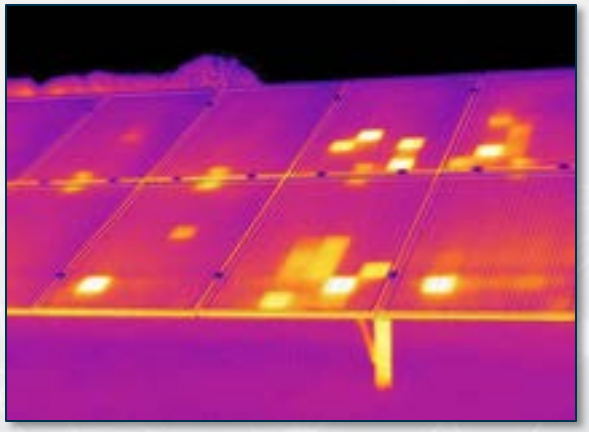
Accessories - Light Detection and Ranging (LiDAR)

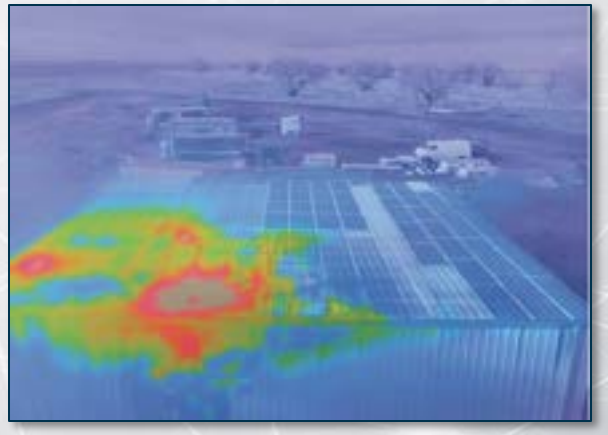
Accessories - InfraRed (IR) Cameras



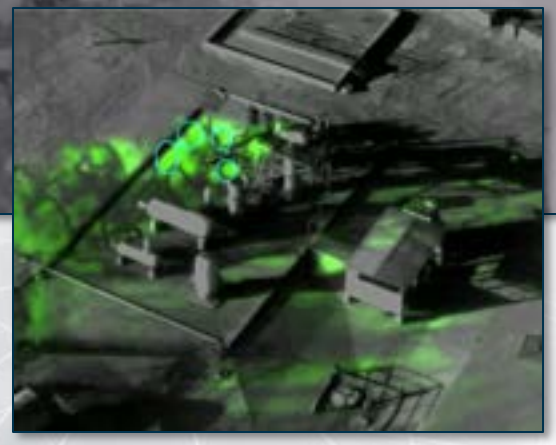








Accessories - Optical Gas Imaging (OGI) camera



DETECTABLE GASES

Ethane	Propane	Propylene	Methane
1-Pentene	Butane	Ethyl Benzene	Heptane
Hexane	Isoprene	Octane	

Accessories - Spotlights & Loudspeakers

Accessories - Tethers

Accessories – Docking stations

Accessories – FPV Goggles

Accessories – Connectivity

Modern drones are increasingly equipped with advanced communication modules like 5G and LoRa radios, dramatically expanding their operational capabilities.

Operational Impact & Integration

- **Gas Utility Monitoring**
- **Infrastructure Assessment**
- **Environmental Compliance**
- **Remote Telemetry Integration**
- **Asset Visualization**

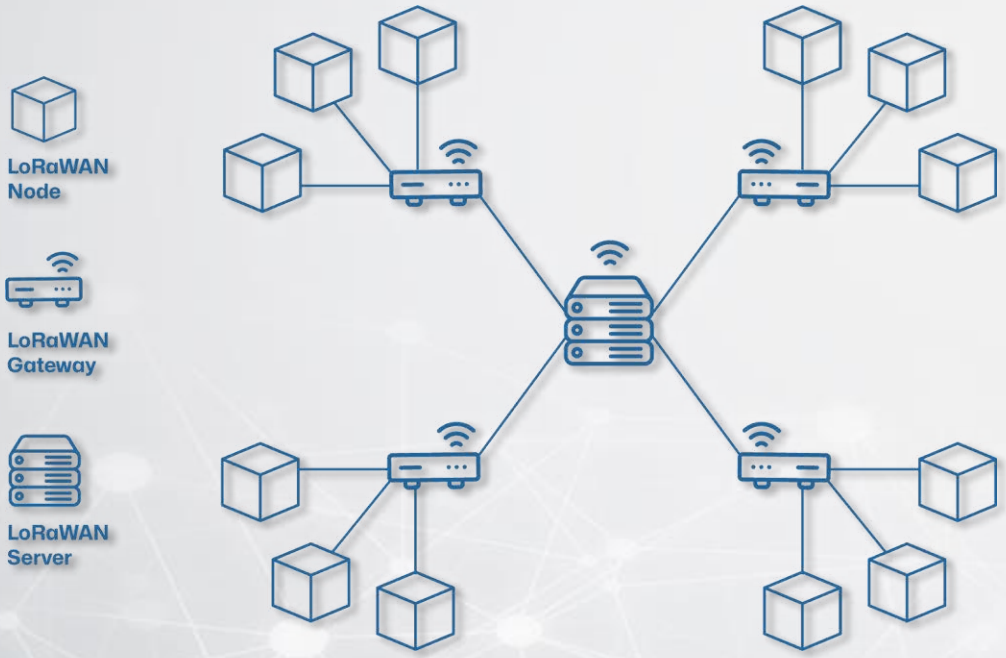
Communication Protocols for UAVs in Disaster Recovery

- **LoRaWAN** (Long Range Wide Area Network) – a low-power, long-range wireless communication protocol designed for IoT applications.
- **MQTT** (Message Queuing Telemetry Transport) – a lightweight messaging protocol ideal for low-bandwidth or unreliable networks.

Integration in UAV Disaster Recovery

- **Real-Time Data Transmission:** enable UAVs to transmit real-time data to ground control stations, enabling immediate situational awareness and faster decision-making.
- **Extended Mission Duration:** The energy efficiency of LoRaWAN supports longer flight times, allowing sustained monitoring of affected areas.
- **Reliable Connectivity:** LoRaWAN's long-range coverage and MQTT's reliability ensure stable communication.

LoRaWAN Star Topology and Mesh Coverage



- LoRaWAN typically employs a star topology, where end devices communicate directly with gateways.
- LoRaWAN's coverage can be extended in a mesh-like fashion through coordinated deployment of relay nodes **mounted on drones**.
- Relay nodes act as transparent repeaters, forwarding messages from devices outside direct gateway range without altering the LoRaWAN protocol.

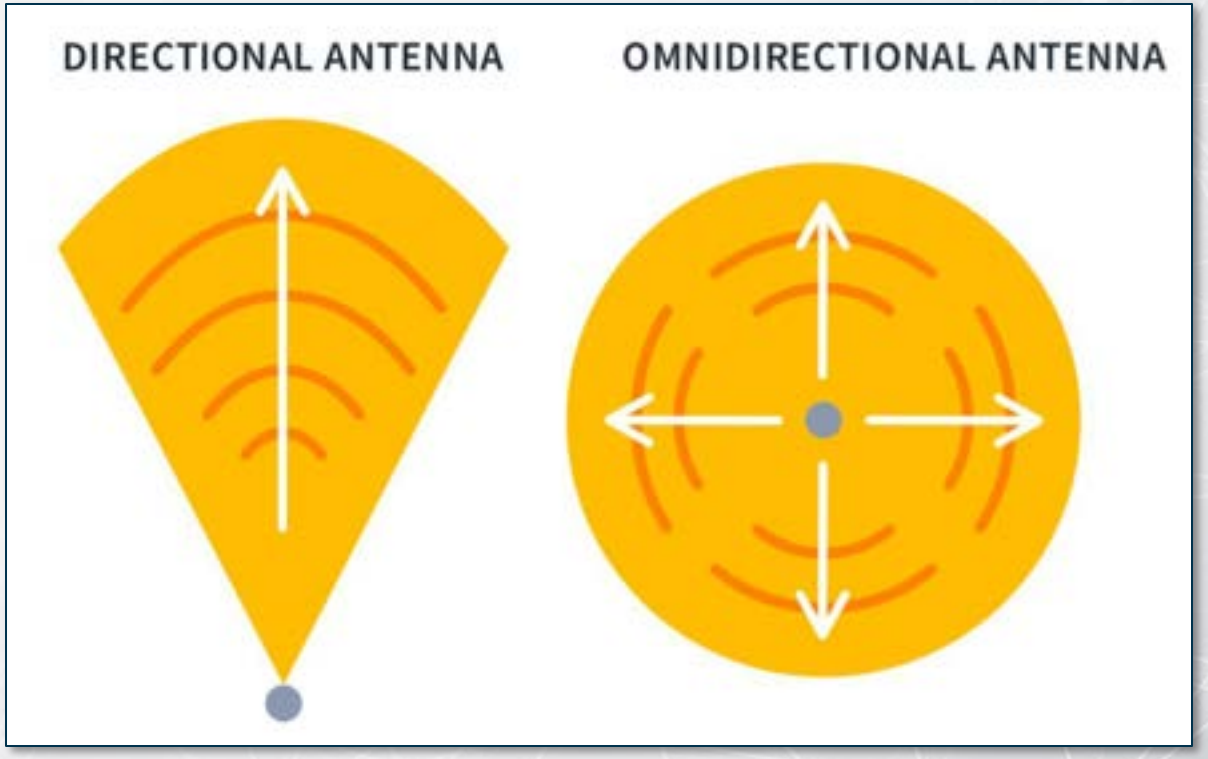
LoRaWAN Range and Antennas

Example Ranges

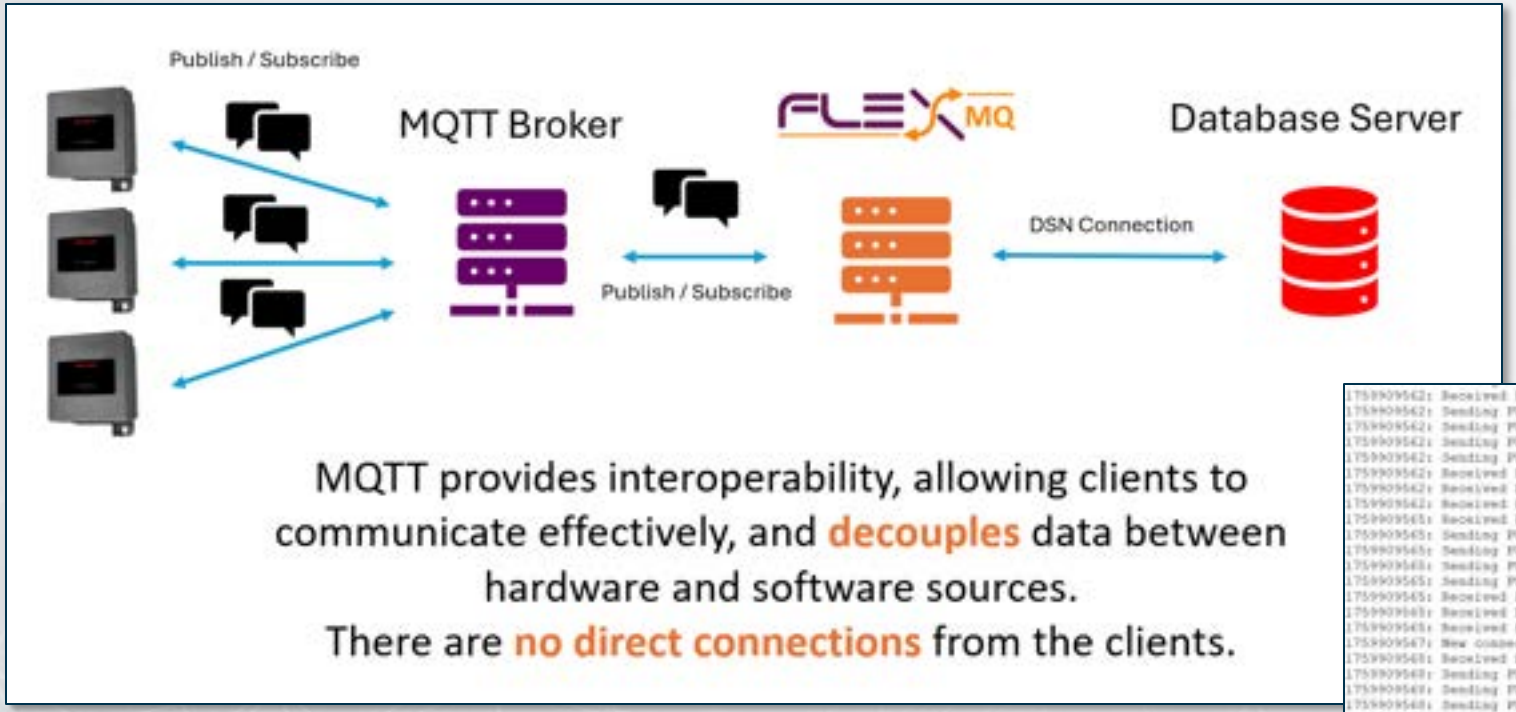
- Urban areas: up to 2 km
- Suburban areas: up to 5 km
- Rural area: up to 20 km

Antenna Types

- Omnidirectional
- Directional Antennas
- Patch Antennas



MQTT – a lightweight Protocol



Field Case Study – Objective

Objective: Validate drone-mounted LoRaWAN relay as a contingency solution for telemetry continuity

Test Setup:

- Suburban field site
- UAV flown at 100 ft altitude
- LoRaWAN relay device mounted onboard

Simulated Scenario:

- Primary FlexGateway intentionally disabled
- FlexPT sensor data rerouted mid-flight

Transmission Path:

FlexPT → Drone Relay → Alternate FlexGateway → FlexMQ

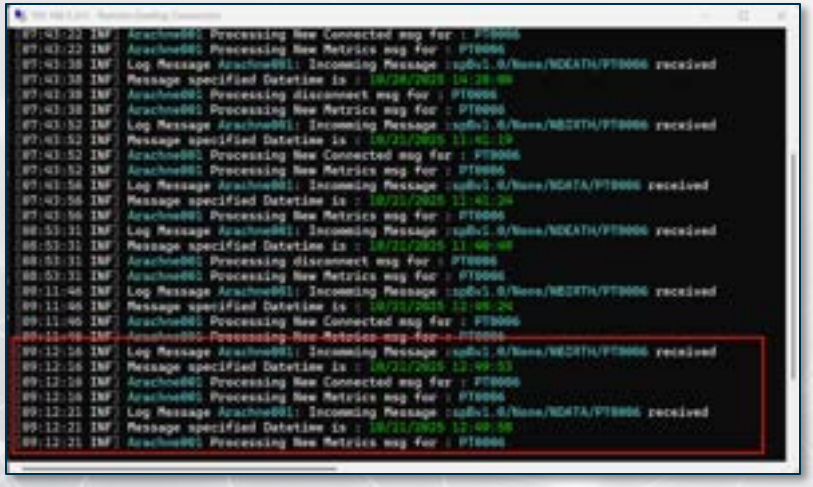
Field Case Study - Results

Results:

- Seamless data flow with no loss or latency.
- Confirmed airborne relay viability for emergency and remote deployments.

Implications:

- Enables mobile infrastructure for gas utilities and environmental monitoring.
- Scalable solution for disaster recovery, inaccessible zones, and dynamic coverage.



Drone Mapping & Data Collection

Drone Mapping: Industries

- **Construction:** Track project progress, estimate fill and excavation, and conduct site assessments.
- **Environment:** Study ecosystems and landscape changes.
- **Emergency Response:** Assess damage for rescue planning.
- **Urban Planning:** Support smart infrastructure development with 3D models.
- **Oil and Gas:** streamline operations by enhancing site visibility, safety compliance, and asset monitoring.

Map Data Collection

Drone mapping refers to the process of capturing aerial data to generate detailed outputs such as 2D and 3D maps, Orthomosaics, and terrain models.

These visuals are achieved by flying drones in systematic grid patterns, during which they collect overlapping images.

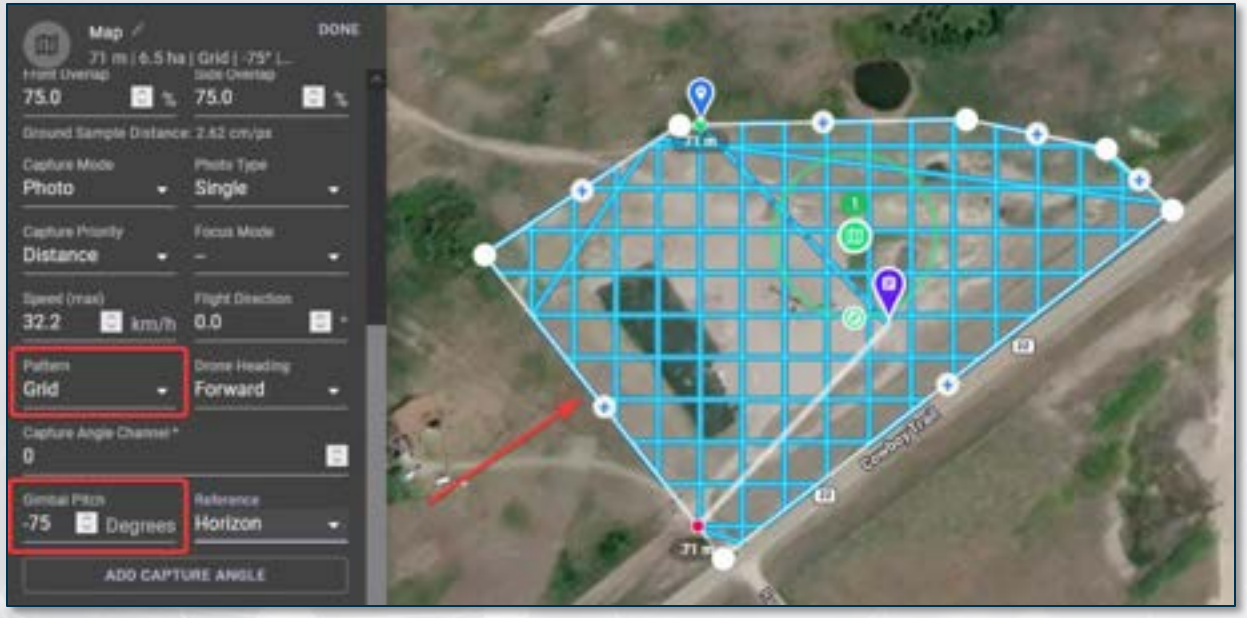
Drone Mapping: Basic Equipment

A drone with a high-res camera and GPS – the core of every mapping mission.

Ground Control Points (GCPs) for accuracy – marked locations with known coordinates to enhance georeferencing.

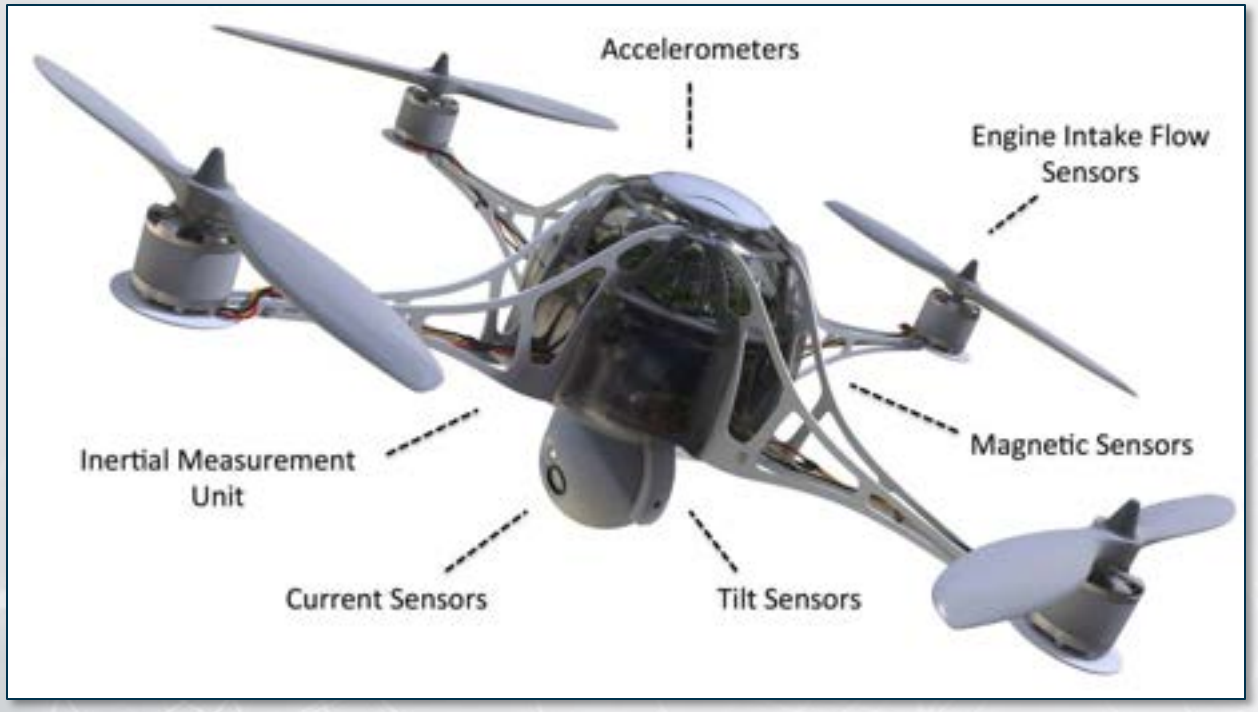
A controller with display interface – for real-time monitoring and manual overrides.

Drone Mapping: Workflow



1. Plan the flight with appropriate altitude and overlap settings.
2. Capture images and sensor data during the mission.
3. Use GCPs or real-time kinematic (RTK).
4. Process the data using specialized software to create Orthomosaics and 3D models.

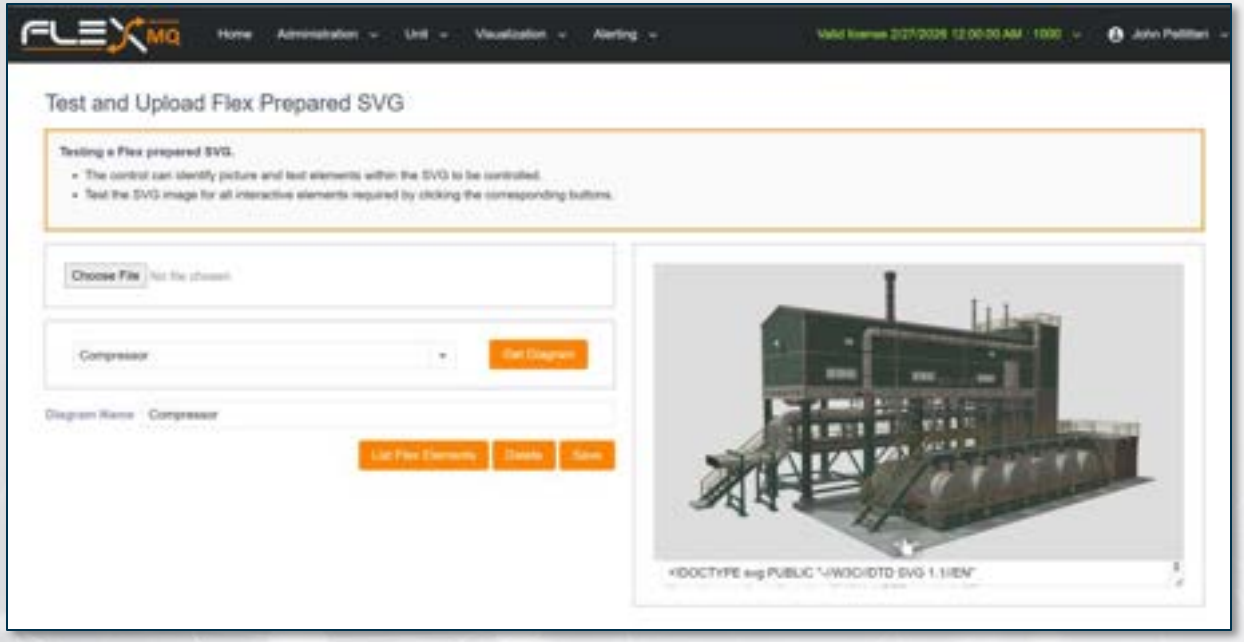
Drone Mapping: Mapping Accuracy



GPS and IMU (Inertial Measurement Unit): These provide precise orientation and positional data for geotagging each image.

Stabilization sensors: Onboard gyroscopes and barometers help maintain steady flight and accurate altitude readings, which is crucial for consistent map quality.

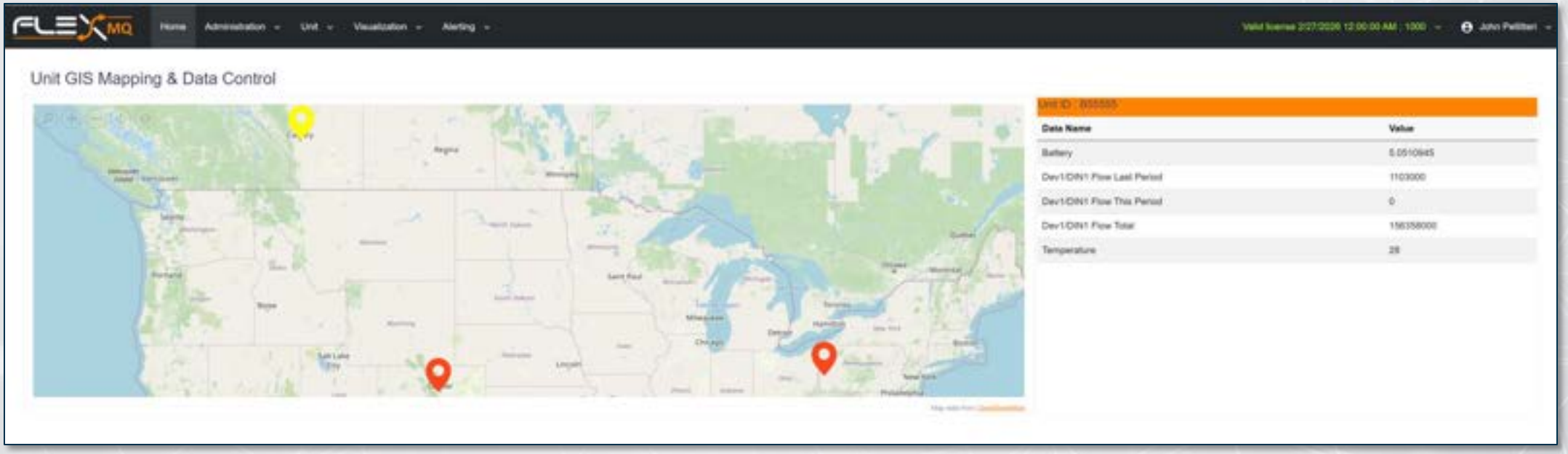
Benefits over traditional mapping



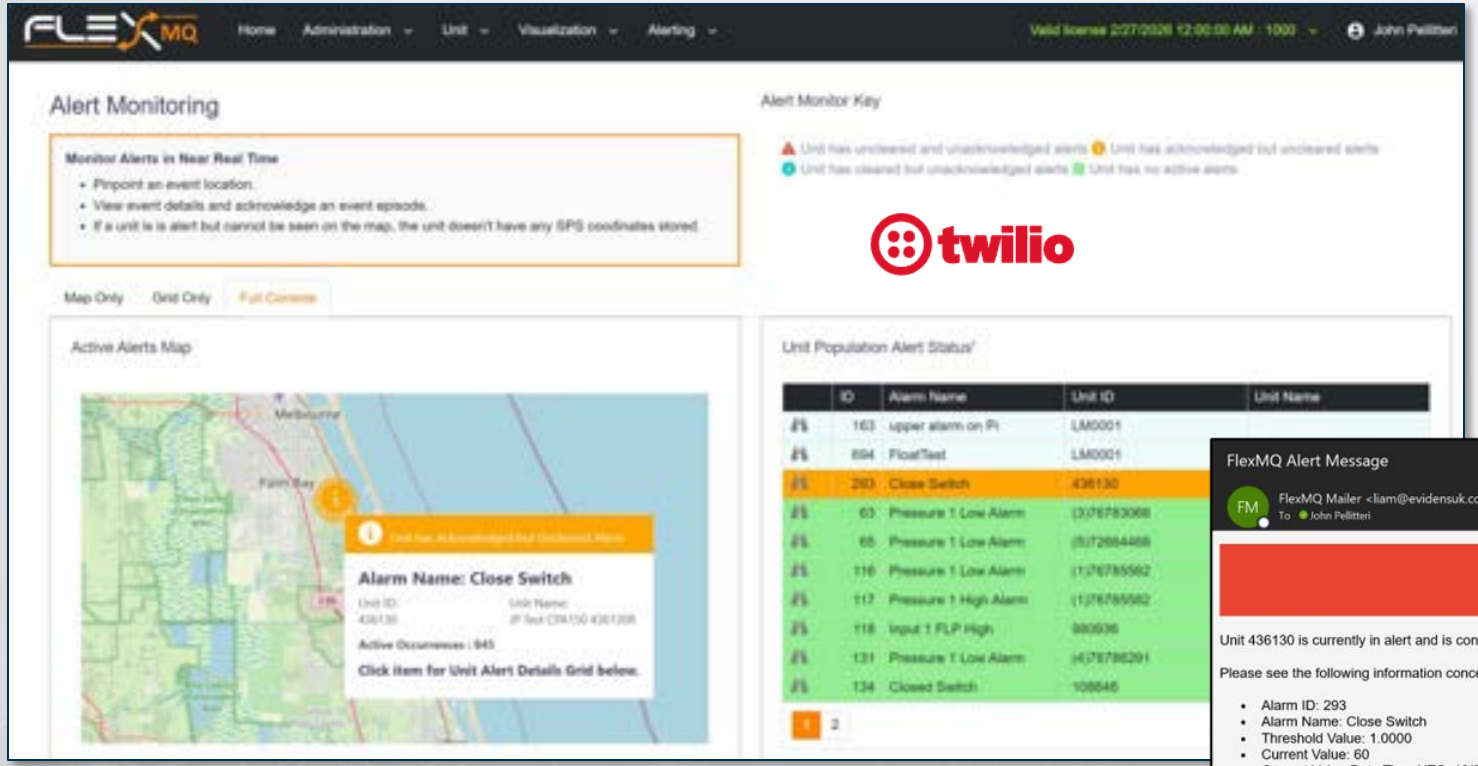
Advantages of Advanced Data Solutions

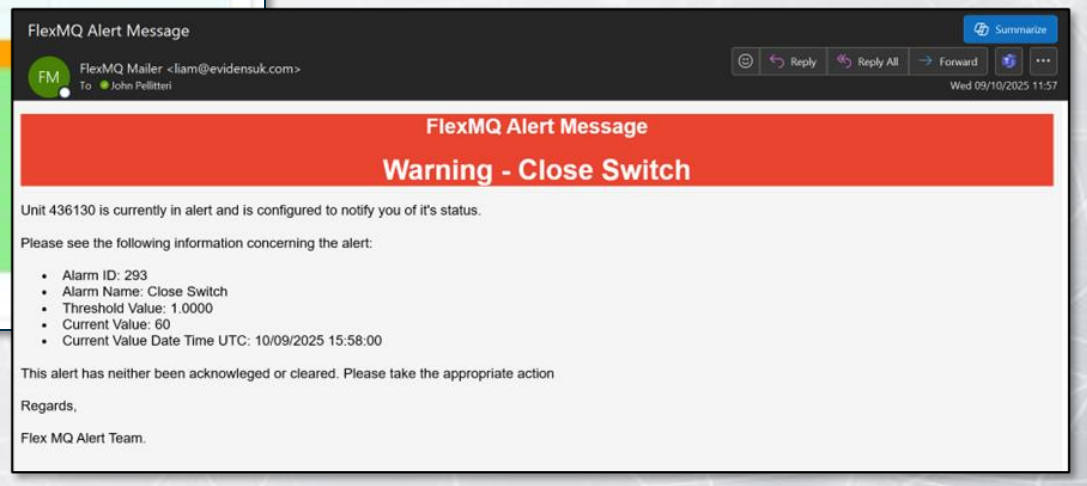
1. Achieve accurate real-time data
2. Enable rapid deployment and data gathering
3. Adapt to challenging locations
4. Reduce environmental footprint
5. Reduce resources
6. Integration into data collection systems

Integrated Field Notifications



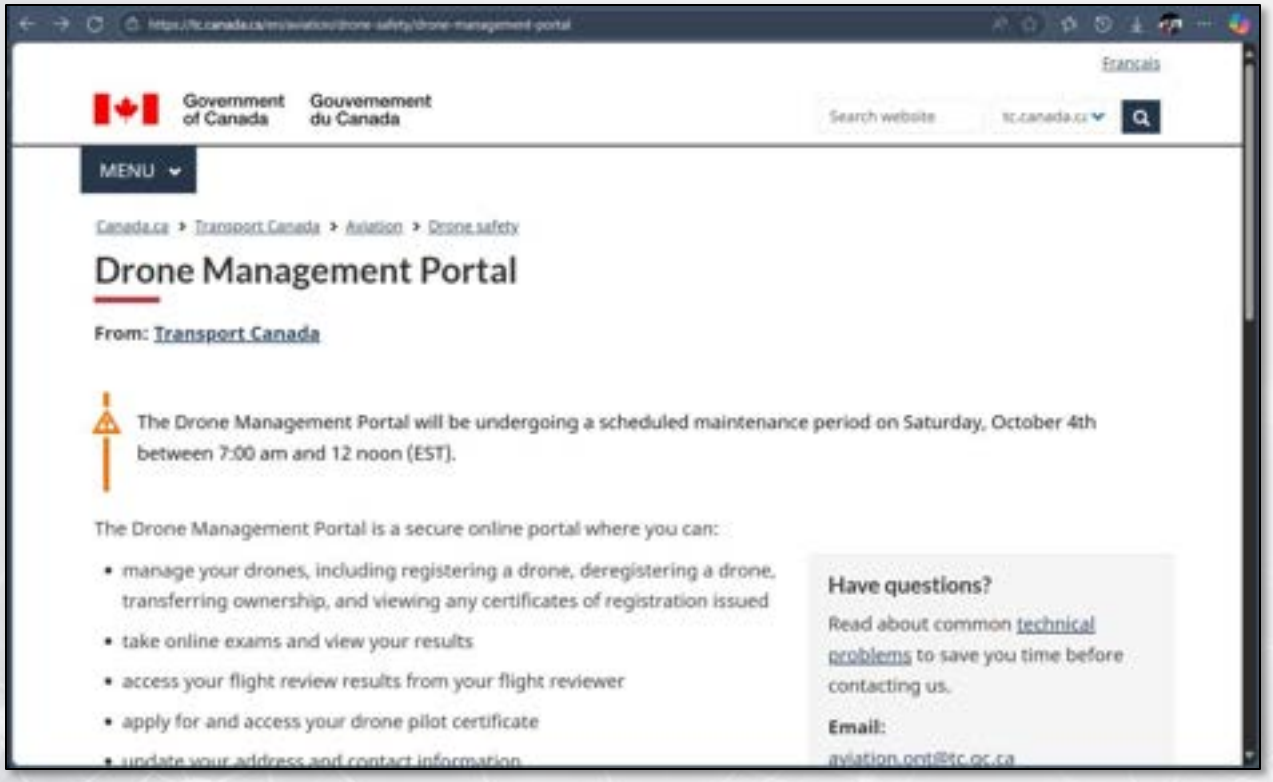
Proactive Alerting





- Dynamic GIS Mapping
- Instant Alert Visualization
- Multi-Channel Notifications
- Secure & Scalable Architecture
- Structured Event Logging
- Geo-Targeted Messaging
- System Integration

RPAS Regulations in Canada



Remotely Piloted Aircraft Systems (RPAS) operations are governed by a comprehensive regulatory framework designed to ensure safety, accountability, and innovation.

Transport Canada is the federal authority responsible for regulating RPAS activity nationwide.

Flight Modes - Autonomous Flight

In the gas industry, autonomous drones provide three key benefits:

- Enhanced Safety
- Increased Efficiency
- Cost Savings

Visual Line of Sight (VLOS)

The main advantage of VLOS is that it allows the pilot to maintain direct visual contact with the drone, enabling immediate manual control if needed.

Beyond Visual Line of Sight (BVLOS)

BVLOS operations require:

- **Automated Detect-and-avoid Systems**
- **Reliable Communication Links**
- **Trained Operators**

The key advantage of BVLOS is the ability to conduct missions, without the need for visual contact with the drone.

Drone Registration

Drone Pilot Certification

Transport Canada Transports Canada

Pilot certificate

Small Remotely Piloted Aircraft System (RPAS), Visual line-of-sight (VLOS)

The individual indicated below may exercise their privileges to fly a drone subject to the rules and regulations listed below and set out under the Canadian Aviation Regulations (CAR).

Issued to:

Date issued (YYYY-MM-DD):
2019-04-26

☑ Basic operations
☑ Advanced operations
☑ Flight reviewer rating

Certificate number:

Transport Canada account number:

Types of Certificates:

- **Basic Certificate**
- **Advanced Certificate**
- **Level 1 Complex Certificate**

Restricted Zones

Operators must avoid:

- Airports/heliports
- National parks (Permit required from Parks Canada)
- Emergency Zones (e.g., wildfires)
- Military and critical infrastructure areas

Insurance Considerations

Coverage Types:

- **Liability:** Third-party injury or property damage.
- **Hull:** Physical damage to drones and attachments.
- **Payload & Ground Equipment:** Cameras, sensors, and control units.
- **Personal Injury:** Privacy-related claims.

Weather Resilience

Beaufort Scale

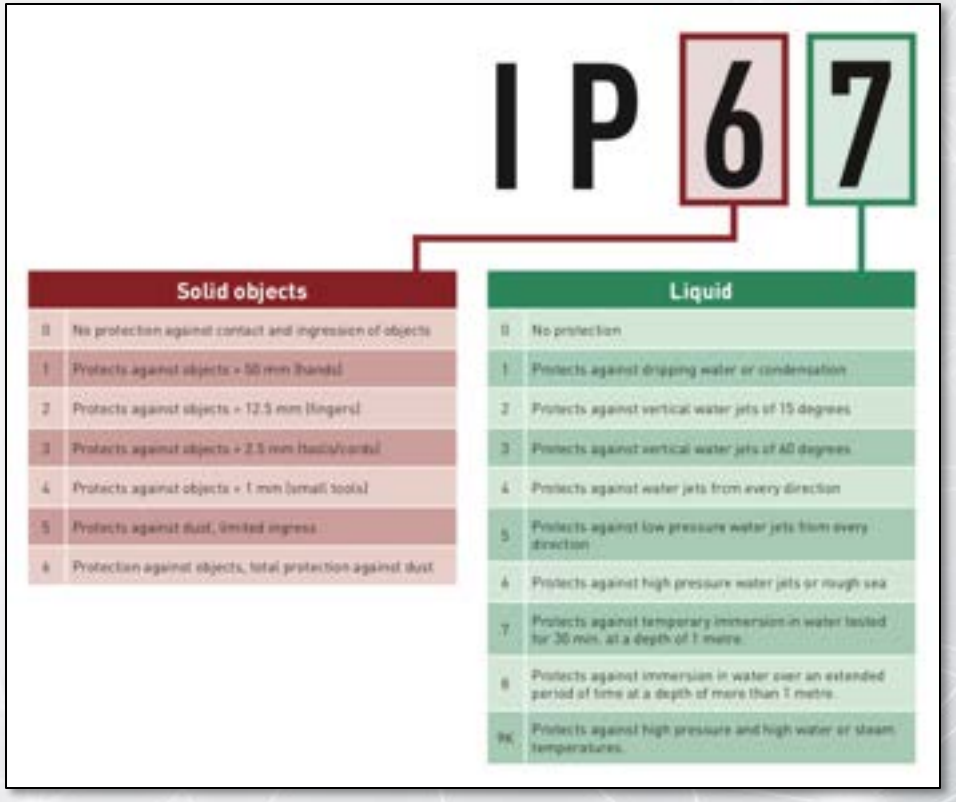
Beaufort Level	Description	Speed (kph)	Speed (mph)
0	Calm	< 1	< 1
1	Light Air	1–5	1–3
2	Light Breeze	6–11	4–7
3	Gentle Breeze	12–19	8–12
4	Moderate Breeze	20–28	13–18
5	Fresh Breeze	29–38	19–24
6	Strong Breeze	39–49	25–30
7	Near Gale	50–61	31–38
8	Gale	62–74	39–46
9	Strong Gale	75–88	47–54
10	Storm	89–102	55–63
11	Violent Storm	103–117	64–72
12	Hurricane Force	≥ 118	≥ 73

Ingress Protection Ratings

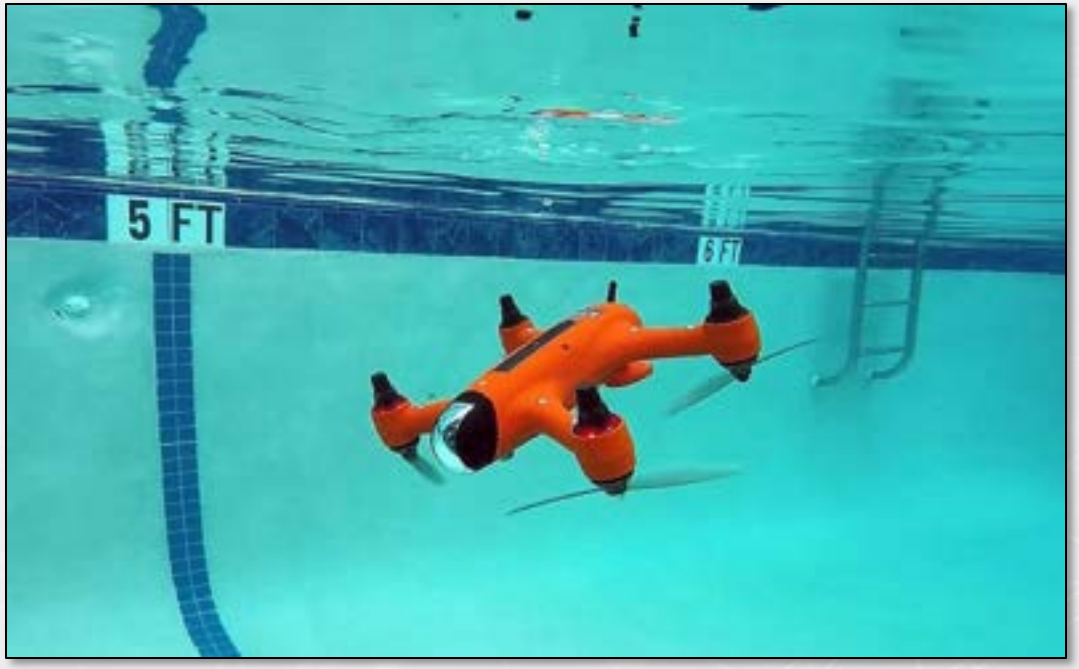
An IP rating is formatted as **IPXY**, where:

X = protection against solids (0–6)

Y = protection against liquids (0–9)



Weather-Resistant vs. Waterproof



Most consumer drones are **not** fully waterproof but may be weather-resistant.

Public Perception in Canada

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Thank You!!!

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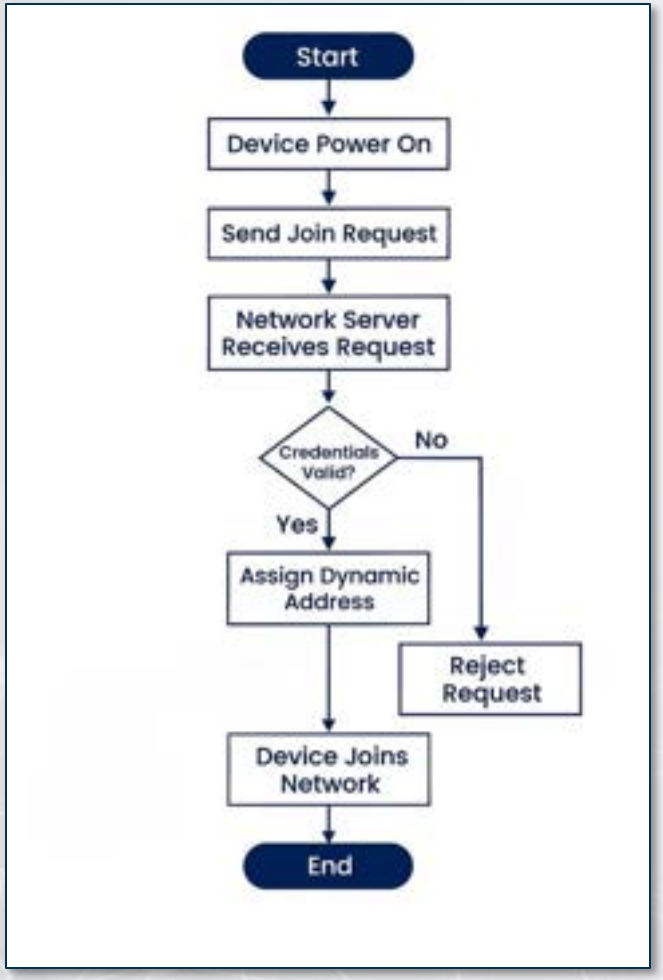

LoRaWAN OTA Flow

Over-The-Air Activation (OTAA): This method involves the device performing a join procedure with a LoRaWAN network, during which a dynamic address is assigned, and root keys are used to derive session keys.