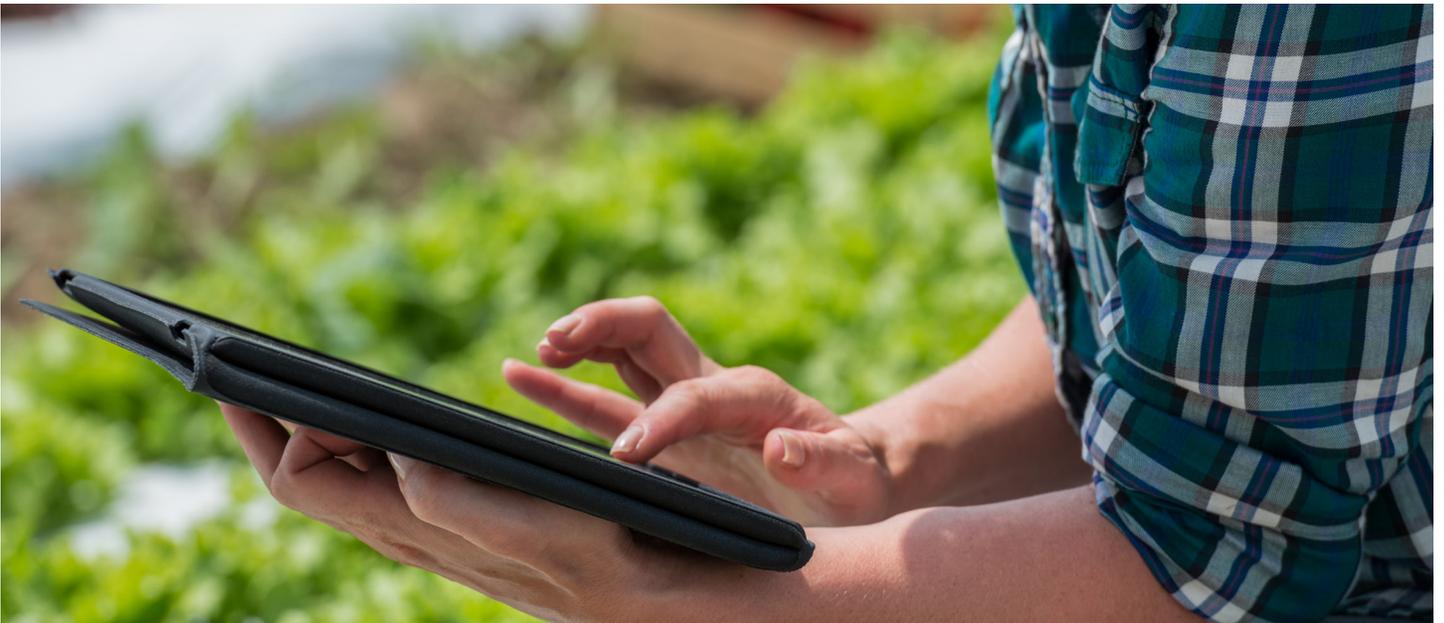




Revolutionizing Smart Agriculture Using Semtech's LoRa Technology



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EXECUTIVE SUMMARY

Over the past century, we have witnessed extraordinary changes across the agricultural landscape as most family owned micro-farms have been replaced by large scale macro-farming operations and the demand for food has escalated at a steady rate. According to the UN Food and Agriculture Organization, the world will need to produce 70% more food in 2050 than it did in 2006 in order to feed the growing global population*. Agribusinesses are turning to the Internet of Things (IoT) for analytics and greater production capabilities as production and operation demands continue to surge. Farmers and ranchers can no longer rely on visual cues or other passive and historical indicators for managing their businesses. Instead, they must create more efficient operations to gather information regularly in the field, quickly synthesize the data and make intelligent business decisions to reap the benefits of precision farming and real-time monitoring of livestock.

IoT is set to push the future of agribusiness to the next level. In some countries, smart agriculture is becoming more common, but in order to accelerate the worldwide adoption of IoT technology, farmers and ranchers need low cost, low-power sensors. Semtech's LoRa® devices and wireless RF Technology (LoRa Technology) and the LoRaWAN™ open protocol are ideal for sensors that only need to update information a few times per hour since conditions do not change radically. Additionally, since many farms and ranches are in rural areas and do not have access to cellular or licensed spectrum coverage they need an easy to install network infrastructure for their IoT applications.

"In cattle feedlots, power consumption is really important. Cattle are not too willing to take off their ear tags for recharging purposes, so the battery has to last for at least eight months as they roam the fields. With LoRa Technology's low-power capabilities, we've seen tags go beyond a year and help monitor sick or pregnant cows."

- Vishal Singh, CEO and founder of Quantified Ag

By leveraging LoRa Technology and the LoRaWAN open protocol, agribusinesses can digitally monitor, manage and analyze every aspect of their business, improving their overall operations and return on investment (ROI). From tracking cattle health, to monitoring pregnant cows to increasing crop yields, LoRa Technology provides a solid platform for the future of smart agriculture as it is easy to deploy and helps farmers and ranchers grow their businesses.

TRENDS IN SMART AGRICULTURE

What if only half of a field needs more fertilizer and it is not getting enough water? What if just one cow out of a hundred is getting sick and you need to know which animal to quarantine to stop the spread of the disease? What if you need to monitor a cow that is ovulating to ensure the mother stays healthy throughout the reproduction process?

The competitive state of the agriculture business has always driven farmers to find a technological edge. Whether it is using a GPS-driven automated tractor, or double planting soy beans to increase yield, farmers are always on the lookout for the next innovation in agricultural technology. The future of farming is one of real-time data monitoring, in-field sensing equipment and long term data analysis.

LoRa-enabled devices can handle a multitude of situations in smart agriculture ranging from tracking a herd of cattle that roam on a vast field to monitoring soil moisture. LoRa-based technologies offer increased battery life and a longer range for data transmission at an affordable price point compared to other farming IoT devices.

Quantified Ag, a developer of cattle health management tags and software, utilizes LoRa Technology to remotely track and monitor both sick and pregnant cows through a variety of stages. For WaterBit, providing farmers with real-time and low cost sensing systems to improve crop quality and yield, leverages LoRa-based devices to closely monitor soil irrigation on large agribusiness farms.

LoRa Technology streamlines and improves daily operations in each smart agriculture application. The technology has become extremely valuable to agribusinesses as they adapt to the changing demands of the agriculture industry.

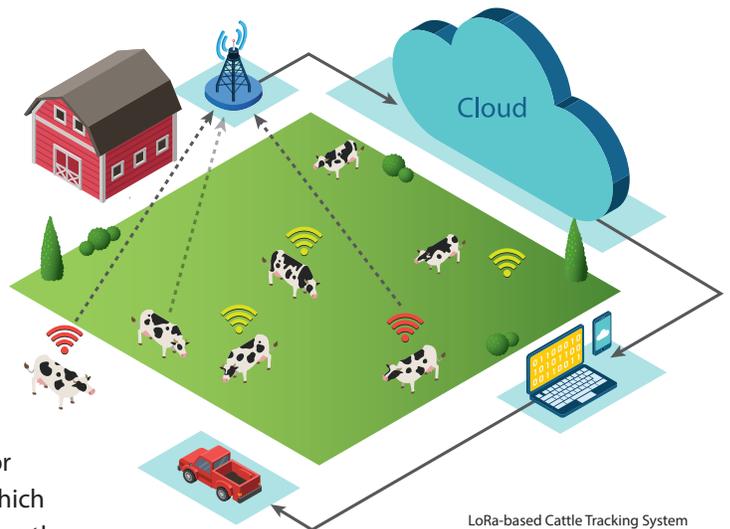
Livestock Tracking

Monitoring a herd of cattle is a full-time job as cattle feed lots can lose billions of dollars each year from infected cows. Ranchers need technology to enhance and simplify their operations while they continue to focus on their financial growth.

Quantified Ag, located in Lincoln, Nebraska, has developed a cow tag, integrated with LoRa Technology that can measure a cow's body temperature, head movement and general mobility. All the data is collected in an application server that looks for "outliers" such as a cow that shows a reduced amount of mobility and body temperature. This data becomes an indicator of sickness. Quantified Ag's solution offers a mobile phone app which notifies the ranchers of potential health issues, so they can examine the cow.

Ranchers can then remotely video conference with a veterinarian who can check the animal's vital signs and gather biometric data. This enables ranchers to quickly give their cattle immediate care to help prevent the disease from spreading throughout the herd.

There are a number of LoRa-based IoT devices coming to market that are tailored to livestock applications. Another device, currently in testing and design, can be fed to cows and used as an in-animal monitoring device. This LoRa-based sensor can monitor body temperature, and can also send a signal to the artificial insemination veterinarian that the cow is ovulating. This saves time and guess work by letting the rancher know exactly what is happening in every potential new mother cow.



Maximizing Crop Yields

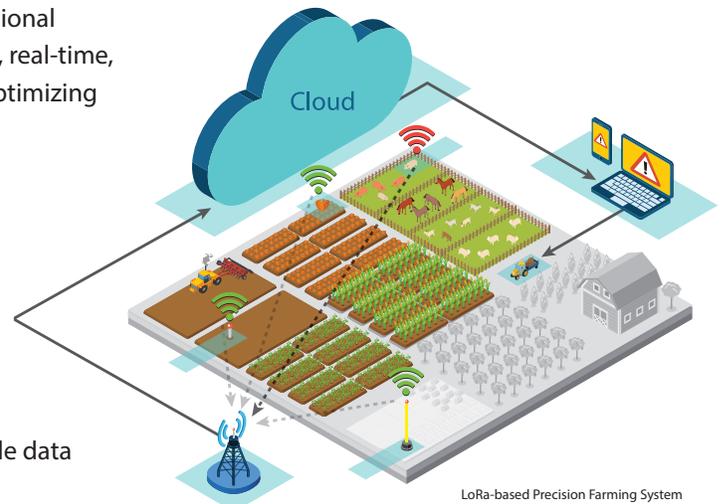
Today's farmers are desperate for data that allows them to make pin-pointed irrigation and fertilization decisions which let them optimize their crop yields. Water and soil are the main factors that mainly drive the crop yields, while everything else remains constant. Once a farmer can control water and soil, he or she can increase crop yields to the maximum level within weather and crop constraints.

"With LoRa Technology, our customers have better water management at higher granularities and for grape crops, farmers have resulted in 20% and 30% yield improvement."

- Manu Pillai, Founder, WaterBit, Inc.

WaterBit, Inc., located in the Silicon Valley and funded by the National Science Foundation (NSF), provides farmers with highly granular, real-time, low cost sensing systems to improve crop quality and yield by optimizing resource use.

The company's irrigation sensor uses LoRa Technology and the LoRaWAN open protocol to connect devices to the gateway. The WaterBit system provides two-way communications to the end nodes enabling them to take sensor readings and implement control actions in response to the primary needs of irrigation and fertilization. The sensors can detect the water level, iron content and salinity of the soil. As a result of that measurement, farmers can streamline their operations by having knowledgeable data to better manage their crops and ensure the highest crop yields.



WaterBit's LoRa-based nodes have been installed on numerous types of crops across California's Central Valley, including corn, cotton, strawberries, almonds, and grapevines, enabling operation, 24/7. The sensors are designed for ultra-low energy and consume just 13 joules per day with the ability to deploy nodes up to three miles away from their gateways in dense foliage. This ultra-low energy design approach also eliminates the issue of battery replacement, resulting in a zero-maintenance product that can be installed in minutes – a unique achievement that is garnering strong customer interest.

KEY BENEFITS OF LoRa TECHNOLOGY FOR SMART AGRICULTURE:

- **Geolocation:** LoRa Technology utilizes a GPS-free geolocation technology that does not require additional power.
- **Low connection costs:** LoRa Technology operates in the unlicensed ISM band, which means no or very low spectrum costs (there may be a very low connection fee if using an external service provider).
- **Open standard:** The LoRaWAN open specification is supported and maintained by the LoRa Alliance™ allowing seamless and easy scalability.
- **Available today:** Public and private networks ready for implementation and widely deployed.
- **Leverage deployed assets:** LoRa Technology's robust signaling can penetrate for wide ranging coverage even in rural areas.
- **Growing ecosystem:** The fast-growing LoRa Alliance™ currently comprises over 500 companies that are creating solutions using the LoRaWAN open specification. The LoRa Alliance™ includes major industry players and many other start-ups and network operators. Combined, this ecosystem offers multiple sources of supply from communications ICs to networks to server-based application platforms. The LoRa Alliance also certifies sensors and other devices for interoperability.
- **Secure:** AES-128 encryption is built in allowing for secure data transmission in rural areas.

CONCLUSION

The future of smart agriculture is in collecting and analyzing data in order to maximize efficiency. For rapid adoption among agribusinesses, the solution must provide long range, low power, easy deployment, and low cost. By leveraging LoRa Technology and the LoRaWAN open protocol, farmers and ranchers are able to maximize their efficiency and focus more on the growth and monetizing of their business.

For more information about Semtech's LoRa devices and wireless RF technology for smart agriculture applications, go to www.semtech.com/loT or scan the quick response code on the right.



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