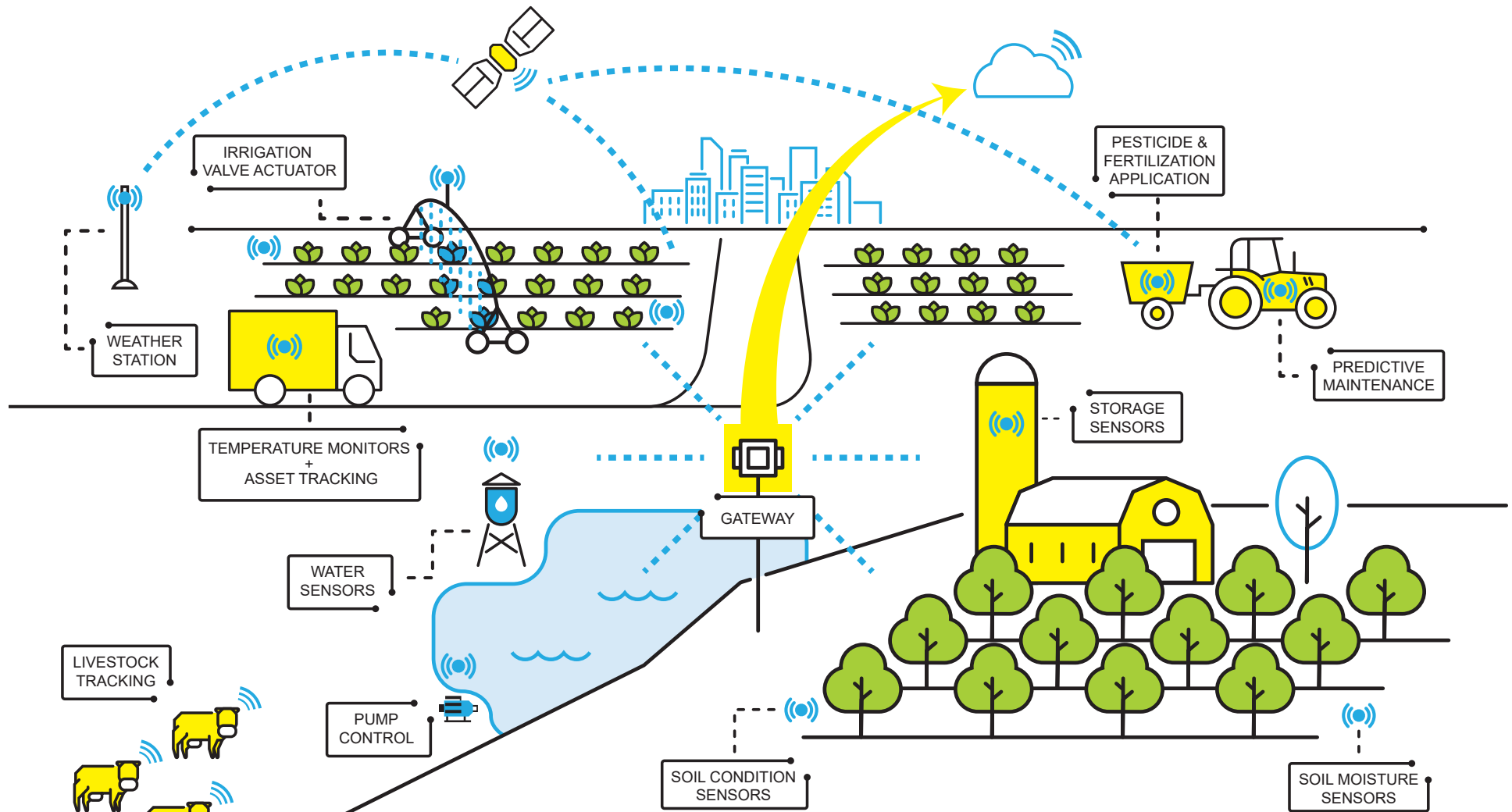


LoRaWAN® FOR SMART AGRICULTURE

IoT in Difficult to Reach Locations



INSIGHTS YOU NEVER HAD, AFFORDABLY

MONITOR & CONTROL

- Soil factors
- Precision irrigation needs
- Livestock tracking & health monitoring
- Micro-climates
- Storage
- Asset tracking
- Fertilizer & feed
- Irrigation valves & pump

ACHIEVE

- Savings of time & money
- Resource efficiency
- Reduced labor costs
- Improved yield
- Optimized pesticide & fertilization application
- Healthier & more productive livestock
- Sustainability

REAL WORLD SMART AGRICULTURE DEPLOYMENTS BY OUR MEMBERS

An entire farm can be served with a single LoRaWAN gateway that connects multiple types of LoRaWAN sensors, across 10 – 15 kilometers, and in remote and challenging environments.



SOIL

SOIL NITROGEN MONITORING

- Challenge: A nitrogen monitoring soil sensor needed connectivity at low cost and low power for remote locations.
- Solution: A hybrid LoRaWAN terrestrial and LoRaWAN sensor-to-satellite solution enables nitrogen readings in soil that reduced and targeted nitrogen application, saving farmers costs without reducing yields and in some cases increasing yields.

SOIL CONDITION SENSORS

- Challenge: Growing berries requires more than just accurate irrigation, it involves precisely controlling soil health variables including moisture, electrical conductivity, pH, and luminosity among others.
- Solution: By deploying LoRaWAN sensors, growers can measure uMol and solar radiation, humidity, pH and EC in real-time. This allows them to make informed decisions on irrigation that improve yield, understand water drainage, avoid runoff, and make optimal use of fertilizers.

SOIL CONDITION SENSORS

- Challenge: Farmers make decisions about fertilizer application and irrigation based on manual soil testing and observations, making this process time-consuming, imprecise, and less timely.
- Solution: Sensors for soil moisture, salinity, pH, dissolved oxygen, phosphorous, and nitrogen provide more accurate real-time information for fertilization and irrigation decisions.

IRRIGATION

ORCHARD IRRIGATION

- Challenge: connecting an orchard's irrigation valves to an irrigation controller that is a few kilometers away is difficult and expensive to accomplish by wire.
- Solution: LoRaWAN creates a long-range wireless solution that employed valve actuators that irrigate automatically and are scheduled remotely without the need of an irrigation controller.

DRIP IRRIGATION

- Challenge: the wires of electrical fences that surround cattle fields and crops were being chewed by rodents.
- Solution: LoRaWAN provides connectivity without wiring.

SOIL MOISTURE MONITORING

- Challenge: A major seed producer needed to collect multi-depth soil moisture data for sugar beet research fields across three countries in Europe.
- Solution: a hybrid LoRaWAN terrestrial and LoRaWAN sensor-to-satellite solution allows data to be captured at low power even where there is no cellular option.

SOIL MOISTURE AND AMBIENT ENVIRONMENT MONITORING

- Challenge: Create an easy-to-deploy and maintain soil telemetry solution that provides growers with improved crop yields, healthier crops, and water savings.
- Solution: Deploying LoRaWAN sensors, farmers can record real-time information (soil moisture and temperature, air temperature, humidity, and ambient light) to make informed irrigation decisions on when to irrigate and how much water to apply, treating each area of their field individually to optimize growth.

PUMP CONTROL FOR IRRIGATION

- Challenge: Synchronize a water pump—that is connected to a remote pond—to water valves that manage irrigation of fields that are far away.
- Solution: LoRaWAN creates a long-range wireless solution where ON/OFF is performed remotely and simultaneously with the various valves, ensuring optimal pressure in the pipes.

FARM WATER INFRASTRUCTURE MANAGEMENT:

- Challenge: Water infrastructure on farms (intake, pumps, pipes, troughs, dams, tanks, ditches, effluent ponds, and more) is implemented across large areas and it is difficult to ensure all the parts are in working order or plan for future requirements (droughts, rain events, river level change).
- Solution: Solar-powered LoRaWAN devices measure water flow, fill levels, pump operations, rainfall, and pressure across farms providing real-time data to a cloud-base app which enables farmers to monitor their farm's water infrastructure in one place.

IRRIGATION FOR PASTURE GROWTH:

- Challenge: Schedule and control hundreds of fixed irrigation sprinklers that are installed on hilly fields and other areas that cannot be served by pivot irrigation.
- Solution: Solar-powered LoRaWAN irrigation control devices can be attached to each sprinkler and send and receive data from a cloud-based application so that farmers can manage irrigation schedules from their phone or tablet.

WATER SENSORS

- Challenge: Monitoring storage levels, sources and and the rate of use are time-consuming tasks, resulting in overuse and additional expense.
- Solution: Sensors provide awareness of water levels in storage and monitor flow for intelligent water use. Automation of control with smart valves eliminates manual labor and enables efficiency. Types of sensors include;
 1. Well water level sensors - to monitor well levels for natural resource management and water-use allocation rules.
 2. Stream and canal water level and flow sensors - to monitor water usage for natural resource management and water-use allocation rules, and to alert for potential flooding events.

3. Irrigation flow sensors - to monitor irrigation water applied to ensure that crops are getting the correct amount of water.
4. Livestock watering tank sensors - to monitor livestock water consumption and to ensure that water is available for livestock.
5. Lagoon level sensors - to monitor lagoon health and alert on potential overflow events (a lagoon is a livestock latrine)

TEMPERATURE & HUMIDITY

TEMPERATURE MONITORING (E.G. IN A GREENHOUSE)

- Challenge: Create a low-cost, easy-to-deploy greenhouse temperature monitoring solution to positively affect the rate of plant development and reduce greenhouse energy consumption.
- Solution: LoRaWAN sensors enable the continuous monitoring of temperature throughout different areas of the greenhouse and send alerts if the set temperature and humidity conditions fall out of optimal ranges.

BEEHIVE MONITORING

- Challenge: A major agricultural player needed reliable beehive data including hive weight, temperature and humidity.
- Solution: A hive lid sensor with LoRaWAN sensor-to-satellite solution allows data to be captured at low power even in remote locations.

WEATHER STATION

- Challenge: Control the temperature and humidity of seeds in the field during the drying process while managing the impact of weather variables.
- Solution: Using a LoRaWAN weather station, farmers can analyze the relationship between weather conditions (CO2, light pollution, relative humidity and temperature) and drying process operations in real-time to prevent over and under drying and optimize equipment utilization.

WEATHER STATION

- Challenge: Farmers make decisions about planting, watering, fertilizing, and harvesting using weather data that is often regional, making the data inaccurate in some instances.
- Solution: Weather stations located at a farm provide real-time, hyper-local weather data, improving the accuracy and usefulness. Many weather stations are modular, allowing the farmer to select a configuration of sensors depending on the particular crop being grown, providing them with the needed information while optimizing the cost of the solution.

LIVESTOCK

LIVESTOCK TRACKING:

- Challenge: Cattle can roam over large expanses of land and need to be located in real-time to have their health monitored in case they need to be tended or removed from the herd.
- Solution: LoRaWAN connectivity expands the network range for large farms to provide exact location of cattle.

HORSE WELLNESS & FOALING

- Challenge: Horse owners must provide quick intervention if a horse shows signs of colic, lameness, casting, escape or foaling.
- Solution: A solar-powered wearable LoRaWAN device on the horse's harness provides real-time data on horse behavior to a cloud-based app which compares current behavior to normal behavior.

EQUIPMENT

ASSET TRACKING

- Challenge: Create real-time location of agricultural equipment to enable efficient and cost optimized operation of an industrial farm.
- Solution: LoRaWAN asset trackers enable farmers to track all their assets, both motorized and non-motorized, regardless of cellular coverage (e.g., harvesters, sprayers, balers).

PREDICTIVE MAINTENANCE:

- Challenge: Farm machines - tractors, trucks, etc. - operating on large, expansive farms need to be monitored to operate efficiently.
- Solution: LoRaWAN long range coverage of large farms allows monitoring of farm vehicles allowing for optimization of performance and savings on fuel, oil, operation & application times, and more.

LEVEL MONITORING

STORAGE SENSORS

- Challenge: The controlled transport and storage of food products must include management of temperature, humidity, volume, and other crucial factors.
- Solution: LoRaWAN sensors allow farmers to record information in real time so that a storage silo or truck can activate control systems like refrigeration, and thus minimize losses.

GRAIN SILO MONITORING

- Challenge: Disruptive "emergency feed" situations arise when farmers with smaller silos (<40T) run out of feed because they avoid climbing the silo to preserve their health, safety and time.
- Solution: A solar-powered LoRaWAN device transmits silo data to a cloud-based app which displays fill level, grain use, predicted days-to-empty, and notifies the farmer when it is time to reorder.