electric imp™

Asset Tracking in the IoT Era

Highlights

Challenge

- Current asset tracking systems are often rigid point solutions not easily customized to customers' specific business requirements or use cases
- Existing Linux-based solutions are too expensive for mass-scale IoT applications
- Connected IoT products, including asset tracking, bring new levels of security vulnerabilities that solutions must address and which vendors and customers can rarely manage

Solution

- A connectivity platform with the functionality and flexibility to easily address present and future asset tracking use cases and business needs
- An optimized software and hardware design for cost sensitive or large-scale IoT use cases
- A platform with certified silicon-to-cloud security for the entire IoT product life cycle

Benefits

- Flexible connectivity platform provides easy customization of new features while reducing development, integration, and maintenance cost
- Software and hardware solution optimized for event-driven IoT applications provide feasible cost points for large-scale IoT deployment
- Managed security platform protects IoT product while alleviating customers to focus on their business value

Asset Tracking Opportunity

In the U.S. alone, 1.9 billion[1] shipping pallets and 15.5 million trucks deliver 70% of freight transported, accounting for $671 billion worth of manufactured and retail goods[2]. Clearly, tracking and ensuring the on-time delivery of these and other goods is vital to the U.S. economy.

Meanwhile in hospitals, the utilization rate of portable clinical medical equipment is only 42%[3] because the devices simply are not in the right location when needed. With thousands of pieces of equipment -- an investment totaling tens of millions of dollars -- in each hospital, tracking clinical assets is an urgent issue for healthcare providers.

Real world asset tracking applications include:

- A GPS location tracker in a refrigeration container will provide its location and ETA of delivery as part of an optimized supply chain
- A temperature sensor in the same refrigeration container will alert operators of a potential failure of the unit so they can take measures before the perishable items spoil
- A hospital nurse immediately locates an IV pump via its BLE tag, improving patient care while maximizing equipment utilization

With asset tracking, business value is realized when location and operational data drives real-time business decisions. Enterprises can optimize manufacturing efficiency, provide delivery transparency, maximize asset utilization, and improve the customer experience, all factors that increase operational profitability.

Asset Tracking Considerations

Asset tracking requires selecting technologies from a complex ecosystem of software, business application, hardware, and sensor solutions. Typical asset tracking systems consist of location trackers and operational sensors (for example, environmental) connected to business applications in the cloud via Wi-Fi, Cellular, or Ethernet.

Such systems will include:

- **Short and/or long-range location trackers** — GNSS (GPS), cellular, Bluetooth Low Energy (BLE), RFID
- **Operational sensors** — temperature, humidity, motion, vibration, and other environmental factors requiring monitoring
- **Business applications** — Web app, mobile app, analytics, SMS, visualization, database, etc.

Ensuring security is a concern in asset tracking, as security vulnerabilities come with connected devices. When compromised, even a trivial connected device can cause significant damage due to the large numbers of devices and the ability for scalable remote attacks. Safeguards are necessary in every phase of the connected device life cycle, starting with selecting software and hardware components with appropriate protection, extending to manufacturing environment, to deployment, and finally maintenance while operating in the field.

Finally, the technical selection and implementation must align with total cost of ownership (TCO) and return on investment (ROI) for the project. In addition to developing software, application, hardware, integration testing, manufacturing, and deploying a connected IoT product, TCO must consider resources for field maintenance after deployment that include application, security, and system updates.

Challenges to Current Asset Tracking Systems

While asset tracking systems exist today, most are point solutions designed for specific use cases. Each system has specific hardware that performs limited functions that provide data to an application that provides specific business intelligence to the user. However, in many use cases such limited point solutions cannot address varying real-world business requirements. For example, retailers distributing goods ranging from home furnishings to ice cream need a system that includes:

1. **On-premises asset tracking system** to track inventory inside its warehouse
2. **Shipment tracking system** for fleet and/or shipment tracking across geographies
3. **Cold chain tracking solution** to track refrigerated products shipped in temperature-controlled trucks or containers across geographies

Using current asset tracking point solutions may require the retailers to acquire three different systems to address all their use cases. This approach is challenging to integrate, difficult to maintain, expensive to implement, and not scalable. This also severely limits deployment opportunities and dramatically reduces ROI.

Multi-Service Asset Tracking Today
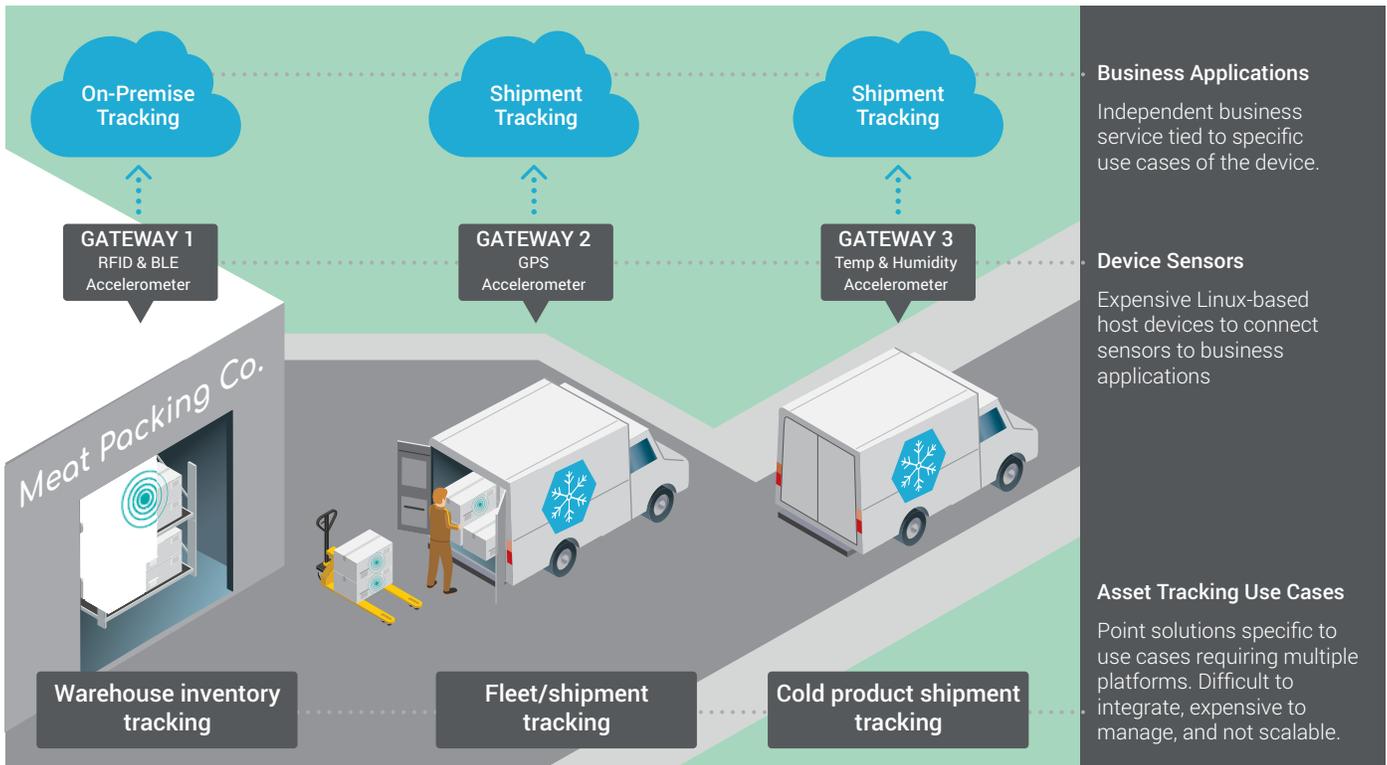
On the hardware side, existing asset tracking solutions often use Linux-based systems for device tracking, interfacing with sensors, and communication with the cloud. While Linux systems are flexible, they are also complex, resource-intensive platforms, and due to their complexity are also notoriously difficult to make and keep secure. Therefore, there is a TCO-penalty when basing an asset tracking system on Linux when the system does not need Linux's compute power. In addition, there are many asset tracking IoT applications with particular requirements — such as long-life battery operation, ruggedization (against vibration for example), small form factor, or low cost — that cannot be addressed by Linux.

Security is a special challenge in IoT in general and asset tracking in particular, and brings new levels of scrutiny. IoT systems operate across the public internet, may remain in place for 10 or 20 years after deployment, and may control critical infrastructure. Connected asset tracking systems may create cyber security vulnerabilities and targets for cyberattacks. Exacerbating the problem is that developers are focused on business value and may lack security perspective and expertise. Developers will need to balance long-term protection and business value to achieve IoT success.

Better Approach to Asset Tracking

Instead of using a fixed-function asset tracking point solution, a well-design connectivity platform can flexibly address different use cases while providing all products the same levels of functionality and security. A platform approach is ideal to tackle the asset tracking challenges in the IoT era.
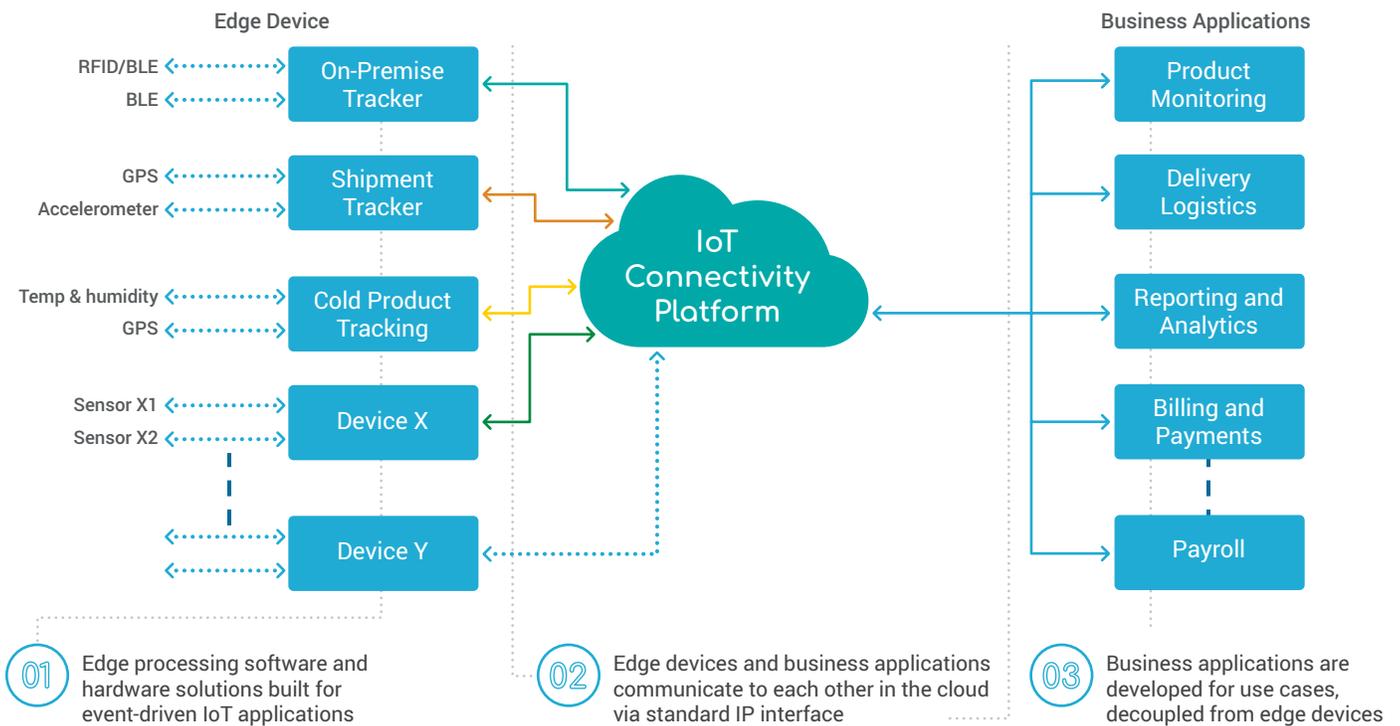
First, a platform provides developers the capabilities to add features today and flexibility to easily customize solutions for new use cases at any time. Using a common platform for new features, development, integration, deployment, and maintenance of multiple products is feasible for enterprises of any size. With a platform that uses standard IP protocol for communications, edge device application and business application development can be decoupled from

each other. This approach dramatically reduces the development scope for both device and business application while making each re-usable for different use cases.

Next, a platform should provide cost-optimized software and hardware solutions for IoT applications that perform limited tasks, including acquiring sensor data, formatting data, and connecting to the cloud. This will reduce device cost points for large-scale IoT deployments.

Finally, an IoT platform purpose built to ensure security for the entire product life cycle will provide every project the same level of protection needed in IoT, and free developers to focus on business values.

Connectivity Platform Approach to Asset Tracking

Edge Device

RFID/BLE ⟷ **On-Premise Tracker**
BLE ⟷

GPS ⟷ **Shipment Tracker**
Accelerometer ⟷

Temp & humidity ⟷ **Cold Product Tracking**
GPS ⟷

Sensor X1 ⟷ **Device X**
Sensor X2 ⟷

⟷ **Device Y**

IoT Connectivity Platform

Business Applications

Product Monitoring

Delivery Logistics

Reporting and Analytics

Billing and Payments

Payroll

01 Edge processing software and hardware solutions built for event-driven IoT applications

02 Edge devices and business applications communicate to each other in the cloud via standard IP interface

03 Business applications are developed for use cases, decoupled from edge devices

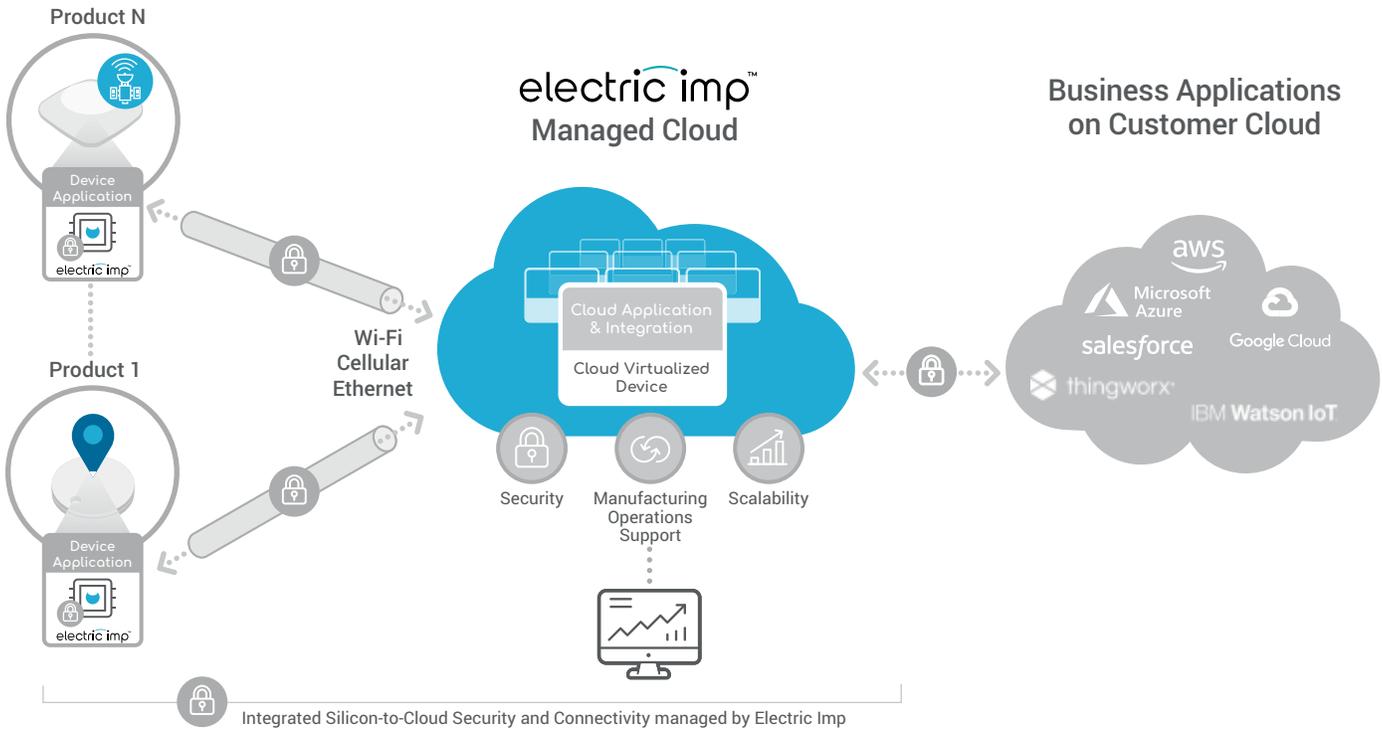## Connectivity Platform Benefits

A purpose-built connectivity platform can benefit enterprises developing different product lines spanning across multiple business groups. A common platform allows:

- Single development methodology around standard protocols enables multiple development teams to re-use common technologies

- Customizable functionality to support new use cases

- Edge device processing dramatically reduces business application development effort

- Platform managed security for entire product life cycle minimizes cybersecurity exposure

- Alleviate developers to focus on their business value that is best for their ROI

- Single platform to manage development, deployment, and maintenance for products reduces development and operating cost
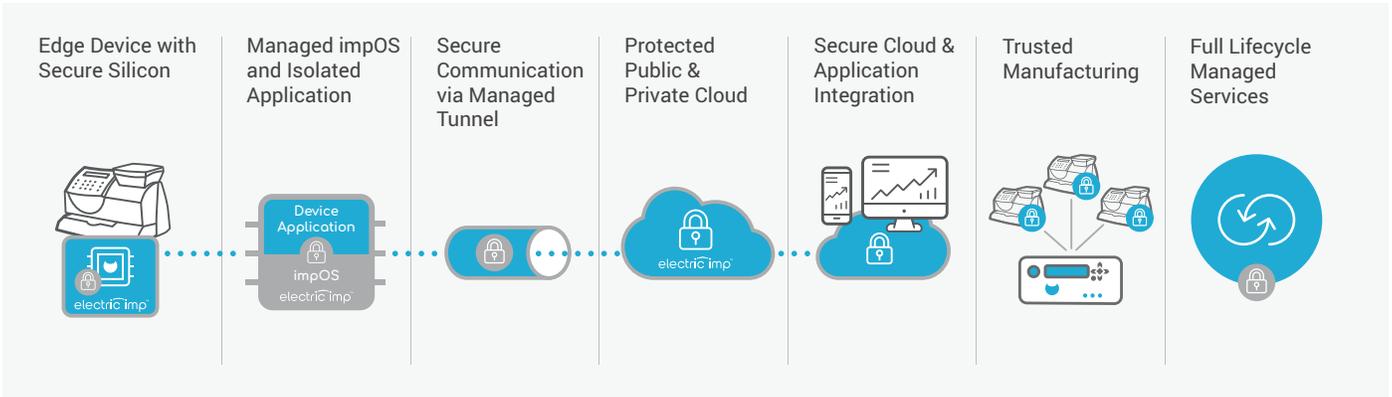
| Edge Device with Secure Silicon | Managed impOS and Isolated Application | Secure Communication via Managed Tunnel | Protected Public & Private Cloud | Secure Cloud & Application Integration | Trusted Manufacturing | Full Lifecycle Managed Services |

1st IoT platform to be independently certified to UL® 2900-2-2

To contain costs, an asset tracking system should be designed with TCO in mind. That is, the entire product life cycle starting from hardware design, to field deployment, and continued maintenance for devices in service must all be considered. Massive IoT deployments are only feasible when the TCO aligns with the ROI.

The comparison* below shows that the design of the Electric Imp platform and services enables customers to achieve significantly lower TCO when compared to Linux-based solutions.

Cost per Device	Electric Imp-based Solution	Linux Gateway-based Solution
Hardware cost	As low as $50 (optimized hardware design)	$500 or more (typ. industrial gateway)
Hardware installation cost	Minimal (pre-provisioned, can be battery-powered — typ. "power-on & go")	Typ. $100 or more (mounting, power, set-up/configuration)
Device services (connectivity service, device management, cloud integrations, software and security updates, and service maintenance) (over 10 years)	$360 (flat service fee)	Up to $2000 or more (full solution requires additional components, integrations, and services agreement(s), likely with multiple vendors)
Cellular cost (over 10 years)	$0 (included in service fee)	$1200 (assuming $10/month cellular plan that supports Linux updates and management)
Support effort	Low (reliable, scalable system, remotely managed)	Potentially high (complex system, often requires physical access to support)
Time-to-Market and Risk (security, technical, business)	Low (proven, fully-integrated solution, UL 2900-2 2 Cybersecurity certified)	Unknown, potentially high due to complex system with new components or custom development
TCO (over 10 years)	$410	Up to $3800 or more (+ risks)

Asset Tracking with Electric Imp

Whether indoor or outdoor, fixed location or mobile, a typical asset tracking system includes the following components:

- **RF tags** — typically for short distance tracking of assets within a building or structure. BLE (active) and RFID (passive) tags function as location beacons when attached to assets to be tracked in a facility, such as warehouses and production lines

- **RF readers** — BLE and RFID sensors that read tags are distributed throughout a facility to determine the distance between the sensor and an RF tag

- **GPS receivers** — for tracking assets that move long distances, GPS receivers determine the precise location of each asset

- **Operational sensors** — temperature and humidity sensors, accelerometers to indicate movement, vibration sensors to detect equipment stress, and other sensors provide specific data for specific cases

- **Cloud connectivity** — software and hardware that connect edge devices to the cloud

- **Business applications** — provide specific business services based on edge sensor data, such as locating equipment on a production line using RF tag information, or delivery logistics based on GPS location of a package

On-Premises Asset Tracking

Electric Imp provides all the components needed to seamlessly implement a securely-connected asset tracking system. In the edge device, the pre-approved imp004m module integrates Bluetooth Low Energy (BTLE) 4.1 and 802.11 b/g/n Wi-Fi radios and antenna. The module comes pre-programmed with latest impOS that supports latest Bluetooth APIs. Squirrel code libraries allows imp004m to be used as BLE tags or receiver nodes. Wi-Fi allows imp004m-enabled nodes to access the impCloud and connect with business applications. The imp004m can be built into dedicated units as well as ceiling lighting fixtures, smart lamps, wall outlets, and lighting switches deployed throughout a building as receiver nodes to track BLE beacons.

The highly integrated imp004m module provides ample compute resources for typical BLE reader use cases while enabling cost points feasible for large-scale deployments. These devices connect to the same impCloud services and are protected by impSecure integrated security. As it is developed on the Electric Imp platform, new features can easily be customized and deployed on installed or new devices.

Electric Imp BLE Asset Tracking
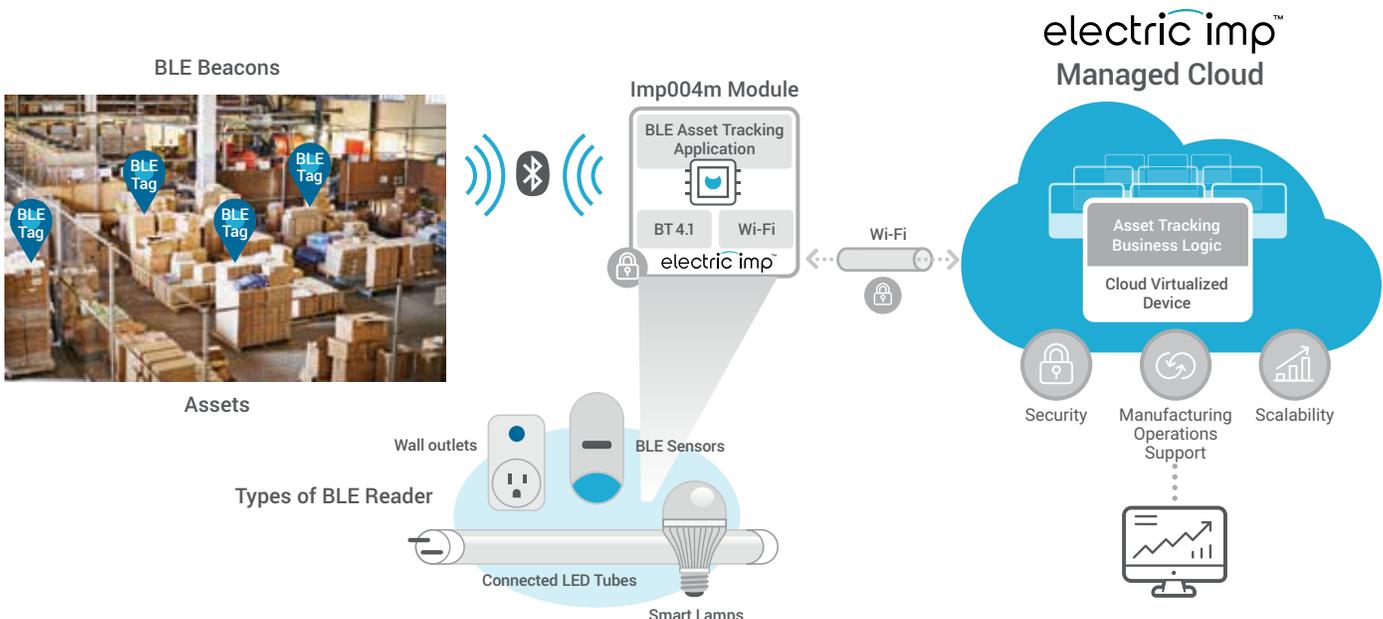
Long Distance Asset Tracking

To track assets that move long distances — such as those crossing the country in trucks — GPS trackers will send location data to the cloud via cellular. The impC001 cellular module integrates a microcontroller and wireless radio that supports LTE CAT-1 cellular connectivity with 3G backup. The impC001 can be paired with a GPS tracker to attain and send location coordinates in real time via the impCloud and to the business application.

In addition to the Electric Imp platform's features and services — impOS, impSecure, and impCloud — the impC001 comes with the impCellular service, which dramatically simplifies cellular IoT by eliminating the pain points of carrier selection, SIM subscriptions, and data plan negotiation. With impC001, GPS tracking can be easily implemented and integrated with other enterprise asset tracking applications. For more information on Electric Imp celluar IoT solution, go to https://www.electricimp.com/cellular/cellular-iot-reinvented/.

Electric Imp GPS Asset Tracking
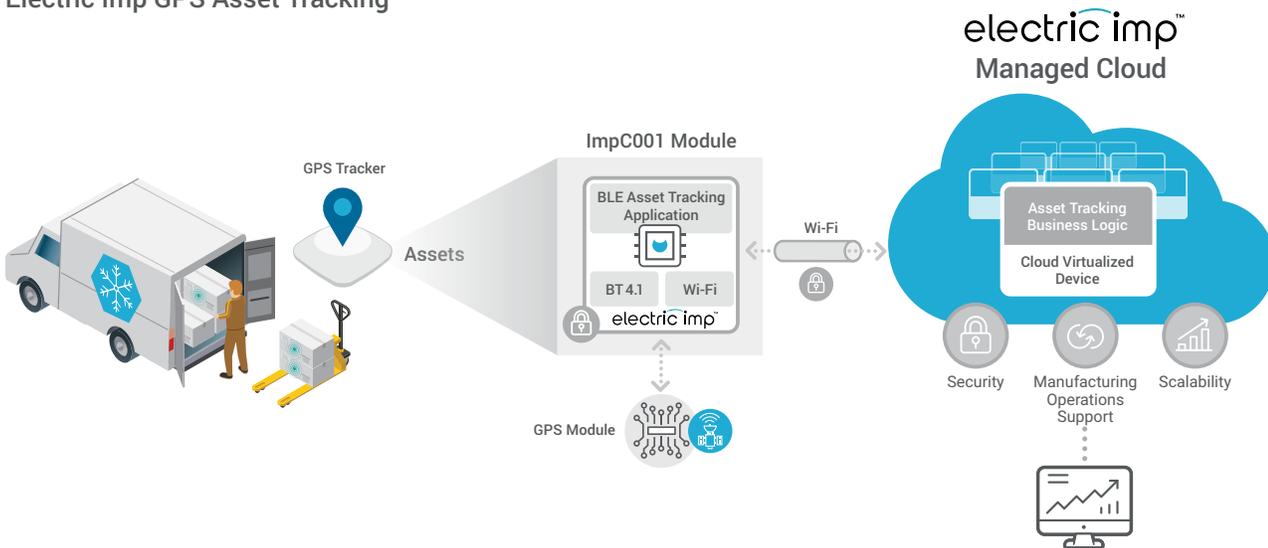
Conclusion

Asset tracking systems have proven extremely valuable, enabling enterprises to optimize operational efficiency, provide supply chain transparency, and maximize asset utilization. While asset tracking systems exist, they are often too expensive, vulnerable to security attacks, or not flexible to address changing or highly customized use cases in the IoT era. The Electric Imp IoT Connectivity Platform is ideal for building asset tracking solutions that meet companies' most demanding requirements, can adapt to changing needs, and are secure. Its purpose-built impOS and pre-approved hardware modules provide ample processing resources for the edge device at cost points necessary for mass deployment. Proven Bluetooth and GPS libraries can be easily integrated into new tracking systems. Combined with UL 2900-2-2 cybersecurity certified impCloud connectivity service, manufacturers can seamlessly tackle the challenges and capitalize on the opportunities that IoT brings.

Additional information about Electric Imp platform can be found at:

https://www.electricimp.com/platform/security/

https://www.electricimp.com/raising-the-bar-on-security-of-mass-scale-iot/

*   For illustration purposes only. Estimated values based on industry data points and realistic product deployments.

1   National Wooden Pallet and Container Association

2   Statistics from www.truckinginfo.net

3   Mobile asset management in the hospital: An in-depth discussion with GE Healthcare by David Williams featuring interview with John McCarthy, GE Healthcare's GM of Asset Management Professional Services

4   The Seven Properties of Highly Secure Devices by Galen Hunt, George Letey, and Edmund B. Nightingale, Microsoft Research NExT Operating Systems Technologies Group. www.microsoft.com/en-us/research/wp-content/uploads/2017/03/SevenPropertiesofHighlySecureDevices.pdf

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