



Disrupting Cold Chain Refrigeration & Improving Food Quality by Taking a Fresh Approach to Asset Quality Management



Axino Solutions (Axino), a leading supplier of smart refrigeration applications, developed a LoRaWAN®-based solution that combines sensor technology with artificial intelligence algorithms to remotely detect the core temperature of refrigerated food items in retail stores. In this white paper, we explore the innovative strategy and steps taken to build a retrofit Internet of Things (IoT) temperature monitoring solution to help food retailers digitize and automate their quality management process, comply with food safety regulations and reduce food waste. The Migros Group, Switzerland's largest food retailer with about 1,000 stores and restaurants, is the first grocer to deploy this revolutionary technology. Its successful implementation improved quality controls and reduced staff workload.



QUALITY MATTERS MORE THAN PRICE

In grocery retail, the fresh food category (comprised of fruits, vegetables, meat, fish, dairy, and baked goods) accounts for about 40 percent of revenue. These food offerings are a strong driver for grocery chain customer traffic and loyalty. Fresh food is fiercely competitive among retailers and is becoming even more critical. Traditional grocers are being challenged by increases in sales from convenience stores and big box retailer home delivery services.

Numerous international food handling and food safety laws have been implemented to reduce the risk of foodborne illness resulting from bacterial growth. A major component of most “farm-to-fork” regulations is the ability to track, report and maintain appropriate temperature conditions inside refrigeration and freezer units throughout the entire cold chain – from processing and production to delivery, storage and store shelves.

McKinsey & Company recently released research from a Pan-European benchmarking survey of 23,000 grocery shoppers. In each of the four participating countries (France, Germany, Switzerland, and United Kingdom), a majority of consumers were dissatisfied with retail fresh produce departments, underscoring the opportunity for European grocers to impact revenue with quality improvements in fresh goods. Results indicated low prices and frequent promotions were attributes that increase customer satisfaction, but food quality and freshness ranked as the consumers' highest concern. According to the research, grocers can boost sales by as much as 10 percent by improving fresh food practices and policies.



"If they [grocery retailers] launch targeted, systematic and sustainable quality-improvement efforts now, they can begin to see positive effects on sales and customer satisfaction in a matter of months."

McKinsey & Company

"Perspectives on retail and consumer goods Number 7,"
Spring 2018

However, providing fresh food is a complex operation for grocery chains as prices are volatile, suppliers are fragmented and quality control processes of perishable products are laborious and costly. In addition, retailers have to offer an ever-expanding range of fresh products, many of which have different temperature and handling requirements.

The process to measure temperature to address cold chain compliance regulations and ensure fresh goods for consumers has primarily been accomplished by manually checking and recording temperature readings of refrigerated units and inserting a probe thermometer into food. This process, though labor intensive and wasteful, is the accepted industry norm.

DATA DRIVEN FRESHNESS IN FOOD RETAIL

Axino is a global leader in communication solutions and services. The company designs, implements and operates comprehensive turnkey, customized software IoT-based solutions for a wide range of customer segments, including retail, automotive, energy, pharmaceutical, telecommunications, and government sectors. Axino spun off from one of Switzerland's core technology companies, ASCOM, in 2016. The start-up solution provider's primary focus has been helping corporations of all sizes fully automate their digitalization processes.

In 2017, Axino set out to develop an automated and continuous temperature monitoring system with innovative technology that could disrupt retail cold chain refrigeration. Its mission is to ensure quality food for shoppers and help reduce product loss ("shrink rate") for retailers.

It all started with the questions: How fresh is our food? Can we digitalize and automate the multiple processes concerning quality assurance? Can we automate the processes in the store itself?

Axino created its end-to-end IoT solution in cooperation with the Institute of Applied Simulations (IAS) and the Institute for Food and Innovation (ILGI) at the Zurich University of Applied Sciences in Wädenswil. The project was funded by the Federal Swiss Innovation Agency, Innosuisse.

During an 18-month period, the group conducted research on six categories of fresh food to detect specific heat signatures and convection attributes, determine the optimal core temperature for freshness for each product and evaluate products in a variety of real-world instances (e.g., packed in plastic, unpacked, sliced). In addition, researchers ran tests utilizing robotic arms to simulate the operating mode of customers opening doors to refrigerated chests and freezers – allowing the software and back-end system Axino was creating to consider and forecast environmental circumstances.

After extrapolating the comprehensive research data, Axino developed a bespoke artificial intelligence algorithm that is highly accurate and can guarantee the core temperature of any food group item within one degree Celsius. Axino's digital measurement software and hardware components, combined with Semtech's LoRa® devices, are able to wirelessly detect and communicate the core temperature of a product with sensors placed inside coolers up to one meter away from the actual food items.

“Quality is no longer a nice-to-have feature as before, it is a critical necessity for retailers to defend their market position. In response to increased demand for fresh food, most Swiss retailers have added 40 percent more refrigerated coolers to their stores within the past five years.”

Ihab Hourani, CTO, Axino Solutions



LoRa DEVICES: DNA OF IoT

With 140 million LoRa-enabled devices connected to networks around the globe expected by 2020, LoRa has earned its reputation as the “DNA of IoT.”

Axino leveraged Semtech’s LoRa devices and the LoRaWAN open protocol for its Axino.IoT.FoodSafety temperature monitoring and asset quality management solution to comply with the ever-increasing legislative requirements related to fresh food operations and customer expectations of a wide choice of quality products.

LoRa is a proprietary spread spectrum modulation technique derived from existing Chirp Spread Spectrum (CSS) technology. It operates in a fixed bandwidth channel (typically 125Khz for uplink channels and 500Khz for downlink channels). LoRa modulation uses orthogonal spreading factors allowing the network to make adaptive optimizations of individual end-node power levels and data rates that preserve battery life.

The LoRaWAN specification is a low power, wide area networking (LPWAN) protocol based on LoRa. LoRaWAN is an ideal IoT networking protocol for long-range, low data rate and low power sensor applications such as Axino.IoT.FoodSafety.

The success of LoRa and LoRaWAN in LPWAN IoT applications speaks for itself: IoT networks based on the LoRaWAN specification have been deployed in over 100 countries with an ecosystem supported by more than 500 contributing members of the LoRa Alliance®, including solution manufacturers like Axino.

Semtech builds LoRa into its chipsets that are incorporated into Axino’s monitoring sensor devices and gateways. These chipsets serve as the tools to provide the necessary sensor data communication capabilities for the IoT solution. Simply stated, LoRaWAN connects devices or “things” to the Cloud.

Using LoRa chipsets, Axino’s solution (comprised of custom software, hardware and a back-end system) provides easy-to-understand, real-time and historical temperature data on a web-based dashboard or mobile device. The visual display includes interactive charts and customized mapping of sensor locations. Alert notifications are built into the system to send warnings when sets of pre-defined temperature rules or thresholds are exceeded.

“The detection process is like magic. There is no other manufacturer who can predict core temperature of food this way. It’s truly a disruptive innovation.”

Ihab Hourani, CTO, Axino Solutions

Axino selected Semtech's LoRa devices and the LoRaWAN protocol based on the following factors:

Industry Leader – The universe of network technology providers is expansive. Axino looked for a proven technology leader with a global footprint and an established ecosystem. Axino “wanted to use technology that would be around for the next 20 years.”

Deep Building Penetration – IT is crucial for cold chain asset tracking since the signals from refrigerators in cellars or cooling chambers need to be well covered. In addition, in this environment, 100 percent of the refrigerators need to be connected and not just a few. With solid indoor penetration capabilities coupled with custom-developed antennas integrated in the LoRa-based sensors, Axino was able to fulfill the business case requirements.

Low Power – Axino's LoRa-enabled sensors utilize standard batteries and have a lifetime up to 10 years.

Reliability – To meet governmental compliance regulations, food retailers require 100 percent auditable reporting data. A single LoRaWAN-enabled gateway can handle millions of messages per day.

Hybrid Network – LoRaWAN operates in the unlicensed ISM band and can be deployed as a private, public or hybrid network. Other technologies Axino evaluated provide only public networks and require a license subscription. Swisscom's public LoRaWAN network is used for connectivity during food transportation from distribution facilities while each store operates its own private LoRaWAN network.

Geolocation – Tracking assets without GPS and the corresponding additional power consumption allows the solution to be used during the entire cold chain transportation process.

Low Cost – Minimal capital expenditure infrastructure investments with low sensor and operating costs are important factors for retailers to achieve a faster return on investment (ROI).

Open Standard – Interoperability between multiple kinds of LoRa-based sensors allows Axino to offer customers additional solutions from its portfolio, such as air quality, vibration and electrochemical sensors for monitoring and utility metering that can operate on the same LoRaWAN network.

Globally Available – LoRaWAN operates globally in regulated frequency bands which allow a successful solution to scale on a global level.



“LoRa-based devices were the perfect choice. They offer low energy consumption, built-in security functionality, low implementation and operating costs, suitability for battery-operated sensors, and reliable public and private network performance.”

Ihab Hourani, CTO, Axino Solutions

MIGROS DEPLOYS IoT TEMPERATURE MONITORING

Migros is Switzerland's largest retail company with annual sales over \$28 billion. Operating with 100,000 employees, it is also Switzerland's largest private employer. Migros is owned by its more than 2 million cooperative members – an impressive share of Switzerland's 7.2 million population.

Migros' commitment to sustainability has been ahead of its time for generations. The independent ratings agency ISS-oekom assessed the social and ecological commitment of 151 retailers worldwide. The Migros Group achieved the best result, making it the world's most sustainable retailer in 2018.

Migros is committed to the responsible procurement of raw materials such as fruit, vegetables and animal products from sustainable sources as well as maintaining strict levels of food quality.

Like the majority of supermarkets in the world, Migros' grocery retailers and restaurants operate with cooling and freezing units acquired from multiple manufacturers. Until now, no practical homogenous manner could solve the requirement to document temperature across various legacy systems. Axino's patented retrofit and vendor-agnostic temperature monitoring system works across all cooling systems throughout Europe.



Migros initially implemented the Axino.IoT.FoodSafety quality management system in stores within the Zurich region. Each Migros store involved in the initial proof of concept deployed, on average, 70 to 100 sensors – one magnet-attached sensor for each cooling unit – and a single gateway providing connectivity for the entire retail facility.

Migros' staff were able to remotely access and review temperature developments from a smart phone, tablet or computer. The plug and play solution reduced staff workload, allowing employees to focus on managing inventory and other responsibilities. Axino's solution enhanced Migros' quality assurance capabilities and Hazard Analysis and Critical Control Point (HACCP) processes.

Based on successful pilot project results, Migros has expanded the adoption of the Axino.IoT.FoodSafety solution to stores in Switzerland's North and East regions, and plans to implement it in over 800 stores throughout Switzerland and Germany by 2020.

“Not only does our solution guarantee fresher food, but employees are able to spend more time taking care of other tasks. If it takes someone even one hour per day to manually record temperature readings, and you multiply that by hundreds of stores, the savings start to add up fast. Migros is projected to have ROI within less than 12 months.”

Ihab Hourani, CTO, Axino Solutions

A WINNING COMBINATION

Axino and its retrofit solution to help food retailers digitalize quality management and fresh food related processes was honored at the 10th Innovation World Cup® Series at Mobile World Congress in February 2019. The competition is the most established open innovation platform worldwide with the stated objective “to discover emerging applications and solutions in industries with massive growth potential.” Axino won the award for Best Innovation in the Transport, Lifestyle & Retail category.

For the first time, grocery retailers are able to remotely and non-invasively monitor the product temperature of perishable food in refrigerated equipment. By implementing Axino's connected temperature monitoring solution with LoRa-enabled low-cost sensors, gateways and LoRaWAN-based connectivity, grocers can improve the safety and security of fresh food while reducing food waste and lost revenues.



“Competing with more than 500 product submissions from all over the world, this award confirms that our solution is on the cutting-edge of innovation in the IoT arena. It’s the absolute highlight of our company to date.”

Michael E. Wallrath, CEO of Axino Solutions

ABOUT SEMTECH

Semtech Corporation is a leading supplier of high performance analog and mixed-signal semiconductors and advanced algorithms for high-end consumer, enterprise computing, communications, and industrial equipment. Products are designed to benefit the engineering community as well as the global community. The Company is dedicated to reducing the impact it – and its products – have on the environment. Internal green programs seek to reduce waste through material and manufacturing control, use of green technology and designing for resource reduction. Publicly traded since 1967, Semtech is listed on the Nasdaq Global Select Market under the symbol SMTC. For more information on Semtech's LoRa devices and the LoRaWAN protocol, visit www.semtech.com/lora

ABOUT AXINO SOLUTIONS

The Axino Group, consisting of Axino Solutions AG in Switzerland and Axino Solutions GmbH in Germany, is a leading provider of communication solutions and services. Based on innovative software, Axino Solutions designs, implements and operates comprehensive IT solutions in the areas of Enterprise Service Management (ESM), Enterprise Asset Management (EAM), and Mobile Solutions, IoT Solutions and International Carrier Business Support Systems. The company has references in the automotive, energy, retail, telecommunications, and government customer segments. For more information, visit www.axino-group.com



Semtech Corporation

200 Flynn Road, Camarillo, CA 93012 Phone: (805) 498-2111

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