

When the Earth Speaks – QuakeGuard Listens



Every day, vibrations beneath our feet carry signs of movement, impact,
or danger — but most go unheard.

What if we could turn the ground itself into a global sensor network?

The problem: Unseen Threats. Unheard Signals.

- Borders and critical infrastructures are under constant stress — from natural and man-made events.
- Explosions, tunneling, or heavy vehicle movement often go undetected in real time.
- Existing monitoring systems are **expensive, centralized, and slow to react.**



The Opportunity:

A New Layer of Awareness – From Below the Surface

- The same data that can warn of earthquakes can also reveal hostile activity.
- Dual-use sensing: the next frontier in defense and civil protection.
- The EU's security depends on **situational awareness**, **low-cost sensing**, and **resilience**.



The Solution: Introducing QuakeGuard

An AI-powered network of **seismic and acoustic sensors** that detects vibrations, explosions, and underground activity — in real time.

- Built on Raspberry Pi and Raspberry Shake hardware.
- Edge AI + cloud fusion for event classification.
- Instant alerts and map visualization.
- Modular, low-cost, rapidly deployable.



How It Works

Smart Detection. Fast Response.

Flow:

- ① Sensors record seismic + acoustic signals.
- ② Edge AI filters and classifies events.
- ③ Cloud AI fuses data across nodes.
- ④ Alerts sent to users or to Intelligence, Surveillance, Reconnaissance (ISR) systems.



Dual-Use Value: From Defense to Civil Protection

Defense Use:

- Border surveillance and underground activity detection.
- Integration with ISR and C2 systems.
- Protection of critical military sites.

Civil Use:

- Early-warning for earthquakes, explosions, or industrial vibrations.
- Infrastructure safety (bridges, tunnels, pipelines).
- Citizen awareness through low-cost IoT.

Innovation & Technology - AI at the Edge – Built on Existing Sensors Network and Interoperability

- Edge ML models (TensorFlow Lite) for seismic + audio classification.
- Cloud fusion for multi-sensor correlation.
- Designed to be interoperable with **European ISR frameworks** and **NATO STANAG data standards**.
- Based on open hardware and software (Raspberry Pi ecosystem).



Ground motion

Water

Market & Impact: Where QuakeGuard Delivers Value

Sectors:

- Defense & Border Security (EU, NATO).
- Civil Protection & Disaster Response.
- Energy & Infrastructure Operators.

Impact

- <2 seconds detection latency.
- Scalable to thousands of sensors.
- Scaling through integration, not replacement.

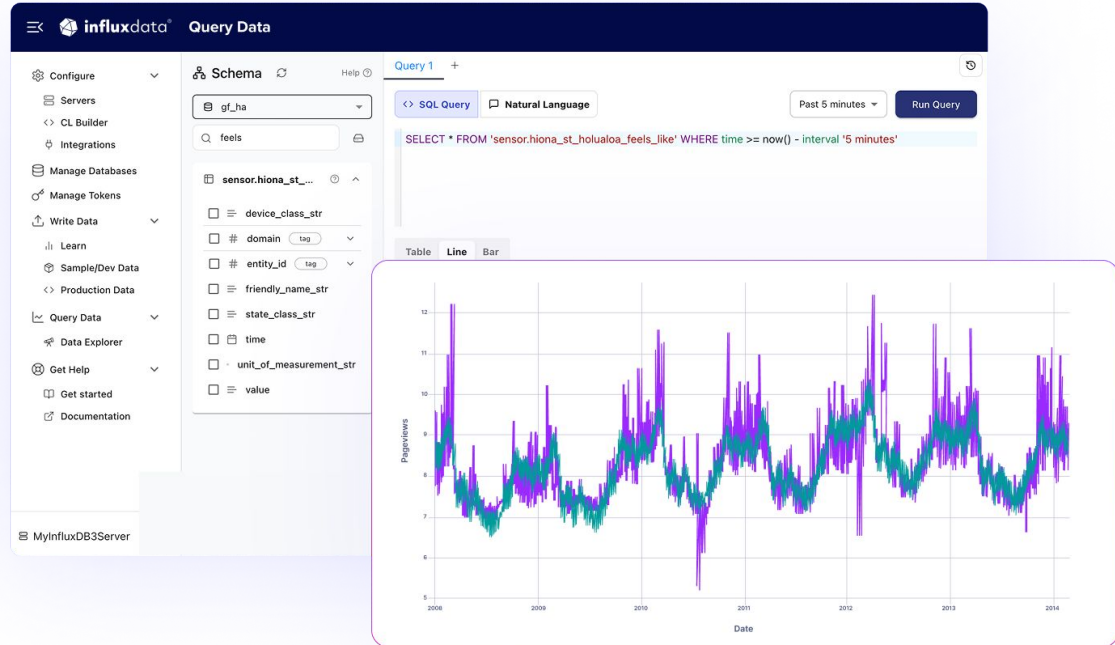
Competitive advantage - Why QuakeGuard Wins

- Dual intelligence - seismic + acoustic
- Open, low-cost hardware = rapid scaling.
- AI-driven detection = minimal false positives.
- Designed for both **civilian networks** and **defense-grade ISR**.



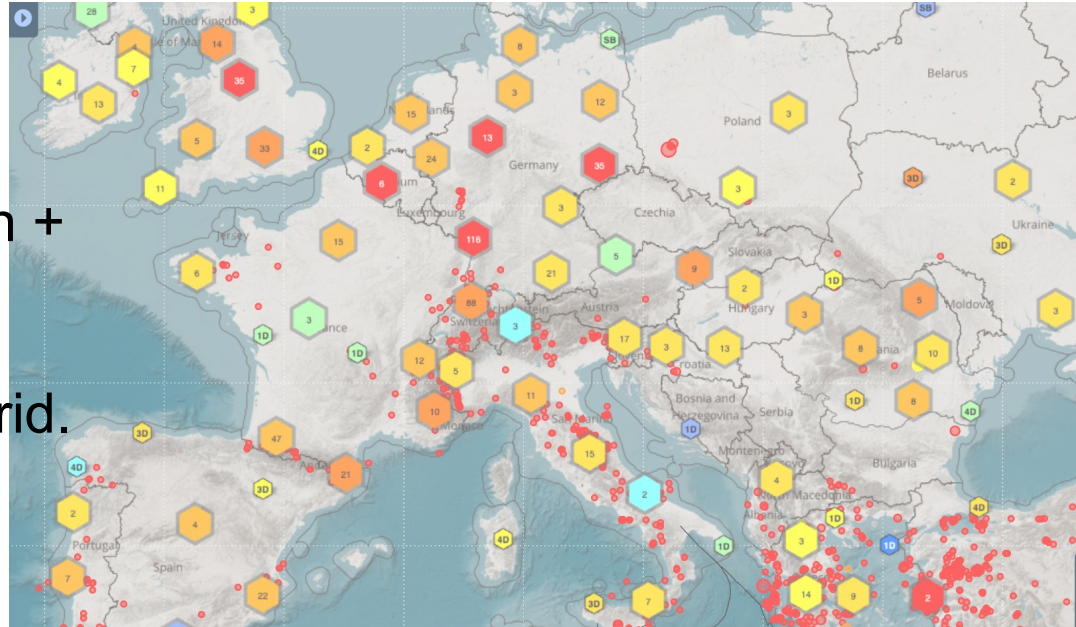
Business model: Seismic-as-a-Service

- Subscription-based for civil customers (alerts & analytics).
- Partnership/licensing for defense and infrastructure clients.
- Hardware sold or leased (plug-and-play sensors).



Roadmap: From Prototype to European Deployment

- **Q1–Q2 2026:** MVP validation, AI accuracy tests.
- **Q3–Q4 2026:** Civilian pilot deployments.
- **2027:** Dual-use certification + ISR integration.
- **2027+:** EU-wide sensing grid.



The Team

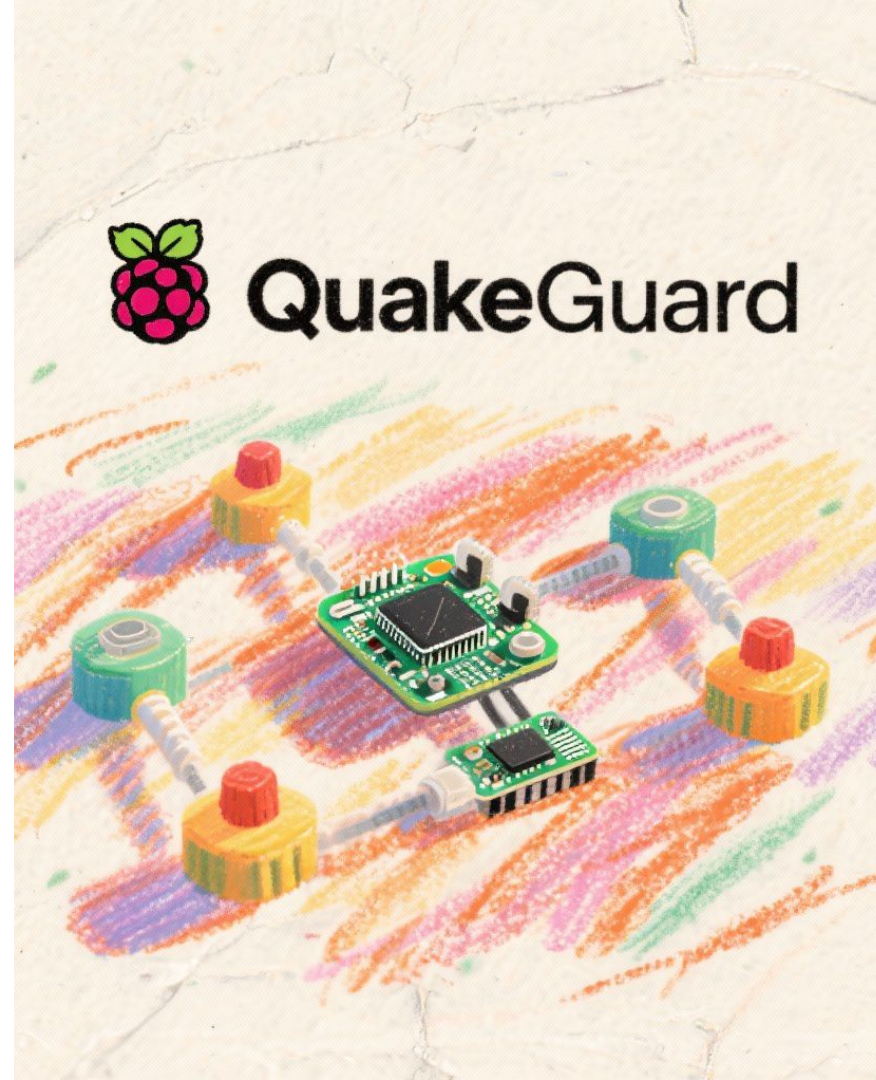
Cross-domain expertise.

One vision: intelligent protection.

- **Catalin Chivu** – Programming & Cybersecurity & AI Systems
- **Vlad Oprea** – Programming, AI Systems, Machine Learning
- **Searching for:** advisors in defense innovation, sensors and seismology.

The Ask

- Seeking **€25K in grants or pilot funding** for field validation.
- Looking for **partners** in defense, civil protection, and research.
- Invitation to **build Europe's first distributed sensing shield.**



QuakeGuard – Turning Vibrations into Intelligence.



hello@quakeguard.net

**Raspberry Shake devices detect mechanical vibrations (0.1–29 Hz)
and infrasound or pressure waves (0.05–20 Hz)**

1. Mechanical Vibrations (0.1 – 29 Hz)

This is the frequency band covered by Raspberry Shake’s seismographs (such as RS1D, RS3D, and RS4D). Vibrations in this range correspond closely to the movement of heavy ground-based objects:

Vibration Source	Typical Dominant Frequency	Detection Implication
Tanks & armored vehicles	1–10 Hz	Very similar to truck/tractor vibrations studied in the 1–20 Hz range pmc.ncbi.nlm.nih +1 . Easily within the detectable band of RS4D.
Truck convoys / road traffic	1–20 Hz	Produces continuous low-frequency ground waves that Raspberry Shakes regularly record as cultural noise.
Footsteps / soldiers walking	>20 Hz (localized, weak amplitude)	Not typically detectable beyond a few meters.
Blasts from artillery / detonations	0.5–15 Hz (ground-coupled)	Within the RS’s passband, strong signals may be recorded several km away depending on soil type and terrain.

**Raspberry Shake devices detect mechanical vibrations (0.1–29 Hz)
and infrasound or pressure waves (0.05–20 Hz)**

2. Low Frequency Explosions and Pressure Waves (0.05 – 20 Hz)

This range refers to the infrasound domain. The RS&BOOM and Raspberry Boom models detect both infrasonic (below 20 Hz) and audible (20–40 Hz) pressure oscillations. These waves travel long distances in the atmosphere—farther than seismic waves in soft ground—by refracting between atmospheric layers.

Source Type	Dominant Infrasound Frequency	Typical Detection Range
Artillery, heavy explosions	0.5 – 5 Hz	Up to tens of kilometres, depending on atmospheric conditions.
Large bombs or rocket launches	0.05 – 10 Hz	50 – 200+ km possible; comparable to volcanic eruption detections pubs.aip .
Low-altitude jets / helicopters	1 – 20 Hz	Mainly local (within a few kilometres), though distinctive patterns can be seen.

3. Factors Affecting Detection Range

Detection range is determined by:

- Energy of the source: Larger explosions or heavier vehicles release more vibration energy.
- Medium coupling: Hard soil or rock transmits seismic energy better than soft ground.
- Background noise: Urban or windy environments raise the noise floor, reducing sensitivity.
- Weather & atmosphere: For infrasound, temperature and wind profiles strongly affect how far pressure waves propagate.

A practical summary:

- Heavy vehicle convoys → detectable within a few km as seismic signal.
- Explosions / artillery → detectable up to tens of km.
- Major blasts / rocket launches → possibly up to 50–100 km under favorable atmospheric conditions.

Thus, a local array of Raspberry Shake units could clearly register nearby military activity such as convoys or firing exercises, and large distant explosions would appear as identifiable low-frequency events.

Why QuakeGuard integration matters

QuakeGuard extends the ISR and C2 “sensor reach” **beneath the surface** — literally.

Most ISR/C2 systems cover the *sky, sea, and surface*, but have limited sensing for:

- **Underground activities** (tunnels, subsurface vibrations).
- **Blast and shockwave detection** (explosions, missile impacts).
- **Micro-seismic data** that indicates movement or sabotage.

That’s where QuakeGuard complements existing ISR architectures — adding a **new sensory domain: the ground**.

How integration works technically

QuakeGuard generates geotagged event data in real time:

```
{  
  "timestamp": "2025-05-19T10:15:00Z",  
  "event_type": "explosion",  
  "lat": 45.123,  
  "lon": 26.456,  
  "confidence": 0.94,  
  "magnitude": 3.2,  
  "source": "QG_Node_34"  
}
```

This JSON or XML can be formatted according to:

- **STANAG 4607 / 4559** (NATO ISR data exchange standards)
- **OGC SensorThings API** (for civil ISR & environmental networks)
- **GeoJSON / WMS feeds** for C2 visualization layers

Communication Layer

Each QuakeGuard node could communicate via:

- **Secure MQTT or HTTPS** → edge-to-cloud ingestion
- **Encrypted REST API / WebSocket stream** → for ISR data fusion
- **NATO FMN Gateway compatibility** → for partner networks (optional)

Data is routed into the **ISR fusion layer**, where it could be combined with:

- EO/IR imagery (from satellites & UAVs)
- Radar or SIGINT detections
- Geospatial intelligence (GEOINT) databases

Integration with Command & Control Dashboards

C2 systems could consume QuakeGuard data through:

- **REST or WebSocket endpoints** feeding map overlays.
- **Event triggers** that update threat layers in real time.
- **API plug-ins** for systems like *ATAK*, *ESRI ArcGIS*, *COP (Common Operational Picture)*.

Possible Example Scenarios

Scenario 1 – Border Protection (Dual-use)

- Multiple QuakeGuard sensors along EU's eastern border detect repetitive low-frequency ground motion.
- Data fuses in the ISR hub → flagged as possible tunneling.
- C2 issues a reconnaissance drone task order automatically.

Scenario 2 – Missile Impact Detection

- Explosion shockwave detected by QuakeGuard node cluster.
- Timestamp and coordinates shared instantly with ISR cloud.
- C2 dashboard shows validated impact; rapid-response team deployed.

Scenario 3 – Civil Emergency Coordination

- Small earthquake occurs near a refinery; QuakeGuard nodes confirm vibration pattern.
- Civil C2 center (through API link) issues alert to local responders.