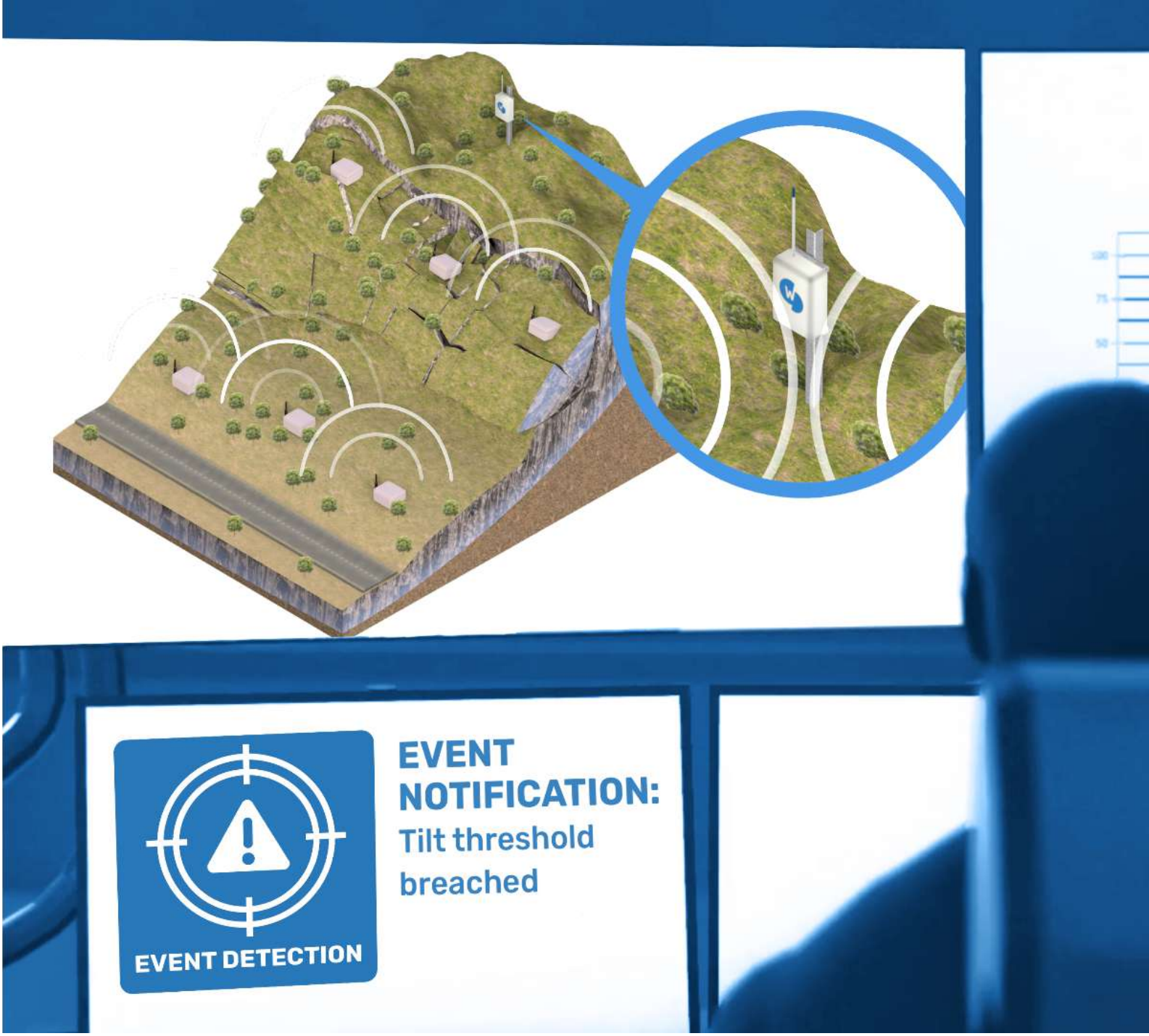

WORLD SENSING

Event Detection Solution

A key component of your early warning system

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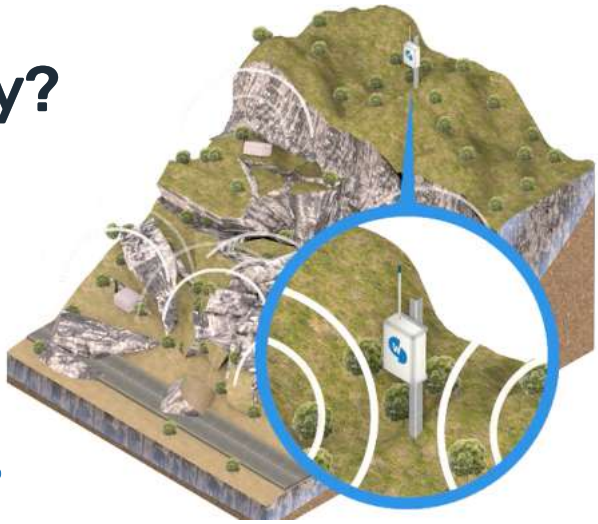
How can you detect early disturbances in land stability?



Land stability plays a critical role in the integrity of any civil infrastructure. However, climate change bringing intense rainfall and extreme weather, and pressure intense construction techniques such as jet grouting and tunnel boring can all rapidly trigger disturbances that affect land stability, causing:

- landslides
- slope instability
- ground movements
- infrastructure instability

Under these scenarios, having access to the early signs of earth movements can help to detect such harmful events and take action to minimize their effects.

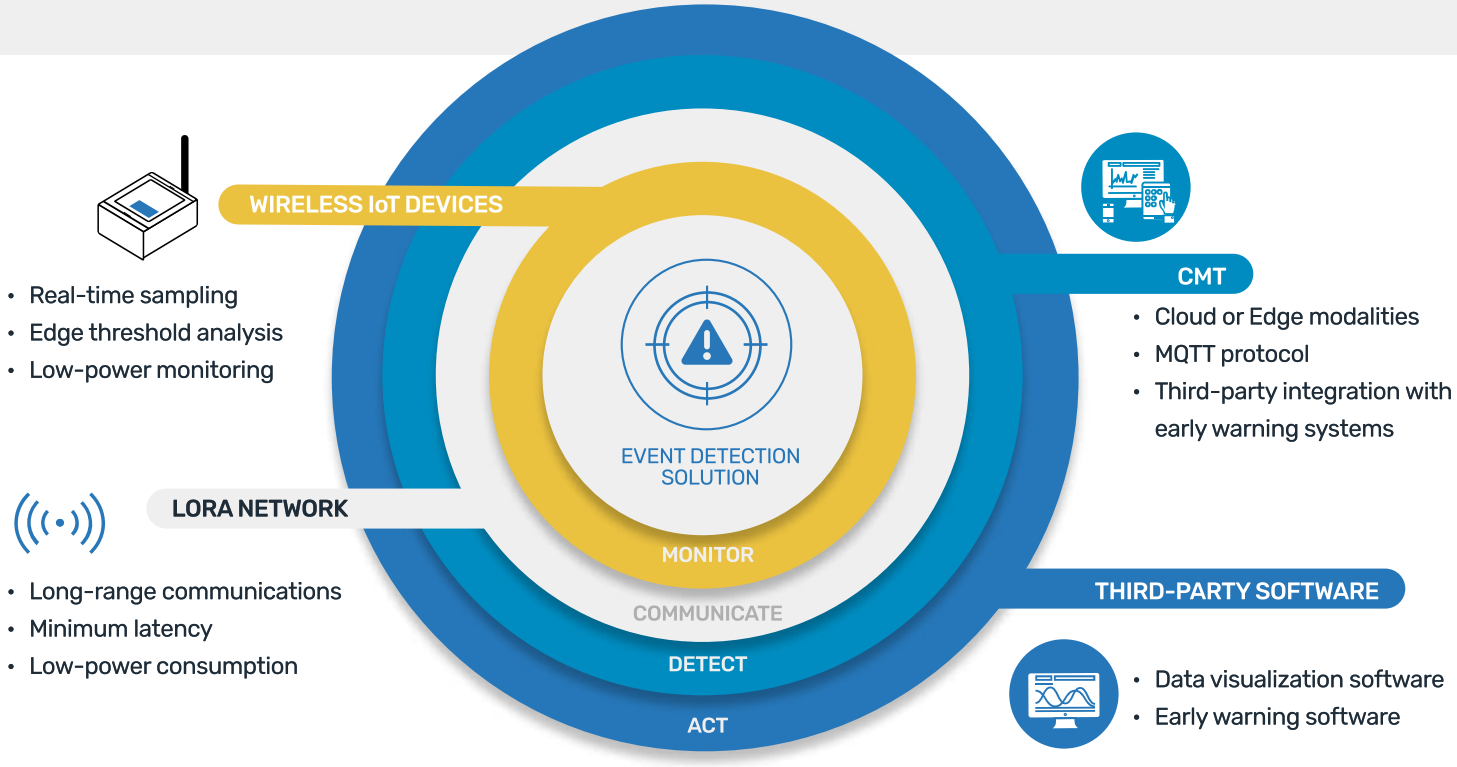
Take data-informed actions with dynamic IoT remote monitoring

Monitor land stability in real time and detect ground movements at early stages to make quick, data-driven decisions to safeguard both humans and the environment.

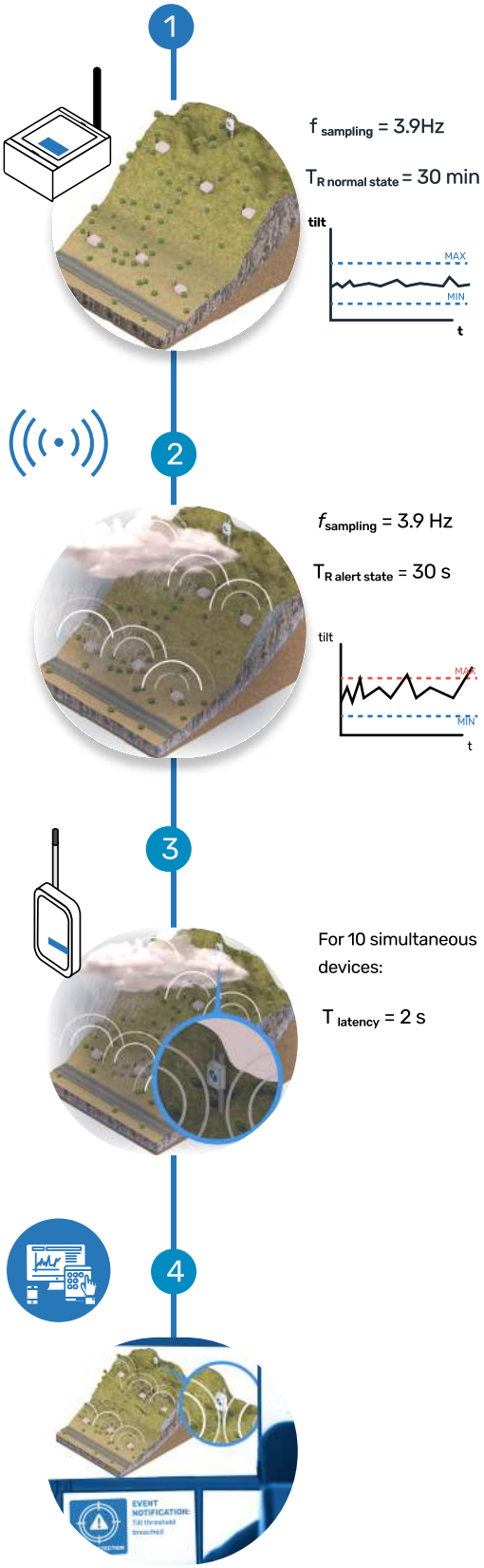
Worldsending's Event Detection Solution (EDS) combines robust intelligent wireless tiltmeters with edge computing capabilities and our LoRa communication network.

By integrating our software with your early warning system, you can access actionable information for event detection across your project site.

Work with a reliable solution that is easy to deploy and that can make your monitoring more efficient.



How does EDS work



1. REAL-TIME MONITORING UNDER NORMAL CONDITIONS

Continuous sampling on the device, roughly 4 samples per second (3.9 Hz). Under normal conditions, the digital logger sends periodic readings of the mean and standard deviation of a dataset. Wireless communication to the gateway via LoRa network can be set at a period T_R ranging from 30 min to 24 h.

2. DEVIATION DETECTED

A robust absolute-threshold algorithm embedded in the data logger continuously compares the last readings to a set of two absolute-threshold values that define the accepted range (threshold included) for any given axis.

When a difference between the readings lay outside the threshold, the **alert state is triggered in the device and the data transfer can increase up to 30 s (configurable).**

3. ALERT COMMUNICATION

Under the alert state, the device sends an alert message notification to the network with a **latency under 2 seconds for ten tiltmeters ($T_{latency}$)** that reach a threshold simultaneously, and under 5 seconds for the next 15 tiltmeters receiving the alert simultaneously. It also sends the data set of the exceeded threshold.

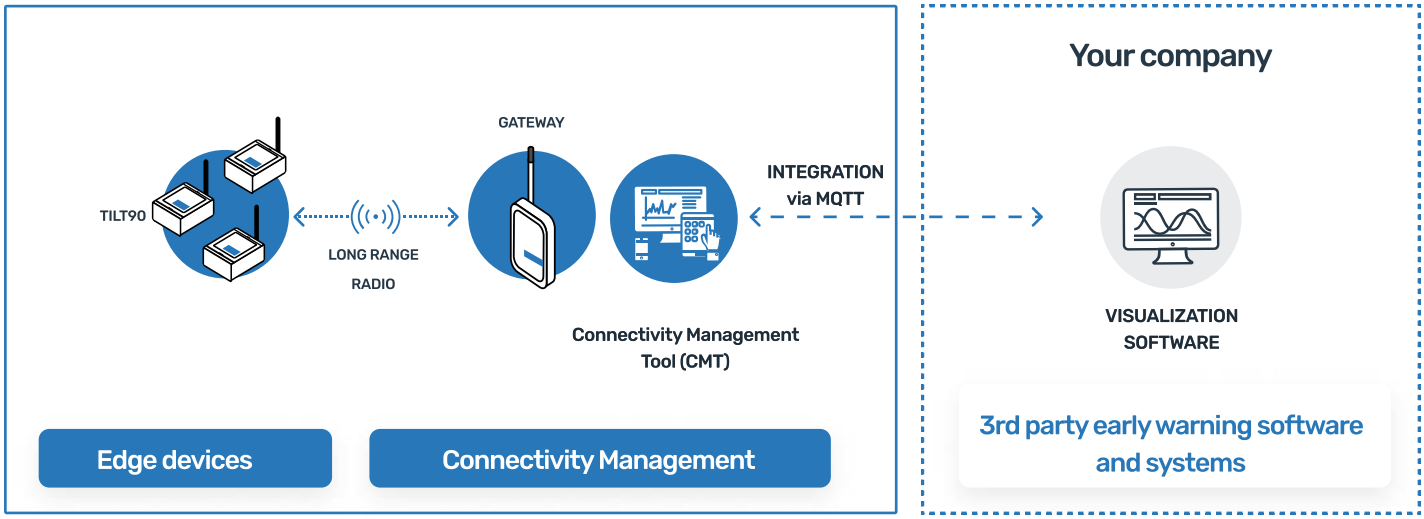
In addition, when an event of interest is detected, the node can increase the frequency of the reporting rate, moving from the reporting period in the normal state to one configured for alert state.

4. ACTIONABLE INFORMATION

The information travels to the CMT Cloud, the EDS software layer. CMT **enables the integration of these alerts into third-party software** to trigger actions based on the detected events. These can be:

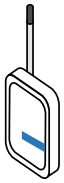
- SMS or email messages
- M2M messaging: road closure, close gate, stop hydraulic pumps in a jacking system or decrease/increase pressure, take a picture/start video recording

The key components of the solution



EDS TILT90-X

The EDS Tilt90-X is a wireless, long-range smart inclinometer manufactured by Worldsensing. Being one of the centerpieces of EDS, it allows you to identify ground movements at a very early stage with high precision and low noise. It features an embedded software that can increase the data frequency when predefined thresholds are reached, so you get relevant data when incidences are detected.



Outdoor LoRa Gateway

Get the widest low-power communication range in the market with the Outdoor LoRa Gateway equipped with an internal antenna and a 4G worldwide module with 3G/2G fallback. Gather data from hundreds of devices in widespread areas, with a radio range of more than 7 km in open sight.

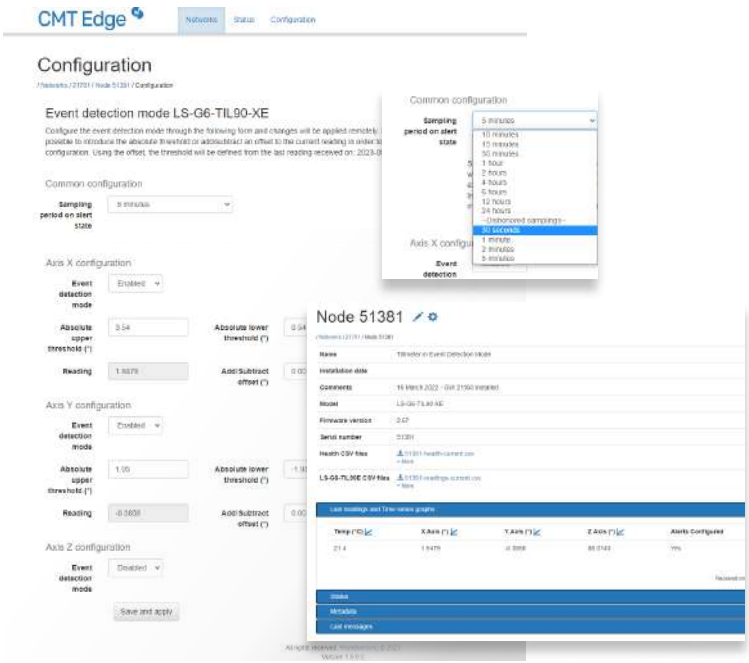
EDS main technical specifications[1]		
Latency	2 s (for 10 simultaneous alerts)	5 s (for 25 simultaneous alerts)
TILT90 wireless smart inclinometer		
Model	LS-G6-TIL90-X and LS-G6-TIL90-I	
Firmware	EDS Mode	
Type	Tilt calculation from 3-axis MEMS Accelerometer	
Periodic readings - Normal Mode		
Repeatability	<0.0003°	
Offset temperature dependency	± 0.002°/°C	
Continuous sampling - Alert Mode		
Repeatability	<0.001°	
Peak-to-peak noise	<0.006°	
Operating bandwith	North America 902-928 MHz	Europe 868 MHz
Transmission power	20 bBm	14 dBm
Radio range in rural areas		
Open sight	7.5 km	6 km
Areas of different elevations	2 km	1.6 km
Battery life estimation	2.8 years	
4G Gateway		
Sensitivity of the receptor gateway in 125 kHz mode	-127 dBm for SF7	
CMT Cloud / CMT Edge		
Device configuration	Thresholds, reporting period in both normal and alert state, enable or disable the EDM and automatic time synchronization	
Gateway configuration	Multi-gateway for CMT Cloud only	
Gateway monitoring	Keep-alive message every 30 seconds	
Communication protocol	MQTT protocol	

[1] See specific device datasheet for more details on technical specifications

Connectivity Management Tool CMT Edge / CMT Cloud

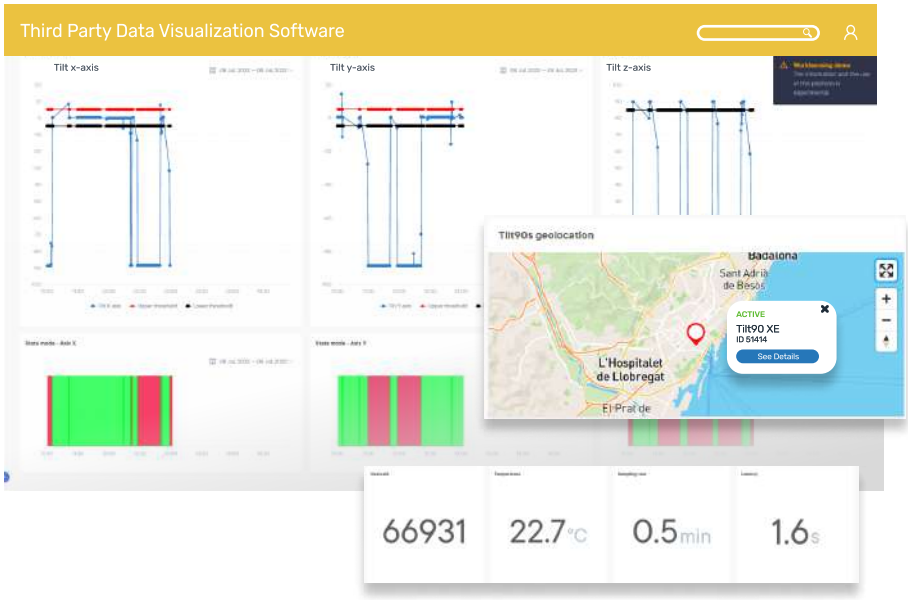
CMT is the software layer in the Worldsensing EDS that allows you to manage all devices connected to your network and set thresholds for each device individually.

Take data-driven actions based on near real-time information. CMT Cloud communicates with third-party systems through MQTT push messages with only a 2-second latency allowing you to stay on-top-of things in close to real time.



Third-Party Data Visualization Software

Integrate EDS with your data visualization software to track the performance of the monitored sites in real time. Configure alerts based on predefined thresholds to take fast actions in case of an incident. Trigger alert-based actions such as SMS, video recording or other more complex Machine-to-Machine (M2M) messaging.



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SUCCESS STORY

EDS providing critical data on the integrity of tailings dams in Brazil

Tetra Tech, a USA-based through its South American team, leading consulting and engineering services firm, was responsible for monitoring solutions deployment for several embankment tailings dams owned by the Brazilian mining company, Mosaic (Mosaic Fertilizantes). For this purpose, Tetra Tech deployed a surface displacement monitoring system based on Worldsensing's detection solution in 17 tailings dams around five cities and three states in Brazil.

SOLUTION SETUP

In addition to the standard instrumentation, these embankment dams were equipped with Worldsensing's IoT tiltmeters connected to Worldsensing's LoRa network. The gateways of this communication network were installed in redundancy, with independent power supply and communication networks to ensure data availability. The gateways send the data via digital radio and fiber optic to Worldsensing's CMT platform, which in turn passes the information to Tetra Tech's monitoring software.

EARLY WARNING SYSTEM INTEGRATION

At Tetra Tech's software level, the engineering firm is now able to monitor the integrity of the slope stability through the real-time data received from the tiltmeters. Data has been collected since the 1st of December 2020 and the monitoring is ongoing nowadays.

Event Detection Solution
Potential application areas

Worldsensing Event Detection Solution can be used across many verticals in civil engineering.

Mining

- Slope stability
- Pit walls

Construction

- Load transfer
- Jet grouting
- Incremental launch of bridge decks
- Lifting heavy structures with the use of jacks

Rail

- Slope stability
- Pit walls

Civil Infrastructure

- Flood levees and defenses
- Slope stability
- Embankment stability

THE BENEFITS OF EDS

Leverage real-time monitoring and reduce your maintenance costs

RELIABLE TECHNOLOGY

- Obtain high-quality data with high-precision devices
- Work at ease with secured network protocols (LoRa, MQTT)

REAL TIME

- Make data-driven decisions based on real-time insights
- Get alert triggers in your early warning system in less than 2 seconds

LOW MAINTENANCE

- Leverage the low-energy consumption of Worldsensing's tilt meters, which can last up to three years with no battery change.
- Rely on high-quality, rugged tilt meter devices with IP67 designed for adverse weather conditions

EASY TO SCALE

- Monitor vast areas and spread out monitoring systems with long-range radio networks that can cover up to 15 km with a single gateway.
- Easily add and manage new devices into the same network.
- Have full visibility of your networks and gateways from Worldsensing's connectivity management tool CMT.
- Count with Worldsensing geotechnical monitoring expertise at your side to scale up

Get started now

SUCCESSFULLY DEPLOY AN EVENT DETECTION SOLUTION WITH WORLDSENSING SUPPORT

PROJECT AND INSTALLATION SUPPORT

- A Worldsensing Application Engineer accompanies on the definition of your project requirements and the proper design of the solution including EDS.

MQTT INTEGRATION

- We can provision you with the format of the MQTT format that will be pushed to the MQTT broker.
- We review, optimize and train your team in MQTT protocol.
- We accompany you in the integration process.

TECHNICAL SUPPORT

- Our team of experts will follow up on the successful project deployment until commissioning.

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About Worldsensing

Worldsensing is a global IoT pioneer. Founded in 2008, the infrastructure monitoring expert serves customers in more than 70 countries, with a network of global partners to jointly drive safety in mining, construction, rail and structural health.

Worldsensing is headquartered in Barcelona and has a local presence in the UK, North and South America, Singapore, Australia and Poland. Investors include Cisco Systems, McRock Capital, ETF, Kibo Ventures, JME Ventures and Bentley Systems.

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