

CGA Energy Nexus & Annual Technical Conference 2025

Enhancing Disaster Response with sUAS and



Presented by: John F. Pellitteri

Managing Director

Space Coast Helpdesk Inc.

Authors: John F. Pellitteri, Alyssa Foster



Fuelling the Future

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

CGA Energy Nexus & Annual Technical Conference 2025

Overcoming Response Challenges in the Gas Industry



CGA Energy Nexus & Annual Technical Conference 2025

UAS in Disaster Response



CGA Energy Nexus & Annual Technical Conference 2025

Hurricane Harvey, August 2017



CGA Energy Nexus & Annual Technical Conference 2025

UAS in Disaster Response

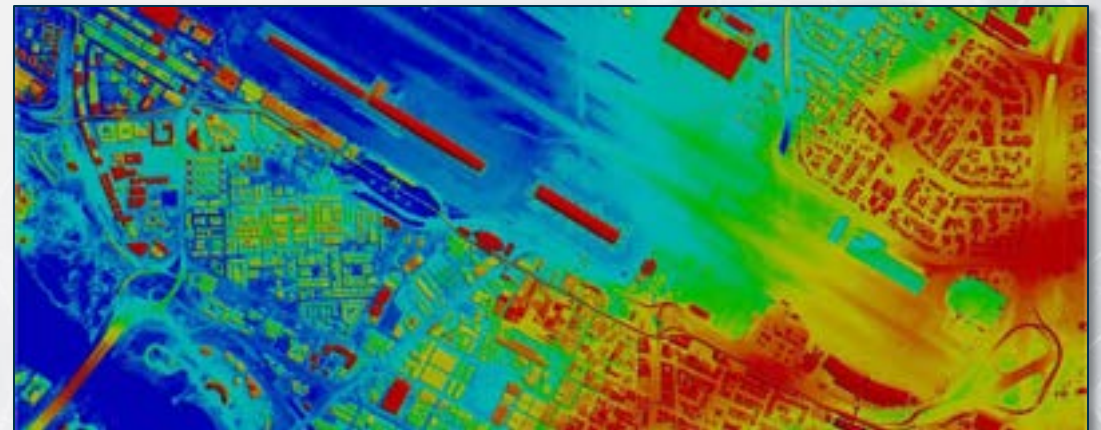


- **Remote Infrastructure Assessment:** Drones stationed at substations and transmission lines were launched remotely to assess damage before crews were dispatched.
- **Optimized Routing:** UAVs helped identify safe paths for repair teams, avoiding flooded zones and debris.
- **Accelerated Restoration:** 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

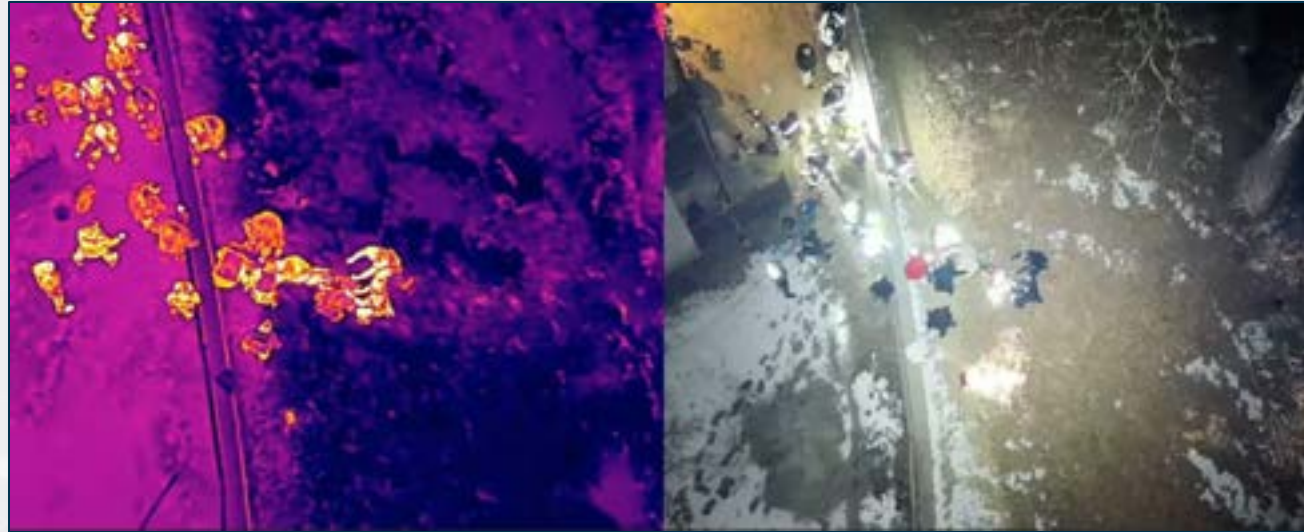


UAS can quickly map affected zones, enabling responders to prioritize resources and plan evacuation routes.



CGA Energy Nexus & Annual Technical Conference 2025

Applications – Search and Security Operations



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

CGA Energy Nexus & Annual Technical Conference 2025

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.



CGA Energy Nexus & Annual Technical Conference 2025

Applications – Communication Restoration



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



CGA Energy Nexus & Annual Technical Conference 2025

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

CGA Energy Nexus & Annual Technical Conference 2025

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.

CGA Energy Nexus & Annual Technical Conference 2025

Drone Accessories for Emergency Operations



CGA Energy Nexus & Annual Technical Conference 2025

Accessories – EO Sensors and telephoto



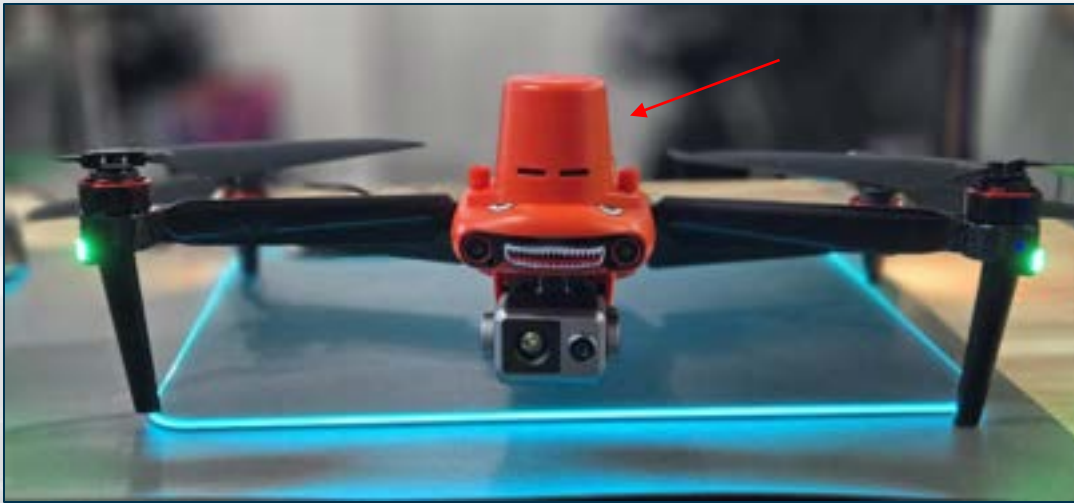
An **Electro-Optical** (EO) sensor on a drone captures high-resolution visual data using visible light.

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

- Gas Meters
- Pipeline Valves
- Flare Stacks

CGA Energy Nexus & Annual Technical Conference 2025

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



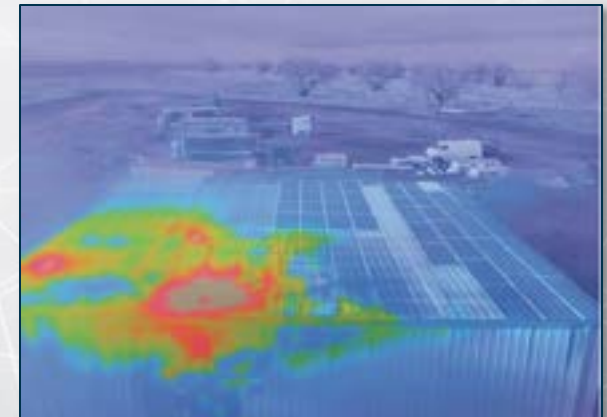
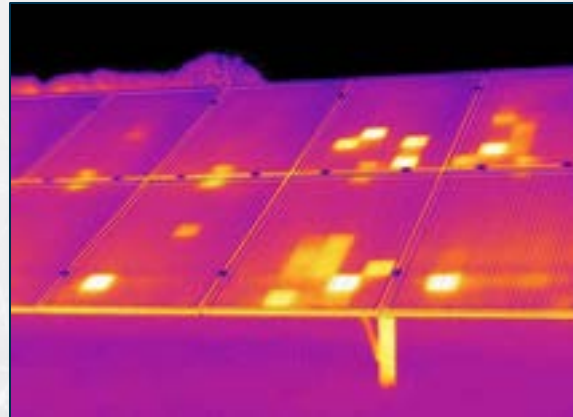
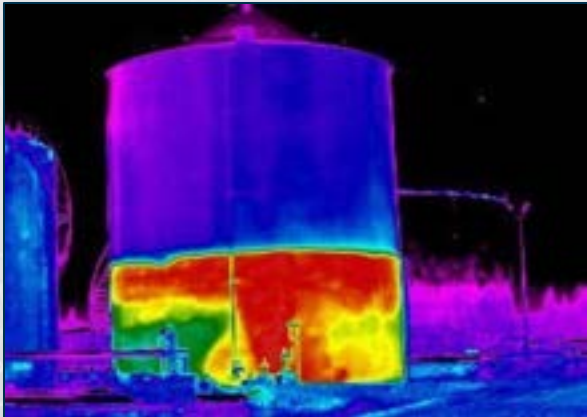
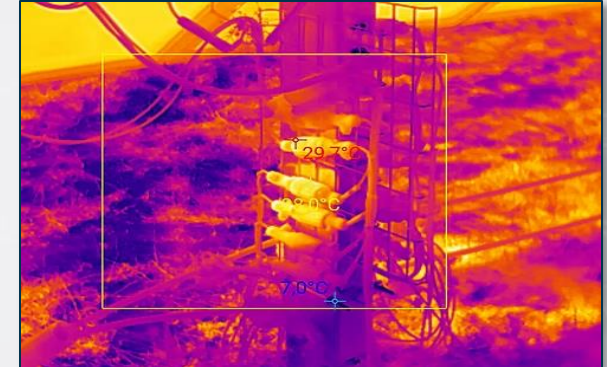
CGA Energy Nexus & Annual Technical Conference 2025

Accessories - Light Detection and Ranging (LiDAR)



CGA Energy Nexus & Annual Technical Conference 2025

Accessories - InfraRed (IR) Cameras



CGA Energy Nexus & Annual Technical Conference 2025

Accessories - Optical Gas Imaging (OGI) camera



DETECTABLE GASES

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

CGA Energy Nexus & Annual Technical Conference 2025

Accessories - Spotlights & Loudspeakers



CGA Energy Nexus & Annual Technical Conference 2025

Accessories - Tethers



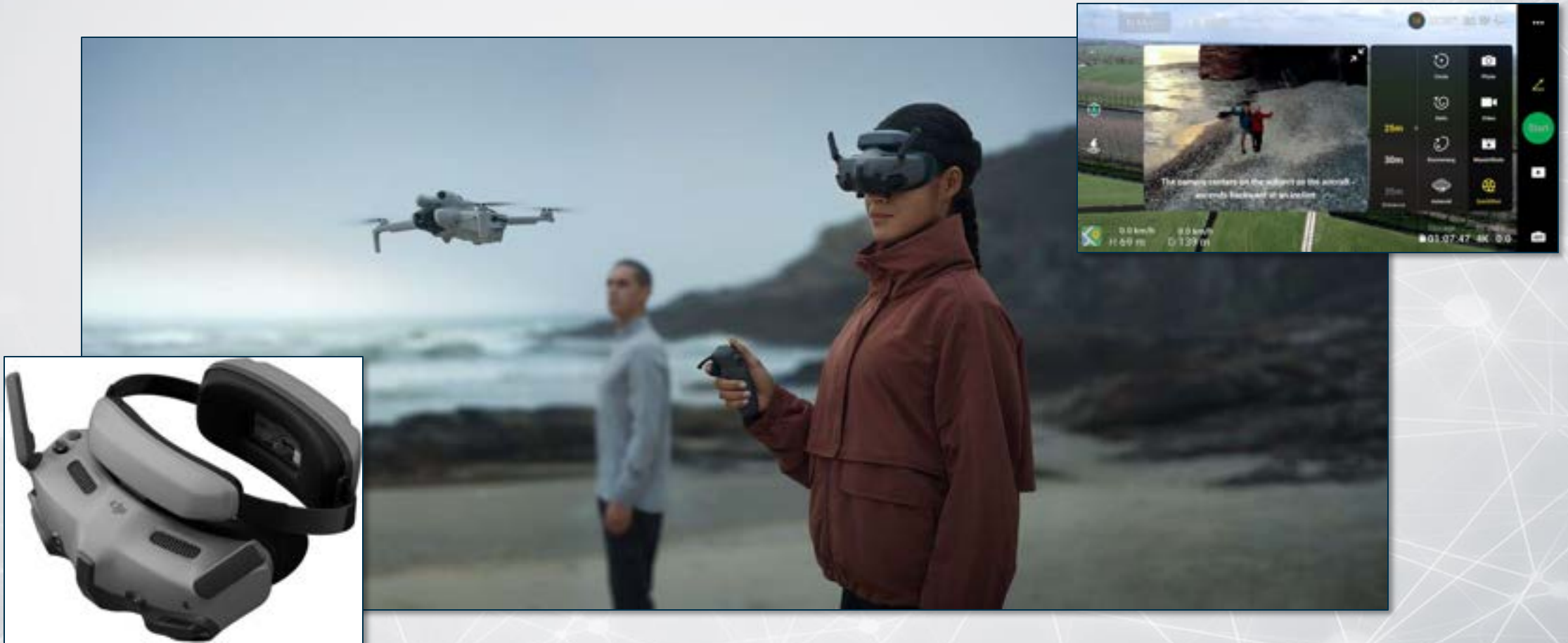
CGA Energy Nexus & Annual Technical Conference 2025

Accessories – Docking stations



CGA Energy Nexus & Annual Technical Conference 2025

Accessories – FPV Goggles



CGA Energy Nexus & Annual Technical Conference 2025

Accessories – Connectivity



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

CGA Energy Nexus & Annual Technical Conference 2025

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.

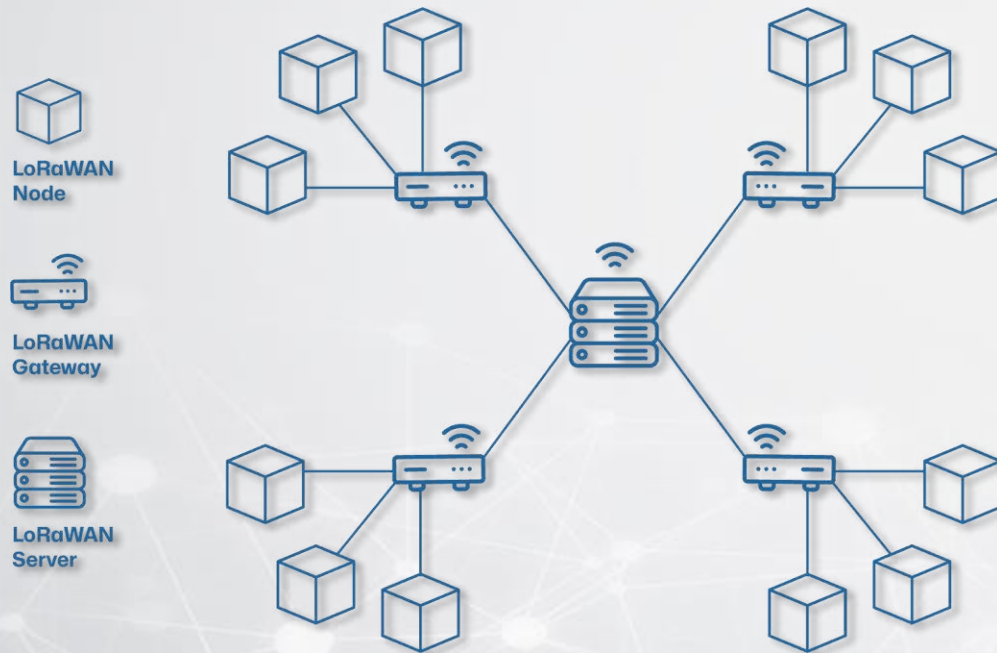
CGA Energy Nexus & Annual Technical Conference 2025

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.

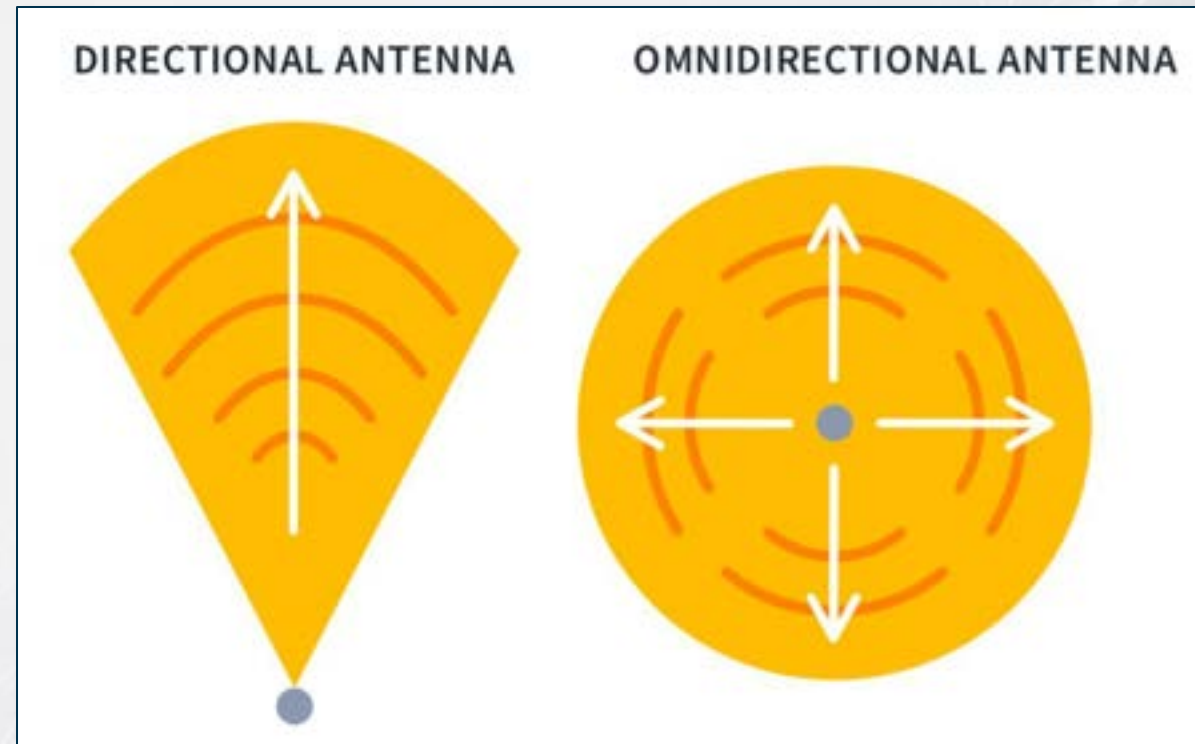
LoRaWAN Range and Antennas

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



CGA Energy Nexus & Annual Technical Conference 2025

MQTT – a lightweight Protocol



MQTT provides interoperability, allowing clients to communicate effectively, and **decouples** data between hardware and software sources.

There are **no direct connections** from the clients.

```
1759909542: Received PUBLISH from 001905 (d0, q1, r0, m0943, "ap@v1.0/none/NEATA/001905", ... (133 bytes))
1759909542: Sending PUBLISH to PowerSpringEast (d0, q1, r0, m01167, "ap@v1.0/none/NEATA/001905", ... (133 bytes))
1759909542: Sending PUBLISH to FlexMQEast (d0, q1, r0, m01167, "ap@v1.0/none/NEATA/001905", ... (133 bytes))
1759909542: Sending PUBLISH to ReportingTest (d0, q1, r0, m46519, "ap@v1.0/none/NEATA/001905", ... (133 bytes))
1759909542: Sending PUBACK to 001905 (m0943, r0)
1759909542: Received PUBACK from FlexMQEast (Mid: 51147, RC:0)
1759909542: Received PUBACK from PowerSpringEast (Mid: 51147, RC:0)
1759909542: Received PUBACK from ReportingTest (Mid: 46519, RC:0)
1759909543: Received PUBLISH from 400424 (d0, q1, r0, m37904, "ap@v1.0/none/NEATA/400424", ... (112 bytes))
1759909543: Sending PUBLISH to PowerSpringEast (d0, q1, r0, m01168, "ap@v1.0/none/NEATA/400424", ... (112 bytes))
1759909543: Sending PUBLISH to FlexMQEast (d0, q1, r0, m01168, "ap@v1.0/none/NEATA/400424", ... (112 bytes))
1759909543: Sending PUBLISH to ReportingTest (d0, q1, r0, m46520, "ap@v1.0/none/NEATA/400424", ... (112 bytes))
1759909543: Sending PUBACK to 400424 (m37904, r0)
1759909543: Received PUBACK from PowerSpringEast (Mid: 51148, RC:0)
1759909543: Received PUBACK from FlexMQEast (Mid: 51148, RC:0)
1759909543: Received PUBACK from ReportingTest (Mid: 46520, RC:0)
1759909543: New connection from on port 8883.
1759909543: Received PUBLISH from 400425 (d0, q1, r0, m21239, "ap@v1.0/none/NEATA/400425", ... (114 bytes))
1759909543: Sending PUBLISH to PowerSpringEast (d0, q1, r0, m01169, "ap@v1.0/none/NEATA/400425", ... (114 bytes))
1759909543: Sending PUBLISH to FlexMQEast (d0, q1, r0, m01169, "ap@v1.0/none/NEATA/400425", ... (114 bytes))
1759909543: Sending PUBLISH to ReportingTest (d0, q1, r0, m46521, "ap@v1.0/none/NEATA/400425", ... (114 bytes))
1759909543: Sending PUBACK to 400425 (m21239, r0)
1759909543: Received PUBACK from FlexMQEast (Mid: 51149, RC:0)
1759909543: Received PUBACK from PowerSpringEast (Mid: 51149, RC:0)
1759909543: Received PUBACK from ReportingTest (Mid: 46521, RC:0)
1759909543: Client 400376 already connected, closing old connection.
1759909543: Sending PUBLISH to PowerSpringEast (d0, q1, r0, m01170, "ap@v1.0/none/NEATA/400376", ... (121 bytes))
1759909543: Sending PUBLISH to FlexMQEast (d0, q1, r0, m01170, "ap@v1.0/none/NEATA/400376", ... (121 bytes))
1759909543: Sending PUBLISH to ReportingTest (d0, q1, r0, m46522, "ap@v1.0/none/NEATA/400376", ... (121 bytes))
1759909543: New client connected from as 400376 ip2, q1, k180, u'400376').
```

CGA Energy Nexus & Annual Technical Conference 2025

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

CGA Energy Nexus & Annual Technical Conference 2025

Field Case Study - Results

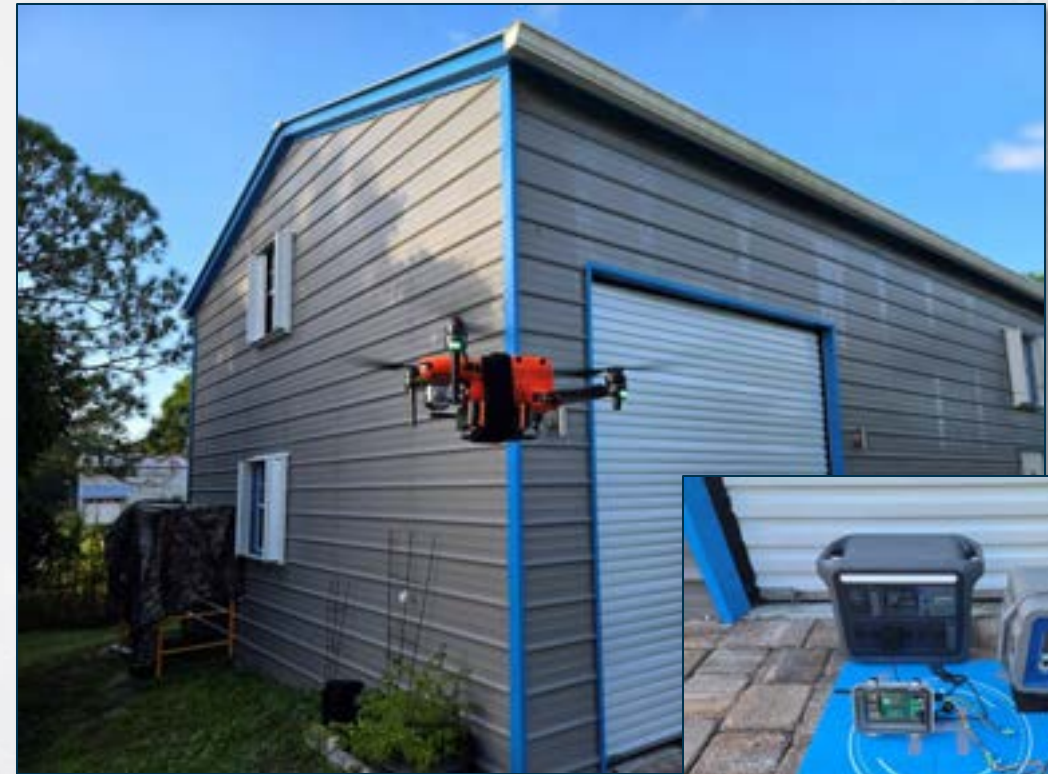
Results:

- 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.

```
07:43:22 INF Arachne000 Processing New Connected msg for : PT0000
07:43:22 INF Arachne000 Processing New Metrics msg for : PT0000
07:43:38 INF Log Message Arachne001: Incoming Message : spb01.0/Name/NCATH/PT0000 received
07:43:38 INF Message specified Datetime is : 10/28/2025 14:28:00
07:43:38 INF Arachne000 Processing disconnect msg for : PT0000
07:43:38 INF Arachne000 Processing New Metrics msg for : PT0000
07:43:52 INF Log Message Arachne001: Incoming Message : spb01.0/Name/NCATH/PT0000 received
07:43:52 INF Message specified Datetime is : 10/28/2025 11:40:19
07:43:52 INF Arachne000 Processing New Connected msg for : PT0000
07:43:52 INF Arachne000 Processing New Metrics msg for : PT0000
07:43:56 INF Log Message Arachne001: Incoming Message : spb01.0/Name/NCATH/PT0000 received
07:43:56 INF Message specified Datetime is : 10/28/2025 11:40:24
07:43:56 INF Arachne000 Processing New Metrics msg for : PT0000
08:53:31 INF Log Message Arachne001: Incoming Message : spb01.0/Name/NCATH/PT0000 received
08:53:31 INF Message specified Datetime is : 10/28/2025 11:40:00
08:53:31 INF Arachne000 Processing disconnect msg for : PT0000
08:53:31 INF Arachne000 Processing New Metrics msg for : PT0000
09:11:44 INF Log Message Arachne001: Incoming Message : spb01.0/Name/NCATH/PT0000 received
09:11:44 INF Message specified Datetime is : 10/28/2025 12:00:24
09:11:44 INF Arachne000 Processing New Connected msg for : PT0000
09:12:16 INF Arachne000 Processing New Metrics msg for : PT0000
09:12:16 INF Log Message Arachne001: Incoming Message : spb01.0/Name/NCATH/PT0000 received
09:12:16 INF Message specified Datetime is : 10/28/2025 12:00:33
09:12:16 INF Arachne000 Processing New Connected msg for : PT0000
09:12:16 INF Arachne000 Processing New Metrics msg for : PT0000
09:12:21 INF Log Message Arachne001: Incoming Message : spb01.0/Name/NCATH/PT0000 received
09:12:21 INF Message specified Datetime is : 10/28/2025 12:00:50
09:12:21 INF Arachne000 Processing New Metrics msg for : PT0000
```



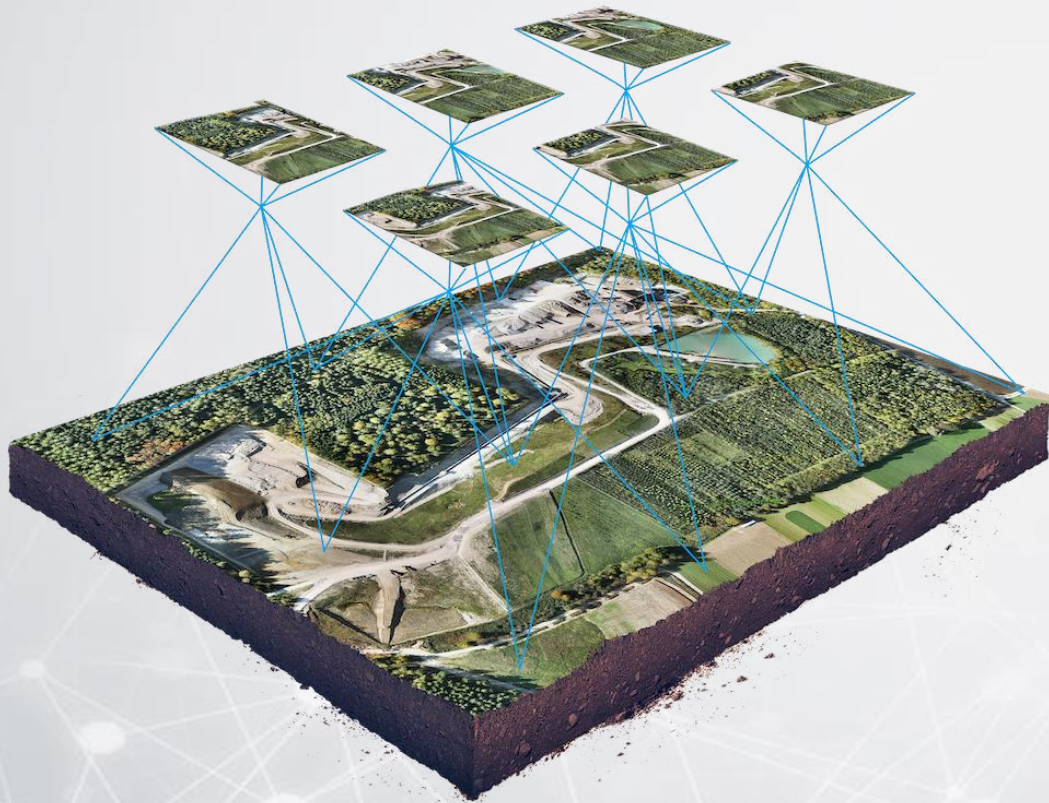
CGA Energy Nexus & Annual Technical Conference 2025

Drone Mapping & Data Collection



CGA Energy Nexus & Annual Technical Conference 2025

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.

CGA Energy Nexus & Annual Technical Conference 2025

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.

CGA Energy Nexus & Annual Technical Conference 2025

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.

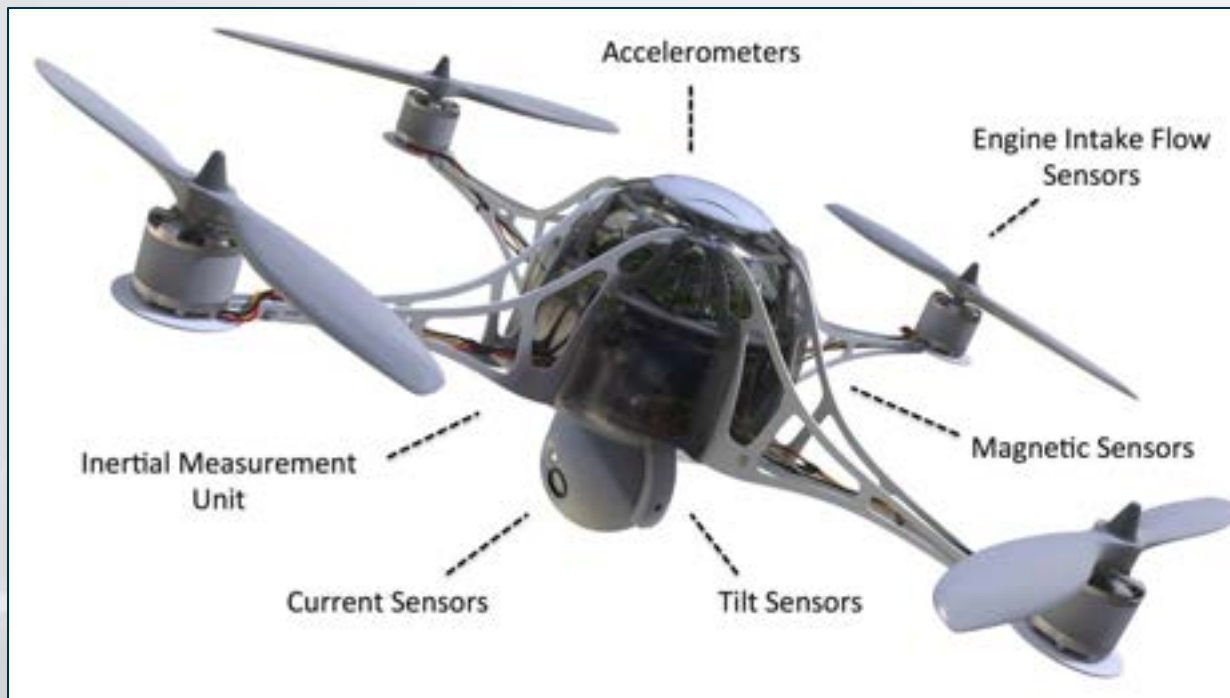
CGA Energy Nexus & Annual Technical Conference 2025

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

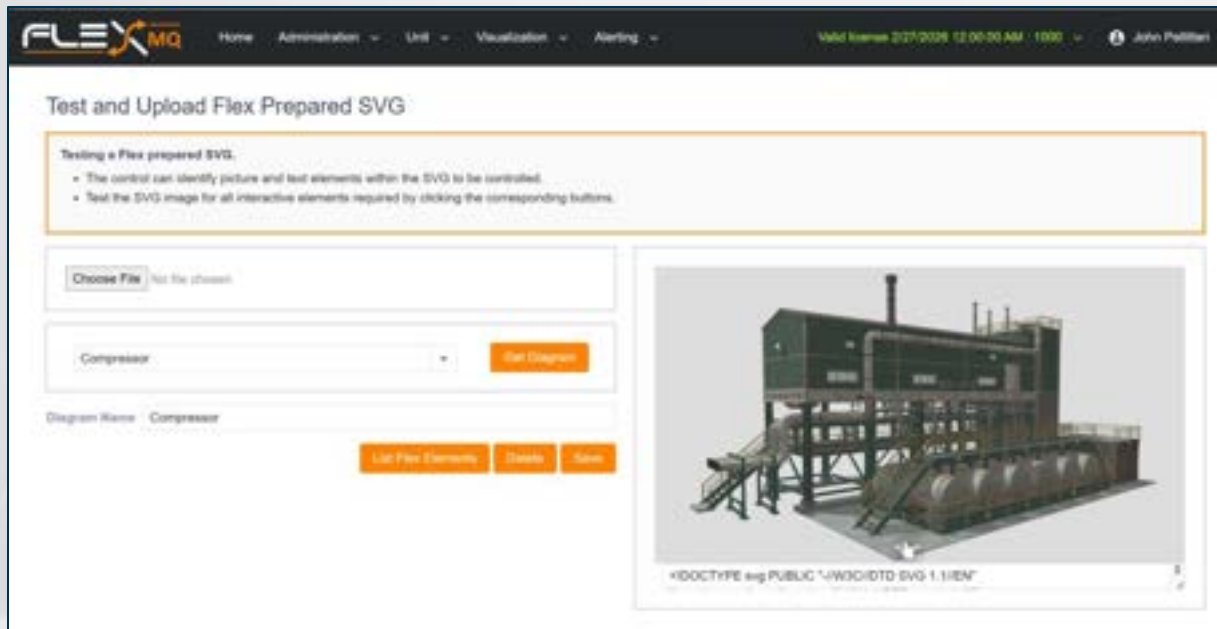


GPS and IMU (Inertial Measurement Unit): These provide precise orientation and positional data for geotagging each image.

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

CGA Energy Nexus & Annual Technical Conference 2025

Benefits over traditional mapping



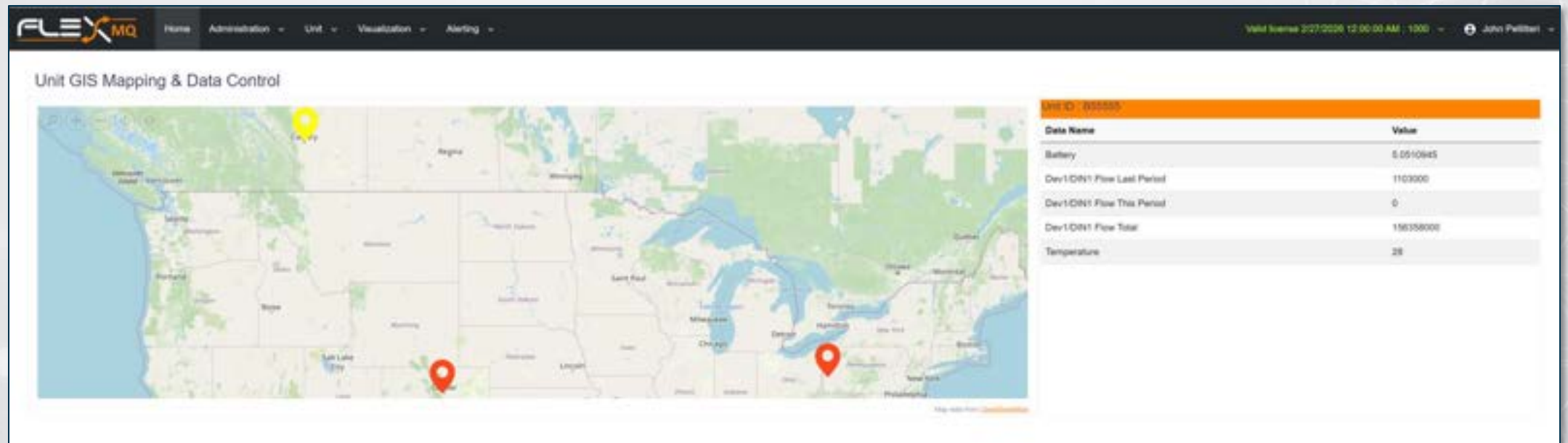
Advantages of Advanced Data Solutions

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



CGA Energy Nexus & Annual Technical Conference 2025

Integrated Field Notifications



CGA Energy Nexus & Annual Technical Conference 2025

Proactive Alerting

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

FLEXMQ Home Administration Unit Visualization Alerting Valid license 2270326 12:00:00 AM 1000 John Pelitteri

Alert Monitoring

Monitor Alerts in Near Real Time

- Pinpoint an event location.
- View event details and acknowledge an event episode.
- If a unit is in alert but cannot be seen on the map, the unit doesn't have any GPS coordinates stored.

Map Only Grid Only Full Console

Active Alerts Map

Alert Monitor Key

- Unit has uncleared and unacknowledged alerts
- Unit has acknowledged but uncleared alerts
- Unit has cleared but unacknowledged alerts
- Unit has no active alerts

twilio

Unit Population Alert Status

ID	Alarm Name	Unit ID	Unit Name
163	upper alarm on Pi	LM0001	
894	FloatTest	LM0001	
293	Close Switch	436130	
63	Pressure 1 Low Alarm	(3)76783068	
65	Pressure 1 Low Alarm	(5)72864468	
116	Pressure 1 Low Alarm	(1)76785582	
112	Pressure 1 High Alarm	(1)76785582	
118	Input 1 PUP High	980936	
121	Pressure 1 Low Alarm	(4)76786291	
134	Closed Switch	108846	

FlexMQ Alert Message

FlexMQ Mailer <liam@evidensuk.com>
To: John Pelitteri

Summary

Reply Reply All Forward

Wed 09/10/2025 11:57

FlexMQ Alert Message

Warning - Close Switch

Unit 436130 is currently in alert and is configured to notify you of it's status.

Please see the following information concerning the alert:

- Alarm ID: 293
- Alarm Name: Close Switch
- Threshold Value: 1.0000
- Current Value: 60
- Current Value Date Time UTC: 10/09/2025 15:58:00

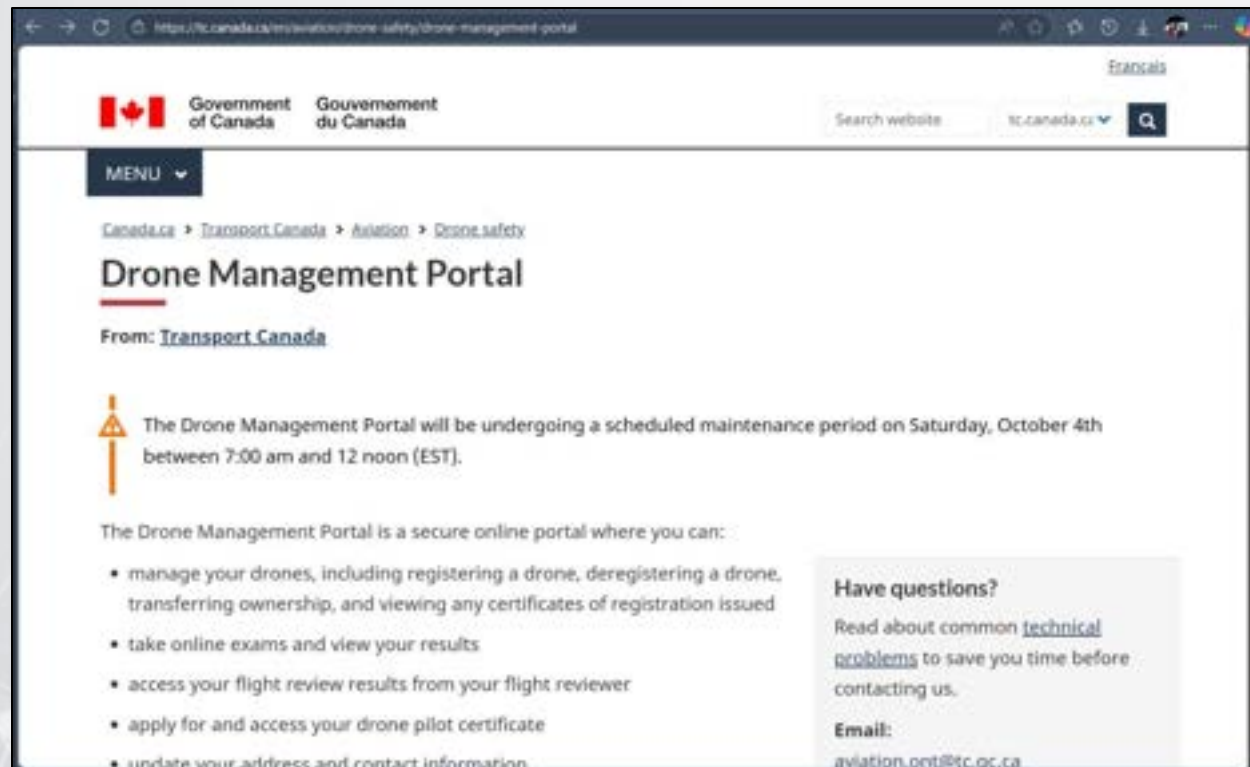
This alert has neither been acknowledged or cleared. Please take the appropriate action

Regards,

Flex MQ Alert Team.

CGA Energy Nexus & Annual Technical Conference 2025

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

CGA Energy Nexus & Annual Technical Conference 2025

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.



CGA Energy Nexus & Annual Technical Conference 2025

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.

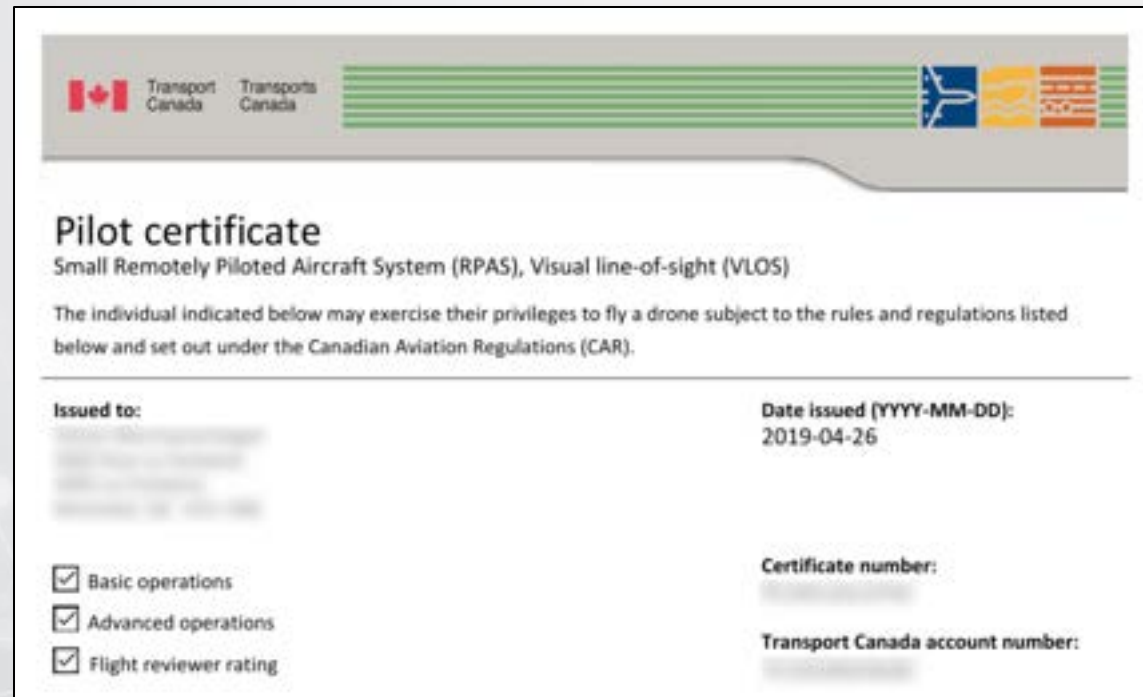



Drone Registration



CGA Energy Nexus & Annual Technical Conference 2025

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: [Redacted]

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

☒ Basic operations

☒ Advanced operations

☒ Flight reviewer rating

Certificate number: [Redacted]

Transport Canada account number: [Redacted]

Types of Certificates:

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

CGA Energy Nexus & Annual Technical Conference 2025

Restricted Zones



Operators must avoid:

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

CGA Energy Nexus & Annual Technical Conference 2025

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.

CGA Energy Nexus & Annual Technical Conference 2025

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

CGA Energy Nexus & Annual Technical Conference 2025

Ingress Protection Ratings

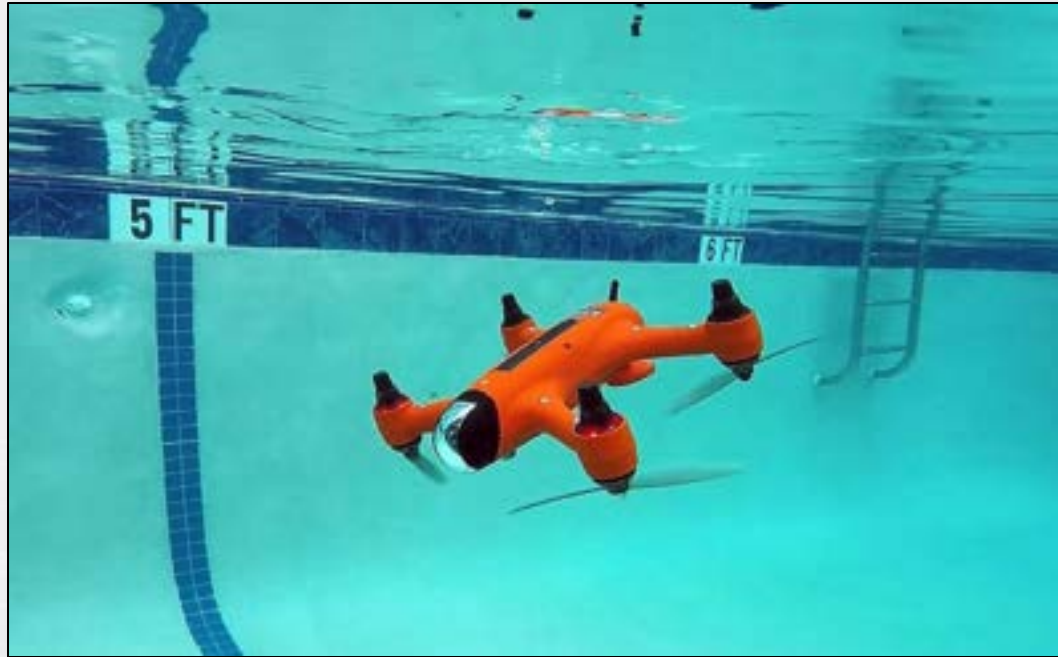
An IP rating is formatted as **IPXY**, where:

X = protection against solids (0–6)

Y = protection against liquids (0–9)

Solid objects	Liquid
0 No protection against contact and ingress of objects	0 No protection
1 Protects against objects > 50 mm (hands)	1 Protects against dripping water or condensation
2 Protects against objects > 12.5 mm (fingers)	2 Protects against vertical water jets of 15 degrees
3 Protects against objects > 2.5 mm (tools/cords)	3 Protects against vertical water jets of 60 degrees
4 Protects against objects > 1 mm (small tools)	4 Protects against water jets from every direction
5 Protects against dust, limited ingress	5 Protects against low pressure water jets from every direction
6 Protection against objects, total protection against dust	6 Protects against high pressure water jets or rough sea
	7 Protects against temporary immersion in water tested for 30 min. at a depth of 1 metre
	8 Protects against immersion in water over an extended period of time at a depth of more than 1 metre
	9K Protects against high pressure and high water or steam temperatures

Weather-Resistant vs. Waterproof



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

CGA Energy Nexus & Annual Technical Conference 2025

Public Perception in Canada



CGA Energy Nexus & Annual Technical Conference 2025

Thank You!!!

Presented by: John F. Pellitteri

Managing Director

Space Coast Helpdesk Inc.

Authors: John F. Pellitteri, Alyssa Foster



CGA Energy Nexus & Annual Technical Conference 2025

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.

