

**SMART EARTHING
MONITORING SYSTEM**



Smart Power Grid Monitoring Through Earthing System



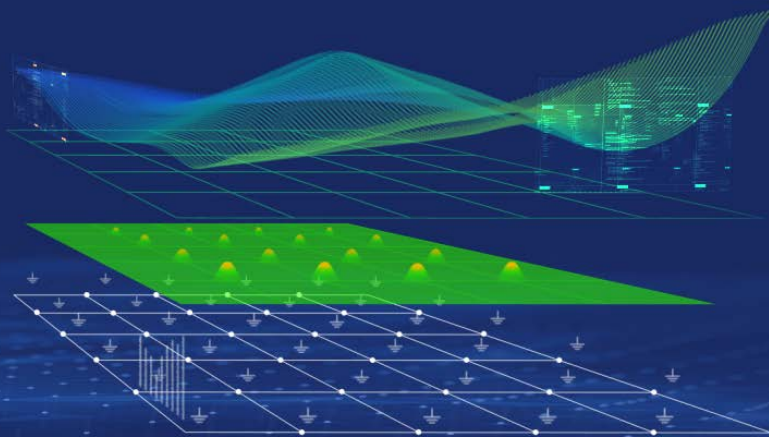
Aplicaciones Tecnológicas S.A. is a Spanish technological company with a strong international presence. Founded in 1986 with a multidisciplinary human team, extensive experience in different sectors and formed by experts in engineering, physics, electronics, communications, IT, IoT, data science and new technologies





SMART EARTHING

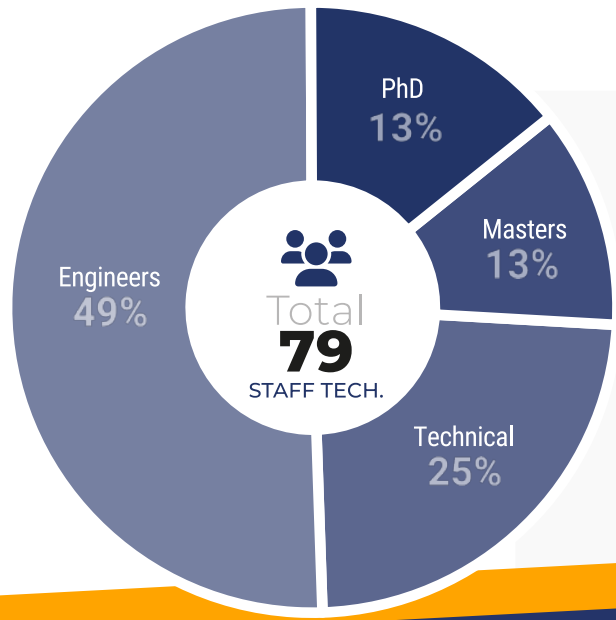
La gama tecnológica más completa de servicios y productos para el diseño, implementación y control de tomas de tierra.



SMART LIGHTNING

La gama tecnológica más completa de servicios y productos para la seguridad frente a tormentas eléctricas, incorporamos la conectividad y otras soluciones inteligentes que crean valor, permitiendo el control de activos públicos y privados a través de una plataforma IoT.





Technical Profiles & Areas

- Architecture
- Data Science
- Physics
- Civil Engineering
- Industrial Engineering
- Computer Engineering
- Telecommunications Engineering
- Mechanical Engineering
- Chemistry
- Mathematics
- Automation Engineering



INTERNATIONAL REFERENCES

▶ Wanda Metropolitano Stadium



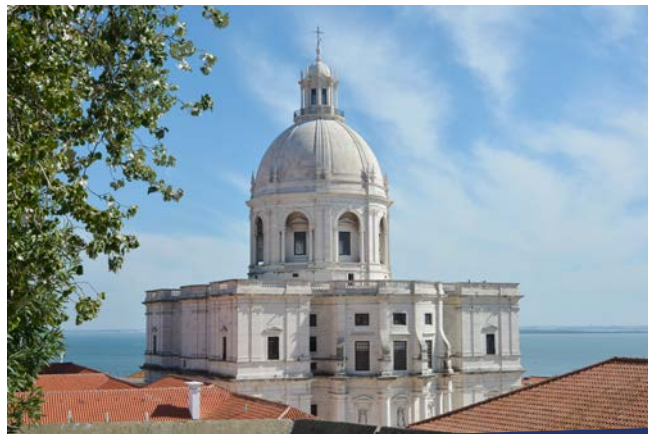
▶ Zhuhai - Macao Bridge



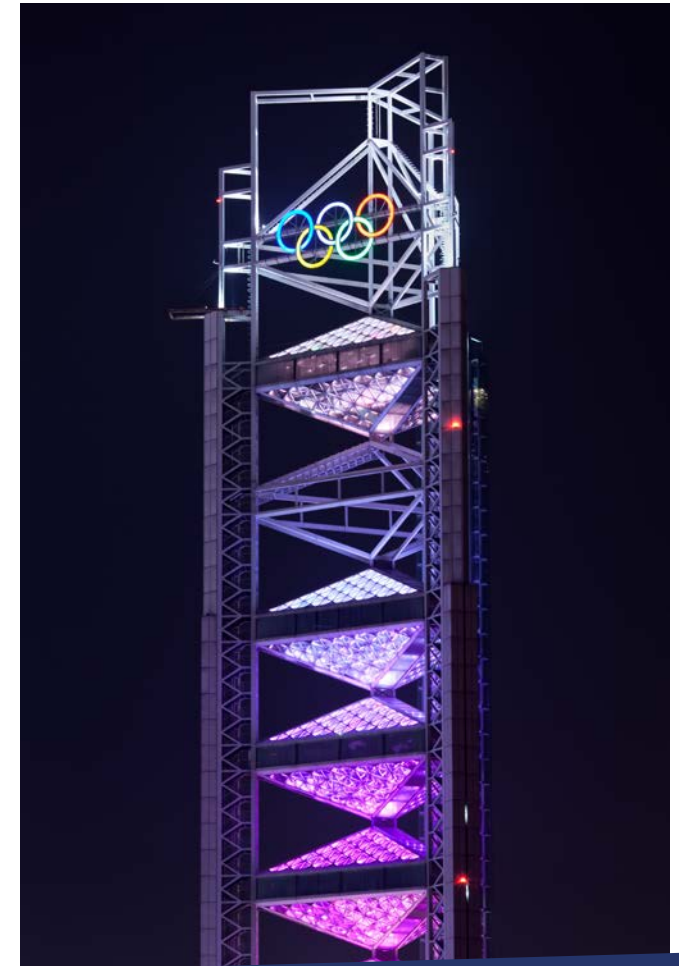
▶ Madrid - Barajas Airport



▶ Panteón Nacional Lisboa



▶ Beijing Olympic Tower



INTERNATIONAL REFERENCES

▶ CITIC Building - Beijing



▶ CACSA - Valencia



▶ Garden by the Bay - Singapore



▶ TATA SKY - India

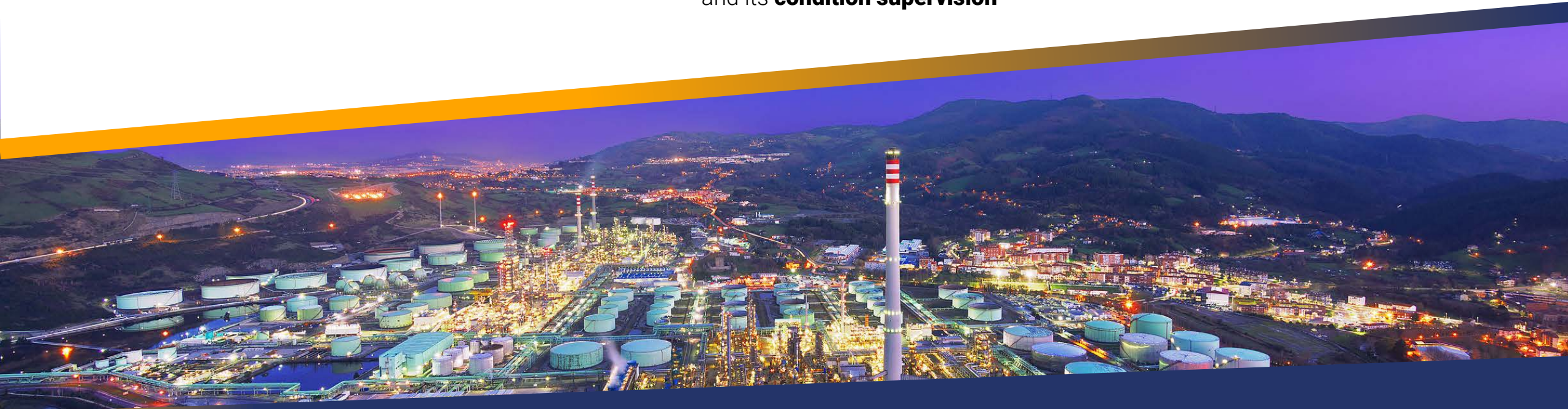


▶ East Bend Station - Ohio

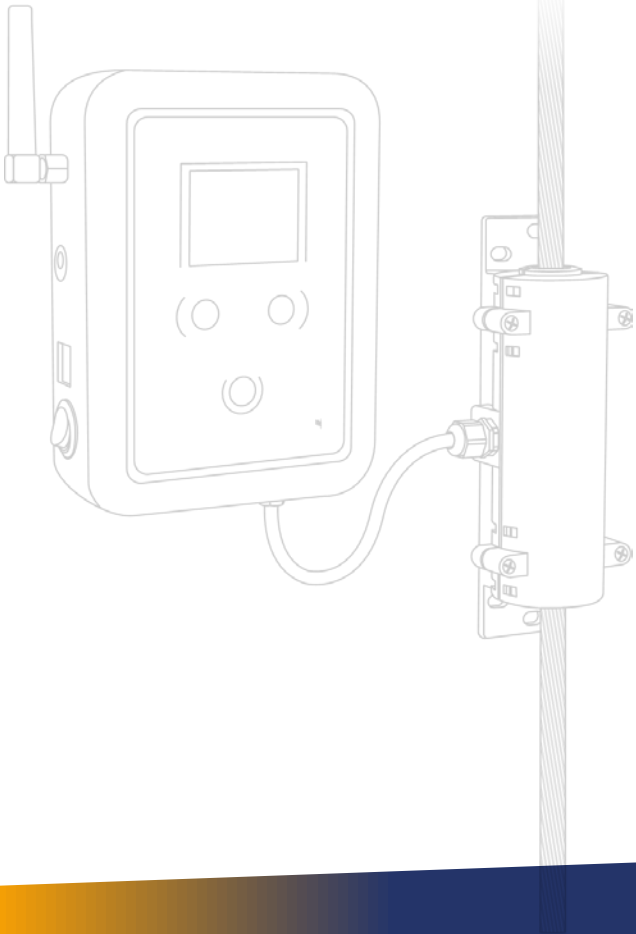


An Earthing System is the foundation of any electrical installation

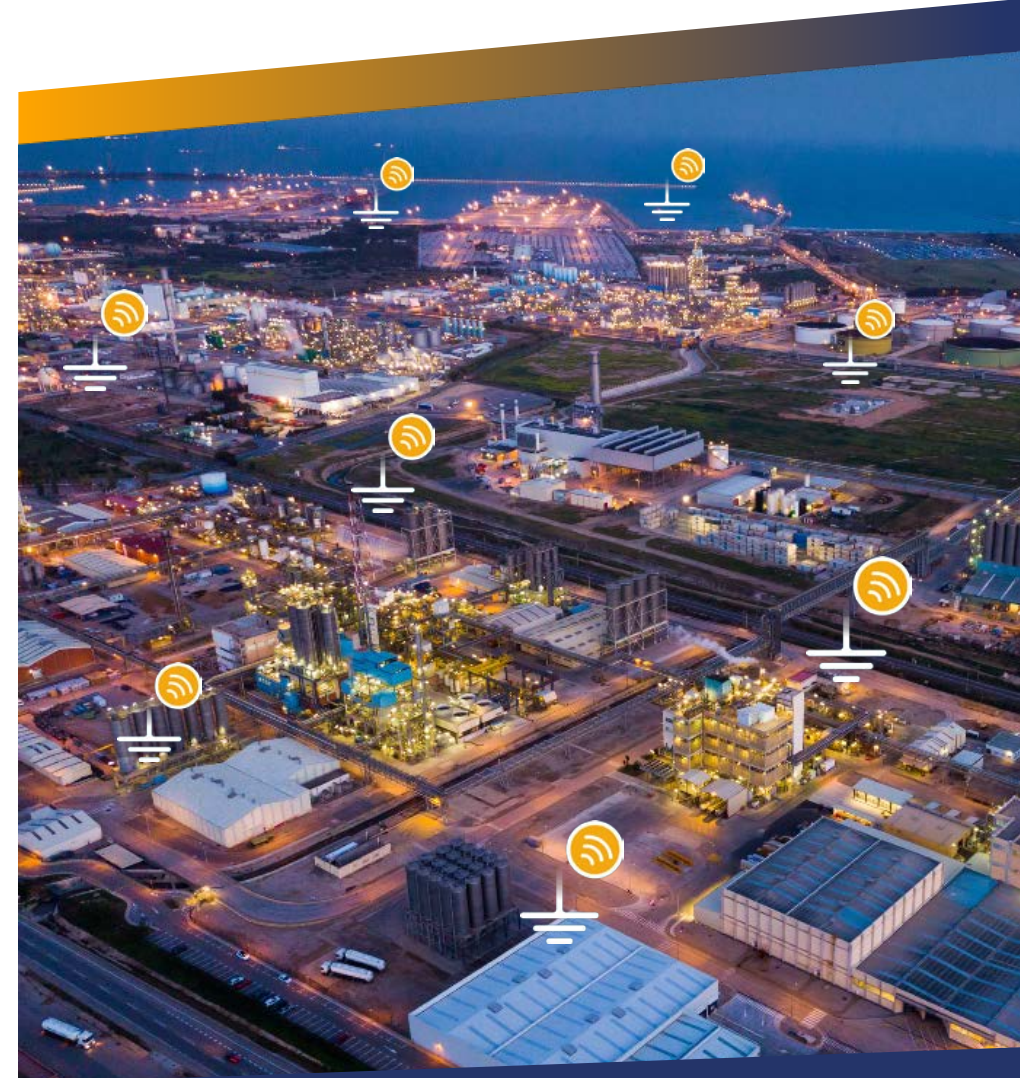
- ▶ Any current excess will dissipate safely into earth, preventing personal injury and failure of the electrical components connected to it
- ▶ The safety of the people and equipment connected to it depends on its **design**, its **execution** and its **condition supervision**



SMART EARTHING MONITORING SYSTEM



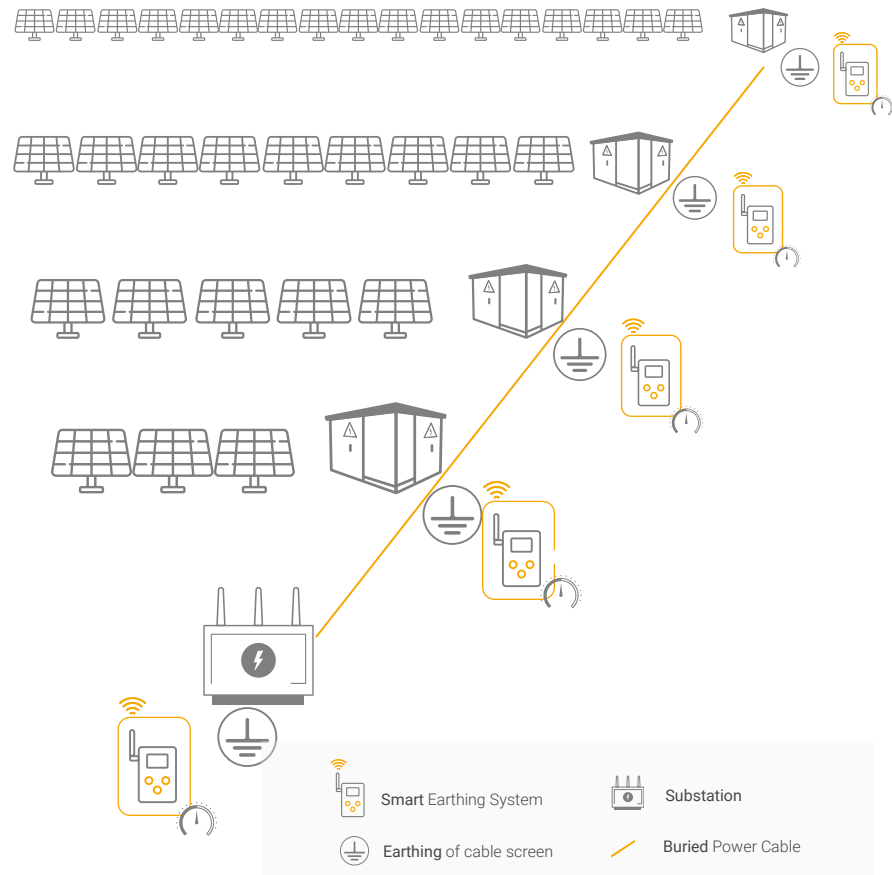
- ▶ Allows the **remote supervision** of the installed **earthing system**
- ▶ **Redefines** the **existing** passive **earthing systems** into **huge and active sensors** of electrical activity in the monitored facilities



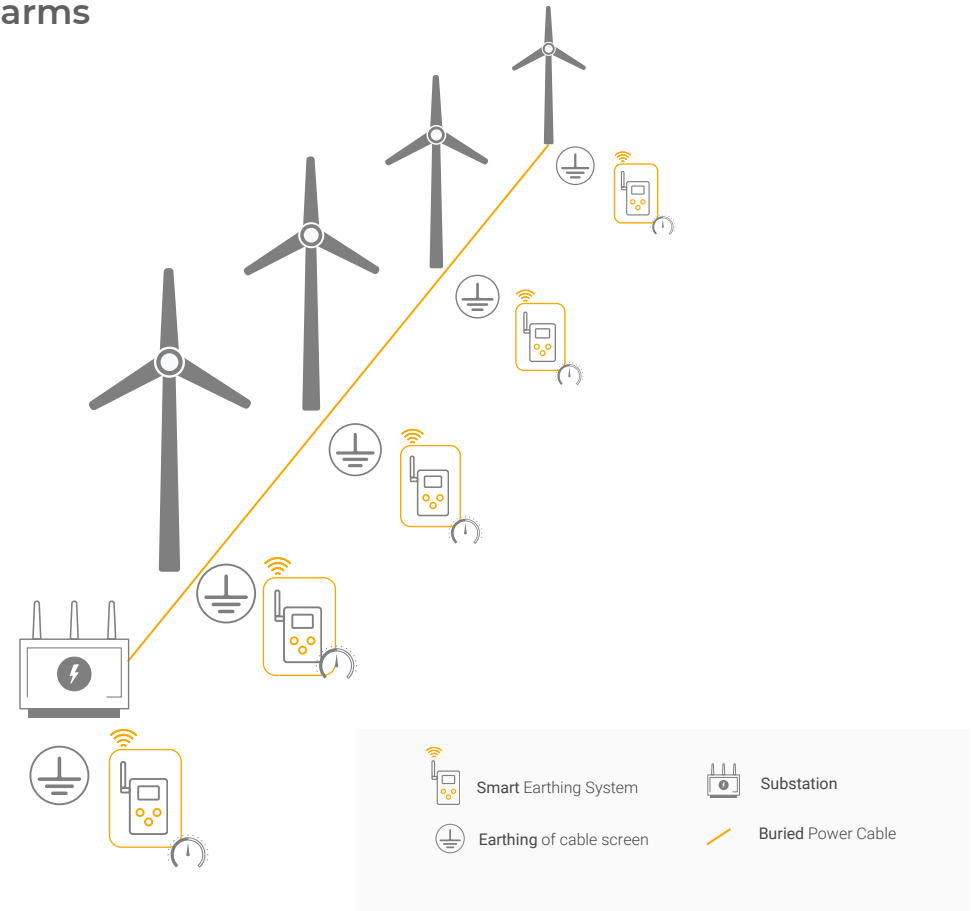
2 SYSTEM TYPICAL LAYOUT

ELECTRICAL GENERATION

Solar Farms



Wind Farms





**EARTHING
SYSTEMS 4.0**

Smart earthing monitoring system for solar farms



**APLICACIONES
TECNOLÓGICAS**

**SMART
EARTHING**

Cost reduction and lifespan extension of photovoltaic facilities by monitoring the earthing system

The SEMS technology developed by Aplicaciones Tecnológicas turns the earthing system of solar farms into an immense sensor where, through Advanced Algorithmics and Artificial Intelligence, it can remotely alert on the need for corrective interventions, implement early preventive actions to mitigate risk situations and even generate predictive models that anticipate future anomalies before they happen.

This 4.0 monitoring system is therefore an essential element to ensure the expected Return on Investment in the expected period.



OPERATIONAL EXCELLENCE

- ▶ Data-driven predictive maintenance.
- ▶ Real-time alerts for corrective maintenance.
- ▶ Prevention of failures and safety-critical situations.
- ▶ Centralised monitoring.
- ▶ Configurable system adaptable to user needs.
- ▶ Remote updates.



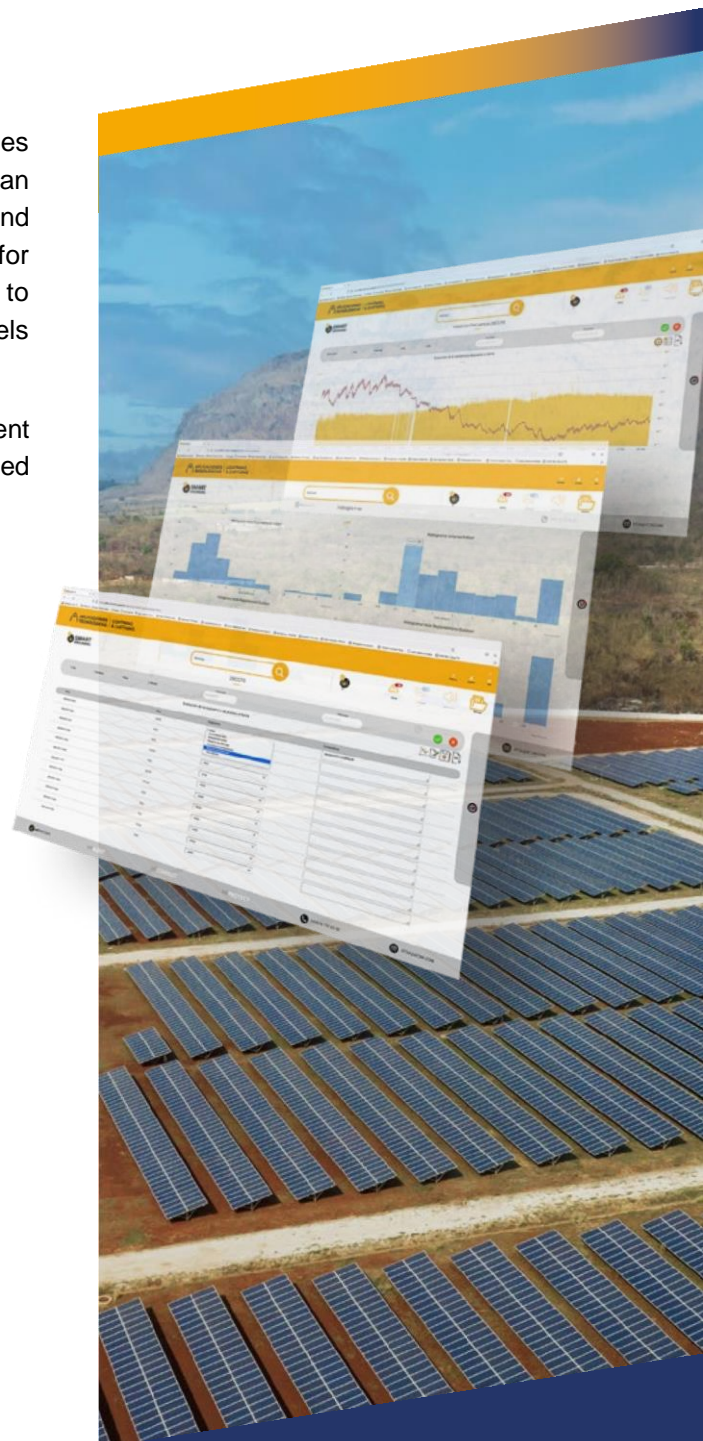
RISK MINIMISATION

- ▶ Reduction of the risk of step and touch voltages with the danger of electric shock for people.
- ▶ Continuous and remote verification of assets status.
- ▶ Real-time detection of earthing disconnections.
- ▶ Alerts in the event of theft, degradation, breakdown or accidental breakage.



FINANCIAL EFFICIENCY

- ▶ Cost savings due to logistical simplification of verification processes.
- ▶ Early detection of asset failure situations.
- ▶ Optimisation of corrective and preventive maintenance.



Smart monitoring solutions for earthing systems in solar farms, our approach:

• Solar farms under project



Preliminary realization of a geoelectric study to determine the stratification and soil resistivity. Aplicaciones Tecnológicas S.A. offers a highly competitive geoelectric study service.



Designs based on international standards using advanced software that allows us to determine objectively the optimum solution.



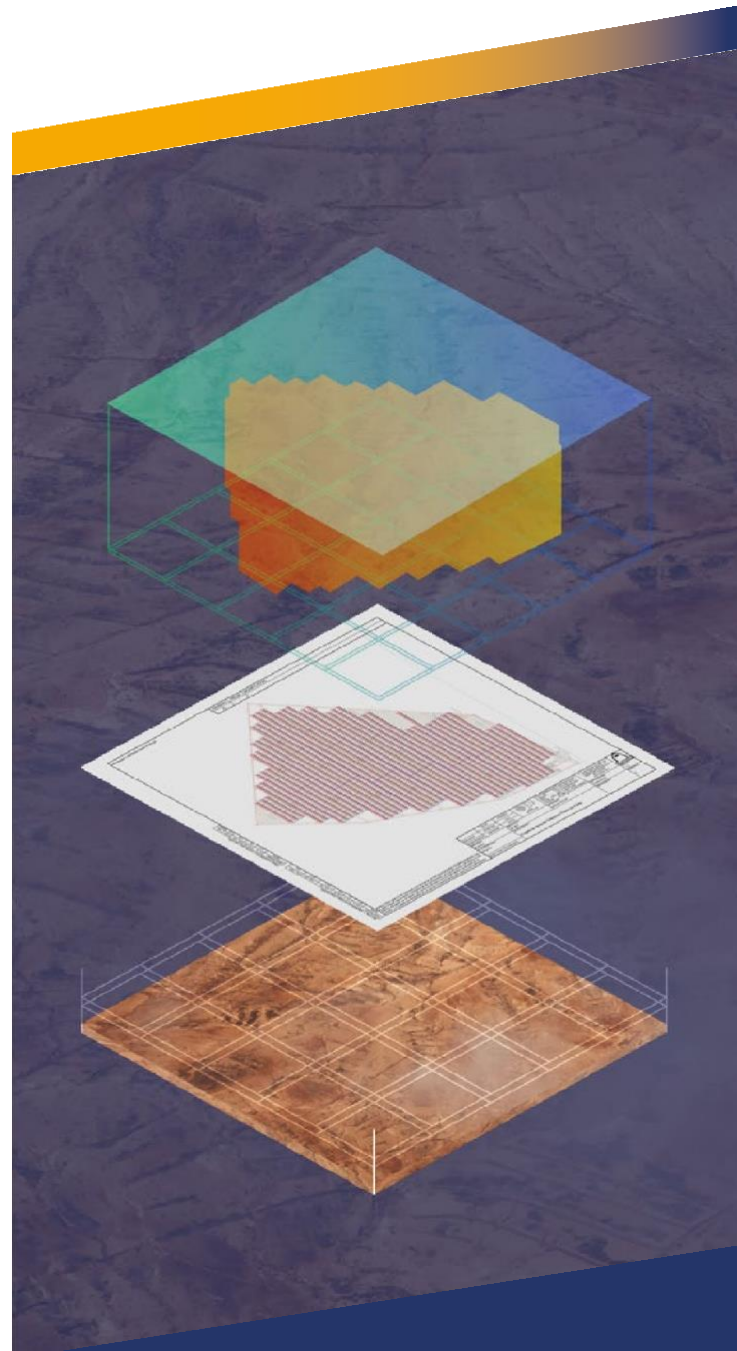
Use of specific anti-theft conductors and electrodes according to the particularities of the terrain: corrosion-resistant electrodes for aggressive soils, special electrodes and/or perimeter ring conductors for highly resistive soils, etc.



Durable connections between conductors by using Apliweld® exothermic welding, which remain in excellent condition for the entire service life of the installation.



Advanced and continuous monitoring system of the status of the earthing system using the Smart Earthing Monitoring System.



• **Operational solar farms**

Diagnosis and enhancement service for solar farm earth connections:



Phase 1: Initial meeting to learn about the problems and areas for improvement identified by the client.



Phase 2: Analysis of the current earthing system using our advanced software GMAT/PAST.



Phase 3: Diagnosis and improvement proposals to achieve the objectives of reducing costs and increasing the longevity of the farm's assets.



Phase 4: Earthing project 4.0. Installation of the Smart Earthing Monitoring System (SEMS).



Efficient supervision of earthing systems: operation scheme.

Distributed sensorization, IoT connectivity and artificial intelligence for the supervision of earthing systems in photovoltaic facilities.



**Data
collection**



**Accurate
diagnostics**



**Multi-channel
objective alerts**

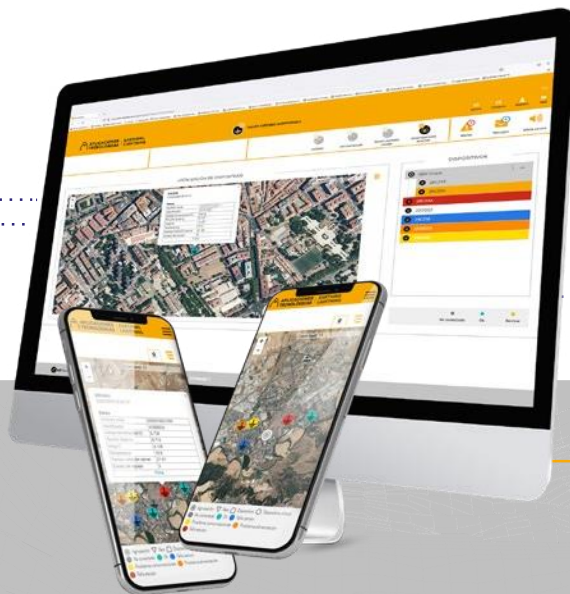
- ▶ Data collection: centralised monitoring of distributed smart sensors.

- ▶ Accurate diagnostics: artificial intelligence for decision-making.

- ▶ Multi-channel objective alerts: multi-platform that allows users to receive feedback, both in the form of alerts and in the form of historical data.

- ▶ Remote problem detection.

- ▶ Real-time reporting.



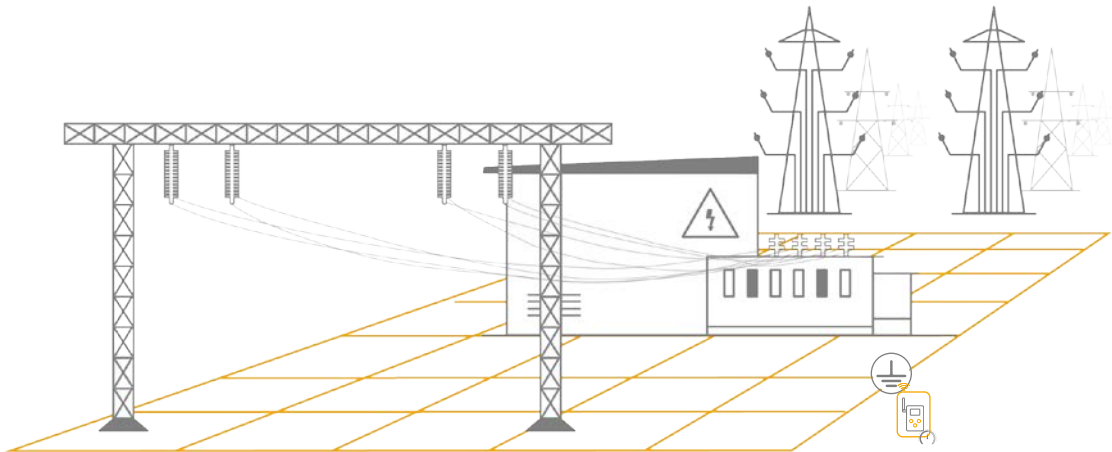
at3w-connect.com

2 SYSTEM TYPICAL LAYOUT

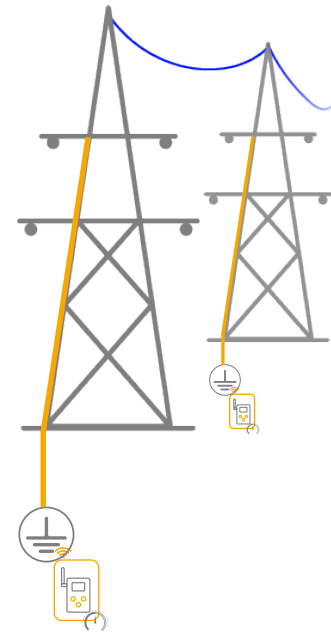
ELECTRICAL TRANSMISSION



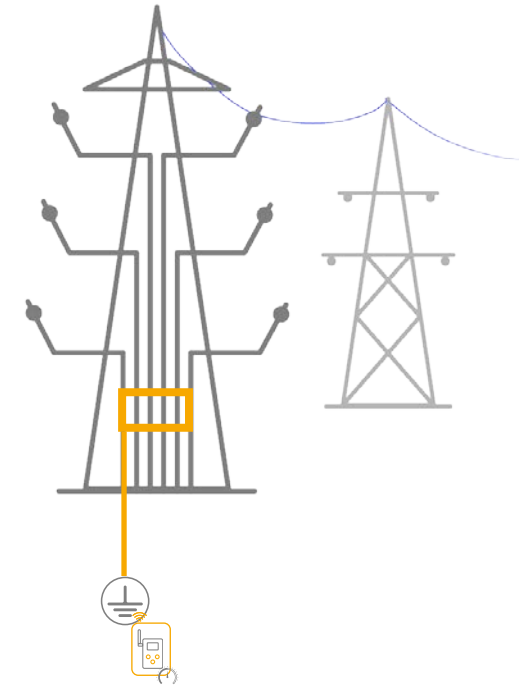
Substations



HV Towers



Overhead to Underground HV Towers

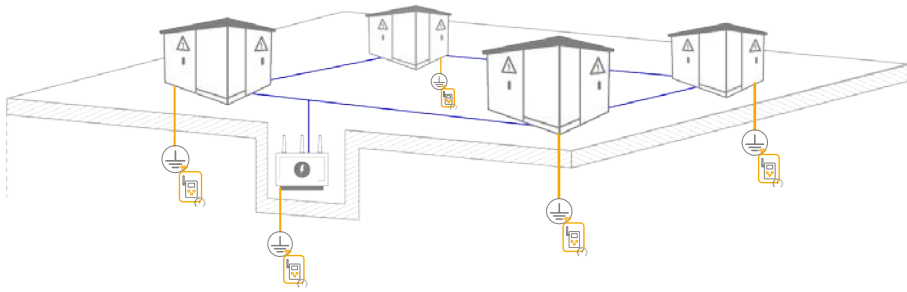


2 SYSTEM TYPICAL LAYOUT

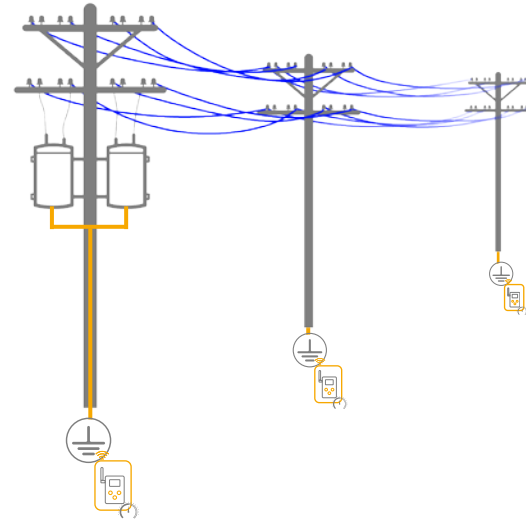
ELECTRICAL DISTRIBUTION



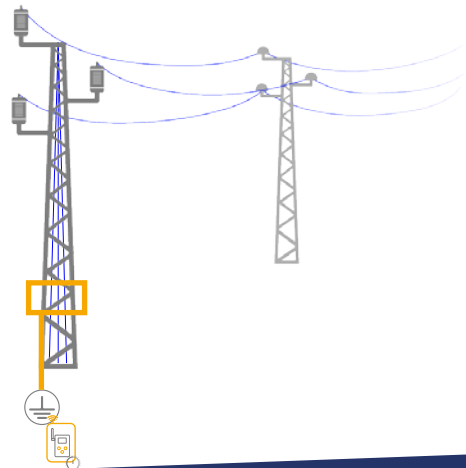
Network of transformers



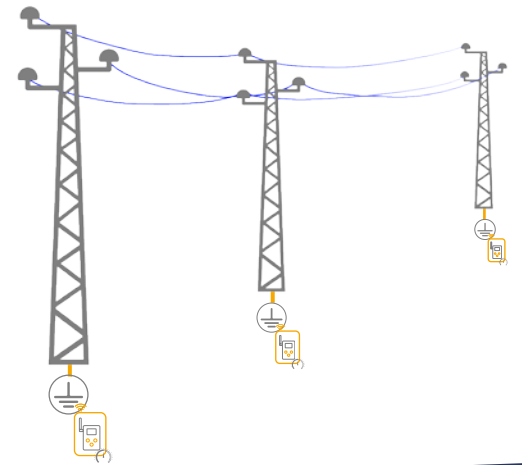
On-pole transformers



Overhead to Underground MV Towers



MV Power Tower



Remote supervision of the installed earthing system

- ▶ **Real-time determination of earthing system values**
 - Logistical and operational optimization of regulatory checks
- ▶ **Verification of asset-to-earthing connections**
 - Identification of both, asset non-connection as well as unrequired connection to the earthing system
- ▶ **Evaluation of earthing continuity**
 - Real-time alerts related to conductors breakage, vandalism or theft
- ▶ **Monitoring of earthing system corrosion level**
 - Signal decomposition analysis allows for the identification of very slow trends associated with the oxidation phenomenon

Earthing system as a huge and active sensor of electrical activity

- ▶ **Excessive leakage currents**
 - The detection of abnormal leakage current is normally linked to isolation degradation in the assets connected to the earthing system
- ▶ **Evaluation of current ground flow related with abnormal electrical activity in the facility**
 - Related to transformers, MV isolated cables, arresters, inverters, wind turbines, etc..
 - Presence of phase-neutral imbalances
 - Identification of the presence of harmonics' (50,100,150Hz...) in the earthing system to determine possible causes of failure
- ▶ **Evaluation of noise level present in the ground conductor**
 - Due to a defect in other elements connected to ground or by couplings on the monitored earthing systems.



SMART EARTHING MONITORING SYSTEM



FINANCIAL EFFICIENCY

Cost savings through logistical simplification of verification processes and early detection of asset failure situations



RISK MINIMISATION

Prevention of **critical situations** -step and touch voltages, fatal asset damages, etc..-



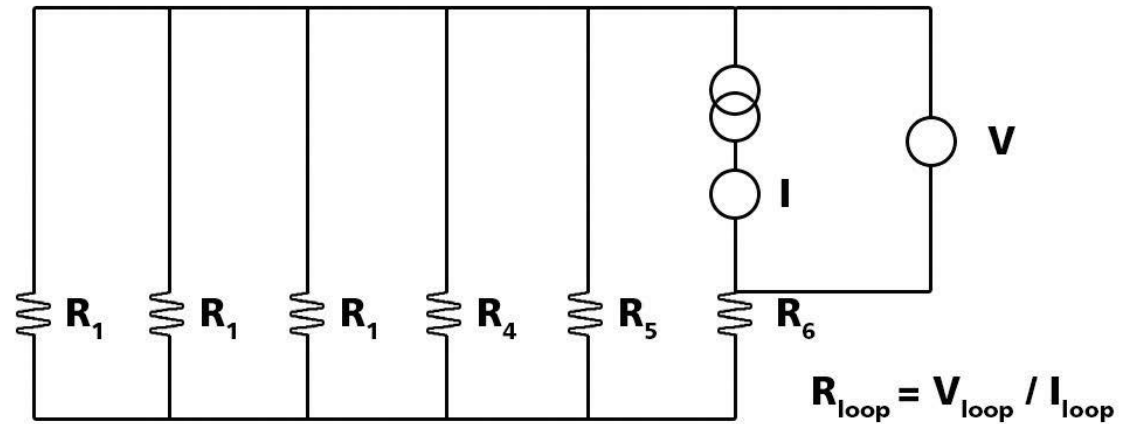
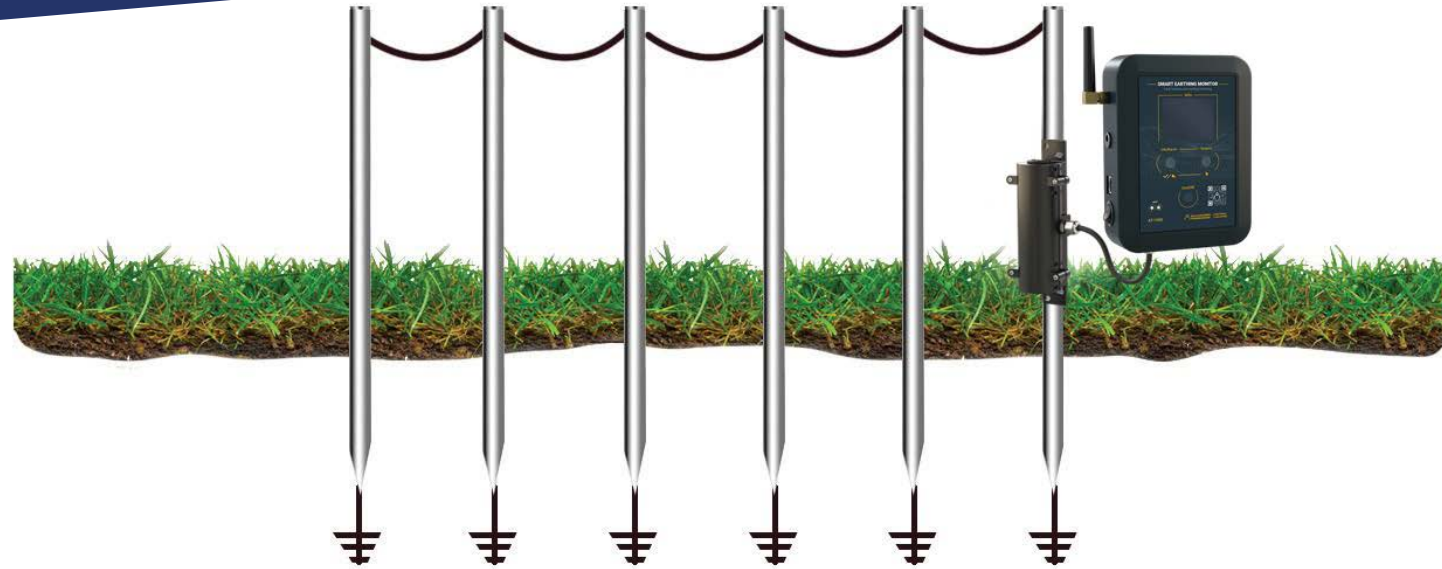
OPERATIONAL EFFICIENCY

Data-driven predictive maintenance that optimizes asset lifetime. **Real-time alerts for corrective maintenance.** Theft and vandalism detection.

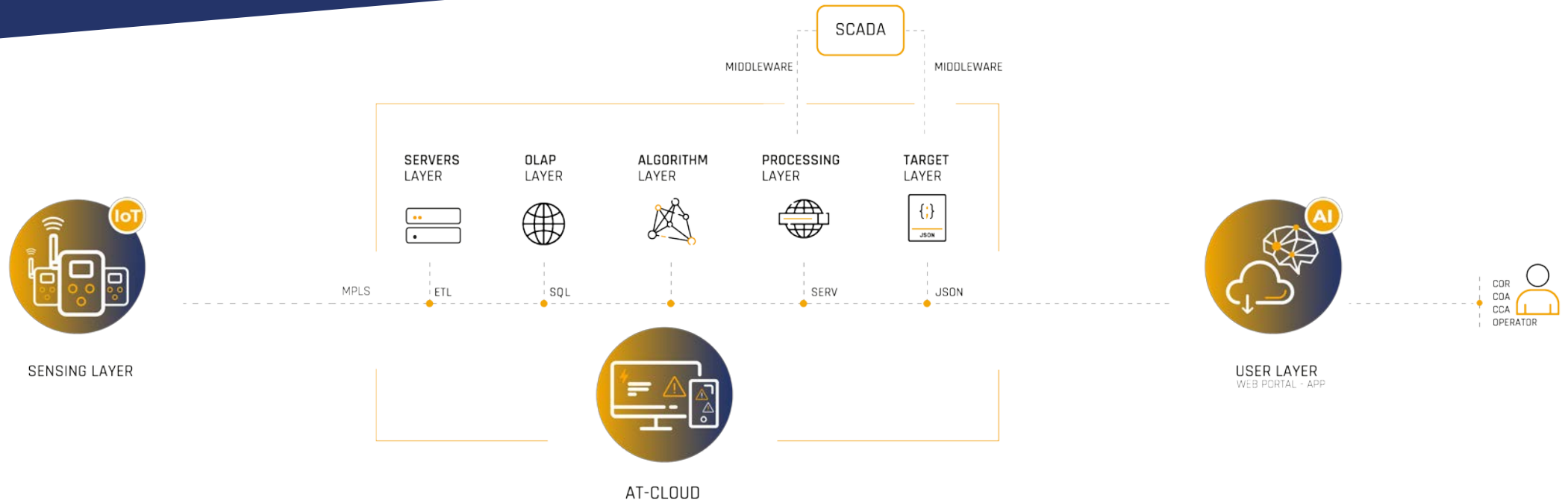


SMART EARTHING MONITORING SYSTEM

Loop impedance measurement method



4 SYSTEM WORKING SQUEME



Sensing layer containing the distributed **smart sensors** on the assets to be monitored.

Interpretation of data through **AI algorithms** and server interaction transform **raw data into relevant information** for complete characterization of the monitored system.

User info can be delivered by **different configurable channels** and **access** to information segmented by user profile.

5 SYSTEM CONFIGURATION



► Power supply

- Mains power supply
- Direct from 48V batteries
- Autonomous supply via solar panel

► Battery

- 5Ah as power backup
- 10Ah for solar power applications

► Visualisation

- Optional 2.4" TFT screen for local operation

► Communication

- 2G/3G network
- IoT bands 4G (LTE-M, NB-IoT)
- LAN port Communication

► Enclosure

- Indoor use, wall or DIN rail mounting
- IP 65 outdoors weatherproof enclosure



6 FUNCTIONAL OPTIONS



▶ Real-time continuity

Generation of real-time alerts when a lack of continuity is detected.

▶ Autocalibration

Unattended calibration of equipment for regulatory verifications.

▶ Expansion port

Allows communication with other devices at site

▶ Potential-free outputs

Allows configurable local actuation

▶ Leakage current detection

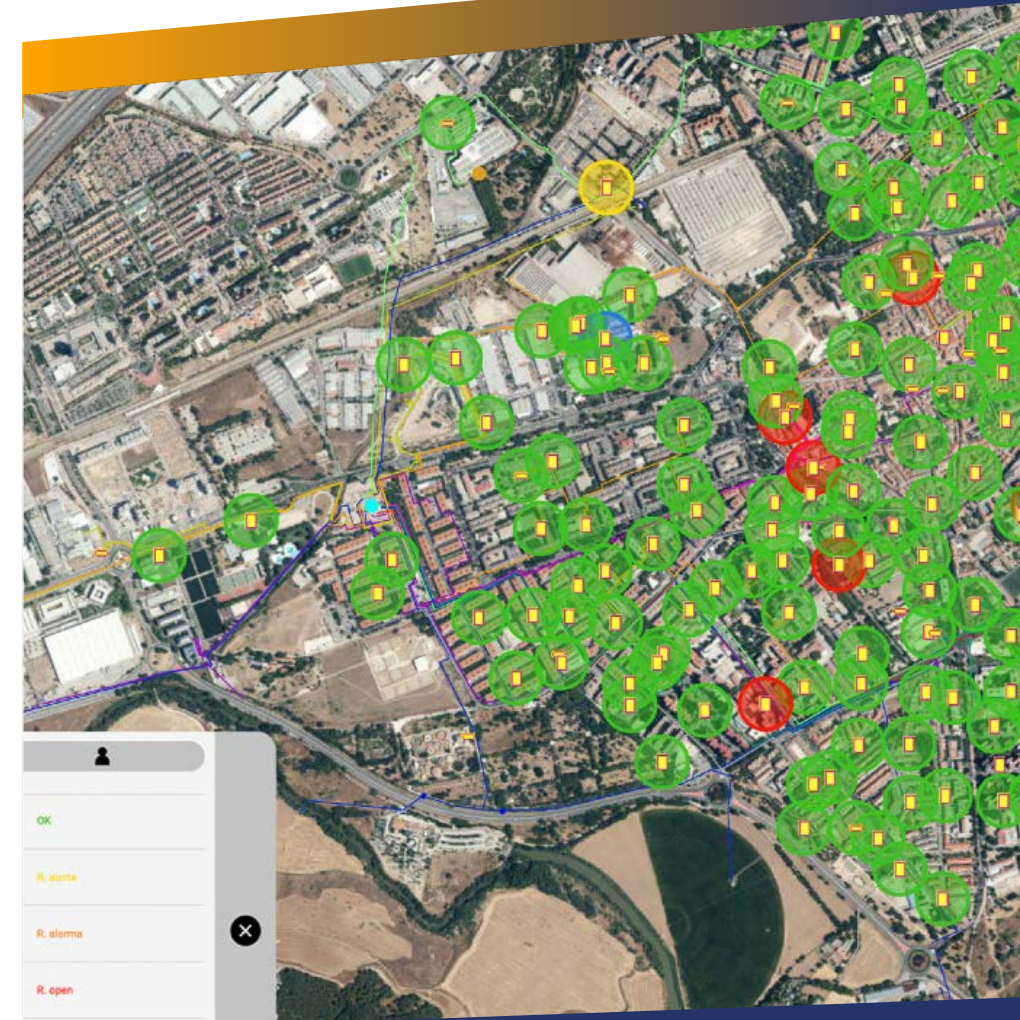
Detection & evaluation of leakage current from equipment connected to the earthing system, e.g. autovalves, transformers, etc.

▶ Comm ports

Analog and digital ports to serve as a comm hub of external sensors

▶ Node evaluation

Status evaluation of interconnection between different earthing systems



7 PLATFORM OPTIONS



▶ CCA platform

Alerts associated with earthing resistance, continuity measurements and leakage current

▶ COA platform

Alerts related to the equipment status.

▶ APP management for equipment activation/deactivation:

Mobile APP for management of activation/deactivation of installed equipment.

▶ SCADA

Integration of data processed in client's system.



▶ Application Maintenance Services

- Remote updating of the application
- 24x7 Technical Service
- Data backup

▶ Equipment Maintenance Services

- Remote equipment updates
- Remote equipment diagnostics
- 24x7 Technical Service
- Local data recovery
- Autocalibration

AT-CONNECT



APLICACIONES TECNOLÓGICAS | EARTHING LIGHTNING



Other recommended services and products

Services

- ▶ Advanced geoelectrical studies.
- ▶ Earthing systems 4.0 projects.
- ▶ Smart storm detection projects.
- ▶ Lightning and overvoltage protection projects.


Products

- ▶ **ATSTORM®**
Smart early warning system for thunderstorm risk.
- ▶ **DAT CONTROLLER® REMOTE**
Smart air terminals with IoT technology.
- ▶ **OVERVOLTAGES**
Transient and permanent.



APLICACIONES TECNOLÓGICAS S.A.

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