

# Enhance Cold Chain Trust and Food Safety with Blockchain



### Introduction

National food recalls are growing more common than ever before. In the United States, the non-partisan Public Interest Research Group reported a 10% increase in food recalls over a five year span from 2013-2018 with a peak of 905 cases in 2016. These increased recalls have led to inquiries for better food processing and distribution systems. The Food and Drug Administration (FDA) requires manufacturers to identify and track all ingredients and products from receipt to processing, packaging, and shipping. Without accurate tracking, false information of containment data can lead to unnecessary recalls and a loss of sales.

The global supply chain for cold chain logistics has been increasingly adopting blockchain technology for Artificial Intelligence of Things (AIoT), the combination of AI technologies and IoT infrastructure to achieve greater operational efficiency and enhance data management and analytics. Blockchain combined with AIoT guarantees data integrity enabling trust between disparate parties, resulting in a better exchange of data, cooperation, and commerce between stakeholders.

### Challenges in Cold Chain Logistics

The primary purpose of cold chain management is to maintain an uninterrupted temperature control to ensure product quality and safety to the end consumer. Due to the nature of the cold chain logistics process, goods in transfer are subject to variable temperature excursions including route, transit time, in-transit handling, and ambient temperature. Along with temperature excursions challenges, maintaining transparency and on-going delays during transit are common recurring obstacles supply chains face.

### Lack of Transparency

The FDA requires a comprehensive collection of electronic records and data analysis in order for compliance. The issue of data integrity arises due to each party in the chain containing individual databases where the data may not be uniform and or consistent for all parties. This becomes problematic and time consuming especially when trying to retrace temperature excursions for safety recalls.

## Monitoring Food Quality and Freshness

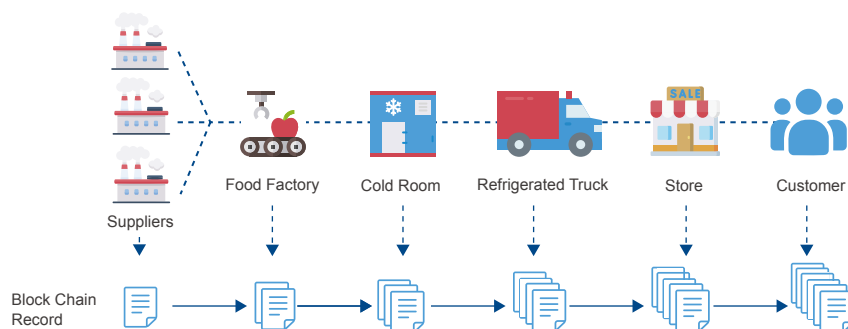
Interrupted temperature and climate control cause supply chains to struggle with having the right technology to monitor temperature, humidity, product tracking and vibrations, while simultaneously providing real-time updates to ensure product quality. Logistics providers lacking the appropriate technology for real-time tracking, cold chains are risking the health and safety of the public when contaminated products enter the market.

## Delays

Transportation delays can cause major issues for cold chains and result in shortages for the retailer. Delays can end up causing unacceptable temperature excursions and result in waste of product. In addition, routine processes such as approval chains and purchase order retrievals only add to the challenges in product delivery.

## When Cold Chain Meets Blockchain

In the current supply chain infrastructure, each party maintains their own database for documenting the goods throughout the chain. Separate databases leave room for discrepancies as it is up to the disparate organizations to accurately maintain their own data. Blockchain offers a solution to maintain an accurate database visible to all parties. Blockchain technology provides a decentralized ledger to record immutable transactions that is managed by multiple entities in the network where everyone involved is held accountable for their actions. The adoption of blockchain in the cold chain is set to streamline the supply chain ecosystem with the added benefits of improving documentation, product quality, increased cost savings, and improved trust resulting in a better product experience for the end consumer.



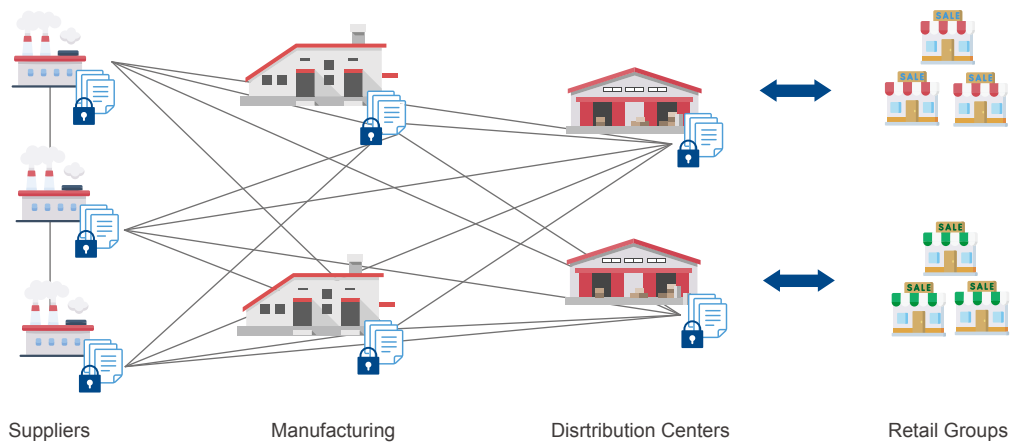
Blockchain process can be integrated at each step in the supply chain and standardized across stakeholders.

## Benefits of Blockchain in Cold Chain

The key benefits of blockchain in the cold chain are that it guarantees data integrity, increases cost savings and, most importantly, facilitates accuracy in product quality and safety, thereby enabling more trust in the data exchange between transacting parties and ultimately improving end consumer confidence.

## Transparency and Data Integrity

In accordance with FDA regulations on cold chain data collection, blockchain offers immutable and secure transactions at each checkpoint. This results in trusted data transparency that can be shared and accepted by all stakeholders since the data security guarantees are fortified by military-grade cryptographic primitives that are immutable. The supply chain can easily identify where in the process the goods have been contaminated before it reaches its final destination. This will aid in the safety and protection of the end consumer as items can be recalled with precision.



A blockchain process influences every stage of a cold chain solution and tracks data in independent flows.

### **Food Quality and Safety**

Food safety is preserved by using AIoT sensors to monitor unacceptable temperature excursions that lead to product waste by notifying all parties in real-time. These real-time actions allow for the products in transit to be safeguarded away from causing potential harm to the end consumer. Automated notifications from the blockchain systems and AIoT sensors can reduce product waste and contamination resulting in increased savings in both cost and public health concerns.

### **Cost Savings**

Along with savings associated with better food quality, blockchain systems can help lower overhead by reducing intermediaries and transaction costs through smart contracts. Once the agreement has been executed funds and payments can be released immediately. Transparency and better food quality processes can also help realize savings from insurance premiums as they are minimizing risk of food recalls and contaminations.

### **AIoT Technology for Blockchain and Cold Chain**

While the role of blockchain is ensuring integrity of data throughout the supply chain, the process can be further strengthened by using IoT and sensors to collect and manage data. Since Blockchain ensures data integrity, organizations can have clean and reliable data that can be fed into AI and machine learning processes. AI algorithms can use real-time data to make decisions that can then be executed automatically while providing a more accurate and detailed performance reporting.

### **LoRa Sensors and Gateways**

Long range sensors (also known as “LoRa” for Long Range) provide a wireless low power solution with low data rate communications network similar to cellular networks. Paired with LoRa gateways, these sensors can capture and transmit real-time data to the cloud system even across vast distances. The ease of use and flexible installation of LoRa sensors make these devices an ideal cold chain companion that can be placed in vehicles, and front and back of house cold storage areas and more.

### **Infrared Thermometers**

Wifi and bluetooth infrared thermometers can rapidly collect temperature data and quickly transmit the data to internal systems without the need for instrument equilibration. Mobile workers can take pictures and get real time temperature readings from one handheld.

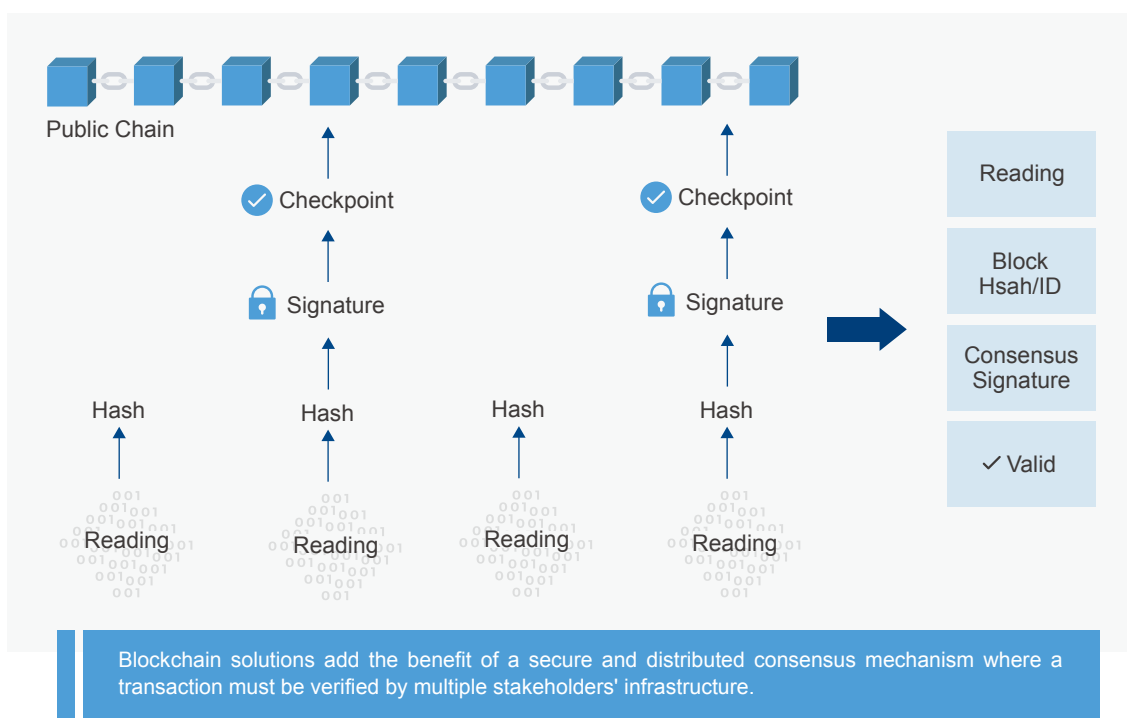
### **ePapers**

ePaper devices provide a low power solution for digital displays in cold storage areas that can easily sync with databases for rapid remote product information updates.

### How it works

The IoT temperature sensors first collect the data and send it to the gateway. The gateway then uploads the data to multiple servers in the cloud controlled by the different stakeholders in the cold chain system. Every time a transaction, such as an automated data synch, is created, the data is saved in a new block. A unique bit number identifier called a hash is then added. Next, these various networked servers communicate with each other to achieve a consensus on the readings. The data is organized into “blocks” pertaining to each of the registered sensors and then committed to the validating servers utilizing threshold cryptographic signatures and algorithms confirming rules of engagement.

These cryptographic signatures are impossible to forge but easy to verify. Thereafter, the data is stored in a distributed manner with redundancy such that the data can be retrieved even if some of the validating servers go offline. This data can also be accessed and used for data visualization solutions and can also be periodically committed to public networks like Ethereum as an additional checkpoint.



Source: UNITYCHAIN

### **Not all Blockchains are Created Equal**

There are many blockchain platforms in the market tailored to various industries. Many can serve the basic functions of product traceability in the supply chain but the most important component that is needed are those that can connect with IoT devices. The capabilities of connected IoT devices and sensors with blockchain technology are very specific and tailored solutions. Not all blockchain solutions can integrate efficiently with IoT devices nor handle the specific technical issues related to collecting IoT data in a tamper-proof way. The novel solution we've created for the cold chain supply chains that utilize IoT devices is tailor-made to be easy to deploy and inexpensive to operate and maintain. .

### **Conclusion**

The adoption of blockchain is projected to grow at a high rate of 80.2% by the year 2025. Businesses such as Pepsi, IBM, Coca Cola and Starbucks have already begun implementing blockchain into their infrastructure to streamline operations. Coke One North America implemented a blockchain system that "allows Coca-Cola franchises to identify whether another franchise can help to fulfill an order without revealing proprietary information about their clients and order volume.", according to a report conducted by Business Insider. This new system is estimated to improve their order reconciliation from weeks to days. Leveraging blockchain will not completely resolve all the challenges of cold chain but it can help improve operations and build trust between all parties within the chain and most importantly the end consumer. The decentralized system will allow for more data transparency while streamlining and automating portions of the chain, along with increased savings, better food quality and safety precautions. Blockchain systems will continue to prove value across multiple industries including consumer packaged goods, pharmaceutical applications, chemicals and more.



## About Advantech's Blockchain Solutions

Advantech is a leader in providing trusted, innovative products, services, and solutions. Advantech's logistics solutions provide industrial-grade embedded computing, in-vehicle PCs, IoT, Edge Gateways, displays and mobile terminals for a broad range of industries: ideal for cold chain, shipping ports, warehouse, manufacturing, and field mobility. Our mission is to enable an intelligent logistics workflow & reliable supply chain that empower the development of a smarter, safer and efficient working environment. Our cold chain management and blockchain solution allows for flexible and easy installations of IoT devices and blockchain software to monitor cold-chain logistics in real time and provide supply chain transparency.



**LEO-D51**  
Sub-1GHz ePaper



**TREK-120**  
LoRa Cold Chain Sensor



**TREK-530**  
Vehicle-Grade LoRa/4G Gateway



**PWS-472 Infrared Thermometer**  
5" Industrial-Grade Handheld

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