

The background of the entire page is a close-up, top-down view of several circular smart meters mounted on a textured wall. Each meter has a digital display showing a number (e.g., 00002638, 00358013, 00079022, 17004932, 00070093, 589) and a barcode. Some meters also have analog dials.

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*Some IoT use cases that*

# CHANGED THE WORLD

*– and some that will*

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Editor, Enterprise IoT Insights

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### Introduction

Was there ever a tech movement more-hyped than IoT? Maybe, maybe not. But for all its world-changing promise, it has proved harder to justify IoT deployments – and importantly, to scale IoT deployments – than it was supposed to be. At the same time, the market has established a number of reference use cases as no-brainer gateway IoT investments for enterprises, including as platforms for wider-reaching smart systems. This report considers some of these – from smart lighting, to smart metering, to smart maintenance, to smart environmental monitoring, and more – and considers the hard and soft return-on-investment calculations in each case. According to many voices in the industry, the hard ROI benefits of advanced metering infrastructure (AMI) and smart street lighting technology are pretty clear. Those voices highlight that utilities and cities should

expect to gain operational savings from automating meter data collection, reduced truck rolls, improved billing accuracy, improved asset management and non-technical loss reduction.

While the intangible societal benefits of AMI and smart lighting are harder to quantify, benefits such as increased equity and access to services, improved customer engagement, reduced carbon footprint, increased safety and expanded economic development opportunities can be expected when cities and utilities adopt these IoT-based use cases.

To know more about the specific details of the already well-established IoT use cases, and the ones that will emerge in the future and that still needs to show the clear benefits of such implementations, Enterprise IoT Insights interviewed analysts, representatives of tech providers as well as customers already implementing some of the use cases.

### Smart lighting

Smart lighting seems to be one of the most established use cases in the IoT space. Moreover, these IoT-based systems are also being used as a platform for the provision of additional IoT applications. According to Nاديم Abdulrahim, global public services scientist at Huawei Enterprise Business Group, turning lighting poles into multi-functional smart poles with the aim of providing many IoT-based services initially requires a communication backbone connecting this infrastructure. “Thereafter, many IoT sensors can be added like micro base station, environmental monitoring, Wi-Fi, video surveillance, digital signage, emergency call/public broadcast, intelligent power distribution, ITS sensors, EV chargers, smart mobility as well as linkage to nearby devices like waste management and irrigation management,” Abdulrahim said.

According to Marcia Walker, research director for the Internet of Things (IoT)



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**Greg Corlis, Principal, Emerging Technologies, KPMG U.S.**

program at consultancy firm IDC, smart street lighting is key to improving municipal operational costs, citizen safety and road infrastructure management. “Benefits include lower power consumption through LED lighting, intelligent dimming and reduced field maintenance. Valuable uses are being utilized including signaling lights to indicate road conditions (e.g., blinking) or emergency public safety (e.g., flashing red), which are available to operators through management software. These systems can be interfaced with enterprise systems including traffic management, emergency response systems/911, weather, and other data feeds,” Walker said.

Twilight, a Dutch provider of smart

lighting solutions, said it had installed 22,000 smart streetlights in the German city of Dortmund as of mid-2022, in a project aimed to help Dortmund improve energy efficiency, increase public safety, reduce CO2 emissions, and lower maintenance costs. The project covers main roads, secondary roads, residential streets and parking lots across the German city.

As part of this project, Twilight installed smart wireless street light controllers and its CityManager light management system to enable the system operators to monitor, manage and control the entire public lighting infrastructure remotely. Also, automatic fault alerts/notifications help turn expensive reactive maintenance to effective and economical proactive maintenance, Twilight said, adding that the light management system helps pinpoint where and what type of failure has occurred to enable the maintenance crew to arrive at the right location and perform the repairs swiftly. This, in turn, reduces unplanned night patrols, and ultimately the maintenance costs, the Dutch firm said.

Twilight also noted that its smart street lighting solution offers precise control over the street lights, enabling the city of Dortmund to provide adequate illumination that boosts both citizen safety and traffic safety. A motion-sensor-based, light-on-demand system will be used at selected locations in the city to enhance the public’s need for safety. According to the European company, the smart street light solution deployed in Dortmund saves over 50% in terms of energy consumption, and it prevented over 710 tons of CO2 during the first half of 2022 through smart switching and dimming.

“Studies [related to smart lighting projects] I have seen are around 45% savings

on energy (...) What I see initially is the energy savings as the primary use case with the addition of convenience for remote control, labor savings as well as replacement of basement generators with battery packs as extra pluses later, said Greg Corlis, principal, emerging technologies at KPMG U.S.

Meanwhile, Pavel Zaitsau, director of marketing, solutions and partner ecosystem at Actility, explained some of the benefits of the smart lighting use case with an example of a recent deployment in which the French firm took part. “The project will cover 200 square kilometers and provides smart street lighting to more than 1.3 million people, improving community and road safety, and reducing carbon emissions by up to 80%. NNN-Co, Wellness TechGroup, Actility and their partners will replace [Uruguay’s capital] Montevideo’s existing lighting system with LED technology and roll out an interoperable remote management system, which is designed to reduce carbon emissions by 31,500 tons of CO2 per year. The project will also improve the quality of public lighting services and provide greater efficiency and operations management to the whole city. Another point is reducing light pollution,” Zaitsau said.

“The direct benefit [of smart street light deployments] is seen in lower maintenance costs, notably in terms of truck roll reductions. Indirect benefits are seen in improved security for citizens, and additional services such as air quality monitoring, barometric, humidity, or temperature sensing. Smart connected street lighting can even be used as a local mesh network, acting as a relay, connecting cities and states,” said Jeremy Gosteau, senior director of IoT



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*Jeremy Gosteau, Senior Director, IoT Product Marketing 4G and 5G at Sequans Communications*

product marketing for 4G and 5G at Sequans Communications.

Gosteau added that cities with smart street light networks can add on various additional sensors with little additional cost and bring new services to a city's local area network for things like monitoring of garbage collection, parking availability, or

air quality to improve city services or enhance the quality of life of residents.

"Smart street lighting is an anchor for smart cities and provides a flexible high-performance city-wide mesh network and a city-wide management software platform. Itron has 4 million streetlights controlled by its CMS software – Streetlight.Vision (SLV), and the world's largest streetlight deployment at Florida Power and Light. Depending on a city's needs and drivers, we have a technology platform, which serves as the foundation for a connected city that provides energy and water savings, improves safety and security, delivers traffic and parking solutions and helps cities deliver their communities advanced urban digital services," said Dan Evans, director of smart cities at Itron. Commenting on the savings generated through the deployment of smart lighting projects, Evans said that the city of Chicago would see energy savings of \$100 million with its smart

lighting project over a period of ten years, while the city of Glasgow, in Scotland, will obtain 60% energy savings through the deployment of smart streetlights.

"Tampa Electric Co. is seeing annual operations and maintenance reduction of \$2 million from smart streetlights," Evans added.

Smart metering / energy

There is no doubt that another well-established IoT use case is smart metering, where smart meters are deployed with the aim of recording information such as consumption of electric energy, natural gas or water. Smart meters communicate the information to the consumer for greater clarity of consumption behavior and service providers for system monitoring and customer billing.

Marco Stracuzzi, head of product marketing at Telit, noted that smart metering currently represents a key market for the company in terms of revenue. The

## **Connected street lighting market to reach \$8.74 billion by 2027**

The connected street lighting market was valued \$1.8 billion in 2021 and estimated to reach \$8.74 billion by 2027, growing at a CAGR of 29.6 % during the 2022-2027 period, according to a recent report by research firm MarketDigits. "Due to the connected LED's remote dimming, on/off capability, and lower power requirement, connected street lighting systems often save 25% of energy. This improves energy efficiency through effective management," the report states.

"By accelerating the deployment of smart lighting, Europe will take the lead. Europe rules the

global market for linked street lighting system technologies. In Europe, a number of lighting organizations are putting forth a lot of effort to put in place smart lighting controls in both the public and private sectors. North America is expected to grow at an outstanding CAGR during the projection period. Energy laws and regulations are being implemented in North America to regulate energy use, encouraging the use and advancement of smart lighting technologies in the region."

executive highlighted that besides utility meters, for automatic reading of electricity, water and gas consumption, the energy segment also covers smart grid applications – like gateways to connect secondary stations in the distribution network. “The other sub-segment is renewables, like solar panel inverters, which are normally connected with cellular for monitoring and remote control,” said Stracuzzi.

He also pointed out that electricity meters usually run on LTE-M or NB-IoT technologies, while water and gas meters mostly run on NB-IoT, as they are battery operated. “But there are differences in the tech options, based on the region. The LPWAN technology often depends on regional deployments. In the U.S., LTE-M is very popular; in Europe, there is more fragmentation, with some projects on Cat-1 even if they don’t need Cat-1 performance, because it is the only technology available nationwide. But for gas and water, NB-IoT is quite well deployed in Europe and is a good technology for those projects,” Stracuzzi added.

“With regards to metering as-a-platform, all utilities have plans to offer more services through their meters. There are a few cases where these services are already being delivered, and a few requests to put more intelligence inside the modules. But it is mostly a vision for the future. Current projects are not really architected that way,” he continued.

According to Abdulrahim of Huawei, smart metering integrates smart energy meters, communication networks and data management. This IoT use case enables utilities to carry out real-time consumption reading, accurate invoicing, load planning and forecasting as well as save time and



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*Marco Stracuzzi, Head of Product Marketing, Telit*

reduce workforce. Smart metering also allows utilities to detect fraud and tamper and carry out preventive and corrective maintenance scheduling, he added.

“The ROI is coming mainly from gains of productivity as well as gains in terms of security/safety. Introducing sensors allows the replacement of repetitive manual tasks with automation, which directly reduces the cost of workforce. It also makes the work more efficient, based on real-time data analytics. The maintenance becomes more efficient and less costly,” said Actility’s Zaitsau.



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The Actility executive noted that metering enables utility companies, cities, municipalities, buildings and industrial sites to improve the performance of their water, gas and electricity distribution systems, as well as reduce infrastructure investment and operating costs by implementing automated consumption monitoring, metering, and leakage detection.

“On the other side, the soft ROI is coming from improved safety and security of people and assets,” Zaitsau added

Evans of Itron noted that smart metering

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solutions give cities and utilities the ability to access real-time and actionable data on a unified platform, which leads to more informed decisions, quicker response times and more efficient operations and also leaves room for additional Distributed Intelligence (DI) applications over time. “A perfect example of this is Tampa Electric Company (TEC). TEC is realizing operational savings, understanding the state of their distribution system and applying corrective actions where and when needed with AMI operations. After partnering with Itron to install smart streetlights and 200,000 DI-enabled smart meters, TEC gained valuable, real-time data for revenue protection and customer safety that the utility didn’t have before. As part of the full population rollout, TEC now has over 800,000 DI-enabled smart meters with nearly 720,000 of them running grid-edge applications,” Evans said.

“TEC now has the resources to focus on more high-value work while moving low-value repetitive work to new workflow automation. The utility has experienced an immediate return on investment with a number of benefits including over 97% successful installation success rate, over 425,000 truck rolls saved and over 9,000 post-installations managed and resolved in AMI operations,” Evans added.

According to Corlis of KPMG, smart metering will have a resurgence as utility providers have to upgrade their existing AMI infrastructure. “These upgrades will improve efficiency as well as increase security of the energy grid,” Corlis said.

Corlis also noted that the deployment of smart metering solutions enables a cut in labor cost due to no need for readings as well as leak detection and remote shutoff.



The analyst also noted that a recent study carried out in Austin, Texas, showed that some properties experienced water savings of 20-30% after the first year of installation.

Sequan’s Gosteau said that the utilities sector is also moving towards cellular IoT because of its ubiquity, and because it is reasonably priced and low in power consumption. “An increasing number of utilities providers today are deploying smart meters for monitoring either the consumption, or the network, or both, resulting in significant operational gain. The entire smart meter value chain—chipset vendor, module maker, connectivity supplier, communication unit maker, meter and utility—is well established, and the business case well known,” he said.

“Smart metering brings value to utilities providers on many levels. First and most well-known is the cost saving enabled by no longer needing to send out meter readers, and making the data collected readily uploaded to the cloud so that the utility can access it and bill accordingly. Additional applications can be offered via cloud access that brings a unified view to utilities companies, and this is where the expertise of the smart meter vendor brings differentiation. One can monitor an entire grid, for example, and take actions when an abnormality is detected such as increasing the frequency of meter reading for better grid monitoring upon an unexpected event, or closing a valve in the gas distribution system when a leak is detected or

an earthquake is anticipated. These additional benefits help improve the network's reliability, providing indirect mid- and long-term cost saving in maintenance and security," Gosteau added.

In the ROI calculation, Gosteau pointed out that once an IoT technology is adopted for a smart metering project, utilities need to think of the longevity of the adopted solution in order to limit potentially high maintenance costs and added that the connectivity choice, and the cellular network operator, must be carefully assessed.

### Security

IoT-based smart security systems combine sophisticated technology to protect residents and critical assets. These systems include connected devices, sensors, video technology, artificial intelligence, advanced software and analytics, networks and IoT-based alarm systems. The deployment of IoT-based smart surveillance systems enable companies and people to use live video surveillance to see who enters and leaves a premise and then store and analyze the data for asset tracking and detection. These systems also enable organizations to monitor conditions remotely with Wi-Fi or cellular connectivity, ensuring that facilities are secure — without on-site personnel and to deliver security alerts to mobile devices, enabling action based on real-time information.

With real-time remote monitoring and control, facility managers can know and adjust the facility's condition and they also could determine if an alarm has been triggered by an accident or threat without law enforcement or an in-person inspection. Real-time alerts and comprehensive visibility help business owners and facility

managers identify risks and improve security processes by collecting and analyzing data from connected devices.

Stracuzzi of Telit noted that home and business security— alarm panels and surveillance cameras, covering all the alarm systems in houses and other buildings, and also CCTV systems in offices and cities represents a relevant sector for the firm in terms of revenue generation. "They benefit from cellular — because it is an easy installation, which does not require setup with a home router, or Wi-Fi network. The module with the SIM connects straight to the network, and, unlike Wi-Fi and fiber, is resilient to power outages on the grounds they typically come with a backup battery — so the alarm panel can still send its alarm," he said.

"Alarm panels, which just need to send an alarm in the event of an intrusion, can use LPWA technologies. LTE-M is very popular in North America. In Europe it tends to be LTE-M with 2G fallback, to guarantee coverage. If the panel needs to establish an emergency voice call to a call center,

then you need Cat-1. With CCTV cameras, you need to transmit media, so you need Cat-1 or even Cat-4 — for better throughput, depending on the quality of the video required," Stracuzzi added.

"Thieves can easily jam the cellular transmission of a GPS tracker but they cannot detect and jam a LoRaWAN tracker. This opened up a great B2C use case we are currently exploiting with Roole, the biggest automobile club in France. They offer Abeeway trackers as part of their Wetrak antitheft service," said Zaitsau of Actility.

German company Bosch has highlighted the case of a manufacturer of basic food ingredients that ships deliveries of goods in containers from production sites in Latin-America to customers in global markets. "A problem of such supply chains is that these are desired targets for thefts and smuggler[s]: They open containers and either steal the content[s] or hide drugs inside. This result[s] in ... huge material and immaterial damage, like a reduction of reputation or trust in people, companies or a





whole supply chain,” the German firm said.

As a result of the customer’s needs, Bosch designed a complete IoT-based security system that monitors the transportation of goods worldwide. To guarantee a high security level, Bosch used complex sensors for monitoring doors, lights, vibrations, tilt angles, accelerations, as well as temperature and humidity values. Determined data will be evaluated in a highly resilient control center network featuring redundant security measures.

“With the combination of sensors, software and services, we created a high quality security system that secures transported goods valued at approximately 58 million euros annually. Our fast detection of tempering prevents far-reaching consequential damage, deters criminals, minimizes negative financial impacts and enhances the customer’s reputation. We prevent drug smuggling in the multi-million euro zone each year and the customer reputation has been enhanced with the customs authorities,” Bosch said.

Gosteau of Sequans noted that the security use case has expanded lately and has been highlighted by the recent pandemic that has increased the urge of people to live more safely. “The progress in machine learning algorithms that enable, for example, face detection, has contributed to making indoor and outdoor security cameras a trusted source of information,” Gosteau said.

“Today, smart city applications include those that can literally save lives. For example, in Annapolis, Maryland, local law enforcement worked with the regional utility to install gunshot detection sensors in areas with high criminal activity. By operating on the intelligent utility network, the

sensors can use advanced technology to detect the occurrence of the event (while filtering out false alarms, e.g. fireworks), the exact location of the incident, the type of gun used and a video recording of the event for police records. Most importantly, gunshot detection sensors can immediately dispatch police to the area for potential life-saving intervention,” Evans said.

### Telematics / fleet management

“There are many use cases around telematics. Stolen vehicle tracking and recovery is a good example – so, systems to detect if a car has been stolen, to locate the car, and even possibly to lock the car in the event it has been stolen. It works very like find-my-phone apps, just for your car. Which is great value, not just for private users, but for car dealers to protect their fleet,” said Stracuzzi of Telit. “And it must be cellular – because you need a technology that is wireless, and also mobile – which connects wherever the vehicle goes. Usually these

telematics boxes attach to the vehicle battery, so they are not necessarily LPWA – because you don’t have problems with power. But they don’t send much data – usually just small alert messages – so you don’t need high speed cellular, either. Which means LPWA works, less because of the power profile, and more because you need cost optimized hardware, and you don’t really need such high speeds.”

Stracuzzi also noted that the after-market telematics segment includes many different applications, including stolen vehicle tracking, stolen vehicle recovery and continuous tracking for fleet management. It also covers real-time monitoring of batteries, which applies to scooter and bike sharing, but can also be applicable to electric vehicles – to connect over cellular to monitor the charge or health of a battery. “For positioning, you normally have satellite positioning next to the cellular data communication. Most of the cellular modules we sell into this space embed satellite





“Access to real-time data and onboard connectivity is helping enterprises boost profits while unlocking new levels of efficiency, sustainability, and safety in online fleet management. As we shift the industry into a new gear, this use case serves as a key indicator of the benefits of leveraging real-time data.”

**Markku Moilanen, IoT Product Marketing Director, Ericsson**

positioning in the same single module. Cellular and GPS are always there; there are a few cases where you may also have Wi-Fi – for example to allow some in-vehicle services, for a connection to other Wi-Fi devices inside the vehicle, where the modem operates as a gateway to the internet. But it is not the most popular,” Stracuzzi added.

According to Verizon, a telematics system includes a vehicle tracking device installed in a vehicle that allows the sending, receiving and storing of telemetry data. It connects via the vehicle’s own onboard diagnostics (OBDII) or CAN-BUS port with a SIM card, and an onboard modem enables

communication through a wireless network. The device collects GPS data as well as an array of other vehicle-specific data and transmits it via GPRS (General Packet Radio Service), 4G mobile data and cellular network or satellite communication to a centralized server. The server interprets the data and enables it to be displayed for end users via secure websites and apps optimized for smartphones and tablets.

The telematics data captured can include location, speed, idling time, harsh acceleration or braking, fuel consumption, vehicle faults, and more. When analyzed for particular events and patterns, this information can provide in-depth insights across an entire fleet, according to Verizon.

“This use case allows to precisely know the vehicle and equipment location in order to reduce their search time and save money on all operations. It also determines usage rates and facilitates the analysis of unavailability and retention rates. Fleet tracking solutions improve ROI through reduced inventory loss, improved productivity, enhanced safety and theft recovery. Better utilization of vehicles can optimize fleet size, saving on maintenance, operating and replacement costs,” said Zaitsau of Actility.

“Access to real-time data and onboard connectivity is helping enterprises boost profits while unlocking new levels of efficiency, sustainability, and safety in online fleet management. We collaborated with Orange Belgium and ZF to look at their asset tracking and operational management improvements, to create more efficient and cost-effective processes and safer, eco-friendly driving behaviors internationally. As we shift the industry into a new gear, this use case serves as a key indicator of the benefits of leveraging real-time

data,” said Markku Moilanen, IoT product marketing director at Ericsson.

Moilanen added that Ericsson is seeing cellular IoT connections growing double-digit annually across industries. “This growth is driven by demand for connectivity management of vehicles, telematics and software updates in automotive, real-time monitoring and tracking as well as optimization of connected fleets in transport and logistics,” he said.

### Tracking / Supply chain

Jeff Eltringham, head of marketing at SmartSense by Digi, believes that IoT and the supply chain today go hand in hand, adding that logistics tracking is one of the most prevalent IoT sectors. According to the executive, IoT supply chain technology can help managers from manufacturing to transport and delivery to monitor logistics and ultimately prevent bottlenecks in critical supply chain networks.

“Using IoT in supply chain management allows logistics partners to collect and use data for better inventory management, transportation and incident response. These capabilities set the stage for using machine learning models to create advanced, responsive supply management solutions that predict bottlenecks, save time and money and speed incident response,” Eltringham said in a blog post.

“Deploying IoT devices across different parts of the supply chain — from manufacturing plant floors to transportation and distribution center inventory systems — offers visibility and data collection. Connecting these devices to IoT device management platforms centralizes that visibility and delivers real-time insights where they’re needed most,” Eltringham added.

“There is no other technology that can guarantee you global tracking of shipments like cellular – because the vaccine will be in trucks, airports, ports, ships. You can’t track with Wi-Fi or Bluetooth, for example,” said Telit’s Stracuzzi. “You have to always sell connectivity independently of the country where the asset is moving around. So with LTE-M you may find places where you don’t have LTE-M coverage yet; the same with NB-IoT. In these cases you have two options – fallback to legacy technologies like 2G, or future-proofed technology like Cat-1, available wherever you have an LTE network. NB-IoT and LTE-M are specific technologies that must be deployed by each operator in each country,” Stracuzzi added.

“Everything from the COVID-19 pandemic to global instability has taught companies the hard way that supply chains are vulnerable to disruption from a number of factors. More visibility, along with more transparency, security and redundancies, are all top of mind. Leveraging IoT, we’ve seen that supply chains can be more efficient and resilient,” said Moilanen, of Ericsson.

Moilanen noted that a clear example of this use case is Ericsson’s recent collaboration with cold-chain management company DeltaTrak and Deutsche Telekom, where the Swedish vendor provided global tracking and monitoring for perishable food and biopharmaceutical products. “We’ve supported by eliminating blind spots and allowing goods to be monitored from origin to destination. This in turn will also help the environment,” he said.

The Ericsson executive also noted that IoT is continuously growing and expanding to encompass new industry verticals and application areas. Asset tracking and smart



maintenance can certainly unlock new and critical capabilities enabled by IoT. This includes real-time data tracking and remote monitoring to predictive maintenance.

“These are functions that can be applied to other use cases across industries such as manufacturing, maritime and ports, utilities and more,” he said.

### ***IoT devices for cold chain tracking to reach 9.2 million by 2026***

The number of active IoT devices for cold chain tracking reached 4.1 million worldwide in 2021, according to Swedish consultancy firm Berg Insight. The calculation measures refrigerated cargo and cargo carrying units, including trailers, intermodal containers, rail freight wagons, air cargo containers, cargo boxes and pallets. The figure will rise at a compound annual rate of 17.4%, to reach 9.2 million by 2026, it said.

The total market value for cold chain tracking solutions reached 720 million euros in 2021, reckons Berg. It will reach 1.2 billion euros in 2026, it forecasts, with CAGR pegged at 11.4% in the period. The report says tracking devices for general refrigerated cargo applications is the largest market for cold-chain solutions today, followed

by refrigerated intermodal containers and trailers. Tracking solutions for refrigerated rail freight wagons and air cargo containers are “considerably smaller”, it notes.

Martin Backman, senior analyst at Berg Insight, commented: “The logistics industry is currently undergoing a major transformation. Accelerated by the supply chain disruptions following the Covid-19 pandemic, the industry is now investing heavily in digital solutions that will increase visibility and security in the supply chain. Cold chain tracking solutions provide significant value for shippers and logistics providers by providing real-time data on the location and condition of temperature-sensitive cargo in-transit.”



“Asset tracking, while well-understood, is a business case that still has significant room for improvement. We were expecting years ago to see an exponential growth in the adoption of cellular technology in this sub-segment, but this has yet to take place. An explanation for this delay can be found in the lack of business case maturity where certain key questions remain unanswered. For example, how can one monetize the benefits of tracking assets, and who is paying for what in the value chain,” Sequan’s Gosteau said. “A recent increase in the loss of inventory witnessed by various large brands is expected to accelerate the adoption of better monitoring and tracking systems for goods,” he added.

### Smart agriculture

Smart agriculture uses IoT sensors to connect everything from irrigation systems to soil and animal production. This use case seeks to maximize food production by providing farmers with all the necessary data to adopt good business decisions. Connected ag-tech solutions help farms to reduce the consumption of water, fertilizer and pesticides, to minimize soil erosion as well as add efficiency into overall operations.

Farms can use IoT technology to track the status of their crops. Sensors can monitor soil, collecting data about its temperature, moisture and fertility. These sensors can also detect weed growth, water levels and pest invasion, among other relevant information. Additionally, farms can gain a better understanding of their crops’ growth and monitor potential threats. Through the deployment of weather sensors, enabled by IoT technology, farms can eliminate climate surprises and plan accordingly.

Also, autonomous farm technology can have a major effect on human manpower requirements for farms. Machines such as self-driving tractors, robot seed planters and agricultural drones can save countless hours of labor for individual farmers and eliminate human error.

Earlier this year, Vodafone Business announced that it was piloting a new service with the aim of achieving the digitization of farming across Europe by providing farmers with a mobile app linked to agricultural IoT sensors.

Five European pilot farms in Germany, Ireland, Italy and Spain are currently testing the service, dubbed MyFarmWeb, which is already being used by 7,200 farmers in the

United States, South Africa, Australia and New Zealand. Vodafone explained that the MyFarmWeb cloud-based platform allows farmers to store, visualize and view information gathered via agricultural IoT sensors and other data sources in the field. The platform collects farm data to support decision making for better soil and crop health, effective water use, and precision fertilizer and pesticide application. This helps improve farm productivity and optimizes farming practices and as a result can reduce greenhouse gasses, Vodafone said.

“Another [use case] is smart agriculture. Connecting sensors and also heavy equipment for agriculture, like tractors and connecting them with cellular to increase the automation of everything that is related to agriculture. It is another ambition. This is another sector that is predicted for growth,” said Telit’s Stracuzzi.

“Smart agriculture is the great unknown and the one that offers the greatest margin for competitive improvement with the application of the IoT. It is a still very traditional sector that needs to clearly see the return on investment before embarking on digitizing and optimizing its processes. And it is something that, as a planet, also



“Smart agriculture is the great unknown and the one that offers the greatest margin for competitive improvement with the application of the IoT. It is a still very traditional sector that needs to clearly see the return on investment before embarking on digitizing and optimizing its processes.”

*Alicia Asin, CEO of Libelium*

urges us. Nearly half of the world’s farmland is used to produce animal feed. And that’s without counting the increase in arable land dedicated to biofuel. It is estimated that 4% of the world’s agricultural land is used for the production of biofuels. It is urgent to be more efficient with the arable land that we have for food production, and we can only achieve this through technology that allows us to know the use and return of each inch of land,” said Alicia Asin, CEO of Spanish IoT firm Libelium.



### Smart buildings

In the commercial real estate market, the deployment of IoT devices can enable the measurement of different parameters like temperature, humidity, indoor air quality, occupancy, pathogens and lighting on a continuous basis and transmit that information to a central core to make decisions enabling comfort, productivity, convenience to its occupants and also financial savings to the landlords. IoT can help with predictive maintenance avoiding the need for unplanned downtime for its occupants due to maintenance issues. The implementation of IoT technology can also help in reducing energy usage in the building by monitoring ambient light, temperature, and occupancy and autonomously adjusting lighting and temperature.

According to Moilanen of Ericsson, smart buildings can help address major challenges impacting the property sector, driven by urbanization, environmental concerns

and digital services demand. The executive noted that the property sector faces serious challenges around energy usage and management. He highlighted that 36% of CO2 emissions come from buildings, which account for 40% of energy use, and 75% of all buildings are wasting much of that energy due to several factors. “With the help of IoT, energy optimization is rapidly becoming one of the most efficient ways to reduce energy use, and as a result, increase property value and reduce CO2 emissions,” Moilanen said.

He added that a recent study carried out by Ericsson showed that the implementation of IoT in smart buildings had the potential to decrease annual energy costs by 10% and CO2 emissions by 9%, while increasing property value. “Cellular IoT connectivity can be seen as a foundational technology to empower smart buildings and energy optimization, providing secure, ubiquitous coverage for transmitting data

to and from sensors throughout indoor and outdoor environments. And as the use case analysis demonstrates, the financial benefits can be substantial," he added.

According to Owen Kell, senior researcher at smart building consultancy firm Memoori Research, IoT technology is already making a significant positive contribution to the efficiency, safety, comfort and health outcomes of properties. "IoT



"IoT sensor technologies offer the opportunity to gather and analyze building user and building systems utilization data at a more granular level in real-time or near real-time. The degree of sophistication of IoT solutions in the sector is varied, with most organizations still at the early stages of their IoT adoption journey, focused primarily on applications centered on operational cost savings."

*Owen Kell, Senior Researcher, Memoori Research*

sensor technologies offer the opportunity to gather and analyze building user and building systems utilization data at a more granular level in real-time or near real-time. The degree of sophistication of IoT solutions in the sector is varied, with most organizations still at the early stages of their IoT adoption journey, focused primarily on applications centered on operational cost savings, while more forward-thinking organizations are going further, and using the IoT to develop services that optimize their operations and provide new means for market differentiation," Kell said.

"Over the next few years we will see a big push in smart building technologies that will support sustainability reporting. As sustainability regulation starts to become more common, property owners and operators will be required to report on building emissions for their tenants at the same time reducing operating expenses for the property. 40% of global emissions are caused by buildings and real estate. The reporting requirements cannot be delivered without IoT solutions," said Corlis of KPMG.

According to Kevin Kinkaid, technology director at Grosvenor Group, IoT technologies provide the ability for building operators not only to get an insight for how their buildings are used, but also to respond in real or near real-time. "For example, IoT can integrate with buildings' systems and automatically optimize lighting and air conditioning based on occupancy data in particular parts of the building, not only providing a healthier environment but also reducing operational costs and reducing carbon emissions. The continuous monitoring of IoT sensors allows data to be constantly collected, which in turn allows predictive analytics to preempt maintenance

and repair, or detecting a leak and automatically notifying an engineer," Kinkaid had said.

To understand how IoT sensors can improve efficiencies in buildings, we can mention the case of Beyond Eyes, a brand initiated by Heijmans, a major Dutch construction-services business. The firm has already deployed over 20,000 LoRaWAN-connected IoT sensors for Heijmans' clients in the Netherlands, as part of their smart building concept. Beyond Eyes uses wireless sensors to collect anonymous data on



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## *IoT in smart buildings to reach \$93 billion by 2027*

The Internet of Things in Smart Buildings (BloT) market recovery through 2021 was healthy, growing 21% to rise above the 2019 market total, at just over \$47 billion, according to a report by smart buildings consultancy firm Memoori.

“We forecast that the market will continue to grow at a healthy 12% CAGR, rising from \$47.07 billion in 2021 to a forecasted \$92.88 billion by 2027. Our latest forecast sees the number of connected IoT devices installed in commercial smart buildings grow at a healthy 11.1% CAGR for the forecast period, rising from an estimated 1.264 billion in 2021 to over 2.5 billion by 2027,” according to Memoori.

“The competitive landscape for BloT remains incredibly complex and varied. The level of fragmentation we continue to observe in the market can act as a source of confusion and frustration for buyers, with many vendors of point solutions and platforms vying for attention. Leading platform solution providers are beginning to emerge, however, and the user base seems likely to coalesce around a more limited number of platform providers, with those unable to maintain a sustainable user base being forced to merge or withdraw from the market,” Memoori said.

a building’s utilization, occupation, usage and indoor environment. Each of these sensors, which can be mounted under desks, walls, and ceilings, have a unique ID number and are wirelessly connected to a software system, using a LoRaWAN



network. The collected anonymous data is then sent to the cloud where it can be analyzed and visualized via an online platform. The firm also noted that the sensors constantly measure activities and circumstances important for office locations, such as space occupation, air quality, temperature, CO2 levels, light intensity, humidity and noise level.

### **Emerging use cases in the IoT field**

The analysts and executives interviewed for this report also described some emerging IoT use cases that still need to define specific business models with clear ROI schemes in order to gain market traction in the future. One of these emerging use cases is vending/retail. “Most vending machines are connected with cellular for different requirements – to ensure payments, to push advertisements on the big screens to drive sales, to monitor the status of the machine to know when to refill snacks or

whatever,” said Stracuzzi of Telit. “LPWA technologies like Cat-M are good. 2G fallback is always nice to have because you are not sure you have LPWA technologies available everywhere yet. For advertising, NB-IoT works for this type of real-time interaction; LTE-M works as well. Otherwise it has to be Cat-1,” he said.

Stracuzzi also noted that EV charging and industrial automation are also examples of an IoT use case that needs to develop further. “Some verticals are promising, even if they haven’t taken off yet. Industry 4.0, or smart manufacturing, is an example of that – which is about using wireless cellular technologies, mostly in private network environments, to replace wires. Today, factories are all connected with wires – all the machines in the production line are wired. And it is very complex to make any change, because everything is wired. The ambition with a smart factory says all the machines on the production line, plus some robots

and AGVs, are all wirelessly connected. Private 5G is getting a lot of interest, even if it is not something that is well deployed today. It is more of a growth segment," the Telit executive added.

"Payment—with ATM[s], but mostly with [point of sale devices]—is an evolving market, with new players bringing additional services to the vendor and the end customer. Using cellular technology, these systems usually facilitate quicker transactions, a centralized payment system for smoother revenue monitoring, paperless billing, and more ubiquitous usage. Also, the eHealth and well-being market is quickly expanding to optimize the cost of health-care by improving prevention through remote patient monitoring, or by facilitating remote diagnostics and medical interventions, saving lives," said Gosteau, about the

emerging use cases in the IoT space.

Zaitsau of Actility highlighted that there are "infinite" tracking-based use cases for all kind of assets, stating that even electrical-pole monitoring is on the rise.

### Conclusion

It is clear that IoT use cases such as smart metering and smart street lighting are two of the main use cases in the IoT space, with proven business models and a clear ROI framework for cities and utilities. An additional advantage of certain use cases, such as smart lighting systems, is that they can function as platforms for the addition of new sensors and connectivity that allow new use cases, facilitating the development of new applications without the need for large investments.

Other use cases, such as smart

surveillance and supply chain monitoring, have developed considerably and are being increasingly adopted by companies, especially after the challenges presented by the Covid-19 pandemic.

Meanwhile, smart buildings and smart agriculture have a certain degree of development, although an increasing deployment of sensors and connectivity in these two fields is yet to be seen and will affect the full potential of these two use cases.

On the other hand, technology and connectivity providers are constantly evaluating and developing new IoT-based use cases that will impact the market in the coming years. The increasing availability of sensors, new technologies, added to a clear visibility of the ROI of these cases, will bring futuristic applications to life in a wide range of verticals. ●

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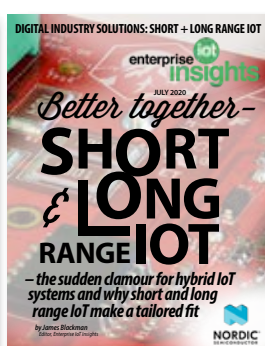
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