Transparent Path Solution Helps Reduce Product Losses and Food Waste

Near-real-time supply chain visibility system deploys Intel® edge-to-cloud technologies and ruggedized IoT sensors to monitor perishable food from farm to retailer—predicting freshness while guarding against costly product losses.

TRANSPARENT PATH.

Food waste costs as much as USD 1 trillion per year worldwide in direct losses, while environmental and social costs add USD 1.6 trillion to that total, according to a report by the Food and Agriculture Organization (FAO) of the United Nations.[1] In the US alone, the Environmental Protection Agency (EPA) estimates that more than USD 161 billion in food is wasted each year.[2] Discarded food takes up 24 percent of the available space in American landfills, where 35 million tons of waste produce methane and other greenhouse gases, according to an EPA study.[3]

"There are numerous systems and solutions in every organization's supply chain, and there is an inability to track and trace products across multiple enterprise resource planning, supply chain management, and customer relationship management applications internally in every organization. The same problem exists across partner ecosystems."[5]

—Predictive Analytics Today

Challenge: You can't manage what you can't see

Global supply chains consist of a vast ecosystem of disparate companies, each of which operates with varying levels of technological capability. Historically, many of these companies have neglected to invest in updating and connecting the complex, growing web of data systems required to manage these chains, in part due to tight operating margins. Many firms in food logistics continue to operate with paper records, faxed orders, and filing cabinets.

Recently the COVID-19 pandemic has disrupted nearly all aspects of these supply chains: labor shortages have led to reduced availability of qualified drivers and warehouse personnel, shut down processing plants, and left perishables sitting on docks to rot. In the face of these disruptions, analog and paper systems are simply unable to cope. Supply chain managers have limited or delayed access to product location and status data. As a result, they are unable to intervene when problems occur. Prompt communication is especially challenging during transit, where 63 percent of problems are likely to occur.[4]

While each organization in the perishables supply chain may have some information about the status of food items while they are in that organization's control, that information may not be complete, and it is seldom passed along as the food continues its journey from farm to table. Even when companies have visibility and share the resulting data, they cannot typically communicate quickly and precisely enough to prevent a massive amount of spoilage and waste.

In summary, the challenge is to combine a comprehensive supply chain visibility solution with constant monitoring of temperature, humidity, and other environmental factors that affect food quality and freshness. The solution needs to answer two questions—"Where is the food?" and "What's happening to it?"—at every stage in the journey. To be fully effective, a solution must communicate all that data up and down the supply chain in near-real time.

Solution: Monitor perishable foods with low-cost IoT sensors and share data across all partners

Transparent Path, a social purpose start-up in the northwestern US, recognized that accurate data and timely communication could help to reduce food waste and costly product losses.

Four specific improvements in data collection and communication could save billions of dollars, according to Transparent Path:

1. Acquire more data, in greater detail, at lower cost, in near-real time
2. Connect systems that currently store data in silos
3. Share data with all supply chain participants in near-real time
4. Deploy the data strategically in AI-enabled operations

By combining IoT sensors with a shared, blockchain-enabled ledger, Transparent Path developed an edge-to-cloud traceability solution for perishable foods.

In a 2019 proof of concept, the company's new solution successfully tracked the provenance and condition of tree-fruit shipments on their journey from a large Michigan packing house to retailers across the US. Another pilot in 2020 provided visibility for fresh produce distribution by Feeding the Northwest, a Spokane, WA–based nonprofit that provides 5 million pounds of produce annually to food banks nationwide.
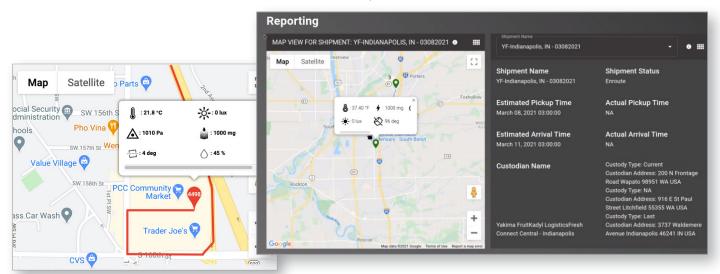
How it works

The Transparent Path solution includes three core elements:

1. **Real-time IoT sensors:** Secure, continuously connected sensors provide ongoing, real-time data, including location, temperature, and humidity. Transparent Path deployed ruggedized 3G sensors in 2020 and switched to lower-cost 5G sensors in 2021, with plans to integrate recyclable sensors in 2022. The next-generation disposable sensors are so affordable that they can be applied to each individual product package instead of much larger units such as cases or pallets. The company plans to release a fully compostable sensor technology by 2024.

2. **Secure logistics data:** Sensor data is audited and secured. Prompt alerts enable supply chain partners to intervene during supply chain failures, preserving product quality and protecting their investment.

3. **AI-enabled predictive analytics:** Transparent Path's AI engine uses IoT data to make freshness predictions about perishables in transit using an algorithm called FreshScore™.

A truck driver transporting a load of fresh fish might get an alert when temperatures or other conditions begin to diverge from the ranges mandated by food safety regulations or the carrier's contract. The driver can then check the container, doors, or refrigeration equipment for issues. If the out-of-range conditions continue, compromising product quality or safety, the product can be diverted so it does not end up on retail shelves.

Dock personnel at warehouses or retail outlets can also monitor the location and status of incoming shipments to staff up appropriately for unloading and minimize costly dwell time for drivers.

Transparent Path's dashboard displays details of each shipment's provenance, location, status, and environmental conditions.

IoT sensors monitor the location, temperature, humidity, air pressure, light, shock, and tilt of perishable food packages or pallets in transit and communicate product status with supply chain partners via 5G and a shared ledger.

Solution description and components

The Transparent Path solution includes an Intel-based mobile gateway and secure Industrial Internet of Things (IIoT) sensors that monitor temperature, humidity, and other environmental factors. The mobile gateway travels with the load so that it can be tracked regardless of cross-docking, equipment changes, or layover time in warehouses.

The data is analyzed in the cloud and communicated to all supply chain partners in the form of a dashboard and event-driven alerts. Users can also opt to enable blockchain-based data storage for enhanced privacy and protection of personal and corporate data.

Gateway

Functionality
- Secure cloud connectivity
- Customer provisioning
- Sensor data aggregation, retention, and reporting
- Edge analytics
- Selectable alarm thresholds
- Cellular, Wi-Fi, and IEEE 802.15.4 mesh communication

Specifications
- Intel Atom® x3-C32XXRK Processor Series (SoFIA 3G-R)
    - 800 MHz quad-core processor
    - 32 MHz MCU with 512 KB internal flash memory
    - Memory: Onboard 8 GB LDDR3
    - Storage: eMMC 8 Gb

Gateway
Local intelligence, global connectivity

Disposable smart sensor tag
Drop into any shipment level

Battery (two coin cells)

LCD

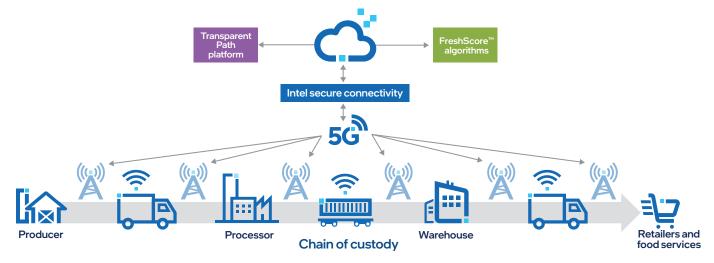Extended battery

Sensors

Functionality
- Continuous monitoring
    - Ambient: OPT3001 (400 nm to 700 nm, 0.01 lux–83K lux)
    - Temperature: HDC2010 (-20°C to +50°C at +/-1°C)
    - Humidity: HDC2010 (0% to 100% at +/-5%)
    - Shock and tilt: LIS2DS12 (16G)
    - Air pressure: LPS22HB (260 hPa to 1260 hPa)

Specifications
- Operating temperature range: -4°F to +122°F (-20°C to +50°C)
- Connectivity: 3G modem, GNSS, Bluetooth, NFC, Wi-Fi, and/or Intel proprietary communication protocol
- Power and battery: 3930 mAH Li-Polymer
- Dimensions: 0.78" H x 3.23" W x 5.7" L (20 mm H x 82 mm W x 145 mm L)

Enhancing supply chain visibility

As Transparent Path continues to improve and upgrade the tracking and monitoring solution, Intel will continue to support the company's transition to 5G-based communications and more-economical, disposable sensors. Transparent Path also plans to add edge communication functionality to enable drivers in the truck's cab to monitor the sensors and load status inside the trailer while in transit. Cameras in the trailers will add visual information to the existing sensor data, and machine learning algorithms will augment human inspection of shipments on departure and arrival, counting items and checking for damage. Additional edge servers at the origin and destination facilities will help to maintain data quality and continuity of data communications.

In one Transparent Path use case, shipments of fresh food are being tracked and monitored en route from beef processors and produce packing houses to food banks across the US for the Pacific Northwest arm of the nonprofit Feeding America.

Learn more

Transparent Path

Transparent Path spc is a technology company focused on end-to-end supply chain visibility for perishable products. Transparent Path's mission is to reduce financial losses and food waste through the real-time monitoring of perishables, enabling interventions when supply chain disruptions jeopardize those products.

Powered by IoT sensors, blockchain security, and artificial intelligence, Transparent Path's secure, scalable platform provides growers, manufacturers, processors, logistics partners, warehouses, distribution centers, and retailers of perishables with the ability to see and act upon supply chain issues in near-real time. As a result, Transparent Path's customers know immediately when something goes wrong, so they can act to prevent risk—even anticipating supply chain issues before they occur.

transparentpath.com

5G Open Innovation Lab

Transparent Path was one of the 15 start-ups invited in 2020 to join the 5G Open Innovation Lab's enterprise innovation program. Companies in the program are led by founders who have demonstrated a vision and strategy for leveraging 5G networks to achieve digital transformation in the enterprise and advanced applications and solutions in artificial intelligence, augmented reality, edge computing, and IoT. These select companies remain in the 5G Open Innovation Lab ecosystem, as they continue to drive innovative, disruptive new products and services.

5goilab.com

Intel® edge-to-cloud technologies

Intel is a founding partner and sponsor of the 5G Open Innovation Lab, which supports Transparent Path's sensor, blockchain, 5G, and edge technologies. Intel also supports Transparent Path's efforts directly, with engineering assistance and access to the broad, interoperable Intel® hardware portfolio, scalable software, and ecosystem of tools.

Intel hardware formed the basis of the gateways and sensors used in the Transparent Path pilot, and the data analytics and core intelligence of the Transparent Path solution run on Intel® Xeon® Scalable processor-based servers in the cloud.

Intel provides the performance and security needed for this and other digital transformation solutions from edge to cloud.

Learn more about Intel edge-to-cloud technologies ›

"Feeding the Northwest is thrilled to be working with the team at Transparent Path. Each month, our organization ships over 5 million pounds of fresh produce to food banks across the nation. Ensuring each load of healthy, nutritious produce arrives safely and the quality hasn't been compromised at any point during transit is of utmost importance. Transparent Path's technology gives us visibility that we have never experienced prior."

—Rod Wieber, executive director, Feeding the Northwest

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1. "Sustainability Pathways," FAO, 2014.
2. "Food Loss and Waste Factsheet," EPA, Jan. 2020.
3. "Advancing Sustainable Materials Management: 2018 Fact Sheet," EPA, Dec. 2020.
4. Data provided by ReFED, 2021. refed.org
5. "The Biggest Supply Chain Pain Points Today," Predictive Analytics Today.