



Industrial IoT

Digitizing assets for a more resilient and safer planet

December 2024

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Today's agenda

01.

Challenge

02.

Worldsensing

03.

Technology
Overview

04.

Use Cases &
Success
Stories

05.

Compliance

06.

Conclusions



Industrial IoT: the core challenge



The Challenge

Poor quality of construction



Brazil tailings dams collapse
\$6B in penalties - 17 fatalities

Age



Embankment collapse in
Florence

Extreme climate events



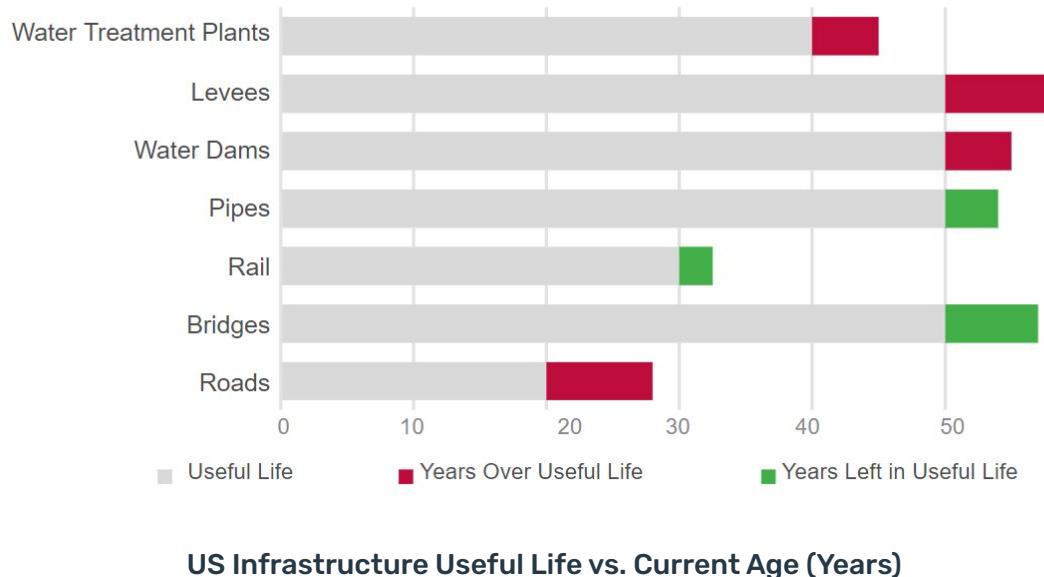
Genoa bridge collapse
39 fatalities - 600M€ in costs -



Miami bridge collapse
6 fatalities

Infrastructure is Aging and Insufficient

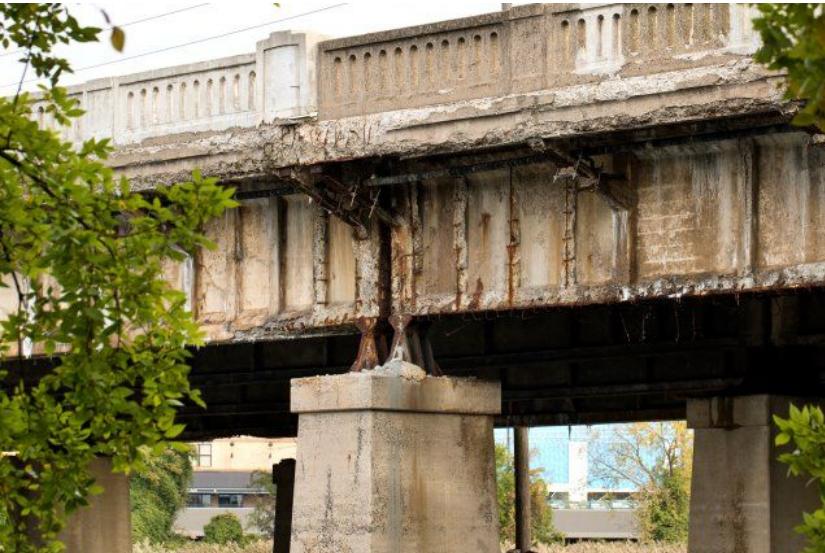
- **Aging Infrastructure:** Global infrastructure is outdated and lacks capacity
- **Global Investment:** Massive, ongoing investment needed to upgrade and expand infrastructure
- **Long-Term Horizon:** A global challenge that will take decades to fully address



Sources: G20 Global Infrastructure Outlook; William Blair Equity Research; Note: (1) Cumulative infrastructure investment in last five years

Climate Change is Compounding the Issue

- **Climate Change:** Adding to this challenge is climate change, which requires urgent adaptation measures
- Most of the built environment was **not designed with climate change in mind** and is vulnerable



Climate Adaptation: A New Infrastructure Imperative

- Climate Adaptation: Now a significant component of infrastructure budgets worldwide
- Data Dependency: Effective climate adaptation requires real-time data for decision-making and rapid response
- Monitoring Necessity: Stricter environmental regulations and standards are pushing industries to adopt advanced monitoring solutions

United Nations Intergovernmental Panel on Climate Change (IPCC) framework for action:

- Extreme weather events increasingly damage infrastructure
- Companies face significant risks: €1 trillion at risk over the next five years
- Urgent investment required in climate-resilient infrastructure, including transport networks, housing and businesses
- Need to advance climate change resilience through practical solutions
- Traditional approaches such as visual inspections are inadequate
- IoT, AI, digital twins and BIM can enhance the resilience of critical infrastructure with rapid and accurate assessments, decision-making and adaptation strategies

(IPCC 6th assessment report, 2023)

Global Geotechnical Instrumentation and Monitoring Market to Reach \$5.6 Billion by 2027:

- Geospatial Technologies: \$9.9 Billion by 2025
- Environmental Monitoring: \$19.6 Billion by 2027
- Weather Monitoring and Forecasting: \$3.3 Billion by 2024
- Remote Sensing: \$18.5 Billion by 2026



The Challenge

Infrastructures in remote and difficult to access locations require efficient monitoring



Manual Readings

Infrequent data availability; Requires a lot of man-hours and costly/cumbersome trips

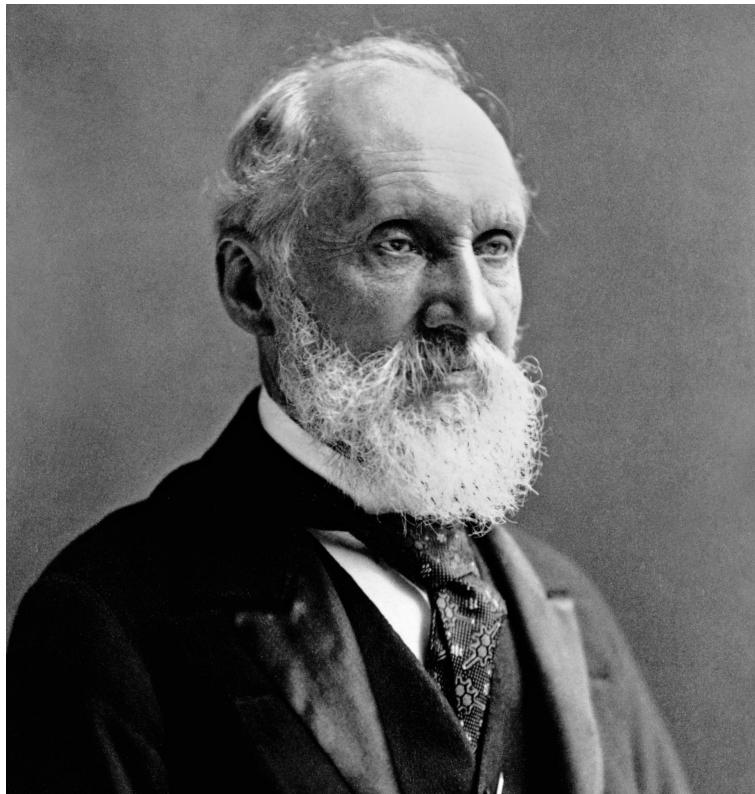
Cables

Cables have to be constantly adjusted. Data is vulnerable to any damages on the physical cables



No monitoring

The Challenge



“If you cannot measure it, you cannot improve it.”

Lord Kelvin



DESIGN

RISK MANAGEMENT

RESILIENCE

COMPLIANCE

The Solution

Digitize monitoring processes
to minimize costs and increase
efficiency [Industrial IoT]



Reduce
cost and speed-up ROI



Increase
Efficiency



Guarantee
safety



Compliance
with global Standards

Worldsensing overview



CHALLENGES

HOW TO MAKE MONITORING SOLUTIONS MORE COST EFFECTIVE & EASY TO OPERATE?

Monitoring solutions have become the cornerstone of any risk management, business continuity or smart maintenance strategy. In this sense, wireless technologies have helped significantly to make monitoring cost-effective and easy to operate. But as the availability of technologies grow, different problems start to arise- and engineers face now issues such as:



Access to high quality data



Network flexibility and reliability



Open and scalable technology

Worldsensing - The Global Industrial IoT Pioneer

We are the pioneer in connectivity for critical infrastructure monitoring in remote locations

2008

Founded

200

Engineering
partners
worldwide

70+

Countries

4,000

Monitoring
networks
deployed



Industries we serve

The front-runner in providing monitoring data to help ensure business continuity and safety.



MINING

We contribute to safer operations in 100+ tailings dams and mines.



CONSTRUCTION

We support geotechnical monitoring across 200+ major construction sites to check if structures are sound.



RAIL

We monitor slope and ground movements along tracks around the globe to prevent incidents.



CRITICAL INFRASTRUCTURE

We collect instrumentation & monitoring data from 100+ critical infrastructures to monitor structural integrity.



European-funded R&D projects

10M €
funding



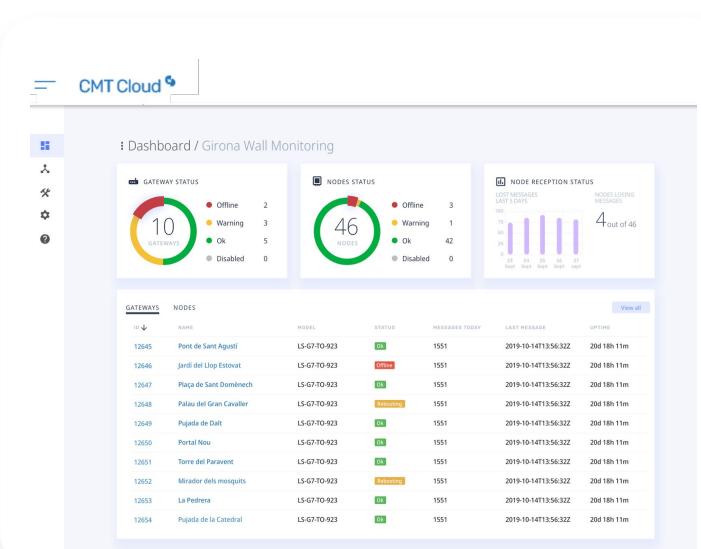
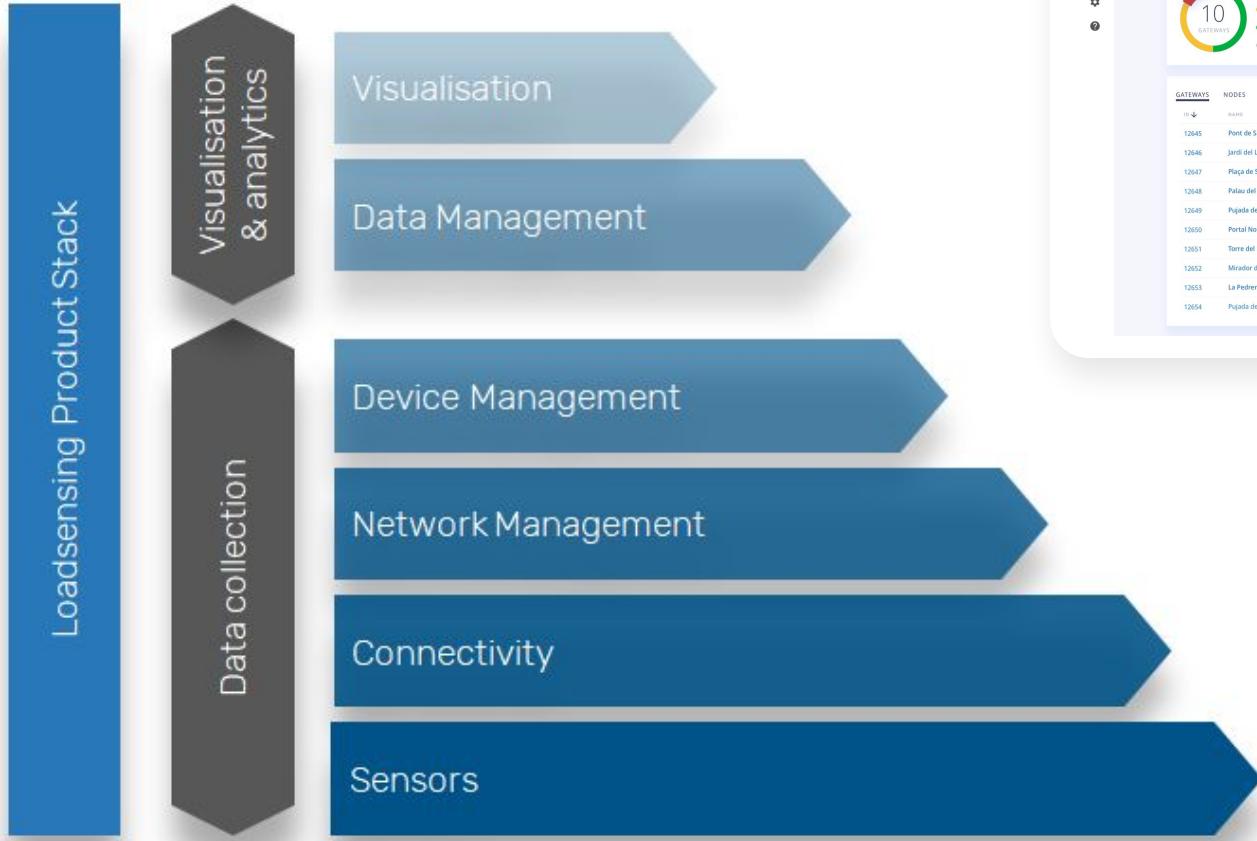
INNOVATIVE SME

Valid until Nov 2nd 2024



<https://www.worldsensing.com/innovation>

End-to-end solution



WORLDSENSING IoT REMOTE MONITORING SOLUTION



The end-to-end, open, interoperable and reliable wireless system for your infrastructure monitoring needs



MOST TRUSTED

4000 deployed networks across 70 countries, monitoring more than 170k sensors and instrumentation



MOST SCALABLE

A system that lets you expand, change or reconfigure depending on the project needs



MOST COMPLETE

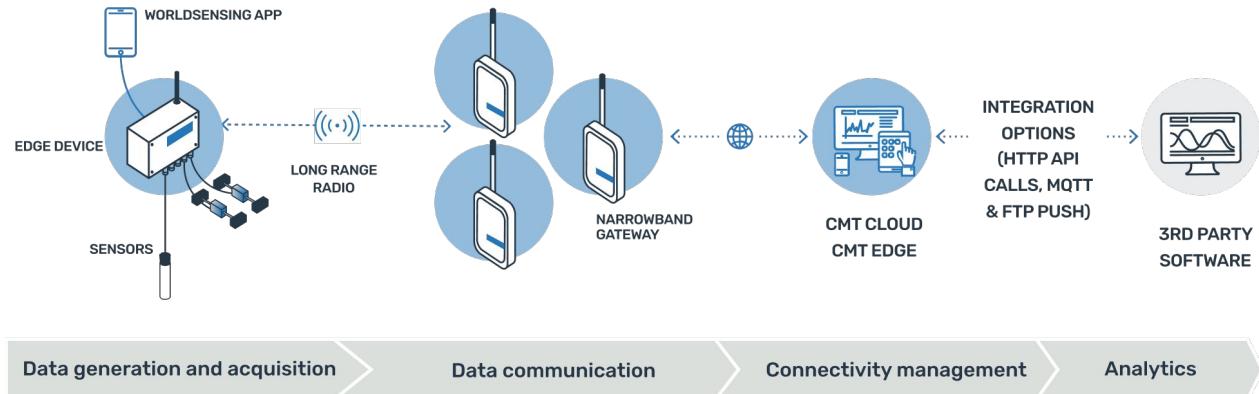
Broadband and narrowband capabilities.
Instrumentation and the most complete catalog of sensor integrations in the industry.

End-to-end solution

NARROWBAND COMMUNICATIONS

For long-range, unattended, low-packet-rate projects.

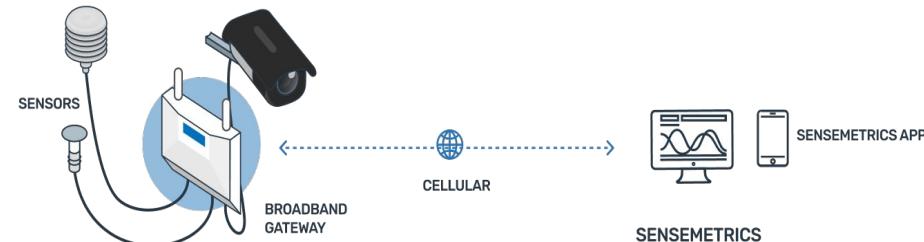
Take advantage of our main communication system based on LoRa/LoRaWAN technology to cover vast distances with low-power devices.



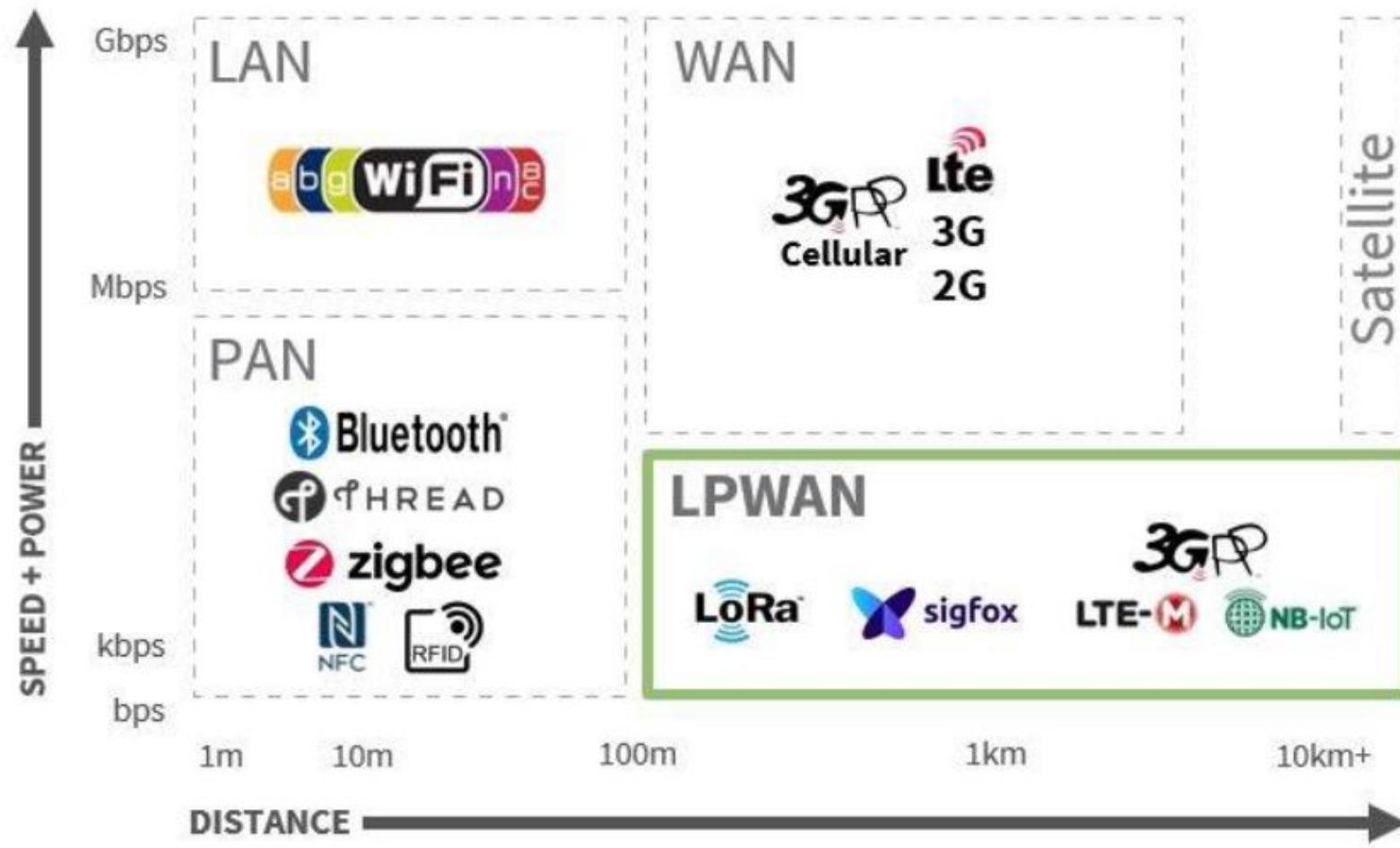
BROADBAND COMMUNICATIONS

Data-intensive, high-power monitoring projects.

Leverage the power of advanced broadband IoT data acquisition and communication technology to connect data-intensive sensors to your software using 4G networks.



Communications Ecosystem

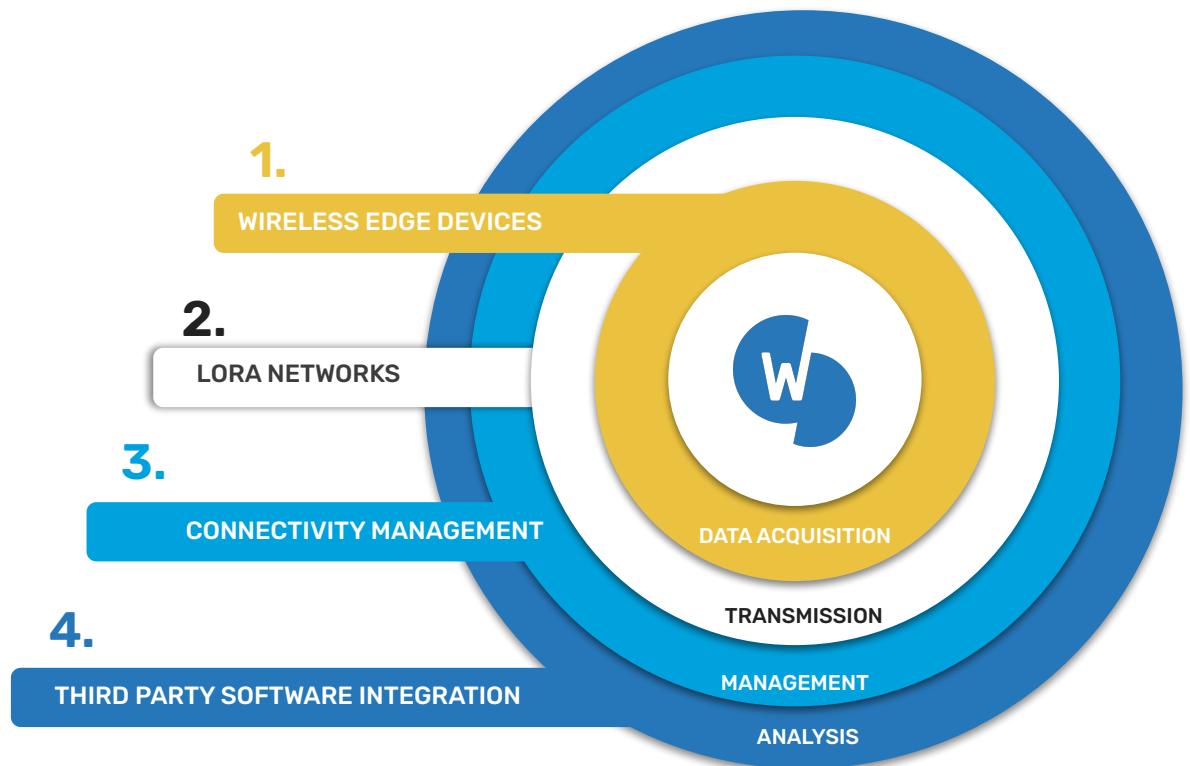


Diving into Technological Aspects



IOT REMOTE MONITORING

The end-to-end solution for data-driven decision making



DATA ACQUISITION

Low-power, low-maintenance wireless IoT devices

Integrated with customers' existing technology stack, these low-power, low-maintenance devices collect and transmit data wirelessly in areas with no or little cellular network connectivity.



1.

WIRELESS EDGE DEVICES



HIGH COMPATIBILITY

Best-in-class for integrating with leading instrumentation and monitoring sensors and systems.



LOW MAINTENANCE

The data loggers and sensors are battery-powered and can last up to 10 years with little or no maintenance.

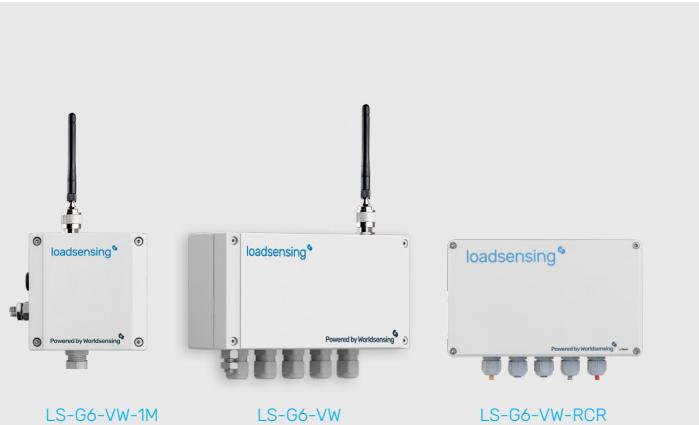


FLEXIBILITY

Connect-and-collect technology with customizable data acquisition rates adapted to customers' risk management needs.



WIRELESS DATA LOGGERS



LS-G6-VW-1M

LS-G6-VW

LS-G6-VW-RCR



LS-G6-PICO

LS-G6-ANALOG-4



LS-G6-DIG-2

VIBRATING WIRE

Automate data collection by wirelessly connecting instruments like piezometers and load cells to your monitoring systems.

With an internal barometer, they also transmit barometric pressure data.

The VW-RCR, a 5-channel device, measures stress and strain in concrete segments.

ANALOG

Connect analog sensors like load cells and thermometers easily to your monitoring systems.

The 4-channel version supports inputs from most analog sensors, accommodating voltage, current, and resistive transducers.

The Piconode, a 3-channel wireless logger, features configurable analog, thermistor, and pulse counter channels for cost-effective data capture.

DIGITAL

The optimal choice for wirelessly streaming data from sensors with RS485 communications and other proprietary protocols to your information systems.

Utilize its autonomy and long-range communication capabilities to connect digital in-place inclinometers (IPIs) and multipoint borehole extensometers (MPBX) in areas with limited connectivity or power sources.

Additionally, the digital logger seamlessly integrates other digital sensors used in geotechnical, structural, process control, and environmental monitoring.

WIRELESS SENSORS



TIltmeter

The Worldsensing Tiltmeter, a 3-axis wireless sensor, measures inclination changes in both fixed structures and ground movements.

These sensors are crucial for monitoring ground stability, structural integrity, and slope settlements.

Tilt90 wireless sensors come with either an external antenna for maximum range or an internal antenna, ideal for applications like railway tracks where minimizing external parts is essential.



TIltmeter Event Detection

The Tiltmeter Event Detection is a smart, 3-axis wireless tiltmeter designed for early detection of ground movements. Its embedded edge algorithm increases data frequency when predefined thresholds are reached, providing timely insights.

Monitor land stability in real time and make swift, data-driven decisions to protect people and the environment.



Laser TIltmeter

"The Worldsensing Laser Tiltmeter combines a laser distance meter and tiltmeter into one device. The laser measures relative distance to reference points, while the tiltmeter detects changes from vertical level in ground or structures.

This wireless sensor provides robust data for monitoring inclinations, movements, and slope or infrastructure settlements.



Vibration Meter

The Worldsensing Vibration Meter is a wireless sensor for automated, continuous vibration monitoring. It includes a tri-axial accelerometer and an edge algorithm for threshold breach detection of vibration parameters like LAW/PPV and frequency.

Comply with vibration regulations for building integrity (e.g., DIN 4150-3, BS7385-2) and human effects (e.g., ISO2631-2).

DATA TRANSMISSION

Long-range IoT network capabilities

Our private long-range LoRa communication network enables to transmit sensor data securely and reliably to control centers for remote data management.



LEADING RANGE

Market leading for transmitting data up to 10 km in one single data hop.



ROBUST

Gateways which can obtain data from hundreds of devices within the same network, with minimal latency.



2.

LORA NETWORKS



SECURE

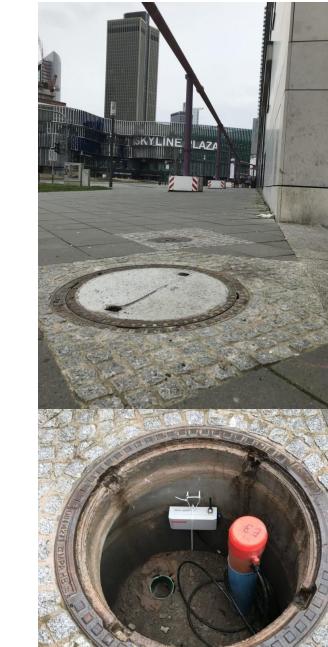
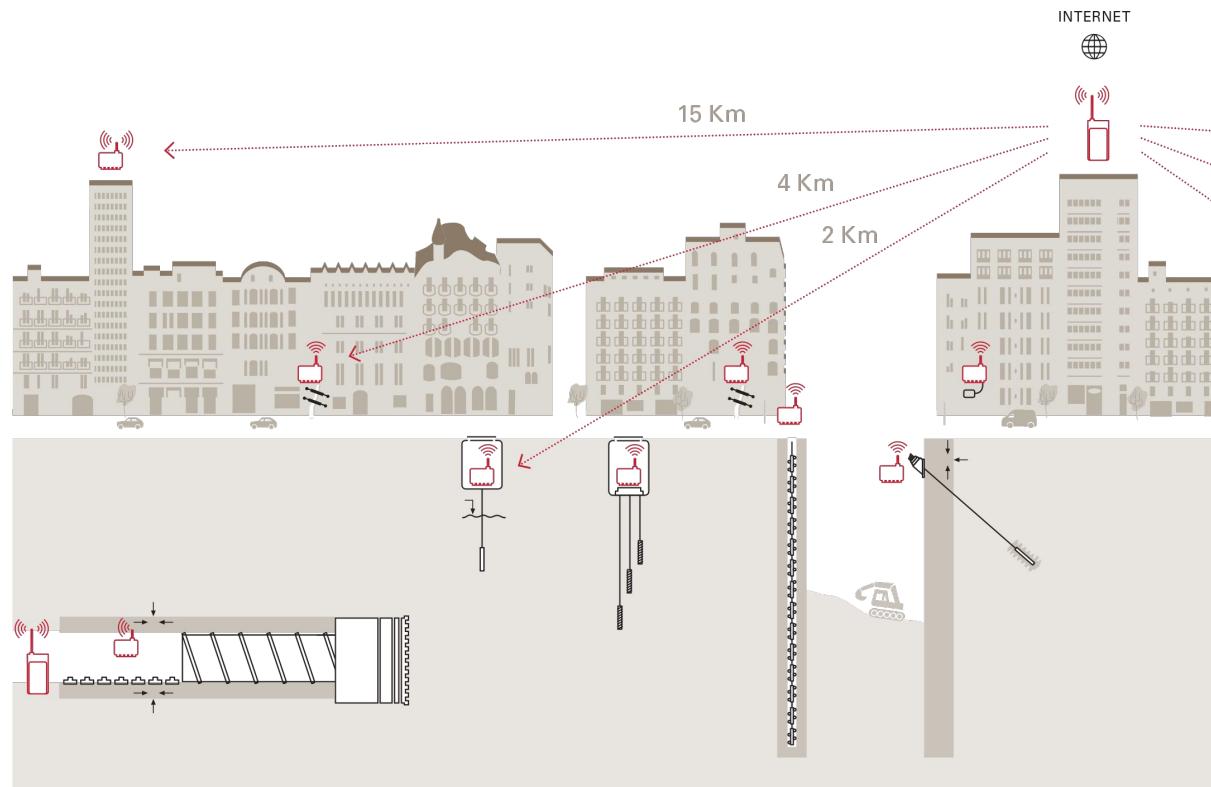
A trusted and field-proven IoT communication technology with strict security protocols.



Loadsensing **Connectivity** benefits



- | | | | | | |
|------------|-----------|-----------------------|---------------|---------------------|------------------------|
| | | | | | |
| LONG RANGE | LOW POWER | LICENCE FREE SPECTRUM | HIGH CAPACITY | END-TO-END SECURITY | OPERATIONAL ROBUSTNESS |



U5 metro line extension in Frankfurt, Germany

Loadsensing Connectivity benefits



LOW POWER

VIBRATING WIRE

BATTERY LIFE ESTIMATIONS⁷

VIBRATING WIRE 1 CHANNEL

Battery Model		LSH14	LM26500
Number of cells		1 cell	1 cell
Sampling Rate	5 min	4.8 months	6.4 months
	1 h	3.4 years	4.5 years
	6 h	7.1 years	11 years

VIBRATING WIRE 5 CHANNEL

Battery Model		LSH14	LM26500
Number of cells		4 cells	4 cells
Sampling Rate	5 min	3.7 years	4.6 years
	1 h	11.4 years	22.7 years
	6 h	13.1 years	>25 years

⁷ Typical Europe radio configuration. Spreading factor 9, radio transmit power 14dBm. Considering laboratory conditions. Consumption varies depending on the sensor used, sampling rate and environmental and wireless network conditions.

Battery life estimations based on the lifetime mathematical model using Barcelona weather profile. Average values provided.

TIltmeter

BATTERY LIFE ESTIMATIONS⁶

Battery Model		LSH14	LM26500	
Number of cells		2 cell	1 cell	2 cells
Reporting Period	30 s	4.8 months	3.1 months	6.2 months
	5 min	3.6 years	2.5 years	5.1 years
	1 h	12.9 years	17.2 years	>25 years
	6 h	15.5 years	>25 years	>25 years

⁶ Typical Europe radio configuration. Spreading factor 9, radio transmit power 14dBm. Considering laboratory conditions. Consumption varies depending on the sensor used, sampling rate and environmental and wireless network conditions.

Battery life estimations based on the lifetime mathematical model using Barcelona weather profile. Average values provided.

DATA MANAGEMENT

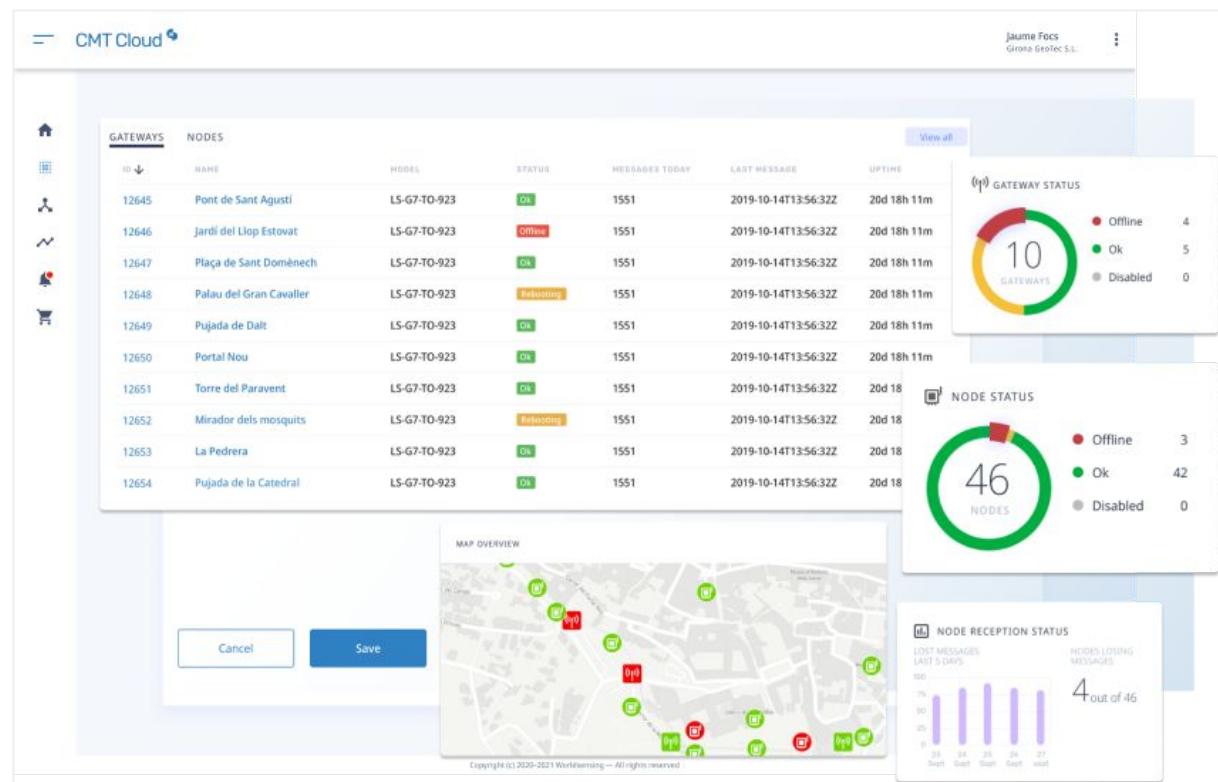
Connectivity management through one single platform

Our software Connectivity Management Tool (CMT) allows managing all data, deployed devices and networks. This way, it's easy for our customers to track how monitoring systems perform across all their project sites.

CMT is available on-premises or through the cloud depending on the customer's monitoring needs.

3.

CONNECTIVITY MANAGEMENT



DATA ANALYSIS

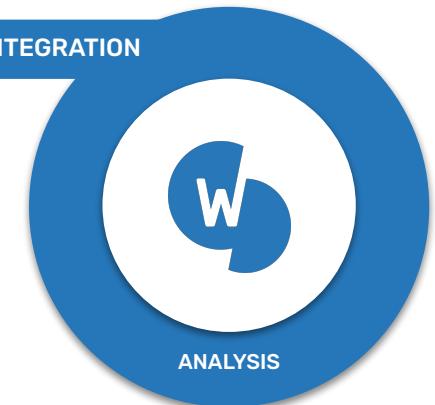
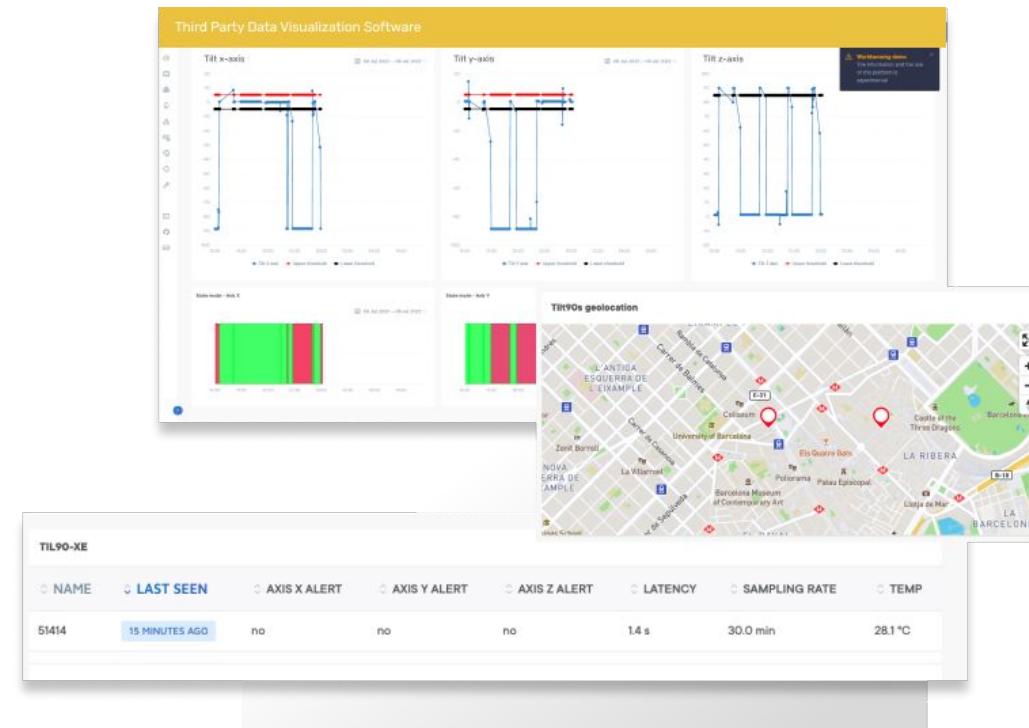
Data-driven decision-making supported by software-hardware integrations

By integrating our CMT software with their software tools, our customers are able to make timely data-based decisions in line with their risk management strategies.

Our CMT software can be integrated with 3rd party software such as data visualization tools through industry standard protocols (FTP, API, MQTT).

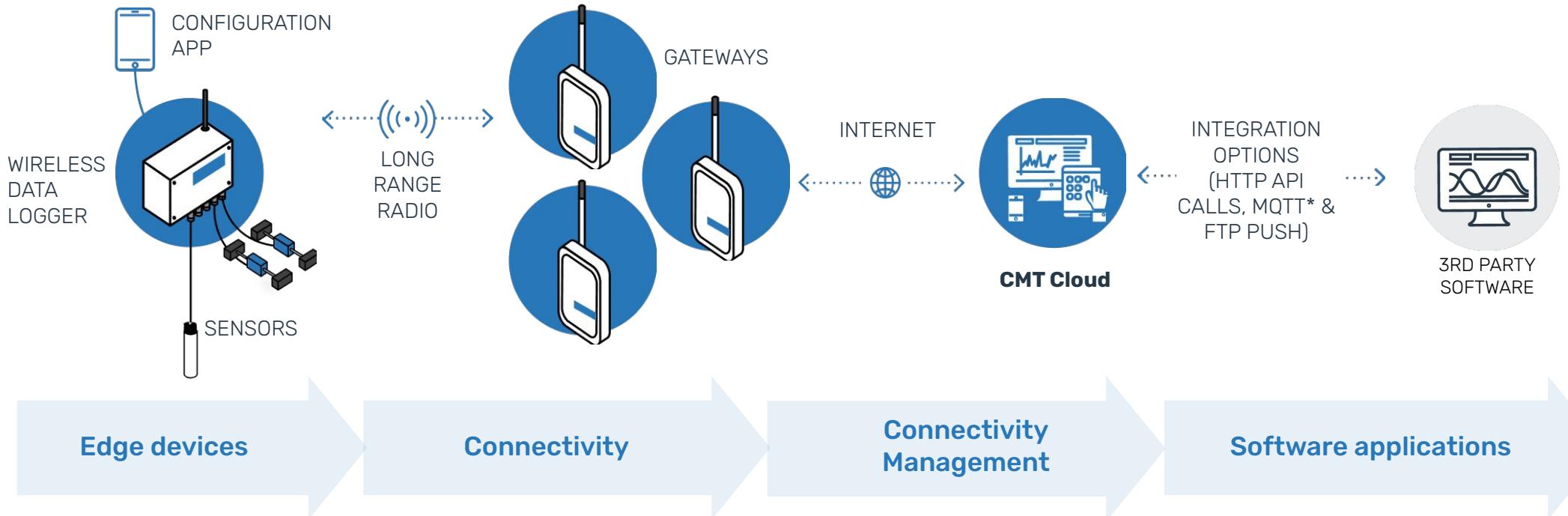
4.

THIRD PARTY SOFTWARE INTEGRATION



How does it work?

Multi-gateway architecture



Data Collection
Collect sensor data through wireless loggers and at your preferred sampling rates.

Communication & Network Monitoring
Decrease the risk of data loss through a redundant network and enjoy 24/7 connectivity management through the cloud.

Data Analytics
Integrate 3rd-party data visualization software.

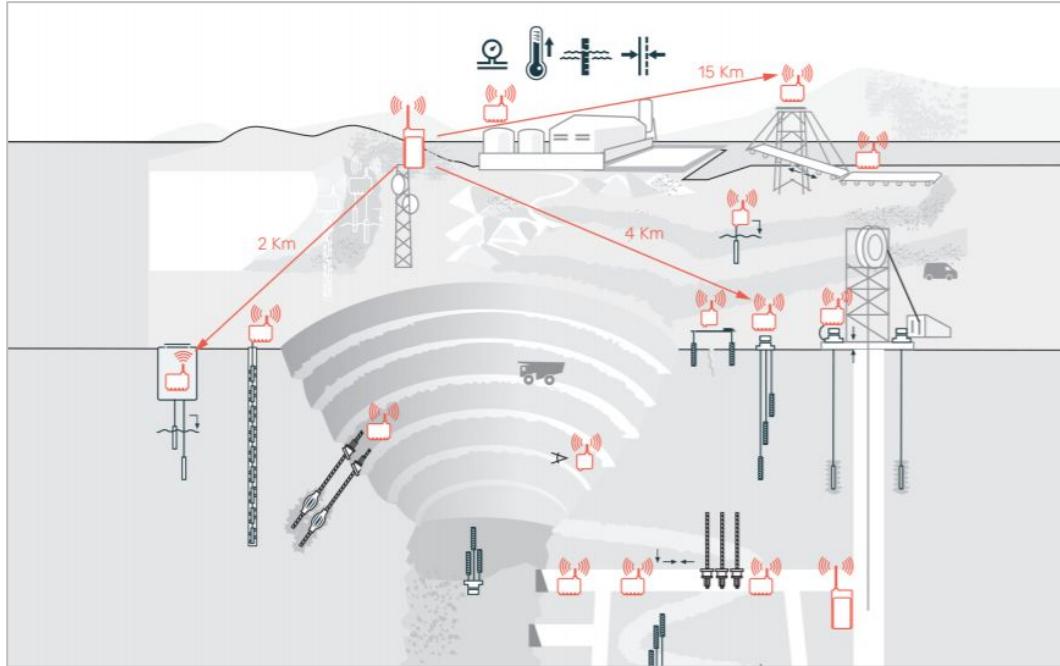
*upon request

Use Cases: some examples

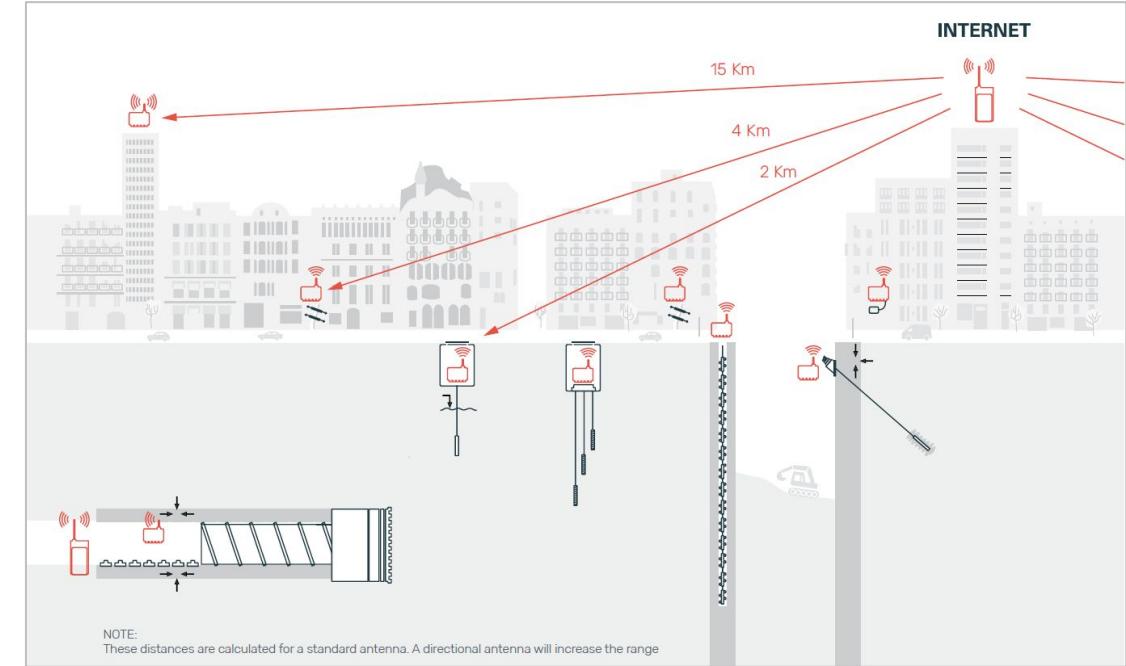


Worldsensing in industrial infrastructure

Worldsensing in mining



Worldsensing in urban infrastructure





+130 Mines
and tailing dams

5 continents
Worldwide presence

INDUSTRIES WE SERVE

MINING

SURFACE • UNDERGROUND • TAILINGS DAMS • TAILINGS DUMPS

Leading wireless monitoring critical areas of the mining industry.

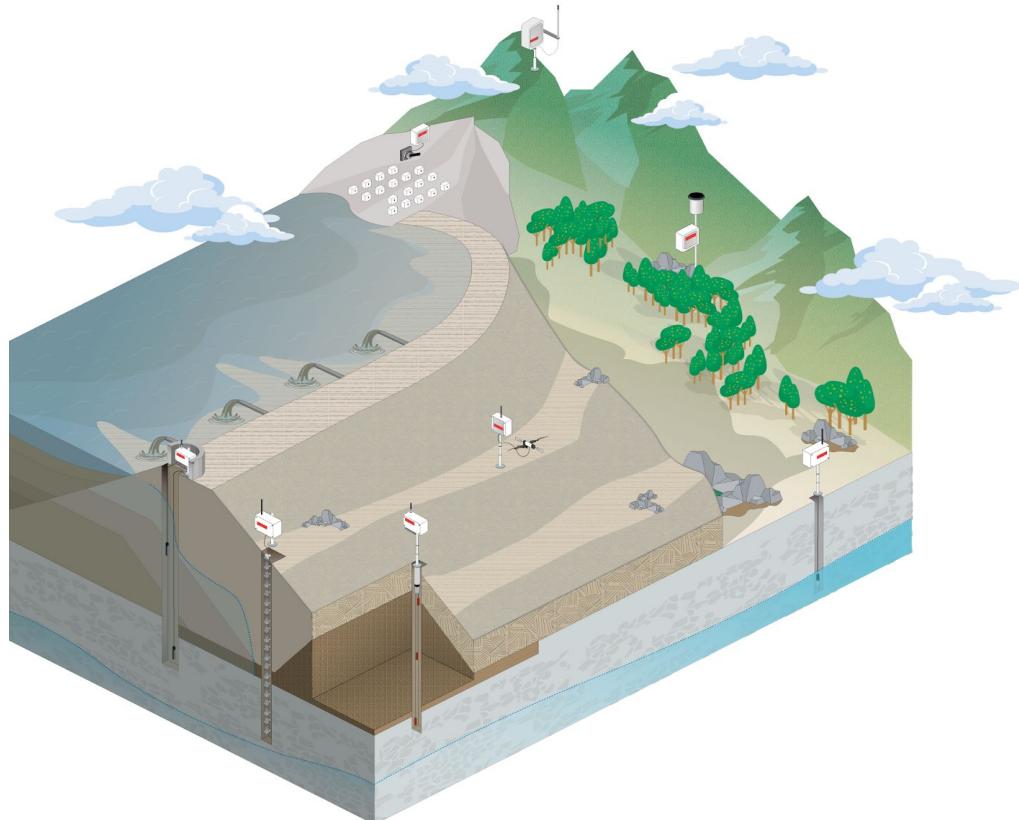


I haven't had to check that gateway since i installed it. This kind of reliability is one of the biggest advantages of the system"

Rodrigo Vlcencio, COO

 GEOSINERGIA

Worldsensing in mining



- Pore water pressure
- Horizontal displacement
- Water level
- Rainfall monitoring
- Movement across surface cracks
- Vertical deformation at various depths
- Tension monitoring
- Remaining load in the anchorages
- Water quality monitoring





+100
Underground Tunnel
projects

+200
Construction sites

INDUSTRIES WE SERVE

CONSTRUCTION

TUNNEL CONSTRUCTION • CONSTRUCTION SHAFT •
SURROUNDING BUILDINGS

Leading the wireless monitorization of ground stability and structural health and environmental compliance in construction projects with the highest quality and safety standards.

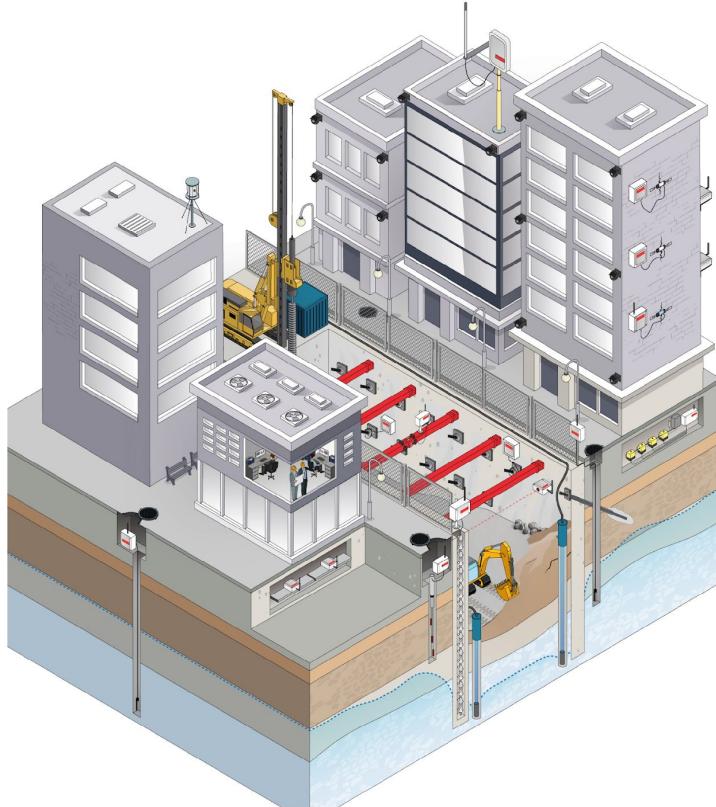
“

This innovation represents a major step forward in tunnel boring safety and efficiency. We can now drastically reduce the delays involved in installing and configuring tunnel monitoring systems, saving time and costs”



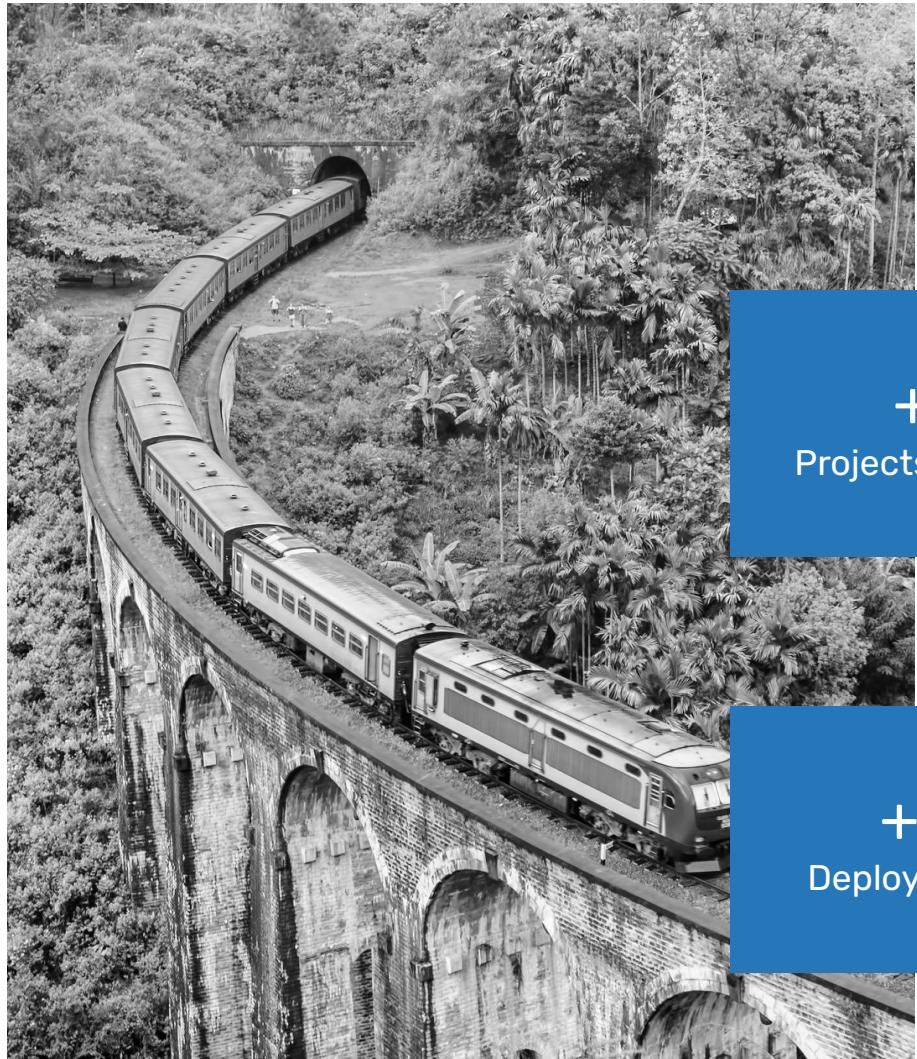
Guillaume Gehu, Contract Manager

Worldsensing in construction



- Pore water pressure
- Horizontal displacement
- Water level
- Liquid level settlement
- Movement across surface cracks
- Vertical deformation at various depths
- Tension monitoring
- Remaining load in the anchorages
- Ground movement





+30
Projects worldwide

+10K
Deployed devices



Die Bahn DB



INDUSTRIES WE SERVE

TRANSPORT

RAIL • BRIDGES • TUNNELS • DISTRIBUTION NETWORKS

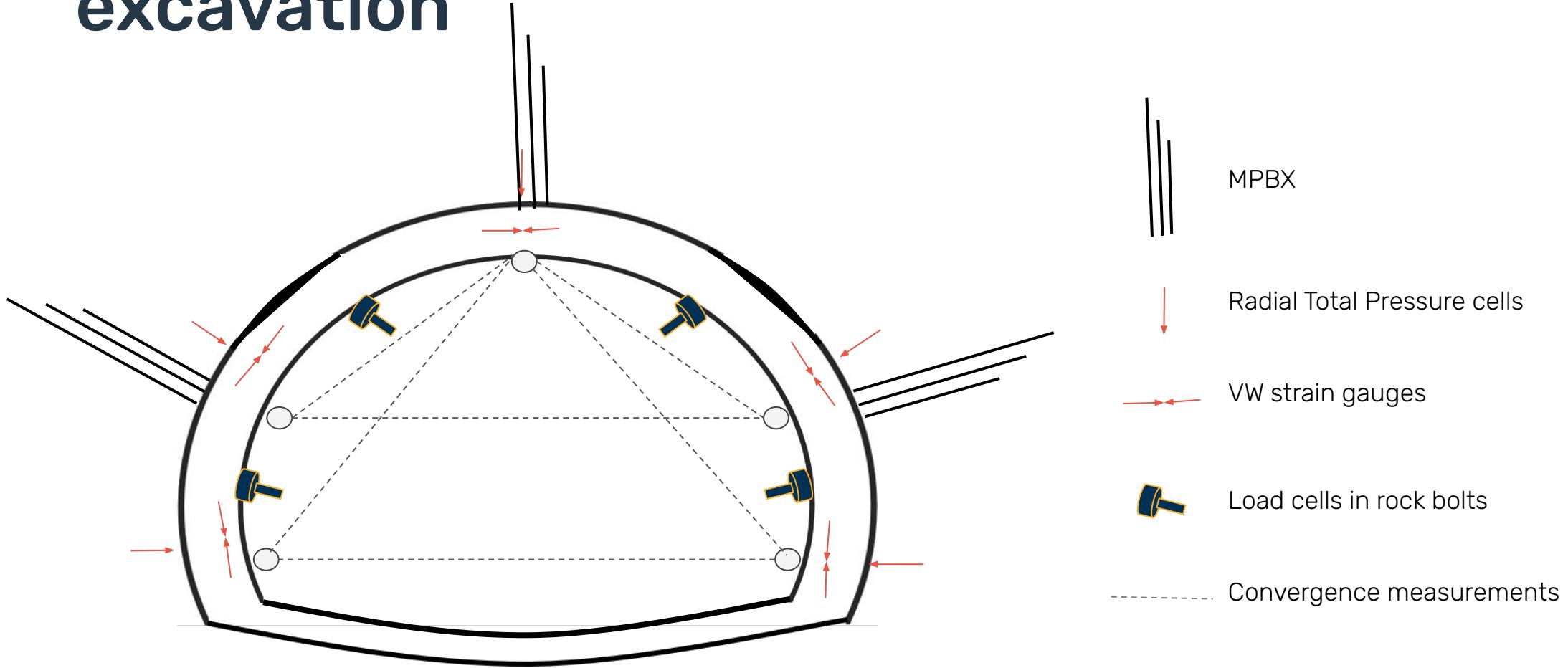
Leading the wireless monitorization of ground stability and structural health of transport-related infrastructure worldwide.

“



It couldn't be more simple – we connect our device to the logger, fill out the information and the data will start transmitting to the gateway and online.”

Monitoring conventional tunnels during the excavation



LaserTilt90

New Features

Combined distance and tilt measurements

A 3-in-1 laser distance meter, inclinometer and data logger

New monitoring applications such as settlement measured from a reference point or to infer vertical settlement at the tunnel crown

More flexible installation options

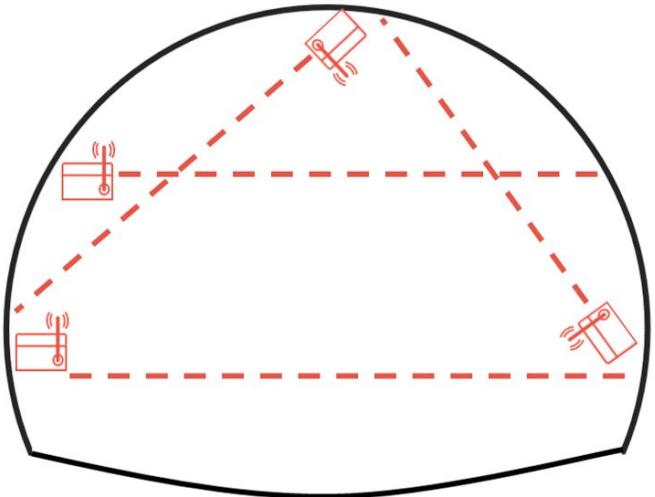
with its $\pm 90^\circ$ range and 3-axis inclination measurement

Provides data set average that can be used to **filter noisy data**



[Download
Datasheet](#)





The LaserTilt90 may be easily relocated along the convergence cross sections up to the excavation front or until the measured relative displacements are stabilized when the required frequency of measurements is reduced. It can also be used when permanent monitoring is required.



Use cases



Infrastructure Geotechnical Structural ⚙ USA

Protecting dams during record snowmelt: A real-time monitoring success



Construction Geotechnical ⚙ Iraq

Engineering excellence: Supporting the construction of Middle East largest immersed tunnel



Transport Structural ⚙ United Kingdom

Worldsensing equipment helps to preserve historic Welsh rail bridge



<https://www.worldsensing.com/success-stories/>

How remote monitoring helped prevent casualties in a bridge collapse in Johor, Malaysia



7 am: Two of Worldsensing's Tiltmeters detect movement on the bridge, triggering an alert that is sent to Geolab's data visualization software. The company closely monitors the data

.

From 7 am to 2 pm: These two devices reveal significant structural movement, while the data from other Tiltmeters remains consistent. The motion is unmistakable. Geolab immediately contacts the bridge operator, necessitating the evacuation of the site and road closure as a safety precaution.

2:09 pm: The operator reaches out to local authorities and the police for assistance.

2:15 pm: The police and emergency services swiftly arrive on-site. The road is closed to the public.



<https://www.worldsensing.com/success-story/how-remote-monitoring-helped-preventing-casualties-in-a-bridge-collapse-in-johor-malaysia/>

Eppenberg Tunnel

Success Story

Country:
Switzerland

Sector:
Construction

Project:
Geotechnical monitoring

Challenge

Work started in 2015 on the Eppenberg Tunnel, Soleura canton, which will link the towns of Aarau and Olten in order to de-congest the traffic on one of the most transited railway routes in the country, used by 550 trains every day. The building of an infrastructure of this type requires permanent and reliable geotechnical monitoring to detect any incident that may affect the works.

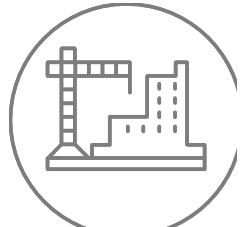
Solution

Loadsensing data nodes (12 vibrating wire, 17 analog) were connected to various sensors (12 uts VW rod extensometers and 55 uts strain gauge load cells) and 1 gateway located as far as 2.5km away. The monitoring included both mouths of the tunnel and adjacent slopes.



Benefits

The robust, flexible and easily expandable monitoring system eliminates the need for manual monitoring and makes it possible to reduce the cost and the time dedicated to supervision tasks.



Grand Paris Metro Project

Success Story

Country:
France

Sector:
Construction

Project:
Tunnel construction

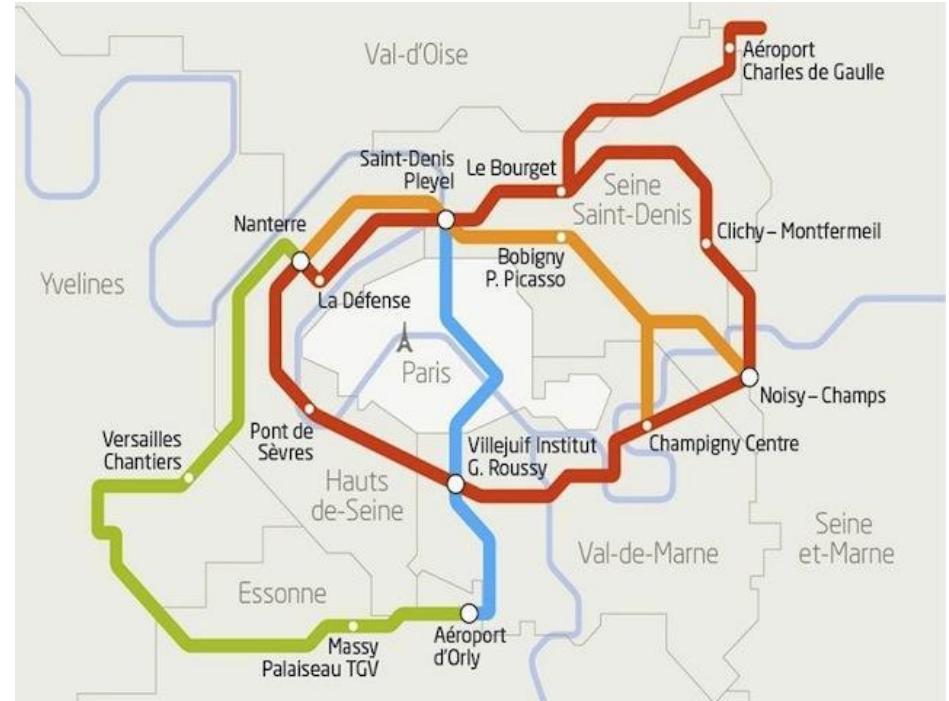
Challenge

The 25B€ project needed to ensure the safety of employees and citizens during the tunnel construction under some densely populated business districts.

Solution

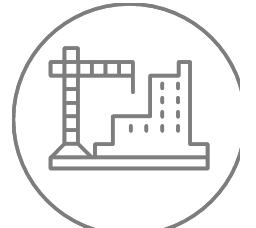
The project was awarded only to the top players in the French market (all of which are using Loadsensing) and all monitoring was done automatically using wireless sensors.

Loadsensing tiltmeters and over 400 data nodes were deployed. Data were gathered from various types of sensors (Inclinometers, Strain Gauges, Load Cells and Extensometers), some installed up to seven basement levels deep.



Benefits

- Helps minimize safety risks for employees and citizens
- Minimal maintenance required for the low-power consumption data nodes



Phosphate mine in Brazil

Success Story

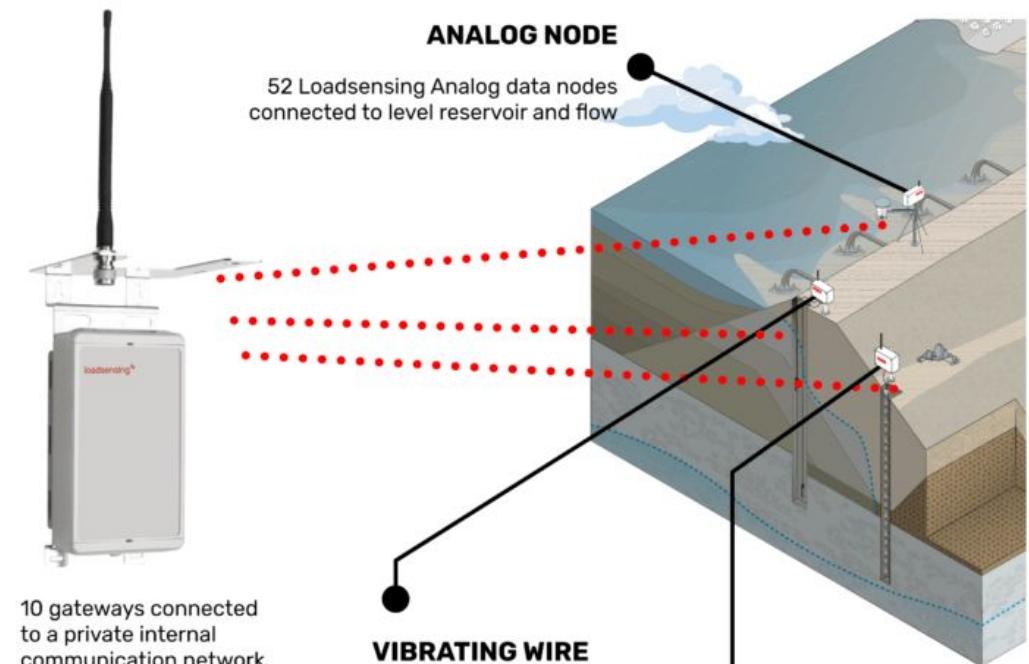
Country:
Brazil

Sector:
Mining

Project:
Tailings dam

Benefits

- No need for expensive cabling and manual monitoring
- Savings of up to 30% on the operations
- Safety of mine employees and residents
- Compliance with safety regulations and standards
- Sustainable growth of the mining industry



Solution: 467 Worldsensing data loggers and 10 gateways
Sensors: piezometers, ultrasonic water level meters and chains of IPIs



Copper mine

Success Story

Country: Chile
Sector: Mining

Project:
Automatic piezometer monitoring in the pit

Challenge

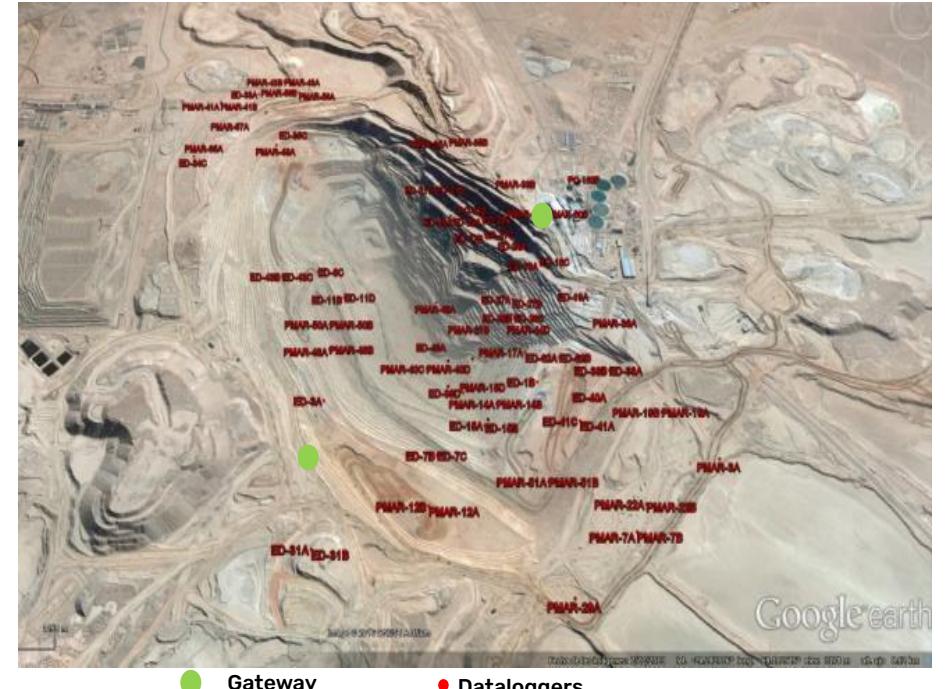
The mine needed to monitor the huge open pit that extends in an area of about 18km north to south and 3km east to west.

Solution

62 Loadsensing data nodes and 2 gateways connected to LAN wirelessly automated the monitoring of 72 piezometers in the open pit.

Benefits

- Long-range data nodes are able to gather data across the large open pit
- No need for expensive cabling costs and manual monitoring.
- Crucial data on the stability of the embankments ensure the safety of the employees and the citizens.



Compliance



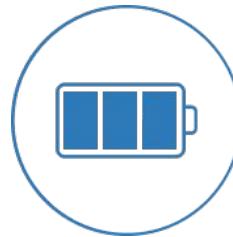
Environmental, Social and Governance



Cable-free



Reduced
technology
stack



Low-power,
long life



Alternative
power
sources



No
digging



Wireless
monitoring of
environmental
indicators



Supporting
UN
Development
Goals



What Compliance Controls Do We Have?

Alignment with international standards



What Compliance Controls Do We Have?



Worldsensing Statement of Applicability - ISO27001 2022 - Version2_Rev01

Aa Control	≡ NIST	▽ Status
<u>A.5.1 Policies for information security</u>	Identify	Applicable
<u>A.5.2 Information security roles and responsibilities</u>	Identify	Applicable
<u>A.5.3 Segregation of duties</u>	Protect	Applicable
<u>A.5.4 Management responsibilities</u>	Identify	Applicable
<u>A.5.5 Contact with authorities</u>	Identify	Applicable



<u>A.8.18 Use of privileged utility programs</u>	Protect	Applicable	
<u>A.8.19 Installation of software on operational systems</u>	Protect	Applicable	
<u>A.8.20 Networks security</u>	Detect	Protect	Applicable
<u>A.8.21 Security network services</u>	Protect	Applicable	
<u>A.8.22 Segregation of networks</u>	Protect	Applicable	
<u>A.8.23 Web filtering</u>	Protect	Applicable	
<u>A.8.24 Use of cryptography</u>	Protect	Applicable	
<u>A.8.25 Secure development life cycle</u>	Protect	Applicable	
<u>A.8.26 Application security requirements</u>	Protect	Applicable	
<u>A.8.27 Secure system architecture and engineering principles</u>	Protect	Applicable	
<u>A.8.28 Secure coding</u>	Protect	Applicable	
<u>A.8.29 Security testing in development and acceptance</u>	Identify	Applicable	

Conclusions



Conclusions

- **Critical infrastructure at risk:** Aging systems and climate challenges demand innovative solutions.
- **Digital monitoring:** Reduces costs, boosts efficiency, and ensures compliance with global standards
- **IIoT benefits:** Long-range, low-power, minimal maintenance, and scalable solutions.
- **Worldsensing leadership:** 4,000+ networks in 70+ countries, pioneering wireless remote monitoring.
- **Proven impact:** Success in mining, construction, and transportation with safety and cost-saving outcomes.
- **Strong compliance (requirements):** Robust cybersecurity, data protection, and alignment with global standards.



Thank you



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