



State of the Market

THE INTERNET OF THINGS 2015

Discover how IoT is transforming business results.

Start small.



THINK BIG.

The Internet of Things is founded on familiar technologies — like sensors, networking, and cloud computing — but its potential for transformation is incredible.

WE PREDICT:

By 2025, best-in-class organizations that extensively use IoT technologies in their products and operations will be up to 10% more profitable.

Verizon²

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It's not hype. The Internet of Things (IoT) is already having a massive impact on business. It offers organizations the opportunity to transform how they operate, and gives both new entrants and established players the ability to innovate and disrupt.

Adoption is growing rapidly, but IoT isn't yet widespread. Whether you're in the public sector or private; big or small — if you don't have an IoT strategy, you should. In this report we cover what IoT is, what organizations are doing with it, and give some recommendations on how to get the most out of it.



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By connecting “things” in the real world — such as cars, buildings, and industrial equipment — IoT promises to revolutionize how we live and work. From wearable devices to smart cities, the benefits reported have prompted organizations of all sizes to ask how IoT might affect their organization and their industry, and what they can do with it.

Executive Summary

Organizations are seeing measurable benefits from Internet of Things (IoT) projects. Transportation companies are saving millions of dollars by reducing fuel consumption using data captured, transmitted, and analyzed in near real-time. Local governments are making budgets go further with LED smart street lighting that doesn't need regular maintenance, but can automatically report when it needs to be repaired. Utility companies are eliminating costly and inconvenient home visits to read meters by introducing smart meters that report more granular usage data without human intervention. These are just a few examples of the myriad ways in which IoT is making new products, business models, and processes possible.

Your organization is unique, and the benefits that you could see from adopting IoT are too. But the primary benefits that our customers are seeing typically fall into three categories: improved customer and citizen experiences, accelerating growth and business performance, and improving safety and reducing risk.

While IoT is widely hailed as the next big thing, the key ingredients — network connectivity, cloud, security, and infrastructure — have existed for decades.

That's why there are already more than a billion connected devices and machines in use today. That said, the opportunity for IoT-enabled transformation has grown massively in the last couple of years, and continues to do so.

First, the declining cost of sensors, connectivity, and data processing power is making the ROI equations for IoT projects look even more appealing. Second, while the economic outlook is still uncertain in many regions, investor and consumer confidence has grown. This is making businesses more receptive to investing in new technologies. Lastly, the number of installed machine-to-machine (M2M) connections continues to grow. In 2014, we saw a 45% year-over-year revenue growth in our IoT business, with 4GLTE activations growing by 135%. Today, Verizon manages more than 15 million IoT-enabled connections for a wide range of industries.

Sources for this report:

- **Verizon usage data:** Analysis of aggregated usage data, including new IoT connections, from 2014.
- **Verizon-commissioned research:** A sizing and forecast of global IoT market by ABI Research¹.
- **Verizon customers:** Insight gleaned from working on real IoT projects with companies and public sector organizations.
- **Third-party research:** We reference reports from Gartner, IDC, and other authorities — see page 23 for full citations.
- **Verizon survey:** Results of online survey on consumer attitudes toward connected vehicles — see page 18.

While IoT has matured significantly and expanded massively in the last couple of years, we've barely scratched the surface.

Reports cite adoption figures as high as 80% for some applications, but based on our data and the opinions of our experts, we'd put the number of enterprises that have adopted IoT extensively at just 10%.² And there are a lot of reasons why more will: we predict that by 2025, organizations that adopt IoT extensively will be at least 10% more profitable than competitors that don't.

We've drawn upon our expertise, data, and insights to create this report for forward-thinking business and public sector leaders. As well as demystifying IoT, we look at the factors driving adoption, offer recommendations on how to plan for growth, and make some predictions for how we think it will affect different sectors in the next 10 years. And we explain why we think that when it comes to IoT you should start small, but think big.

The Internet of Things Defined

The Internet of Things (IoT) refers to machine-to-machine (M2M) technology enabled by secure network connectivity and cloud infrastructure, to reliably transform data into useful information for people, businesses, and institutions.

You've probably seen all kinds of innovative new applications and devices that promise to enable the connected home and vehicle, smart city and lifestyle, but how do you define what's IoT and what's not? We believe that for a solution to be considered a part of the Internet of Things it should demonstrate the "Three As":



AWARE

A connected asset must be able to sense something about its surroundings, this might be location, proximity, altitude, temperature, vibration, humidity, light levels, or motion. If it doesn't sense something, it's not IoT.



AUTONOMOUS

The data processed from a connected asset must be transferred to a central location or processing application automatically — either at a set time, or when a condition is met or a threshold passed. Without connectivity, it's not IoT.



ACTIONABLE

IoT isn't just about gathering data; it's about using it to make better decisions — that's the value of IoT. Regardless of whether the output is manual or highly automated, analysis of the data must be integrated into business processes. If the data is not actionable, by you or a third party, it's not IoT.

A study that we commissioned from ABI Research¹ shows that the IoT market is likely to experience strong growth, rising to 5.4 billion connections across the globe by 2020, counting cellular, fixed line, satellite, and short-range wireless connections, up from 1.2 billion devices today.

Number of B2B IoT connections, 2011 to 2020 (forecast)

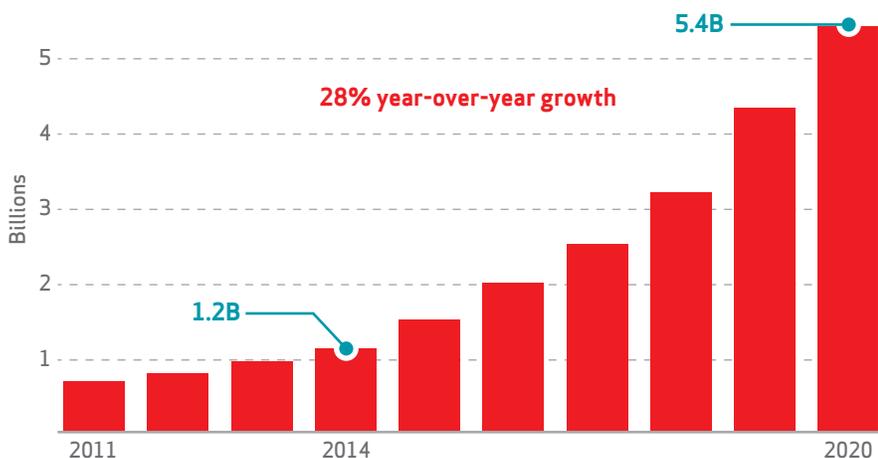


Figure 1: ABI Research for Verizon, 2015¹.

IoT SOLUTIONS: WHAT'S INVOLVED?

Every IoT solution involves many moving parts.



Analytics is at the heart of IoT. The data gathered can feed near-real time business intelligence systems that help make more informed decisions more quickly.

Factors Driving Adoption

IoT BY THE NUMBERS

Here's how M2M connections on our network increased from 2013 to 2014 by sector:

Manufacturing	204%
Finance & Insurance	128%
Media & Entertainment	120%
Home Monitoring	89%
Retail & Hospitality	88%
Transportation & Distribution	83%
Energy & Utilities	49%
Public Sector/Smart Cities	46%
Healthcare & Pharma	40%

Verizon²

The massive growth of the Internet of Things is being driven by a mix of technological, political, and social dynamics.

IMPROVING CUSTOMER AND CITIZEN EXPERIENCES

The use of social media and mobile technology has transformed expectations. Whether they are playing the role of consumer, employee, or citizen, people want greater personalization and more integrated service. This has made improving insight a strategic priority for many organizations. The answer is to use analytics and cloud-enabled platforms, that are making it possible to understand and engage with your customers better, whatever medium they choose. IoT can help by making services:

- **More personal:** Organizations can now use data to understand where a customer is and what they are doing. This makes it possible to predict what they might want or do next. For example, if a customer is passing one of their favorite stores, digital signage could present them with a personalized offer based on previous purchases.
- **Faster and better:** M2M technology is transforming the delivery of goods and services. For example, major retailers are using telematics and asset tracking solutions to offer next-day, or even same-day, delivery. And the same data can be used to offer customers the ability to see exactly where their delivery is via a smartphone app or website.
- **Accessible to all:** IoT technologies can also help reach previously underserved communities. For example, financial institutions are attracting younger customers with innovations like mini branches and video tellers. The elderly and infirm are benefiting too. Highly intelligent but easy to use IoT devices are making it possible for them to manage chronic health conditions and live independently for longer.
- **Available everywhere:** IoT is also taking services to new places. The car is quickly becoming a hub for data gathering and service delivery. For example, companies are offering navigation services that gather real-time traffic information from other road users.

The top 14 automotive manufacturers, which according to our telematics experts account for 80% of the worldwide market, all have a connected-car strategy.



Making Car Insurance More Personal

Automotive insurers are looking at new ways of setting premiums to commercial and fleet customers through a solution called usage-based insurance (UBI). Instead of pricing based on traditional indicators (such as an individual's age and gender), UBI involves installing a device in the user's vehicle, which can track how many miles a driver drives each year, when and where they take their trips, and how safely they drive, aligning premium against measured risk. UBI also allows insurers to add new loyalty- and revenue-building services that their customers can use.

ACCELERATING GROWTH AND BUSINESS PERFORMANCE

After years of focusing on cost-cutting, many industries — from financial services to manufacturing — are looking for new ways to differentiate themselves and boost share prices. Many incumbents are also looking to fend off the threat of disruptive new entrants. The ability to gather data and turn it into insight is an important factor in building and sustaining competitive advantage. IoT can help:

- **Increase revenue:** Companies are using IoT to find new ways to grow revenue and increase profits. For example, industrial equipment manufacturers are selling outcomes, like machine hours, rather than just products. This uses IoT technologies to measure use and enable predictive maintenance; it's known as servitization.
- **Improve operational efficiency:** M2M sensors can enable organizations to monitor assets, from elevators to shipping containers, in near real time. For example, food and drug manufacturers can monitor shipping containers for changes in temperature that could affect product quality and safety using cheap battery-powered sensors and 4G LTE connectivity. And farmers are using IoT to improve yields while conserving water, a precious commodity in many places.
- **Find new ways to do things:** Enterprises are taking on startups by investing in hackathons and incubators to find new uses for their products and new ways to deliver their services. For example, companies as varied as banks and supermarkets are running public innovation events to generate new ideas for using IoT sensors and data. Innovation, and attracting and retaining the best talent are vital for future success.

IMPROVING SAFETY AND REDUCING RISK

Revamping the overall health of critical infrastructure, including bridges, buildings, highways, and airports is a symbol of national safety and global competitiveness. China's investment in infrastructure over the last few years has outpaced more developed markets in Europe and the Americas. IoT can help:

- **Meet regulatory requirements:** Organizations are using IoT in their efforts to meet new environmental standards and safety targets. For example, smart grid solutions are enabling energy and utility companies to improve efficiency and cut waste. And train companies and automotive manufacturers are fitting vehicles with IoT-enabled systems that can predict and help prevent accidents.
- **Improve worker safety:** IoT can help keep employees safe, especially those working alone in hazardous areas. For example, IoT-enabled cameras in truck cabs can watch for problems, such as a potential collision between vehicles, and raise the alarm or take action directly. Wearable devices can sense environmental factors — such as temperature, levels of toxic gases, or prolonged periods of inactivity — and identify when a worker has had an accident or is in imminent danger.
- **Protect remote assets:** IoT offers new ways to protect valuable and sensitive inventory, equipment, and plant machinery, particularly for remote sites or large areas. Connected alarms, door locks, motion sensors, and tracking devices can help staff detect threats remotely. And when a threat is identified, they can automatically activate cameras, isolation doors, and other countermeasures, and notify emergency services. And should an item be stolen, M2M connectivity can help find and recover it.

With 33,000 lives lost in traffic accidents each year in the U.S. alone, there's huge potential for IoT to improve safety³.

45% GROWTH

In 2014, we saw a 45% year-over-year revenue growth in our IoT business, with 4GLTE activations growing by 135%.

Verizon²

[tweet this](#)

25%

of car buyers said that connectivity made a vehicle much more desirable at the time of purchase.

Verizon²

tweet this

SOPHISTICATION OF APPLICATIONS

IoT solutions may have very different levels of sophistication to suit the kinds of business purposes they're applied to. Understanding the possibilities can help organizations plan and grow. We think that IoT solutions can increase in sophistication in two ways — in the way they gather data and understand the world, and the way they act to apply that knowledge.

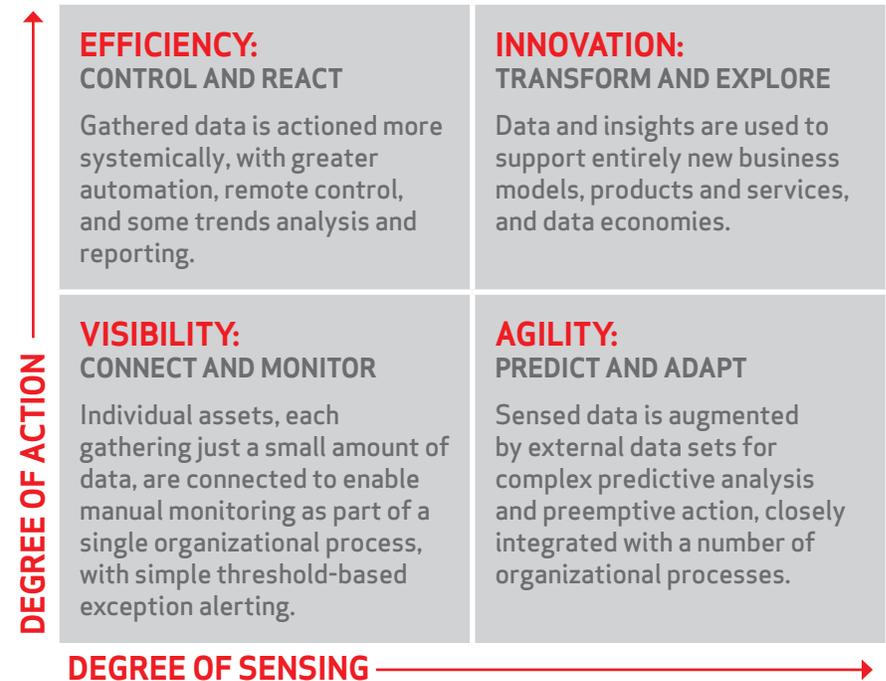


Figure 2: Verizon's IoT sophistication model, 2015.

DIVERSITY OF THINGS

The range of “things” that can be part of an IoT solution is practically unlimited. From the small and simple to the large and complex, the possibilities are enormous. We've worked with public- and private-sector organizations to connect all kinds of assets. And we've been at the forefront of using IoT to monitor the health and wellbeing of 2,500 of our employees and their partners, through a volunteer pilot program.



IoT in Action Updating the “User Pays” Principle in Oregon

The state of Oregon pioneered the “user pays” principle, charging drivers a gas tax for road maintenance, nearly a hundred years ago. In December 2014, they agreed to the first road usage charge system as a new, fairer way to pay for the upkeep of its highways. Starting from July 2015, the state will run an IoT-based mileage recording system for up to 5,000 voluntary participants. Cars and light commercial vehicles will receive a tax credit on fuel purchases and instead pay 1.5 cents per mile.

The Internet of People

Fitness trackers are now a multi-billion dollar market, worn by people of all walks of life. And now governments and businesses are looking at how they can use wearables to increase safety and wellness, and reduce the cost of medical care and lost productivity.

REDUCING THE COST OF HEALTHCARE

The rising cost of healthcare is a major issue. Governments are striving to increase activity levels to cut obesity and find more economical ways to look after aging populations.

Wearables can help elderly people remain independent for longer. An unobtrusive device can both monitor their vitals and contain a panic button to call for help. This can improve quality of life and cut the cost of social care. The same technology can be used to help manage chronic conditions such as diabetes.

Where in the past doctors would keep patients in hospital for monitoring, in many cases it's now possible to let the patient do the monitoring from the comfort of their own home — which also frees up beds, allowing doctors to treat more patients.

IoT-enabled wearable devices can also play an important role in preventive medicine. By encouraging the population to lead a more healthy lifestyle, the incidence of obesity and other conditions that can be a factor in many serious health conditions can be reduced. Wearables can also help general practitioners to make sure that patients are sticking to activity plans.

WELLNESS IN THE WORKPLACE

Wellness matters to all employers. Healthy employees are likely to take less time off work and be more productive. That's why many companies, particularly in the U.S., have introduced Wellness programs. Wearables can contribute to the effectiveness of these programs by making it easy for employees to monitor their progress and organizations to incentivize participation.

Organizations will introduce more than 13 million health and fitness tracking devices into the workplace by 2018⁴.

Instead of relying on employees to track and report data — such as minutes of activity, calories burned, or flights of stairs climbed — it can be automatically uploaded from the device into the corporate application. This improves accuracy and is likely to increase sustained involvement. Wearables can also help to increase engagement by introducing a social or gamification aspect to the wellness program.

Wearables can also be used to improve the safety of lone workers and those operating in potentially hazardous environments. Instead of relying on an employee to manually trigger an alarm, an IoT-enabled device can detect a possible problem and warn the employee or call for help automatically.

The following pages explore the key applications and challenges that the IoT presents in four industries: energy and utilities, manufacturing, public sector, and transportation.

+86%

The participation of overweight people in a wellness program increased 86% when wearables were incorporated.

Verizon pilot study⁵

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+80%

The use of wearables, advanced coaching, and social gamification increased participation by up to 80%.

Verizon pilot study⁵

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Sector insight:

ENERGY AND UTILITIES

WE PREDICT:

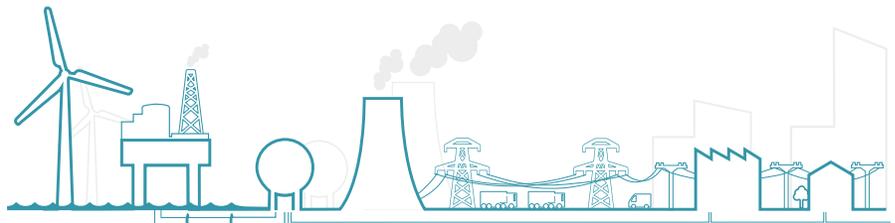
By 2025, more than 10% of electricity will be micro-generated by consumers and contributed directly to the smart grid.

49% GROWTH

Verizon data shows 49% year-over-year growth in the number of IoT connections in the energy and utilities sector.

Verizon²

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Organizations in the energy and utilities sector face ever-changing regulatory requirements, large fluctuations in prices, and increased merger and acquisition activity. They have a lot to gain from IoT. That's why they, particularly those involved in electricity distribution, were among the earliest and remain some of the most enthusiastic adopters of the technology. Utilities can start small, using telematics to improve job scheduling and routing for example, but also think big, like extending the life of their infrastructure.

THE PERFECT STORM FOR ADOPTION

In many regions, regulators set targets for utilities companies to roll out smart meters and smart grids. In the U.S., the 2007 Energy Act kickstarted efforts to monitor consumption and balance the supply across smart grids. The EU has also set an ambitious target for smart metering, challenging the 28 member countries to replace 80% of meters by 2020.

While regulation was vital to getting the ball rolling, energy and utilities companies were keen to embrace IoT. That's because there's a clear business case in terms of improved customer service, reduced risk, and increased operational efficiency.

STARTING SMALL: INCREASING EFFICIENCY OF EXISTING ASSETS

Energy companies were pioneers of SCADA (supervisory control and data acquisition), and IoT offers simple ways to extend these applications.

Another way that utilities can start with IoT is installing smart meters in commercial premises. As well as cutting the cost of sending out people to read meters, this can enable providers to offer new services to differentiate their offering. A good example of this is energy management applications. By sharing the data gathered, utilities can give organizations tools to help them improve the efficiency of their buildings.

Oil and gas companies can cut costs and increase efficiency in the field. Sensor data and advanced analytics can be used to predict the failure of critical components in the oilfield, avoiding costly breakdowns. And detailed information on local weather conditions and connected systems can enable the automated start up and shut down of equipment, increasing production.

1.1 BILLION

94 million smart meters were shipped worldwide in 2014, and the total installed base is predicted to reach 1.1 billion by 2022.

Navigant Research^{6,7}

THINKING BIG: SMARTER, GREENER INFRASTRUCTURE

Residential smart meter programs are inherently more complex. Deploying tens of millions of meters is a major undertaking. For the end user, the most visible benefit of smart metering is reducing the inconvenience and expense of manual meter readings or estimated bills. The provider can use the consumption data gathered to offer them more appealing rates, recommend ways to save energy, and recommend value-added services.

Together these abilities drive customer loyalty and retention, and cut customer acquisition and support costs.

Smart grid rollouts are more challenging. They involve making “in flight” changes to critical infrastructure, where failure is unthinkable and a security breach could paralyze the nation. Remote monitoring can spot problems more quickly while reducing the need to send engineers to inspect equipment at sites across the grid. IoT can also help cut energy theft by identifying potential discrepancies between demand and supply. And there’s cost avoidance, too. The company benefits from a more accurate view of capacity, demand, and supply, so it can predict trends and invest more wisely. By safely increasing utilization and efficiency, utilities can put off building new infrastructure, which can cost billions.

In the years to come, power will increasingly come from local wind, solar, biogas, and other microgeneration sources. If we’re to increase efficiency, this power must be accounted for, stored, and moved around the grid to where it can be used at periods of peak demand. That’s a challenge when these sources of power generation are outside of the normal distribution infrastructure and when the power they generate is unpredictable because it depends on weather and other conditions. This trend reinforces the need for a reliable and resilient grid to incorporate these new approaches to meet the demand for electricity.

The smart grid is a prerequisite for a more sustainable distributed energy generation model.

This data can create additional operational efficiencies and provide a path for utilities that want to transform from the traditional role of selling a commodity, to being a provider of energy and energy-related services. Therefore, those who adopt data management, cloud, and advanced analytics strategies will be better positioned to respond to potential threats to their existing business model in the future.

Despite the challenges, there are plenty of reasons why utility companies have a favorable environment for deploying IoT. Generally, metering and grid infrastructure is housed in secure, accessible locations, with power and backhaul network infrastructure in place. But most importantly, the clear business case makes overcoming these difficulties well worth the effort.

Metering Across the Industry

Electricity smart metering and smart grid are the most well-known applications of IoT in the energy and utilities sector. But IoT also applies to residential and commercial water and gas metering, as well as to monitoring water pipe networks, gas and oil pipelines, storage tanks, processing facilities, and energy sites like wellheads.

\$6 BILLION

of electricity is stolen in the US each year.

Accenture⁸

2.5M MILES

The length of pipeline across the US alone.

U.S. Department of Transport⁹

Smart metering — connecting utility meters to provide more granular data and reduce the costs of meter reading.

Smart grid — connecting assets in the generation, transmission, and distribution infrastructures for improved monitoring and control.



Sector insight:

MANUFACTURING

WE PREDICT:

By 2025, many manufacturers will get more revenue from services than from product sales.

204% GROWTH

Verizon data shows 204% year-over-year growth in the number of IoT connections in the manufacturing sector.

Verizon²

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While manufacturers vary greatly, on the scale of production and the kinds of products they make, IoT can add value to most, if not all. Companies can start small, using sensors to track shipments for example, but also think big, like moving to servitization.

SHIFTS DRIVING ADOPTION

As with other industries, many manufacturers must now gather more data in order to comply with regulation — for example “food to fork” rules that require chain-of-custody recording. IoT is also creating opportunities to capture and interpret data leading to new services, avoiding commoditization. And of course, manufacturers are always looking for ways to streamline processes and increase efficiency.

STARTING SMALL: TRACKING ASSETS AND PROTECTING PEOPLE

Inventory, equipment, and sites are extremely valuable and sensitive, so security is paramount. IoT-connected alarms, door locks, cameras, and tracking devices installed on plant, equipment, and stock offer an easy way to help staff maintain security integrity. Sensors can also protect staff and goods from hazards, such as the buildup of noxious or explosive liquids and gases.

IoT-enabled asset tracking not only provides manufacturers with better control of their logistics, but using the data can also enable them to offer their customers near real-time tracking of shipments, an appealing differentiator.

Production line monitoring and automation is one of the most mature IoT applications. By connecting production-line systems, manufacturers can move to predictive maintenance, helping to make better use of resources and reducing unplanned downtime. This strategy can improve equipment utilization and plant output overall. Most production-line systems already contain the necessary sensors — it’s just a case of adding connectivity.

Manufacturers can also track pallets, shipping containers, and equipment both on- and offsite, using location-aware IoT devices. Using a mix of connectivity technologies, including cellular and satellite, this tracking can cover shipments across road, rail, sea, and air transport. This end-to-end monitoring reduces the chance of loss or theft, and additional sensors can be used to verify that perishable or fragile goods are kept in appropriate conditions and handled properly throughout their journey.

The factory of the future will be more capital efficient and flexible. Updates from product design teams will be introduced more quickly, and customizations incorporated more easily. Schedules will reflect changes in demand within hours, not days. Managers will be able to see what stock and raw materials are on hand, and exactly where they are, from their tablet.

By adopting asset tracking throughout the supply chain — from inbound raw materials and parts to outbound shipments of finished products — manufacturers can reduce shrinkage and damage; and forecast their material needs more accurately, achieving the ultimate in lean operations, lower stock, and fewer outages.

THINKING BIG: THE SHIFT TOWARDS SERVITIZATION

Manufacturers of larger goods — generators, elevators, air-conditioning units, jet engines, and medical equipment — frequently already sell maintenance contracts along with equipment. These contracts are often lucrative, but they create problems for both parties. They require regular inspection and maintenance visits, and customers still experience downtime and an emergency call-out if there's a problem in between visits.

Manufacturers are increasingly moving towards “servitization”, where instead of selling products they contract to deliver outcomes.

With IoT, manufacturers can remotely monitor the condition of equipment and look for indicators of imminent failure — for example vibration, temperature, or pressure outside normal limits. This means that the manufacturer can make fewer visits, reducing costs and freeing up employees. For the customer it means less disruption, increased uptime, and ultimately higher satisfaction. Taking this to the next level, manufacturers can offer a price-per-use, inclusive of all hardware, installation, and servicing. This is servitization, and it's very attractive to customers looking to spread costs and increase accountability.

While the smart home is fairly new concept, sales of wearable computing devices, smart thermostats (like Google Nest), and smart lighting (such as Philips Hue) have been strong, and Verizon's network data shows an 89% year-over-year increase in the number of connections for smart alarms, cameras, and other home security solutions².

Nearly 20 million smart thermostats will ship by 2023, according to Navigant Research¹⁰. Canals forecasts more than 43 million wearable bands will ship in 2015¹¹. These are just two of the new product categories IoT is opening up.

Enterprises offering IoT services are able to generate additional product revenue and increase the stickiness of end-user relationships by having access to richer data.

IoT in Action Being Proactive

When Schindler Elevator Corporation, a leading global provider of elevators, escalators, and related services, needed a partner to provide connectivity for its new integrated service delivery model, it selected Verizon. It uses our 4G LTE network for its Remote Monitoring Center, a key part of its advanced maintenance delivery system¹⁴. This system spots impending mechanical failures, so Schindler can take corrective action and maintain uninterrupted service.

53%

of manufacturers will offer smart products by 2016.

Oxford Economics¹²

Those organizations that have implemented IoT have experienced increased:

Efficiency

82%

Product quality

49%

Customer satisfaction

45%

HBR Analytic Services¹³

[tweet this](#)



Sector insight:

PUBLIC SECTOR

WE PREDICT:

By 2025, smart cities capabilities will become a critical consideration for companies deciding where to invest and open facilities, due to their impact on operating costs and talent availability.

46% GROWTH

Verizon data shows 46% year-over-year growth in the number of IoT connections in the public sector.

Verizon²

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Budgets are tight, but public sector organizations are faced with the challenge of adapting to changing demographics. Typically populations are growing and aging, affecting the types of services required and making service delivery more challenging. IoT can help municipal leaders make their communities safer and more pleasant places to live.

SHIFTS DRIVING ADOPTION

Today more than half of the world's population lives in urban areas¹⁶; by 2050, that figure will be 70%¹⁷. This trend is forcing local and federal governments to reconsider how they deliver effective services to citizens, control crime, protect aging infrastructures and keep core systems, such as power and traffic running smoothly. Leaders must look to the future, building more sustainable developments with limited resources.

STARTING SMALL: SELF-FUNDING PROJECTS

Towns and cities can start with projects like energy-efficient smart streetlights, car sharing and smart parking, and use the cost savings and revenue to help fund bigger projects, including tackling pollution and upgrading infrastructure like roads and subway systems.

Smart lighting solutions can not only cut energy and maintenance costs, but also enable new features such as environmental analysis, public announcements, emergency call stations, and digital signage.

Parking is a major issue in many towns and cities, adding to congestion and discouraging people from visiting. IoT-enabled smart parking systems can track space utilization and availability using cameras and sensors in the road. Drivers can find out where there is a vacant spot via an app on their cellphone or built into their vehicle. In cities like London, where it can take drivers twenty minutes or more to find a parking space, the opportunity is huge. These solutions can also include smartphone apps that enable mobile payments, alert drivers when their time is running out, and even let them add time to the meter remotely.

70% REDUCTION

Verizon helped the city of Lansing, Michigan cut the energy and maintenance costs of street lighting by 70%.

Illuminating Concepts¹⁵

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30% of congestion in cities is caused by people looking for a parking space¹⁸.

Increasingly, urban residents are deciding that the benefits associated with owning a car aren't worth the cost. Car-sharing or "unattended rental" programs offer on-demand access to vehicles by the hour. Drivers can pre-book a car, unlock it, and be billed for their use all via their smartphone. IoT technology is fundamental to achieving this and delivering a seamless customer experience.

While wholesale replacement of infrastructure would be a massive undertaking, many cities are introducing IoT as part of planned renewal. For example, in the EU, regulation EC 245/2009 requires around 100 million streetlights to be replaced by 2015 in order to meet goals for reducing CO₂¹⁹. This is a great opportunity to install smart streetlights that can respond to their environment based on centrally defined rules. They can also include additional features like panic alarms and digital signage — screens that can be updated in near real-time with information about traffic, air pollution levels, and other municipal information.

THINKING BIG: JOINING UP FOR SMARTER CITIES

The real value in IoT comes from integrating multiple connected systems. It's the data that's really valuable. When decision-makers have a holistic view of everything from energy use and traffic flows to crime and air pollution, they can make better policy decisions.

Digital signage, connected CCTV cameras, and fleet management solutions can enable emergency responders to coordinate activity in response to a disaster.

Advanced analytics tools are needed to process video footage in near real time and identify anomalies in normal behavioral patterns. Cloud platforms are needed to provide the storage and processing infrastructure.

Aggregating data from smart parking, cameras, traffic lights, and public transit systems can help planners understand and manage how people are moving around the city. The insight gained from this can help make better investment decisions and cut congestion.

Networked sensors can automate the collection of data related to air and water quality, weather conditions, noise and condition (including dams, waterways, and vulnerable historical monuments). With this data, local authorities can issue smog warnings and enforce noise pollution orders, water companies can impose water usage restrictions, and maintenance crews can be sent to fix infrastructure. Sensors can also monitor for dangerous levels of UV and radiation, temperature, gas leaks, flood, and other environmental risks that may need intervention.

IoT in Action Sharing a Ride

Launching in the U.S. in 2015, Verizon Auto Share allows rental agencies, car dealers, and municipalities to rent, use, and return cars and other vehicles using a car-sharing application on a smartphone or tablet. The infrastructure enables enterprises to provide their customers with an enhanced rental experience virtually anywhere and anytime, without interacting with an on-site attendant. In the future, Verizon Auto Share will also be available to the public sector, including municipal transit authorities, to help streamline rideshare and van pooling programs.



of municipal energy costs come from street lighting.

Navigant Research²⁰

20M TONS

The EU has set a target to reduce the CO₂ emissions of professional lighting by 20M tons by 2020

M2Mworldnews¹⁹



of the world's energy use takes place in cities.

United Nations²¹



\$120B/YEAR

Wasted in time and fuel each year which can be mitigated using intelligent transportation systems.

Texas A&M²²

One U.S. city used IoT cameras to monitor flood damage remotely, cutting the costs associated with sending staff out into the field for inspections.

Verizon²

The business case for IoT solutions is strong. Even a small reduction in accidents and crime, can reduce the burden on emergency healthcare, police and the courts. This can make a major impact on public sector finances and on a city's reputation as a safe place to live, work, invest, and visit.

The biggest barrier for smart cities today is funding. In the U.S., most municipalities would require substantial resources from the federal government or the private sector to fund a full smart city implementation. There's also the issue of disruption: major deployments in big, busy cities require meticulous coordination to avoid exacerbating the problems that they are trying to resolve — albeit temporarily.

This explains why most of the extensive smart cities deployments have been in China and the Middle East, where significant public funding is allocated to build greenfield urban environments as a technological showcase.

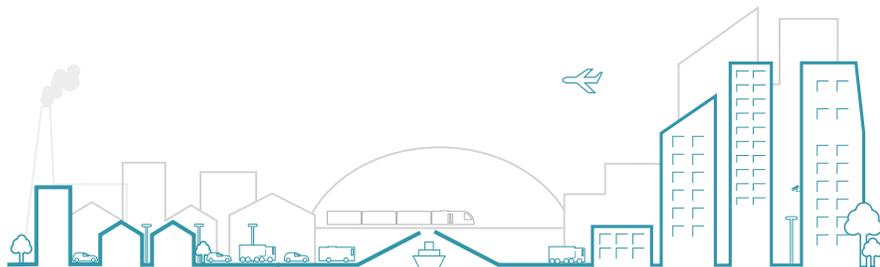


IoT_{in} Action Cutting Energy Use

An energy management initiative in Charlotte, North Carolina aimed to make the city the most sustainable urban core in the nation, targeting 20% energy reduction within five years by integrating data from 61 commercial buildings covering water, security, lights, and legacy systems and connecting to the Smart Grid. In the first two years, the city has already achieved reductions in total energy costs of 8.4%, equal to \$10M in savings. Greenhouse gas emissions have decreased by 20% or 220,000 metric tons²³.

Sector insight:

TRANSPORTATION



Regulation and competition are forcing transportation companies to ever higher standards of efficiency and safety. Whether they are moving people or goods, organizations must reduce fuel consumption and pollution, and strive to increase safety. And those making cars, trucks, trains, ships, or airplanes are expected to offer greater comfort and economy.

SHIFTS DRIVING ADOPTION

Transportation has changed a lot in a generation. Fuel economy has soared, and vehicles have gone from being practical to luxurious — a second home. But expectations of passengers, vehicle buyers, and regulators are demanding even greater advancements. As well as greater comfort and safety, transportation companies must offer greater economy and meet increasing environmental standards.

STARTING SMALL: BUILDING SMARTER VEHICLES

Fleet management was one of the earliest uses of IoT, and remains one of the most widely deployed today, specifically in North America. Any organization that runs a fleet of cars, vans, or trucks (car hire firms, manufacturers, retailers, utilities providers, and field force service companies) can see and measure the benefits of being able to locate, monitor, and instruct their vehicles more effectively.

Fleet management can increase efficiency, saving time, and cutting fuel costs by assigning and adjusting work orders automatically. It can also improve the customer experience by enabling transportation companies to keep them informed on the location their shipment and anticipated delivery time. And it can help improve safety and simplify compliance with regulations by logging driver's working hours, speed, and driving behavior.

Asset management solutions can automate maintaining thorough chain of custody records for at-risk goods, like pharmaceuticals and high-value items.

Through timely diagnostics, predictive analytics, and the elimination of waste in fleet scheduling, the rail industry is looking to achieve savings of \$27 billion globally over 15 years²⁴.

Once cars are connected, automotive manufacturers can gather detailed data about how often they are driven, which amenities are being used, which systems are malfunctioning, and thousands of other data points. The manufacturer can spot the underlying causes of

WE PREDICT:

By 2025, at least five countries will have set a “zero road fatalities” target, relying on intelligent connected cars and smart road infrastructure to avoid and mitigate accidents.

83% GROWTH

Verizon data shows 83% year-over-year growth in IoT in the transportation and distribution sector.

Verizon²

[tweet this](#)

UP TO 20-25% FUEL SAVINGS

are possible when using IoT fleet management solutions.

Frost&Sullivan²⁵

Many vehicle manufacturers are now building connectivity into their vehicles. We are already providing connected car solutions for Mercedes Benz and Volkswagen.

8%

Despite the hype, only 8% of all cars globally are connected to the communications network.

McKinsey²⁶

33,000 LIVES

are lost in traffic accidents in the U.S. alone each year. Bringing down the number of deaths on the road is a priority for many public sector organizations.

CDC³

failures, pre-emptively issue recalls, improve designs to iron out problems, better target new features to driver and market preferences, and issue guidance to dealer sales and maintenance staff.

Despite the enormous upside to smart cars, our telematics experts say that 600 million automobiles remain unconnected worldwide. Manufacturers around the world are trying all kinds of business models to see what works, including free trials, upfront payments, built-in costs, and monthly fees. The right answer will depend on the particular customer base, country, and marque.

In late 2014, we conducted a survey to capture driver preferences towards connected vehicle features². 31% of our survey respondents self-identified as intermediate or advance users of connected-vehicle services. 72% ranked vehicle diagnostics as the most important feature. Safety features ranked as the second highest option and in-dash navigation ranked third (see figure below for additional findings).

Most common features included in Connected Vehicles



Figure 3: Most common features included in Connected Vehicles³⁰

THINKING BIG: LEVERAGING THE FULL POWER OF YOUR DATA

Intelligence built into vehicles — such as proximity and lane-alert sensors, automatic braking, automatic headlamps, automatic wipers, and the ability to call the emergency services automatically — are a big part of urban road safety. But the environment itself has a role to play.

We're working with vehicle manufacturers, public transport operators, and government bodies on innovative solutions, such as command centers that allow city planners to monitor traffic, authorities to manage resources in emergencies, and streetlights that adjust their brightness automatically according to the volume of cars on the road, and weather conditions.



IoT in Action Staying on the Rails

As part of the U.S. Rail Safety Improvement Act of 2008, the Federal Railroad Administration (FRA) mandated that certain critical rail lines must implement a system for monitoring and controlling train movements to provide increased safety by 2015. This is known as Positive Train Control (PTC).

Verizon has been helping railroads modernize their safety systems to comply with federal requirements for more than a decade. To date, we've integrated PTC into more than 7,000 locomotives. We work on-site with several major Class-One railroads. We help operators run the daily operations, the mission-critical processes, and provide business continuity solutions.

Making IoT Happen

The ecosystem required to build an IoT solution can be complex. While the technologies involved are established, there's still a lot of work to be done in agreeing and ratifying standards. We are seeing more "off the shelf" solutions and building blocks emerging, but a high degree of customization is common. Selecting the right providers, partners, and technologies is critical to achieving reliability, performance, coverage, and interoperability.

NETWORKING

With billions of devices autonomously pushing data up into the cloud and receiving instructions in return, there will be much greater reliance on networks, even though most IoT traffic will be low volume and in short bursts. Work is already underway to develop intelligent devices that process, filter, and analyze data right at the edge of the network, so decisions can be quickly made.

Network technologies will proliferate and everything from wired LAN to cellular and short-range radio will play a role.

As the number and variety of devices grow, personal area networks (PANs) will become commonplace. Using the connectivity of smartphones, cars, and home broadband-based gateways, PANs will simplify the management of the dozens of devices that we'll all rely on in a few years. But all applications will ultimately need the WAN and cloud platforms to share, host, and process data — meaning capacity, scalability, and resilience will be critical factors in technology decisions.

CLOUD COMPUTING

The data gathered by millions of connected endpoints must be stored reliably and securely and made accessible to people and other systems. As your IoT requirements grow, your infrastructure needs to be able to support this. The cloud provides an ideal location to host applications and store data. It's highly scalable and offers a flexible, low-risk home for IoT applications and management platforms.

The experience and expertise of a trusted hosting partner can help to reduce the complexity involved in developing an IoT solution, reducing time to market and ROI.

A cloud compute and storage platform (public, virtual private, or private) offers the flexibility and scalability that an IoT project needs, from development through to enterprise-wide deployment. The experience and expertise of a trusted hosting partner can help to reduce the complexity involved in developing an IoT solution, reducing time to market.



92%

of banks implementing or piloting M2M cited "complexity" as their primary challenge.

American Banker²⁷

THE GROWTH OF MOBILE THINGS

Cellular networks can deliver the right levels of coverage and performance, and often at a fraction of the cost of proprietary radio networks. With 4G networks widely available, high-bandwidth applications such as digital signage are now a realistic proposition. On average, IoT devices on our 4G LTE network use more than 600 times as much data as those on our 3G network². This is largely due to rich content being distributed, for which 4G LTE is ideal. But bandwidth isn't everything, many customers still choose our 2G network for their IoT applications.

To keep their infrastructure and customers' information safe, enterprises must maintain a proactive security posture from the outset — not only at the device level, but at every level — making having the right technology infrastructure in place to enable IoT even more critical.

SECURITY

We believe that IoT will fundamentally change how the world sees data security and privacy. Every sensor, device, and connection that gathers, transmits, stores, or processes sensitive data is a potential risk. A study by HP found that 70% of the most commonly used IoT devices contain security vulnerabilities²⁸. The diversity of IoT assets makes achieving effective governance and cybersecurity challenging.

In a mature IoT world, there will be millions of intelligent endpoints, such as cars, pacemakers, and aircon units, each equipped with dozens of active sensors and millions of lines of code. Many of these endpoints will be accessible, often physically, to hackers. The network connections that these endpoints use to communicate may also be vulnerable, giving access to central applications and databases.

Because IoT is all about physical “things”, hackers that gain access can not just perform the usual digital attacks like stealing data, moving money, or shutting down websites — they can cause havoc by tampering with infrastructure like electrical grids and traffic signals, or put lives at risk by meddling with healthcare devices, airplanes, or elevators.

Companies need to address these privacy concerns and be prepared for changes in data protection regulation.

Privacy is also a major concern. IoT applications gather large volumes of data about people's behavior. Consumers and employees are increasingly concerned about how the data might be used, and the risk of criminals stealing it during a breach. Companies need to address these privacy concerns and be prepared for changes in data protection regulation.

How to Secure Your IoT Infrastructure

Even the most security-conscious sectors may be unprepared for the security impact that IoT connected devices can have. So what can you do to protect IoT solutions?

- Build security in from the start of the initiative.
- Evaluate the specific threats facing your application. The risks associated with a wearable fitness band are different to those facing a smart grid.
- Authenticate and authorize connections; verify both identity and access rights.
- Provide appropriate security for data transfers.
- Consider the user experience. If security measures — such as passwords — become cumbersome, users will either circumvent them or avoid using the IoT service entirely.
- Reduce data risk, particularly with regard to personal data.
- Plan for what to do if something goes wrong. Understand that compromise will happen, and plan a workflow for getting compromised credentials out of the system.
- Communicate about security and privacy. Educate employees, partners, and customers about what you're doing to protect them, particularly if sensitive data is at risk.

DEVICE MANAGEMENT

IoT can dramatically increase the volume and variety of mobile devices and machines that must be provisioned, secured, managed, and eventually decommissioned. And it's not just devices, often many companies need to be involved to deliver even a simple solution: including providers of network-certified chipsets and modules. This can be overwhelming for many organizations.

A partner with a strong ecosystem of OEMs can help simplify creating an effective device management strategy. This includes a platform that ensures each device is correctly configured, operates properly, and can provide over-the-air updates seamlessly with diagnostics to maintain maximum device productivity.

AUTHENTICATING DEVICES AND SECURING TRANSMISSIONS

Digital certificates can help address growing C-suite and public concern and meet regulatory demands around the IoT and cybersecurity. Digital certificates enable systems to authenticate devices when they try and connect and create a secure connection to transmit data and instructions.

Uses include:

- Authentication and verification applications.
- Services and enterprise applications (e.g. online shopping).
- Critical infrastructure (e.g. smart grid deployments).
- E-government service delivery that requires sophisticated identity-proofing capabilities (e.g. license plate renewals and passport services).

Start Small, Think Big

The Internet of Things has the potential to fundamentally disrupt the way we live and work. It offers organizations the opportunity to transform how they operate: improving their customer experience, accelerating growth, and managing evolving risk. It's already transforming whole industries, from healthcare to retail. And there's much more to come.

START SMALL

But it needn't be daunting. IoT isn't just for multinational companies investing tens of millions of dollars. Projects don't have to be huge to make a difference. A few dozen sensors and simple automated alerts can cut costs, create new revenue opportunities, and transform customer service. And if you've planned properly, once you start seeing success you can expand existing projects and launch new ones quickly.

THINK BIG

Many of the organizations we're working with are on their fourth or fifth IoT project. As well as extending IoT into new areas of the business, they are joining projects up and seeing exponentially greater results. By integrating IoT into core business systems and processes, they're enabling decision-makers to gain powerful new views of their markets and operations, and ultimately to deliver sustainable competitive advantage.

IoT knows few limits: from connected fridges in South Africa, to smart cities in India, and from digital signage in the U.S., to proactive maintenance programs in Spain.

That's why we know IoT is critical to our future, too. Over the past several years we've made strategic investments in cloud, managed security services and telematics, and invested billions in expanding our global IP and 4G LTE networks. These resources provide the building blocks to help drive IoT adoption. We are committed to making it easier for organizations to deploy IoT solutions, whether they want to connect 50 pieces of plant equipment or 5 million smart meters.

SCALE FAST

So whatever industry you're in or type of asset you want to connect, remember to think big. Even if you start small, you can move from pilot program to full-scale, and from one project to many, quickly; if you've made the right strategic decisions. While standalone IoT projects can offer significant tactical benefits, it's when you start to connect multiple projects and leverage the data as a whole that it becomes truly transformational.

While standalone IoT projects can offer significant tactical benefits, it's when you start to integrate projects and leverage the data as a whole that it becomes truly transformational.

About Verizon in IoT

Verizon is at the forefront of IoT, innovating in networks, cloud, security, and complete solutions that bring IoT to life. Gartner positioned us a Leader in its first Magic Quadrant for Managed M2M Services 2014²⁹.

Verizon has more than a dozen years of experience in connected solutions, and today we manage millions of connected devices. We've invested in building up an unparalleled base of expertise and technology, making targeted acquisitions, such as automotive specialist Hughes Telematics and M2M platform provider nPhase.

COMPLETE SOLUTIONS

We can offer you all the pieces of the puzzle you need to make a success of IoT, including:

- **Global connectivity:** With some of the world's largest and most reliable fixed and mobile networks, including 4G LTE, our global IP network, and our Private IP network. Even as traffic volumes grow, our core networks will keep your data flowing.
- **Secure and scalable infrastructure for hosting IoT solutions:** With more than 50 data centers in nearly 20 countries including 10 top tier Network Access Points (NAPs).
- **IoT Management Center portal:** Provides specialized features to provision service, monitor connectivity, and control the usage of M2M devices.
- **Partner program:** Puts you in touch with a pool of hundreds of specialist providers of devices, software, services, and complete solutions to suit your particular needs and industry — all vetted by us and supported by direct access to our networks and management tools.

SECURITY FROM THE START

We also offer dedicated security services for IoT. For example, our Managed Certificate Service provides a lightweight and efficient cloud-based solution specifically designed to identify and authenticate IoT endpoints and secure the data transmitted between them, helping to prevent attacks on your core systems.

Our networks and data centers are designed for security from the start, providing a solid foundation for your solutions.

END-TO-END SUPPORT

Our approach to IoT is founded on professional services. Our experts can assist you from the very start of your IoT initiative, conducting readiness assessments and helping you formulate plans throughout your IoT lifecycle, including business planning and go-to-market support.

We can help you with engineering support during development, too. We give our clients access to our dedicated innovation centers, which speed up development and testing of solutions by enabling you to experiment with hardware and software combinations on our networks, including prototyping, diagnostics, and readying them for certification.

And through our IoT developer community, we provide tools and resources to speed up the creation of new and enhanced applications and devices for use on our network — such as our cloud-based M2M Application Development Environment.

To find out more about IoT and the potential for your organization, download additional resources, or find out about Verizon's IoT solutions, visit vz.to/1mIWXdK

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