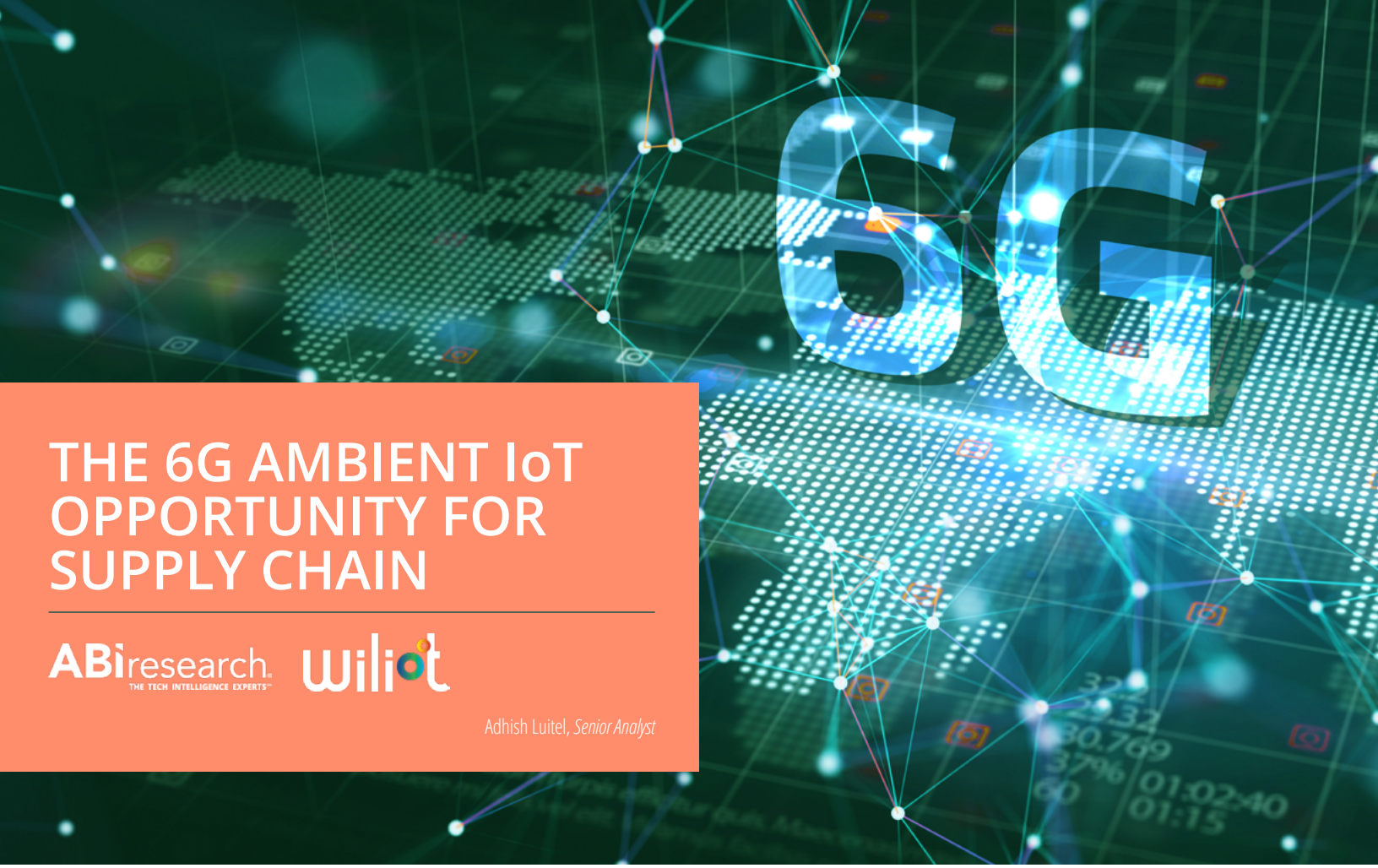


THE 6G AMBIENT IoT OPPORTUNITY FOR SUPPLY CHAIN

ABIresearch THE TECH INTELLIGENCE EXPERTS™ Wiliot

Adhish Luitel, *Senior Analyst*

TABLE OF CONTENTS

EXECUTIVE SUMMARY

Today's supply chains are being stressed by enormous volumes, extremely high speeds, high levels of interconnectedness, and low margins. In addition, as industries are engaging closely with consumers, supply chains need to respond more rapidly to demands and market trends. Given the volatile nature of supply chains in recent times, real-time visibility at a granular level is key. A new class of Ambient Internet-of-Things (IoT) technology, which delivers pervasive connectivity to products that were previously disconnected, can help supply chains provide that much-needed granular real-time visibility.

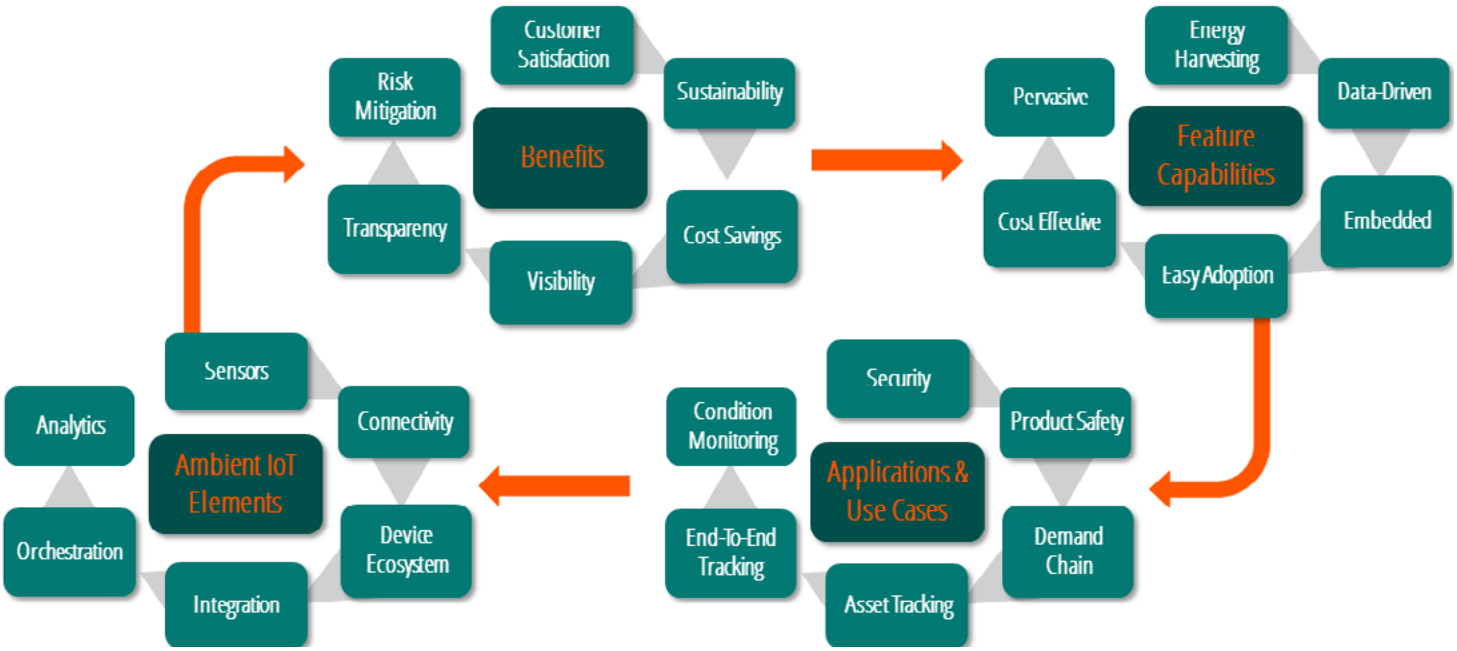
Ambient IoT is a technology that enables most items in a supply chain to be connected to the Internet, delivering real-time triggers and information about location and condition at a minimal cost, using existing wireless infrastructure, without human intervention.

While Ambient IoT was pioneered by a small number of specialist technology providers, its role is set to scale up and become mainstream as the standards bodies that control the technology on the wireless devices that surround us are actively working on including "ambient" in their next generations.

This report examines the effects of the introduction of Ambient IoT in supply chains, specifically food and pharma. It aims to identify specific use cases and benefits that can lead to optimized and leaner supply chains, and result in enhanced sustainability. Figure 1 highlights the relationship between Ambient IoT's inherent features and capabilities driving benefits and advantages, and key applications and use cases across segments, markets, and industries. Clearly, Ambient IoT is moving the needle in terms of how IoT connectivity can enable a wide set of use cases across key verticals in terms of ease of deployment and management, power consumption, and sustainability, and, perhaps most importantly, at a much lower cost compared to alternative technologies.

Figure 1: Ambient IoT's Relationship between Features and Capabilities, and Key Applications and Use Cases

(Source: ABI Research)



SUPPLY CHAIN MARKET TRENDS AND PAIN POINTS

ABI Research has identified the following as the most important trends and pain points facing the global supply chain that can be addressed by Ambient IoT.

GROWTH OF RETAIL E-COMMERCE

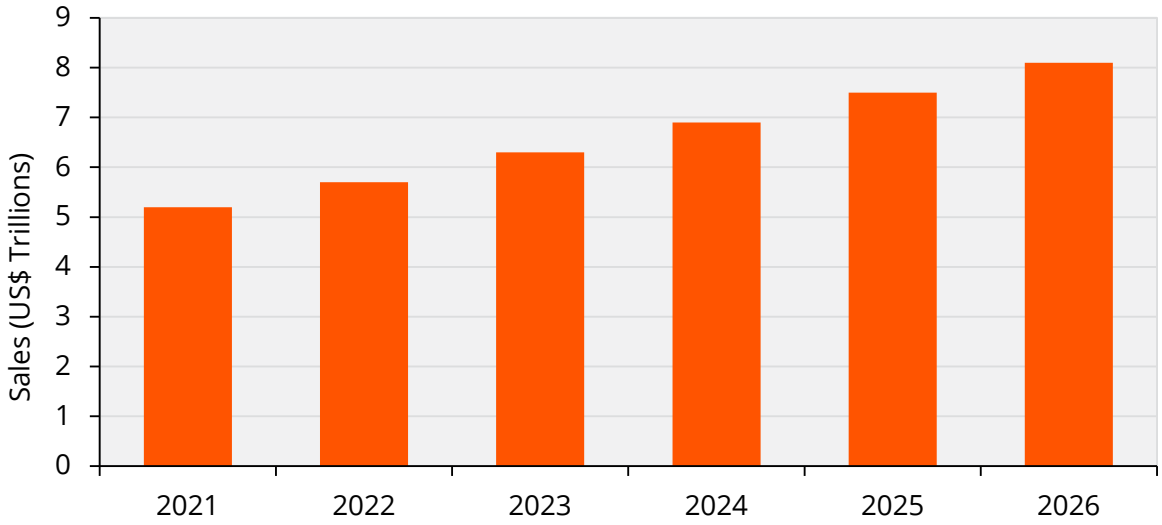
The last few years have seen historical growth in online retail, with e-commerce growing to US$4.9 trillion in 2021, with over 14% Year-over-Year (YoY) growth. In 2021, the United States' share of e-commerce to retail was 13.6%, and nearly 24% in China, with a European average of 15.3%. Sustained growth in e-commerce can be attributed to a large growth in omnichannel sales among retailers. In 2022, click-and-collect sales in the United States are forecast to grow 19.4% com-

pared to the previous year. Global e-commerce revenue is expected to grow by over 15% to US$5.7 trillion this year.

Chart 1 shows the projected growth of global e-commerce in terms of expected generated revenue.

Chart 1: ***Global E-Commerce Sales World Markets: 2021 to 2026***

(Source: ABI Research)

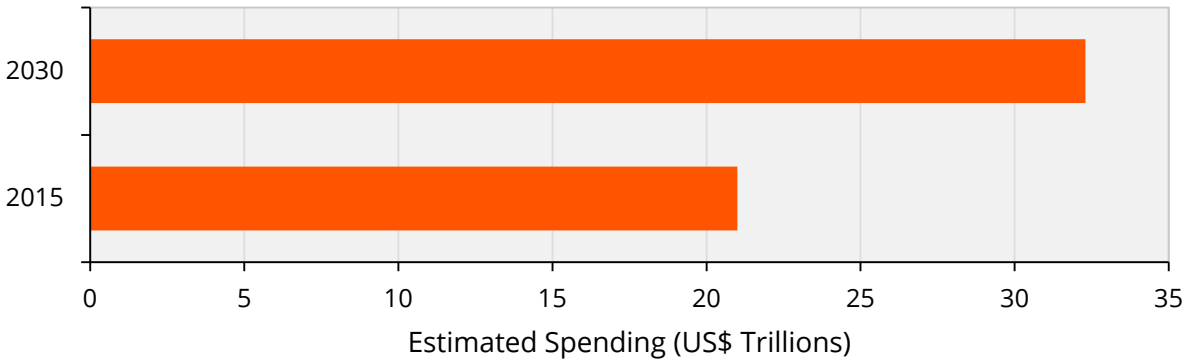


FOCUS ON SUSTAINABILITY

In recent years, there has been a significant focus on sustainability among companies. Retailers have started to work with manufacturers to build reusable packaging in their stores and distribution networks. Additionally, some national regulations have started aiming to force the elimination of single-use plastics: France is an example of this, with laws being phased in since 2020 with the goal of eliminating single-use plastic tableware, cutlery, bottles, stirrers, Styrofoam containers, straws, etc. These types of initiatives make the management of more valuable packaging assets a valuable initiative for food retailers and food service providers.

Chart 2: ***Estimated Total Sustainability Development Goals Spending World Markets: 2015 and 2030***

(Source: ABI Research)



PRODUCT INTEGRITY AND DIVERSIONS

Products can be compromised when going through the supply chain, especially food and pharmaceuticals. Fresh food and pharma players need to consider variations of different conditions during transit. Temperature is an imperative metric here that should be tracked constantly to ensure that food and pharma items do not deteriorate. Additionally, there are other complex metrics to consider like humidity levels, light exposure, and Carbon Dioxide (CO2) or nitrogen concentration. Equipment failure in refrigerated containers or vehicles followed by poor driving practices is one of the leading reasons behind cold chain wastage. In addition, poor load and unload practices have also been identified to be one of the primary reasons behind compromised food and pharmaceuticals. Broken integrity of supply chain conditions can result in lost sales through the damaged product; or in poor customer satisfaction by shortening the shelf life of a product, or by compromising the quality of the goods on sale.

HIGH-VELOCITY SUPPLY CHAINS

The nature of supply chains differs by product and industry vertical. The food and grocery industry has the quickest supply chain from the point of production to the point of sale. As a result, lead times for fresh produce are extremely short, with minimal stock kept at warehouses, fulfillment centers, or at the back of the store. Distributors rely on efficient cross-docking and Just-in-Time (JIT) to accelerate the efficient movement of goods. Fast-Moving Consumer Goods (FMCG) are usually delivered from regional distribution centers or warehouses to stores. This entails optimized route planning and the ability to quickly react to any disruption. Short lead times also require coordination throughout the supply chain; a disruption upstream may mean out-of-stock products within days. The FMCG industry continues to rely on rapid and highly efficient processes, with ever-higher production volumes accompanied by lower manpower, requiring increasingly automated supply chain processes.

Figure 2 shows various stages of supply chain, highlighting the need to be high velocity for FMCG.

Figure 2: Supply Chain Stages

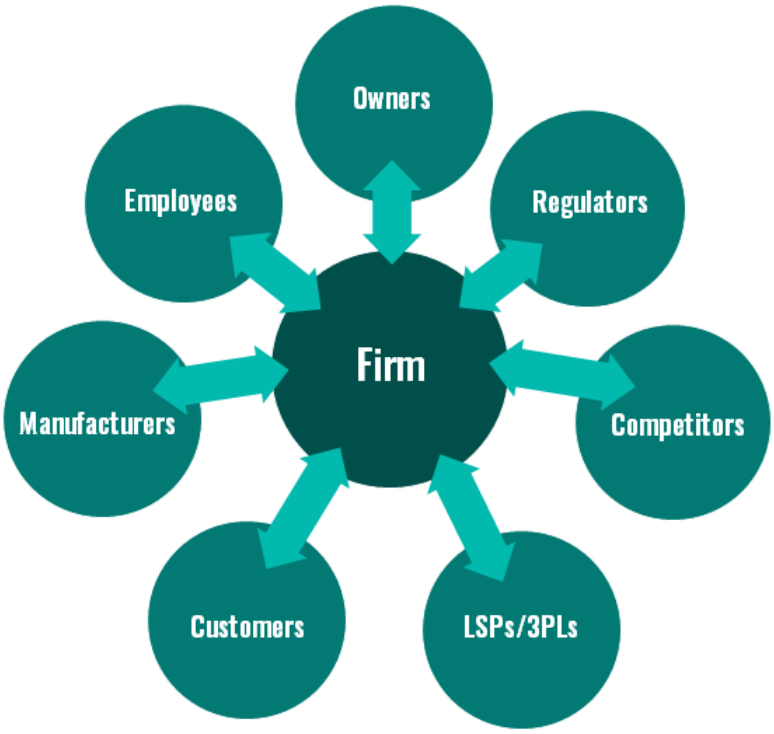
(Source: ABI Research)

LARGE STAKEHOLDER NETWORKS AND HIGH DELIVERY EXPECTATIONS

Stakeholders at different points of the supply chain receive goods from many suppliers and ship them to various trading partners. They might use different Logistics Service Providers (LSPs) and Third-Party Logistics (3PL) providers to transport goods. Managing transportation for dispatch, pickup, and delivery of goods is imperative to keep costs lower to maintain profit margins and efficient operations, through coordinating different parts of the supply chain. This is required to maintain the pace of internal processes. In addition, trading partners expect real-time visibility into the expected time of arrival of a product shipment to assist them in managing and optimizing their own internal operations. New-age distribution channels, such as e-commerce, omnichannel sales, microfulfillment, and smaller supermarket sizes, further heighten the need for planning, inventory control, and efficiency. Figure 3 illustrates a retailer's possible stakeholder supply chain network.

Figure 3: Potential Stakeholder Supply Chain Network for a Retailer

(Source: ABI Research)



WASTE

Stakeholders across the food and pharma supply chain operate via First Expired, First Out (FEFO) and First In, First Out (FIFO) systems. Efficient operations are needed to control the high levels of waste caused by products expiring before reaching the point of sale. This requires constant coordination between warehousing or fulfillment facilities and transportation entities. Often, retailers and stakeholders across the supply chain may also face throwing away entire batches of food and vaccines, primarily due to a lack of granular visibility at the item level.

Figure 4: Food Losses and Waste across the Supply Chain and the Major Causes

(Source: ABI Research)

LACK OF VISIBILITY

Stakeholders, especially in the retail and pharma sectors, often have no or very low visibility into a product between the origin and the final delivery point. Supply chain visibility issues have further heightened with port congestion. Ports have contributed to elevated visibility issues and trade frictions in the global transport system. This has caused a lot of visibility issues across the supply chains of major manufacturers and retailers. Visibility with real-time tracking can help monitor every step of the journey, thus holding transportation providers accountable. Real-time visibility can also help decision makers mitigate any potential threats and risks before they arise.

Figure 5: The Reasons behind the Importance of Supply Chain Visibility

(Source: ABI Research)

Full item-level visibility can also help retailers optimize their inventory management. Omnichannel businesses today are struggling to maintain complex coordination of product movement among many stakeholders across multiple purchase channels. Having real-time item-level visibility in stores, for example, can help ensure that stock levels in stores are updated for click-and-collect orders.

REGULATIONS

Incoming regulations are slowly bringing in a need for real-time food safety data available on demand to authorities, and the capability to trace any item forward or backward along the supply chain. Below are just a few examples of the type of regulations that need to be considered:

- **Food Safety Modernization Act (FSMA) Rule 204:** Calls to identify a list of foods that require additional record keeping and traceability.
- **The Beijing Cold Chain Food Traceability Platform:** Requires extended traceability data, including batch number, product codes, country of origin, and port of entry along with certificates focused on disinfection.
- **The European Union's (EU) General Food Law:** Requires extensive traceability, facilitating the withdrawal of unsafe food/feed from the market

LOSS OF RETURNABLE ASSETS

Many retail stakeholders use returnable assets to move products, including metal trolleys (e.g., milk deliveries to a supermarket) and plastic crates (e.g., fresh produce and bakeries). These are often distributed to a high number of trading partners, and often suffer a very high loss or theft rate. For example, Bakers Basco in the United Kingdom suffered losses of around 60%, sometimes exceeding 100%, on its bread baskets and dollies, resulting in several million in losses each year. Retailers want to understand where the leakage points in their supply chain are, helping them save extensively on the procurement of new assets. In a very low-margin business, this pain point is significant.

USE CASES, APPLICATIONS, AND BENEFITS

The pain points above can be mapped out to current and future use cases for tracking, tracing, and monitoring technologies enabled by Ambient IoT, as outlined in Table 1.

Table 1: Pain Points, Use Cases, and Benefits for Supply Chain Visibility

(Source: ABI Research)

Pain Point	Use Case	Benefit
Counterfeits and Product Safety	Brand protection via item-level product validation and serialization	Ensure products are authentic and safe for consumption, and to prevent reimbursement fraud
High-Velocity Supply Chains for FMCG and Pharma	Transportation network design optimization; asset and resource use optimization	Enhance efficiency and usage of vehicular/non-vehicular assets to optimize usage, loading, and velocity of asset pools
Produce and Food Waste	Automated alert-based inventory management Understand batch/item-level expiration dates through visibility into individual products	Better product visibility, fulfillment and inventory management, and product lifecycle management
Reverse Logistics Complications	Automated item/aggregate level reporting	Optimize reverse logistics to improve returns and recalls, and better target individual products, rather than Stock Keeping Unit (SKU)-level recalls
Shortages and Stockouts	Optimization of inventory at item level	Improved supply chain management planning at a granular level to reduce excess inventory
Environmental, Social, and Governance (ESG) Compliance	Understand environmental footprint at SKU or item level	Automated compliance reporting at an aggregate level in real time
Resource Wastage in Manufacturing Facilities	Enable smart energy management via optimized power and water utilization	Track resource utilization to enable improved/optimized resource management
Complex Reporting Requirements	Enable automated item/ aggregate-level reporting	Automated reporting to reduce time and resources spent on compliance processes
Delivery Disputes	Automate data collection on delivered goods to provide proof of delivery and a single source of truth for invoicing	Improved customer relations
Loss of Returnable Assets	Enable returnable asset visibility by tracking assets in real time	Greater visibility in distribution and leakage points in the supply chain of returnable assets to reduce expenditure on asset replacement
Faulty Omnichannel Fulfillment Due to Inaccurate Inventory	Item-level tracking of retail store and fulfillment center inventory in real time	Streamlined fulfillment of click-and-collect orders
Poor Stakeholder Collaboration	Efficient Service-Level Agreement (SLA) and Estimated Time of Arrival (ETA) commitments	Increase efficiency of transportation to meet Less than Truck Load (LTL) transportation requirements, reduce empty miles, and improve collaboration Provide better ETAs to meet increasingly demanding SLAs from retailers and reduce waiting time

TOTAL ADDRESSABLE MARKET

Ambient IoT has the potential to both enable new use cases and replace existing legacy visibility solutions for a range of applications. Overall, Ambient IoT can cater to a Total Addressable Market (TAM) of more than 10 trillion devices across different verticals, such as automotive, apparel, home devices, office devices, commercial buildings, manufacturing components, luggage, etc.

Given the challenges of quality, waste, sustainability, legislative pressure, and other market drivers, food and pharma markets are some of the most relevant to the application of Ambient IoT.

To gauge the size of the TAM for Ambient IoT in food and pharma, Chart 3 and Chart 4 provide the total numbers in the food and pharma sector at an item-level.

Chart 3: ***Food Sector TAM by Item Level (Includes Produce, Perishable Packaged, and Non-Perishable) World Markets: 2020 to 2026***

(Source: ABI Research)

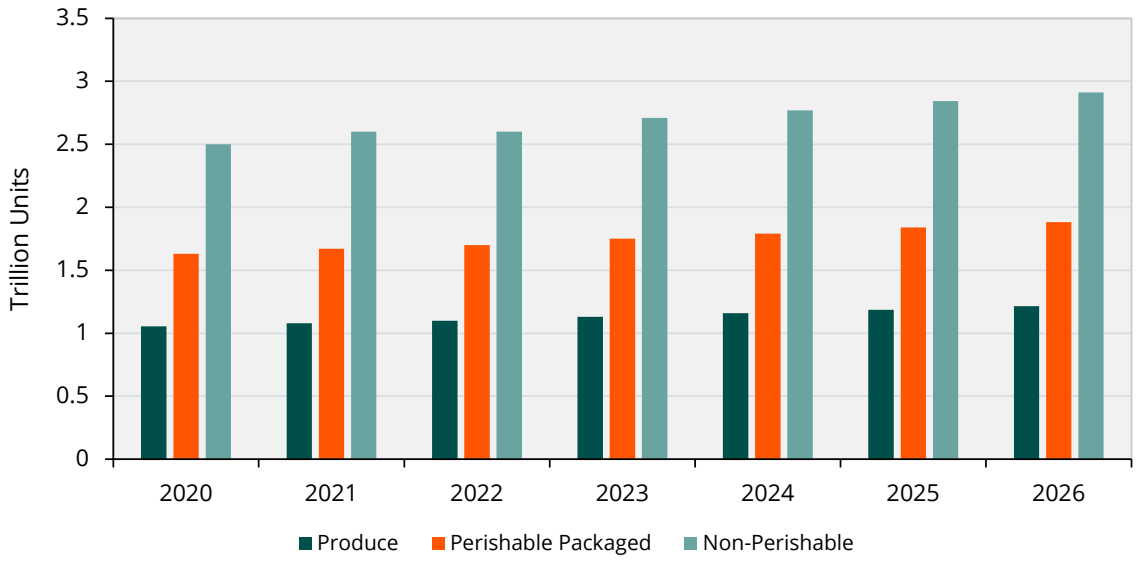
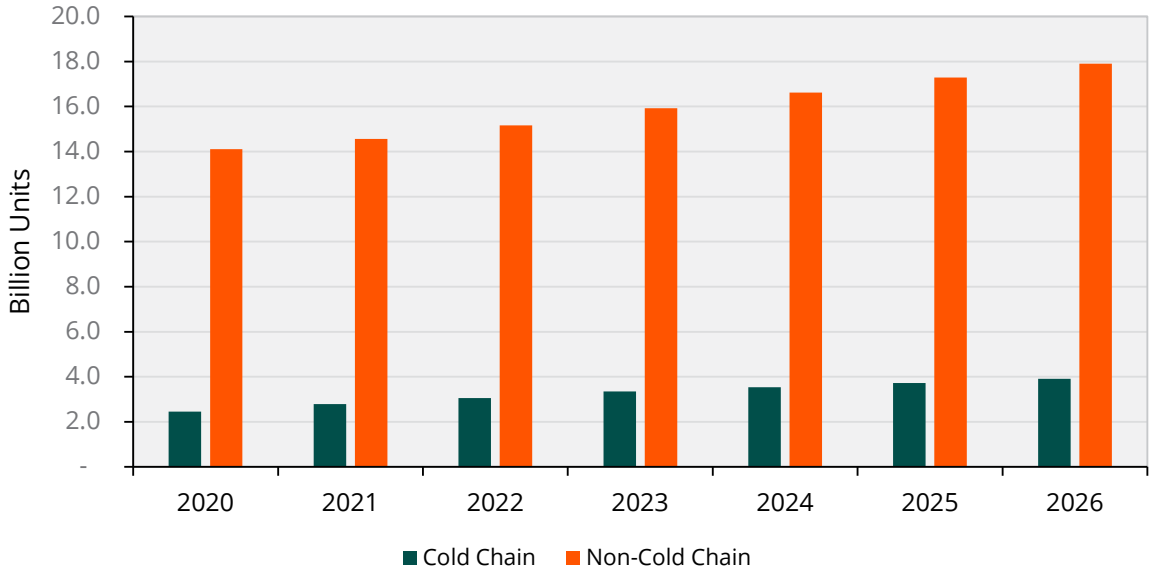


Chart 3 shows the TAM for the food industry globally. ABI Research expects total food at an item level to grow up to 6.01 trillion by 2026. Non-perishable foods account for the considerably largest volume within the food industry, encompassing a wide number of products, including beverages and dry packaged foods. The second highest volume category of perishable packaged goods consists of meats and seafood, dairy, and eggs as major categories. Produce is the third category ranked by volume, with goods more usually transported in bulk, but they may also be individually packaged.

Chart 4: Pharma Sector TAM by Item Level (Drugs and Vaccines) World Markets: 2020 to 2026

(Source: ABI Research)



Similarly, Chart 4 shows the TAM for drugs and vaccines globally. The non-cold-chain market is substantially larger than the cold-chain market, though it frequently attracts less attention because of the lower value of the items in question. As the cost of technology comes down, this will represent an increasingly large opportunity for technology providers.

Chart 5: Pharma and Food Returnable Assets (aggregation Level; Crates and Pallets) World Markets: 2020 to 2026

(Source: ABI Research)

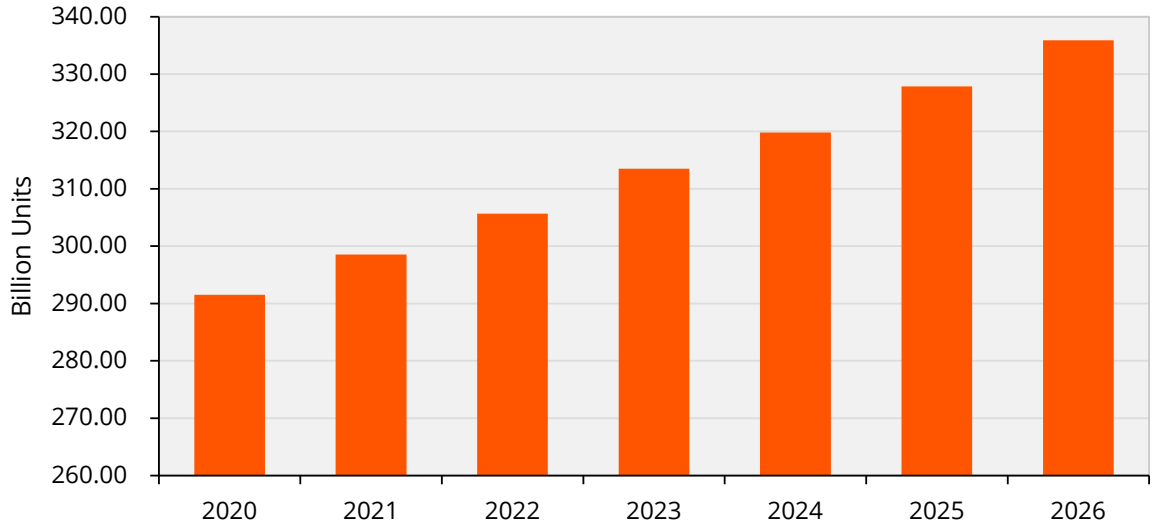


Chart 5 shows the TAM for returnable assets in food and pharma, set to grow to US$336 billion by 2026. It includes transportation assets (e.g., pallets and crates), as well as boxes in which individual packs of medicine are aggregated before being loaded into a transportation asset. The largest share of numbers at the aggregation level comes from these boxes, which must be moved several times throughout the supply chain, as well as being aggregated and disaggregated at different stages of the supply chain.

AMBIENT IoT VERSUS RFID

Ultra-High Frequency (UHF) Radio Frequency Identification (RFID) has been used since the 1990s for automation to achieve greater visibility of inventory and supply chains. However, it has not delivered on the original vision of real-time pervasive visibility from the factory to the store and into the home. Ambient IoT tags resemble UHF RFID and are manufactured using the same high-speed reel-to-reel process.

Table 2: Comparison between RFID and Bluetooth Low Energy Technology behind Ambient IoT

(Source: ABI Research)

TECHNOLOGY TYPE/ CAPABILITIES	COST AT SCALE	RANGE	FORM FACTOR	SECURITY	INTEGRATION	ROBUSTNESS	TRANSMISSION	REQUIRED ENERGY	PERVASIVENESS
RFID	H	L/M	M	M	M	H	L/M	M	M/H
Ambient IoT (Bluetooth)	L	H	H	H	H	H	M/H	L	H

Table 2 provides a high-level, cross-vertical comparison between RFID and Bluetooth Low Energy (BLE), the underlying technology behind Ambient IoT. If absolute minimum tag cost is the sole criterion for system selection, then RFID is generally the best candidate, as RFID tags can be very inexpensive. However, total system cost and performance are generally the most important criteria for system selection. With RFID systems, the expense and complexity of readers, which are essential for system functionality, as well as the complexity of system integration, can frequently result in systems with cost exceeding the benefits.

BLE also benefits from much more secure data communication and the ubiquity of Bluetooth devices that surround us every day in workplaces and homes. Bluetooth is also an "active" technology—one that does not require scanning or placement near a reader to receive data. This standards-based Bluetooth ecosystem enables easy interoperability, as well as low-cost devices for tags and receivers. Bluetooth also frequently incorporates data sensors, enabling the condition (temperature, humidity, fill level, etc.) to be communicated, along with identification and location.

While the use of Bluetooth as a mechanism to transmit the signals from Ambient IoT has the benefit of compatibility with existing devices, such as phones, smart speakers, appliances, and network devices, the Bluetooth standard does not currently encompass a number of features required for Ambient IoT to become truly pervasive. These include the energizing of tags, security, management of edge devices, and the interconnection of data across networks. Current solutions for these are, therefore, vendor specific. This leaves open an opportunity for competition between standards organizations to provide a more comprehensive framework.

ROLE OF 6G AND 3GPP STANDARDS DEVELOPMENT

The 3rd Generation Partnership Project (3GPP) is an umbrella term for a wide range of standards organizations that develop protocols for mobile telecommunications. It is best known for the development and maintenance of the following:

- GSM and related 2G and 2.5G standards, including GPRS and EDGE
- 5G NR and related 5G standards, including 5G-Advanced
- An evolved IP Multimedia Subsystem (IMS) developed in an access independent manner

3GPP is currently specifying the connectivity requirements for Ambient IoT devices and, given the size of its wireless carrier members, can act as an enabler toward widespread adoption. It is currently in the process of defining future releases of 5G that will inevitably progress to become 6G and issuing technical reviews about Ambient power-enabled IoT, addressing concerns about the technical possibilities of achieving widespread adoption. 3GPP carefully reviews every aspect of the IoT and how any issues can be resolved. 3GPP is set to publish a technical report by the end of 2024 with normative text. Once this report is completed, all the technical specification groups within 3GPP, such as Core Network & Terminals (CT), Radio Access Networks (RAN), and Services & Systems Aspects (SA) will be aligned. Each group will work on these specific items that relate to its expertise and how they are going to implement these features that make it through their process.

SIGNIFICANCE OF 6G:

There will be two important releases that pertain to Ambient IoT as GSMA gears up to launch 6G:

- **Release 18:** 3GPP currently is in the process of closing Release 18. This release, along with Release 19, will define the requirements for enabling Ambient IoT. This release will act as a study item for the RAN (which covers base stations and radio towers for cellular connectivity) group to understand if it is reasonable to include requirements in Release 18. This group will start to study how Ambient IoT within a RAN can be used and defined. This group will start to study how Ambient IoT within a RAN can be used and defined.
- **Release 19:** This will entail defining Key Performance Indicators (KPIs) for Ambient IoT for downstream groups like mobility and security; although this needs to be supported by the CT technical specification group as well.

So, there is a strong possibility that these standards and technology specifications can enable Ambient IoT chips to harness the connectivity provided by base stations and handsets, as well as mobile devices, and interact with them. Figure 6 shows the roadmap to adoption.

Figure 6: Roadmap to Adoption of Ambient IoT

(Source: ABI Research)

The Institute of Electrical and Electronics Engineers (IEEE): Another standardization body that can act as an enabler to Ambient IoT is the IEEE. Its objectives are the educational and technical advancement of electrical and electronic engineering, telecommunications, computer engineering, and similar disciplines. The IEEE is also looking into the use cases of Ambient IoT, so there might be more than one standard that supports the pervasive form factor provided by Ambient IoT.

Bluetooth Special Interest Group (SIG): The Bluetooth SIG is the standards organization that oversees the development of Bluetooth standards and the licensing of the Bluetooth technologies and trademarks to manufacturers. Although Bluetooth SIG has not made any public comments on Ambient IoT, it is well positioned to build on the connectivity it offers today to provide a more comprehensive set of standards that will guide this technology into a pervasive and inexpensive standard for use across the consumer and enterprise arenas.

WILIOT'S TECHNOLOGY

Wiliot is a company engaged in the design and development of Ambient IoT products. It offers IoT Pixels or tags, and cloud platforms that enable security and connectivity. It develops self-powered tags that can be attached to products and packaging to sense a range of data. The company caters to the pharma and healthcare, food and beverage, and retail sectors. Wiliot's highlight offering is its IoT Pixel chips that "turn every single thing into an agent of change." Wiliot's "Three Tier Architecture" allows data processing on the edge, which enhances privacy protection and data security. It can also help reduce operational costs, enhance reliability and resiliency, and support streamline Artificial Intelligence (AI)/Machine Learning (ML) applications.

THREE TIER ARCHITECTURE

Wiliot provides open-source software to an ecosystem of its "Works with Wiliot" edge device providers. Its architecture is divided into three separate categories:

- **Pixels:** Battery-free and/or battery-assisted tags that can be attached to items or containers. These postage stamp-sized compute devices are assembled and sold by third-party tag manufacturers.
- **Bridges:** Low-cost devices that extend range, and allow transmissions from many tags to be filtered to gateways. These bridges perform the following functions:
  - **Energize:** Provides energy for Wiliot Pixels to harvest
  - **Read:** Recognizes Wiliot Pixel data packets and forwards them to the Wiliot Cloud
  - **Repeat:** Selects and repeats amplified Bluetooth broadcasts to gateways
- **Gateways:** Devices that enable the encrypted Pixel broadcast to connect to the Wiliot cloud, where it can be decrypted, organized, analyzed using AI for sensing, and accessed by open-0source Application Programming Interfaces (APIs). This role is often accomplished by standard Wi-Fi Access Points (APs) that are BLE enabled.

Figure 7: Wiliot's Three-Tier Architecture

(Source: Wiliot)

Table 3: Two Different Types of Pixel Tags Wiliot Enables

(Sources: Wiliot, ABI Research)

NAME	COST	RANGE	ENERGY SOURCE	ENERGY LIFE SPAN	TRANSMISSION ANTENNA	HARVESTING ANTENNA	RADIO FREQUENCY (RF) PROTOCOL	BROADCAST FREQUENCY	SIZE
Battery-Free Band Pixel	<10c-35c+	10 Meters (m)	Battery free; harvests RF	No limits	2.4 GHz	Sub-1 GHz (LoRa, UHF RFID), 2.4 GHz	BLE 2.4 GHz	0.5 seconds to 1 minute	2.8x4.4 Centimeters (cm) Battery-Assisted Pixel
Battery-Assisted Pixel	US$1 to US$2	10 m	Dedicated printed battery	4 years	2.4 GHz	N/A	BLE 2.4 GHz	Every 4 seconds	3.6x6.0 cm

Wiliot's IoT Pixels' standard connectivity leverages existing Bluetooth infrastructure, giving it the potential to be pervasive. One of its unique features is its computing power, despite its size. These chips use the Arm Cortex M0+ processor, which has enabled a more flexible and rapid evolution of the underlying technology. It has superior antenna imaging for "sensor-free sensing" that allows tags to measure temperature, proximity, and content level. Reporting metrics like humidity and ripeness for produce is also in the pipeline. The unique foundation of the Wiliot IoT Pixels is its ultra-low power design, enabling it to be truly ambient. Wiliot IoT Pixels have 100X better harvesting sensitivity than RFID, which means they can capture the energy from weaker signals than other energy harvesting systems. This translates to an ability to leverage lower-cost energy sources, so more IoT devices and appliances can be used. IoT Pixels also have 100X lower power leakage compared to standard energy harvesters. This enables the energy once harvested to be retained and used in the system, while more power is accumulated from successive radio waves. This ability to accumulate and retain energy over time is key to operating in ambient environments and harvesting from radio waves, rather than other less pervasive sources, such as solar (line of sight of solar is not always available when tags are embedded in products).

It is also possible to have printed batteries attached to the chips. While these batteries remove the need for a predictable source of RF power to harvest, are very low cost, and are smaller than a business card, the finite life, temperature sensitivity, and need for replacement can be said to compromise the ambient nature of this form of the tags.

FUTURE PLANS:

Wiliot is on track to ramp up the production of its chips to billions of units. It is planning a Version 3 tag that can be scaled down to less than US$0.10 in cost when mass produced. The V3 chips are set to be much smaller (0.6 Square Millimeters (mm2)) and will allow for harvesting energy from phones.

DEPLOYMENT SCALE CONSIDERATIONS:

Deployments in a warehouse or a retail store may consist of thousands of tagged items, and dozens of bridges (energizers, depending upon scale), and a handful of gateways (or no gateways at all if BLE-enabled Wi-Fi APs are used).

Table 4 shows price ranges for each component today, including estimated cost at scale for an average 15,000 Square-Foot (sq ft) retail store seeking to track all of its inventory on a continuous real-time basis.

Table 4: Price Ranges for Ambient IoT Components

(Source: ABI Research)

Component	Price	Cost at Scale
Pixels	<US$0.10 to US$0.35	US$3,000 (tagging an average of 10,000 crates/pallets)
Energizers/Bridges	US$25 to US$75	~US$1,000 (around 20 bridges needed in a 15,000 sq ft store)
Gateways	US$0 (existing Access Points), or US$75 to US$150	US$1,500
	Total Infrastructure Cost	**US$5,5000**

IMPLEMENTATION RECOMMENDATIONS:

It is important for prospective adopters to look at Ambient IoT from a strategic perspective by looking at their respective business models and formulating a plan accordingly. The end goal for Ambient IoT adoption can vary enormously. It could be to support waste reduction, sustainability, the enhancement of inventory accuracy as part of an omnichannel strategy, a complete reengineering of the supply chain to give visibility of products from the factory into the consumers' home, or a change in business model, moving from being a commodity producer to a Product-as-a-Service (PaaS) business.

Prospective adopters should start with small projects to achieve quick wins. Embedding crates and pallets to minimize the loss of returnable assets, for example, could be a good start. Widespread adoption should be a collective ecosystem approach that may involve multiple stakeholders, even competitors, to enable a more open data-sharing environment.

Some use cases will have a higher priority than others. While there are many use cases that enterprises may want to address with supply chain visibility, companies need to prioritize according to their internal resources. The most pressing use cases that will drive the adoption of digital ID software are regulatory compliance, brand protection, and fulfillment/inventory management. Other use cases that are starting to take off include consumer engagement and product lifecycle management.

While the value of supply chain visibility lies in the software, many implementation challenges occur in that layer because of the difficulties of integrating with existing enterprise systems. Customers are usually very reluctant to touch their Enterprise Resource Planning (ERP) and other central systems. The new generation of enterprise software systems tuned for serialization and digital twins that Ambient IoT enables should be considered. End users must develop deep relationships with enterprise system providers to enable seamless integration. As enterprise systems migrate to the cloud, the integration will increasingly become more flexible and allow for faster and lower-risk implementations.

CONCLUSION

Ambient IoT enables a paradigm shift in the way products are made, distributed, sold, used, reused, and recycled. The ultimate scale of "things" being connected to the Internet is likely to be orders of magnitude beyond what it is today. The technology can be used tactically, but it can also be used strategically to enable new business models. 6G, the IEEE, and Bluetooth standards will enable more pervasive adoption of Ambient IoT. While standards efforts will take several years to play out, early adopters are implementing Ambient IoT today in an effort to gain the kinds of advantages that first movers to the Internet achieved. Companies wishing to hedge their bets, learn, and be prepared should look at more tactical use cases that can be implemented today without major reengineering of business models or technical infrastructure.

Published November 2022

157 Columbus Avenue 4th Floor
New York, NY 10023 USA
Tel: +1 516-624-2500

www.abiresearch.com

About ABI Research

ABI Research provides actionable research and strategic guidance to technology leaders, innovators, and decision makers around the world. Our research focuses on the transformative technologies that are dramatically reshaping industries, economies, and workforces today. ABI Research's global team of analysts publish groundbreaking studies often years ahead of other technology advisory firms, empowering our clients to stay ahead of their markets and their competitors.