



WHY LoRaWAN® IS THE LOGICAL CHOICE FOR ASSET-TRACKING CONNECTIVITY



INTRODUCTION

Asset tracking has been among the earliest applications to gain significant traction first in the machine-to-machine (M2M) market over the last two decades and, in more recent years, in the Internet of Things (IoT). In early iterations, the connectivity used for asset tracking was either cellular or satellite. The objective was purely to have remote visibility of the location of the asset. However, with the evolution toward IoT and the increasing availability of new technologies—such as low-power wide-area networks (LPWANs)—asset-tracking applications are becoming more ubiquitous, pervasive and sophisticated. We are now able to communicate not only the position of the asset but also key information, such as the status of the object and data, such as temperature, speed and asset-specific information. This paper explores the importance of asset tracking within the evolution of logistics.

THE LOGISTICS SECTOR

Supply chain and logistics are often used interchangeably, but this is not always accurate. Based on the Council of Supply Chain Management Professionals (CSCMP) definition, logistics is seen as “part of supply chain management that plans, implements, and controls the efficient, effective forward and reverse flow and storage of goods, services and related information between the point of origin and the point of consumption in order to meet customers’ requirements.”

Using the CSCMP definition, the logistics competitive landscape can be grouped based on different business models. Noting that companies can operate using different business models, they can be grouped in the way illustrated in *Figure 1*.

Figure 1. Logistics Market Classification

Logistics Player Type	Logistics Player Business Model	Typical Customers	Segment
Logistics Service Providers (LSPs)	Mainly freight forwarders, third and fourth parties	Manufacturers, wholesalers, retailers	B2B
Carriers	Trucking, rail freight, sea freight, air freight	LSPs	B2B
Courier Express Parcel (CEP)	Last-mile delivery	Retailers and manufacturers, other companies with the need to deliver items	B2B and B2C

Source: Elaboration on classification by PWC “Shifting Patterns: The Future of the Logistics Industry”

Those players are the protagonists in an incredible move of goods and assets all over the planet. It is not simple to give the complete picture of the impact of logistics on trade and intercountry exchanges. However, the data elaborated by the OECD Transport team can provide some insights.²

Figure 2 shows an elaboration on OECD data on three logistics types: freight transport by road, container transport by sea and container transport by rail. For each of these, Figure 2 lists the top 10 countries in terms of traffic.

Figure 2. Top 10 countries per three different types of logistics measured per unit of transport (2017-2018) – See definition in the footnote

Countries	Freight Transport	Countries	Container Transport by Sea	Countries	Container Transport by Rail
China	6,677,150	Spain	17,088,447	Germany	7,103,537
United States	2,954,190	Germany	15,130,100	Canada	4,654,397
India	2,435,870	Netherlands	13,888,161	Italy	2,466,147
Germany	316,767	Turkey	10,843,998	Czech Republic	1,803,175
Japan	210,467	United Kingdom	10,324,000	Austria	1,802,305
Canada	185,245	Canada	6,660,315	Poland	1,770,082
France	168,480	Greece	5,300,026	Netherlands	1,686,000
United Kingdom	161,112	France	5,052,827	Turkey	990,092
Italy	111,728	Russia	3,888,129	Hungary	707,524

Source: OECD – Definition of indicators in the footnote.³

In the period 2017-2018, there was movement of almost 14,000,000 million tonne-kilometers of freight; almost 89 million TEU (twenty-foot equivalent units) containers via sea and almost 23 million TEU via rail. Despite not giving the exact picture, these numbers give the sense of how vast the logistics market is. There are several estimations in terms of revenues by analysts and consultants that vary from almost \$6.5 trillion to \$13 trillion in 2022. The discrepancies demonstrate how hard it is to scope the volume of freight moved, but the message is clear: This is an enormous market.

THE EVOLUTION OF LOGISTICS

As the backbone of trade and any asset-based exchange, logistics are inevitably influenced by socioeconomic and technological changes. Therefore, the sector needs to adapt to those. There is a vast array of technologies that can enable sustainability, improve operational performance and respond to the new shopping experience. The convergence of the internet of things (IoT)—currently at

the core of development in logistics—with other emerging technology frameworks such as artificial intelligence (AI) and blockchain can help the industry to address emerging trends. These are the three trends that are expected to shape the face of logistics in the coming years.

- 1. The shopping experience is becoming increasingly customer-centric.** With digital shopping solutions driving demand for transparency, affordability, convenience and speed in delivery, as well as compelling frictionless returns, it is essential to create new business models and solutions that cater to these needs. As a sector, logistics needs to respond to this. Omnichannel logistics, fresh chain, service-based solutions and connected life-oriented solutions are all areas in which logistics need to evolve to respond to the demands of the customer-centric era. This area will also be affected by privacy legislation, such as general data protection regulation and requirement of mechanisms for trust and data consent.
- 2. Becoming a zero-emission industry.** The logistics industry is at the center of the commercial exchange, but it uses a variety of vehicles and therefore has a

significant impact on the environment. The industry needs to move toward sustainable ways of delivering goods, ways that reduce emissions and optimize usage of resources. There are already efforts in this direction such as the Green Energy Logistics initiative by DHL. Legislation that aims to move transport systems toward electric vehicles will have a great impact on how the logistics industry will change.

3. New ways of working and the new workforce.

The increasing use of technologies such as robotics, IoT, augmented reality (AR) and virtual reality (VR) are changing the working environment in logistics. Robots are freeing humans from dangerous tasks. Collaborative robots are working together with humans. All this creates new workplaces, and that requires investments on machine/human interactions. It is also likely that legislation in this area is forthcoming.

ASSET TRACKING IN LOGISTICS

The asset tracking is an important application for addressing the first two trends described in the previous section. That is because it is an important component of the logistics services. In fact, the World Bank LPI (Logistics Performance Index), a composite indicator that measures the logistics capabilities of a country, includes ‘Tracking and Tracing’ as one of the six indicators, which the index is composed of.⁴ Figure 3 shows the top 10 countries based on the LPI score and their scores on “Tracking and Tracing.” Note that the score goes from 1 (Very Low) to 5 (Very High).

Figure 3. Top 10 Countries by LPI and their “Tracking and Tracing” Scores

Top 10 LPI Countries	Tracking and Tracing Score
Germany	4.24
Sweden	3.88
Belgium	4.05
Austria	4.09
Japan	4.05
Netherlands	4.02
Singapore	4.08
Denmark	4.18
United Kingdom	4.11
Finland	4.32

Source: World Bank LPI (<https://lpi.worldbank.org/international/global>)

In spite of these scores being quite positive, the quality of the asset-tracking capabilities needs to be further developed to enable the logistics industry to face the challenges of customer-centric shopping and sustainability. The IoT vision, in convergence with other emerging technologies, can create a venue for technological development in asset tracking.



THE ASSET-TRACKING SOLUTIONS LANDSCAPE AND FURTHER DEVELOPMENTS

A typical asset tracking solution aims to trace and track the asset in movement both indoor and outdoor. There are four fundamental elements of an asset-tracking solution:

1. the tracker, which is a position sensor
2. the connectivity that sends the location data to the management center
3. the platform for device management
4. the application software, such as enterprise resource planning (ERP), warehouse management system and many others.

There is a reasonably large marketplace of companies offering asset-tracking solutions, and these companies are also evolving to face the challenges of asset tracking in the digital era.

There is the challenge of trust that must extend along the chain of players that take an asset from origin to destination. Ensuring that trust at every step complicates the entire process. To solve this problem, there are several activities around the convergence of IoT, blockchain and other forms of distributed ledger technology. The Food Trust initiative by IBM, Walmart and others is an example of this type of effort.

There are then connectivity issues. An asset-tracking solution needs to function smoothly across countries and continents without roaming problems and incurring additional connectivity costs. Asset tracking needs global connectivity.

Finally, asset tracking needs indoor coverage to enable and drive development of the connected warehouse, where pallets, individual items and operational equipment can be tagged—perhaps with low-cost sensors—to optimize resource utilization, increase efficiency and enable predictive maintenance. The idea of private networks with long-battery life sensors and devices can be the building block of connected warehouses.



WHY LoRaWAN FITS THE NEEDS OF LOGISTICS ORGANIZATIONS

From the huge volume of tonne-kilometers transported globally, it's clear that asset tracking, particularly of shipping containers, is an enormous market, and this is only added to by smaller assets, parcels, equipment and vehicles that need to be tracked throughout the logistics industry. A unifying factor is that much of the assets to be tracked cross borders, even moving from continent to continent, and therefore globally applicable solutions to asset connectivity are needed to enable tracking.

Of similar importance is that this is not a high bandwidth industry. The asset only needs to communicate its location in order to be tracked and, even advanced applications such as cold chain transport only need to transmit small amounts of data about the temperature of the product being shipped. Therefore, relatively low bandwidth and low latency connectivity is ideal.

In addition, when stacked against the cost of higher bandwidth satellite or cellular connections, it's clear that LPWANs such as LoRaWAN have much to offer and can easily handle the sheer scale of asset-tracking market demands.

LoRaWAN specifically is an excellent fit, because it brings together competitive cost with the capability of handling extremely high device density at a given site. If you think of a logistics facility with the tens of thousands of containers, assets and parcels that traverse it every day, this capability is essential. Also essential is the ability to have deep indoor

coverage, which is vital for the large warehouses that form the core of international logistics, some of which involve underground capacity. LoRaWAN has the capability of penetrating these large buildings, ensuring uninterrupted asset tracking.

At these facilities, LoRaWAN offers the option of public or private networks, which is attractive to large site operators because it can drive economies, assure performance and is perceived to be highly secure. In either type of deployment, it's worth noting that LoRaWAN has mature security that has been developed over many years.

A further strength is that LoRaWAN devices typically have very long battery life, making them ideal for multiple long journeys, such as for the months involved in intercontinental shipping, or for more complex applications such as updating the location and status of a truck daily. LoRaWAN-enabled asset trackers can be simply and cheaply affixed to containers or other assets, enabling smooth deployment.

Asset tracking isn't performed in controlled environments, and logistics by its nature involves shock, vibration, temperature extremes and other factors not present in smooth, nonmobile environments. LoRaWAN is rugged so that it can continue to operate in most extreme situations.

USE CASES

There are a growing number of compelling use cases for LoRaWAN within the asset-tracking sector. Just a few of these are listed below to give a flavor of the applications that LoRaWAN can enable effectively.

VEHICLE TRACKING

GPS tracker manufacturer Maxtrack operates in Latin America and has sold more than 3 million devices in Brazil over the last 20 years, supplying the largest insurers and tracking companies in the country. Each year in Brazil, approximately 650,000 vehicles are stolen—about 1% of the total fleet. However, with the average cost of insurance being USD \$800 per year, only 20% of the fleet has insurance. GPS tracking, which costs around USD \$180 per year, is therefore an attractive solution.

Previously, the market has relied on 2G cellular communication, which covers about 93% of the population. However, with 2G being retired, alternatives are needed, because the current cost of 2G data for SIM cards with 10MB data plans is USD \$1 per month. For 4G/LTE, the cost for the cheapest data plans is USD \$7.50 per month, so there is a huge cost gap that needs to be addressed.



LoRaWAN can be the technology to address this need. American Tower has already started rolling out its network, and plans to cover 85% of the population this year.

Maxtrack is therefore introducing LoRaWAN for data tracking in its devices. It is enhancing LoRaWAN-only devices with context awareness to minimize raw data transfers, and will scale up its solution to be deployed in all cars with insurance and roadside recovery service in Brazil. This effort is already ongoing with the largest roadside assistance provider and the second largest insurance company in Brazil.

LOGISTICS TRACKING

Abeeway has provided its tracking devices for GEFCO's IoT Track & Trace Solution in order to reduce the number of cradles required for transportation of motors for a motorcycle manufacturer. This enables better cradle fleet management and optimization of operations that has allowed GEFCO to build a new service for customers.

The solution includes the ThingPark X Location Engine for device management and data storage, with a single API for data collection. It uses the Abeeway Industrial Tracker for fitting to motor cradles and providing positions every five minutes. The tracker has a battery lifetime of up to four years, and the company claims it offers the lowest bill of materials cost in the market.

The hardware is connected via LoRaWAN connectivity over the public Orange network based on Actility's ThingPark platform. Finally, Wakeo track and trace analytics are provided along with an application dedicated to logistics that matches the asset, tracker and truck telematics.

REFRIGERATION

Refrigerators in retail stores and vending machines need their locations, and critically, their temperature status, to be tracked so food and beverages are kept fresh.

Temperatures inside refrigerators can fluctuate widely, because of thawing cycles; environmental changes; interactions with customers, such as opening of doors; and employee interactions, such as restocking.

One example has seen National Brewery in Nigeria—which

rents more than 150,000 point-of-sale refrigerators to retailers—deploy 20,000 temperature and humidity end devices to ensure optimum temperature of beer. The deployment involves 502 Kerlink iBTS gateways supported by Kerlink Wanegy Geolocation and the Kerlink Wanegy Management Center.

In addition to being able to monitor refrigerator temperature, National Brewery can monitor the operational inputs of the rented refrigerator, such as how often the door is open or closed. This enables it to ensure the refrigerator is being used in a retail environment rather than for storage. In addition, geolocation enables it to avoid theft of the refrigerator by monitoring its location.

The deployment enables refrigerators to be deployed outdoors and helps improve the customer experience by ensuring beer is at the correct temperature and refrigerator maintenance is optimized.

SMART BUTTON READERS

Die Post, the national postal service of Switzerland, has deployed LoRaWAN-enabled smart button readers from Miromico to enable it to offer customers a range of services from supply logistics that are supported by button, such as for deliveries from pharmacies, to enabling reverse logistics, and postal workers picking up items for delivery.

Die Post's device can be simply used to scan an area of a parcel and transmit this information via LoRaWAN, notifying the sender's or receiver's stored email address or mobile number via SMS.

The system enables—thanks to the 95% LoRaWAN coverage from Swisscom in Switzerland—a variety of tasks, including payment for services to be communicated, and is intuitive for postal workers and those receiving mail. It enables accurate tracking of deliveries and collections, enabling efficient operations and improved customer service for the postal operator.

MANUFACTURING

Ineo-Sense's Clover-Core sensors have been chosen by Lauak Group, a French manufacturer of primary components and assemblies for the aeronautics industry. Based on Semtech's SX1276 low-power wireless transceiver, the sensors deliver real-time, zone-based



inventory data by locating and tracking tooling racks and packages. These expensive assets are often difficult to find in a large warehouse when they are out of the process flow or in the wrong part of the building.

More than 14,000 asset-tracking solutions have been supplied to Lauak for use at its assembly site in southwest France, and are integrated into Lauak's manufacturing containers for accurate monitoring for items in transit through the company's facilities.

Lauak has seen a reduction in production lead times by up to 20% and a drop in downtime of at least 10% following the implementation of the LoRaWAN-based sensors. The company already plans to expand the deployment to its site in Portugal, and is expected to implement the sensors at sites in Canada, India and Mexico in addition to its other sites in France.

CONCLUSION

For asset-tracking applications, which have relatively low data payloads and seldom require low latency or high quality of service, it's clear that LoRaWAN offers the coverage, battery life, deployment ease and cost efficiency the logistics industry requires. LoRaWAN is versatile, flexible, cost effective, reliable and secure. In addition, it offers the widest ecosystem of app and device developers, so you can get exactly the right devices and connectivity you need for your logistics deployment.

THANKS TO THE FOLLOWING LoRa ALLIANCE® MEMBERS FOR THEIR CONTRIBUTIONS TO THIS PAPER:



REFERENCES

¹ https://cscmp.org/CSCMP/Educate/SCM_Definitions_and_Glossary_of_Terms.aspx

² <https://data.oecd.org/transport/container-transport.htm#indicator-chart>

³ Freight transport refers to the total movement of goods using inland transport on a given network. Data is expressed in million tonne-kilometers, which represents the transport of one tonne over one kilometre.

Container transport refers to the transportation of goods in standardized resealable transportation boxes by rail and sea. Data is expressed in tons and twenty-foot equivalent units (TEU). TEU is based on a container of 20-foot length (6.10 m) providing a standardized measure of containers of various capacities and for describing the capacity of container ships or terminals. One 20-foot container equals 1 TEU.

⁴ <https://lpi.worldbank.org/international>