



DATA-DRIVEN AGRICULTURE FROM FARM TO FORK

**Enabling transparency, traceability,
and intelligence across the food
value chain**

Intel®-based IoT solutions are helping to
address the complex challenges of modernizing
agriculture and the food value chain.

Intel®-Based Smart Agriculture in Action: Sample Use Cases

Digital Soil Testing for Small Holder Farms

Grameen Social Business, Ltd.

The International Fund for Agricultural Development (IFAD) announced it would scale Grameen Intel's farming apps, called the eAgro suite, across 210 locations in Cambodia, setting the country up to export over 1 million tons of rice a year. The joint partnership with IFAD and Grameen Intel will drive greater food security, job creation, and long-term economic growth for farmers and their families in Cambodia, while also helping farmers in Nepal, Bangladesh, India, and Macedonia.

Tracking Freight at the Package Level

Honeywell Connected Freight* Solution

Intel collaborated with Honeywell to create Connected Freight*. This shipment monitoring IoT and cloud solution provides shippers and logistics companies with the ability to monitor freight to avoid theft, reduce waste, and minimize damage. Connected Freight uses cost-effective sensor tags that sense a range of factors such as temperature or vibration. A mobile gateway can capture the sensor data within a truck or shipping container and then transmit it to a cloud-based platform for users.

Asset and Equipment Monitoring

Sonim XPi* Monitors Assets in the Field

The Intel® LTE IoT Quick Deployment (Intel® LIQD) device simplifies asset monitoring in the field. The Sonim XPi* runs on the Intel® Quark™ SE microcontroller. It is precertified on AT&T's LTE network and provides out-of-the-box access to AT&T's IoT platform. Ultra-ruggedized design ensures configurable sensors can survive harsh environments. This device brings vital data to customers to enhance visibility and traceability of their most valuable assets.

Sensing, Connectivity, and Compute on Farms

Intel and its ecosystem partners offer building blocks and a framework to help the agriculture industry and its solution providers architect a wide range of IoT solutions and take advantage of Intel's compute and security leadership. The configurable sensing platform supports a wide array of sensors and exceeds connectivity distance by miles.

Intel is enabling the transformation of today's food and agricultural value chain with data-driven insight and smart, connected, and secure solutions.

Building a connected agriculture ecosystem through partnerships

Intel-based IoT solutions help agriculture players across the food value chain improve operations and business models, create new services, increase productivity and quality, and reduce costs.

Achieving Agriculture 3.0 with Intel® architecture innovation

Intel® technologies play a role in innovative smart agriculture solutions—from the edge to the cloud and back to users—by supporting the integration of sensors, gateways, connectivity, management, security, analytics, and user devices.

Enabling traceability across the food value chain

Intel offers a spectrum of solutions and technologies covering the gamut of IoT implementations, including small farms, multinational agriculture conglomerates, equipment manufacturers, food processing facilities, transportation companies, and the retail, restaurant, and hospitality industries.

BENEFITS OF INTEL® ARCHITECTURE FOR THE FOOD INDUSTRY

- **Increase yield, predictability, and performance:** Improve crop yield, quality, and equipment utilization to cost-effectively meet increasing production demands.
- **Manage costs:** Lower costs and optimize production with data-driven insight on usage of fertilizer, pesticides, seed, water, and vital resources.
- **Minimize environmental impact and improve sustainability:** Monitor, increase control, and manage nitrogen runoff, water conservation, and risk.
- **Improve traceability:** Improve insight via analytics into food production, packaging, distribution, and retail.
- **Get the insight of intelligence at the edge:** More easily acquire pertinent data to apply analytics on demand.

MEGATRENDS IN THE FOOD INDUSTRY

Intel is helping the food industry—from farmers and transport to retailers and hospitality—to meet new demands and create new opportunities.

- Sustainability
- Food safety and security
- Globalization and the changing economy
- Health and wellness

The Intel Value: Traceability, Intelligence, and Optimization

In order to meet increasing demands, food producers, processors, packagers, transportation companies, and merchants need a **whole chain traceability system**. This requires more sensors and devices collecting data on farms, in processing facilities, and in transport, connected to advanced gateways with analytics

at the edge, and a secure database architecture that enables transparency across the food value chain.

Intel works closely with the ecosystem to deliver smart Internet of Things (IoT) agriculture solutions based on standardized, scalable, reliable Intel® architecture. These solutions range from sensors and gateways to server and cloud technologies to data analytics algorithms and applications.

Intel provides essential capabilities—performance, manageability, connectivity, analytics, and advanced security—to help increase productivity, efficiency, and quality across the food value chain. Intel can help food producers, processors, packagers, transport companies, and retailers use data to monitor, control, optimize, and benchmark, as well as to share historical and real-time information to improve decision-making.

DATA-DRIVEN OPTIMIZATION

On the farm	Processing	Transportation and logistics	Retail	Across the value chain
<ul style="list-style-type: none"> • Increase yields • Improve resource utilization • Detect disease 	<ul style="list-style-type: none"> • Optimize production and lower costs • Monitor processing and packaging • Increase product differentiation 	<ul style="list-style-type: none"> • Optimize food distribution, transportation, and logistics • Improve inventory management • Reduce asset losses 	<ul style="list-style-type: none"> • Improve customer experience • Reduce product loss • Drive increased sales 	<ul style="list-style-type: none"> • Improve food safety and traceability • Help secure and streamline transactions • Reduce food spoilage and loss

Intel Agriculture Solutions

Soil Testing Solution

The Intel soil testing solution enables actionable recommendations based on data collected from the digital soil test and eAgro software suite. The soil testing platform quickly and accurately characterizes soil samples and records sample characteristics, GPS data, and farm environmental information. The sample is evaluated by the eAgro software to give real-time, expert recommendations.

The hardware allows the entrepreneur to test the nutritive chemical makeup of a farmer's soil. Most small farmers must take their soil to a far-off testing station or ship soil to a lab. Because of the lost time and related costs, this is rarely done. Now the testing center is brought to the farm.

The solution helps small farmers make more informed decisions on key aspects including seed and fertilizer selection, harvest planning, and sales management.

LoRa IoT Services Reference Architecture and Platform

Intel and its ecosystem partners offer building blocks and a framework to help the agriculture industry and its solution providers architect a wide range of IoT solutions and take advantage of Intel's compute and security leadership.

Platform features:

- Sensors and sensor hubs
- LoRa (long range) gateways for data aggregation, analytics, and actionable intelligence at the edge
- High-performance networking and storage
- Cloud-based applications and analytics

Intel® Connected Logistics Platform

Respond quickly to unexpected situations, save shipping costs through early detection of lost products, and identify conditions leading to shipment damage or delays. This Intel platform is designed to help automate shipment tracking

and increase shipment visibility of goods as they move across the food value chain. This product is used for tracking small assets such as pallets of food, boxes, and small equipment in the agriculture segment.

Platform features:

- Based on the Intel Atom® processor
- Provides thorough and continuous updates about package condition
 - Save shipping costs through early detection of damaged products
 - Identify conditions leading to shipment damage or delays
 - Monitor perishable products during shipment and transport
- Sends automatic alerts when a package's location or condition changes unexpectedly
 - Respond quickly to unexpected situations
- Delivers near-real-time data analytics and insights
- Protects confidential asset information with data encryption



Intel LTE IoT Quick Deployment Program (Intel LIQD)

- A flexible combination of both hardware and software designed to enable the deployment of intelligent mobile sensor systems. With Intel LIQD, OEMs can manufacture a new category of carrier precertified, quick deployment devices that make it easy to remotely manage intelligent sensors in the field. Intel LIQD helps the agriculture industry easily access platform services on carrier-certified IoT devices in a way that reduces time to market and saves money for end users. This product is used to track large assets such as shipping containers, freight, and equipment.
- Sensors include temperature and humidity, ambient light intensity, atmospheric pressure, magnetometer, inertial measurement, and accelerometer and gyroscope.

Hyperspectral Imaging (HSI)

Intel's hyperspectral imaging platform featuring low-cost sensor technology uses advanced computer vision and machine learning algorithms to train and characterize the quality of crops during inspection, precision farming, or food processing applications. Algorithms running on Intel® devices are accelerated by Intel® FPGAs (field programmable gate arrays) and Intel® Movidius™ Myriad™ VPU (video processing units) technologies.

Intel® Responsive Retail Sensors

The Intel® Responsive Retail Sensor is an end-to-end, retail analytics-based solution designed to help ecosystem solution providers and retailers create and display innovative retail systems.

Built to increase inventory accuracy, the Intel Responsive Retail Sensor provides better inventory tracking, faster time to insights from retail data, and tools to help increase customer satisfaction. It can help minimize inventory carrying costs; detect inventory shrinkage; improve order fulfillment; and expand customer services.

- Track items through RFID tags, preserving customer privacy.
- RFID data can also be combined with other data, such as video, and quickly analyzed to provide a cohesive portrait of store activity and customer preferences.

Simple, integrated components:

- Intel®-based retail sensor: Low-cost, low-power integrated retail sensor with RFID capability and an expandable sensor suite that allows for the inclusion of additional sensors in a seamless and future-proof way.
- Intel®-based gateway: Gathers and filters sensor data, providing intelligent, trusted connectivity at the edge.
- Cloud platform: Open source analytics platform-as-a-service (PaaS) for cloud applications.

Blockchain

Improve food traceability and supply chain management. Intel architecture-based IoT sensors are used to track data on a blockchain, recording information such as ownership, position, location, temperature, humidity, motion, shock, and tilt. This solution provides a permanent digital record of transactions to open up new opportunities for interactions between parties that require trust and validation. Intel® Software Guard Extensions (Intel® SGX) technology provides a more secure and scalable architecture for blockchain solutions for the agriculture industry.

Intel Software Guard Extensions (Intel SGX):

- Designed to increase the security of select application code and data, protecting it from disclosure or modification.
- Intel® processor technologies provide unique capabilities that can help improve the privacy, security, and scalability of distributed ledger networks.

Drones

Intel's drone platforms, the Intel® Sirius™ Pro system and Intel® Falcon™ 8+, offer configurable payloads (sensing technologies) to map out seed, vegetation, and crop conditions. The drones feature advanced flight planning, 3D data, and analytics specific to agriculture applications. The MAVinci™ desktop software enables automatic terrain following, real-time flight data, and telemetry visualization, while also ensuring 100 percent coverage of the survey area.

Learn more

Talk to your Intel representative or [explore Intel IoT solutions ›](#)

Connect to the IoT ecosystem and bring smart agriculture solutions to market with the [Intel® IoT Solutions Alliance ›](#)



Intel technologies' features and benefits depend on system configuration and may require enabled hardware, software or service activation. Performance varies depending on system configuration. No computer system can be absolutely secure. Check with your system manufacturer or retailer or learn more at intel.com.

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