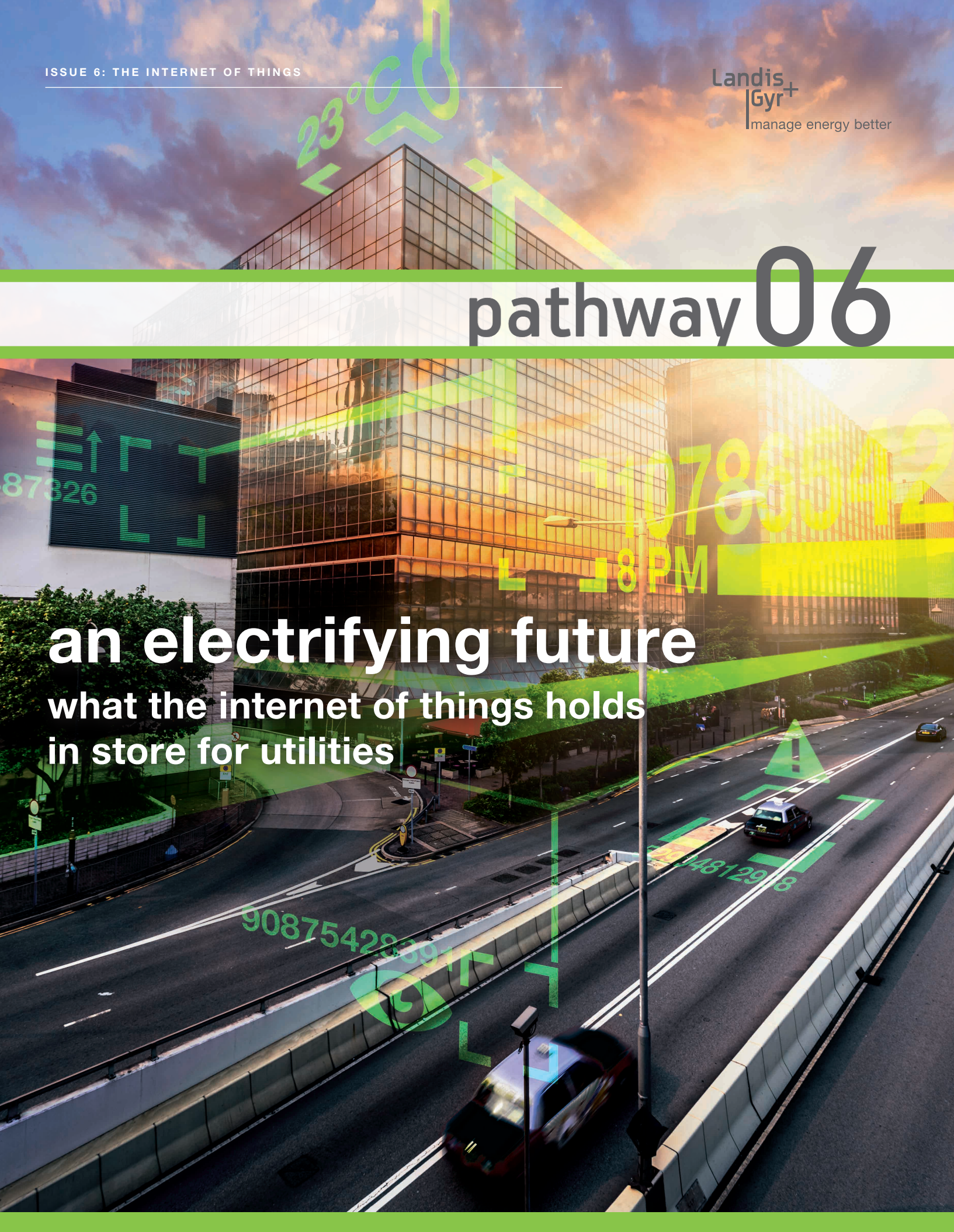
ISSUE 6: THE INTERNET OF THINGS

Landis+Gyr
manage energy better

pathway 06



an electrifying future

what the internet of things holds in store for utilities

from the editor

Welcome to the future!

Has there ever been a bigger buzzword than the Internet of Things? Other recent phenomena like Industry 4.0 pale in comparison, and with good reason: IoT entails a fundamental paradigm shift that extends far beyond business and technology.

IoT involves all sectors of our society, driven equally by businesses, consumers and politicians. And this collaboration is essential, as it's only by working together that we can realize this radical transformation and secure a future that benefits us all – whether financially or in other ways. As part of this revolution, the role of technology companies like Landis+Gyr needs to evolve as well, as we grow into a vital link between energy providers and consumers.

Many energy companies are in the process of shifting their strategic focus towards the implementation of IoT technologies. For businesses, this means examining established processes and models in a new light. And the clock is ticking – the fully connected world is no longer just science fiction. Around the globe, people and companies are working on new products and applications, new ways to do business and create value, using actionable data insights to drive real business transformation. For example, Landis+Gyr has been working with Toshiba to push the envelope in the area of smart cities, a way to redefine our urban spaces using the Internet of Things.

In this issue of "pathway" magazine, we want to give you an overview of the world of IoT. We will show you where the energy industry is today, and what the Internet of Things holds in store for us. We want to give you inspiration and ideas for your own business development, and we look forward to continuing to work with you as we experience this fascinating change together!

Enjoy the read!

Oliver Iltisberger
Executive Vice President EMEA, Landis+Gyr

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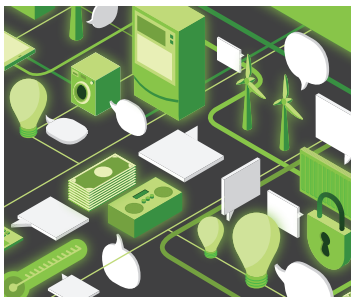

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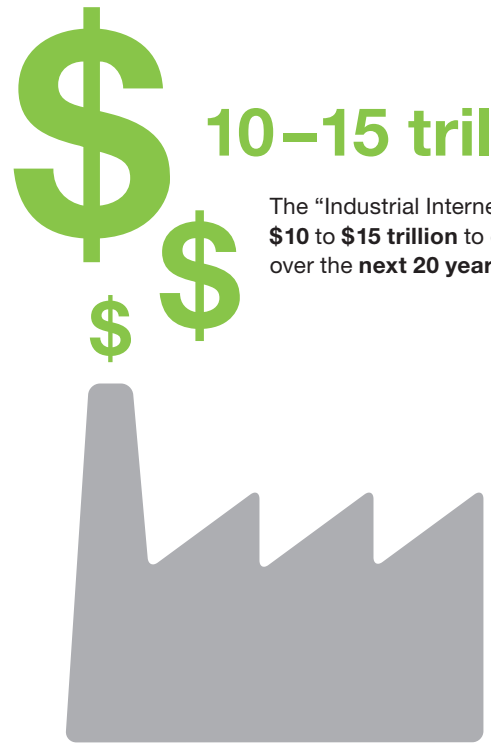


10–15 trillion

The "Industrial Internet" will add **$10** to **$15 trillion** to global GDP over the **next 20 years**.[1]

935 million

The number of smart meters installed worldwide will nearly double to **935 million** in **2022**.[3]

40,000 exabytes

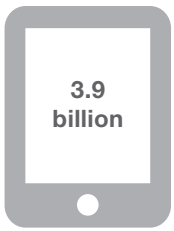
40,000 exabytes (40 trillion gigabytes) will be running across networks in **2020**.[2]

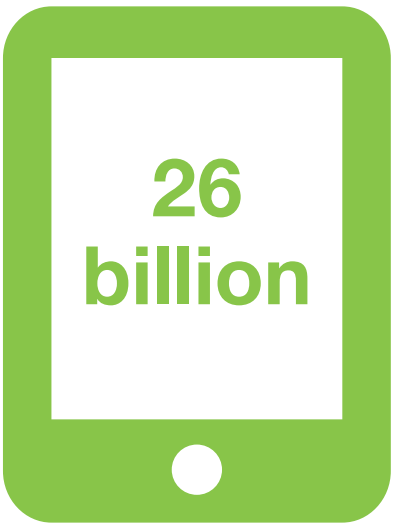
$7.3 billion

Global revenue attributed to residential IoT devices is expected to grow from **$7.3 billion** in **2015** to **$67.7 billion** in **2025**.[4]

$67.7 billion

Approximately **3.9 billion** connected things were in use in **2014** and this figure is expected to rise to **26 billion** by **2020**.[5]





Connect to our IoT Hub for further updates on Landis+Gyr's innovations.

1 Accenture + GE report: www.ge.com/digital/sites/default/files/industrial-internet-insights-report.pdf 2 www.idc-cema.com/eng/events/54405-idc-big-data-and-business-analytics-forum-2014
3 Navigant Research report "Smart meters" Q3 2014 4 www.navigantresearch.com/research/iot-internet-of-things-for-residential-customers 5 Gartner www.gartner.com/newsroom/id/2684616

an electrifying future

what the Internet of things holds in store for utilities

The Internet of Things (IoT) is under construction all around us. But what does this transformation mean for the utilities of tomorrow and, for that matter, today?

The utilities segment is about to experience a period of unprecedented change. This is due, in the most part, to a single phenomenon: the interconnection of billions of smart devices on the Internet of Things, unlocking their ability to collaborate with each other and human beings like never before. This has particular relevance for the power grid of the future because it will enable billions of smart devices to communicate and exchange valuable information between utilities, technology vendors and end consumers via the Internet and other smart grid communication networks. The information collected will contain terabytes of data that will be stored and analyzed, providing maximum business value to utilities.

The potential benefits of implementing IoT solutions include improved asset management, the reduction of supply chain risks, real-time decision-making, and reduced operating costs. The Internet of Things will improve customer relationships and enable the creation of new utility services capable of adding value to both the end user and the energy company. IoT makes it possible for the end consumers of tomorrow to directly control their consumption, and even generation of power as more and more people and organizations begin to feed surplus renewable energy back into the grid. The impact of IoT is such that Europe is altering its regulatory framework to accommodate the rapid adoption of IoT already taking place in the renewables sector, and in anticipation of a similar move by the entire utilities industry. This places utilities under pressure to reinvent their businesses in a way that optimizes their ability to take advantage of IoT.

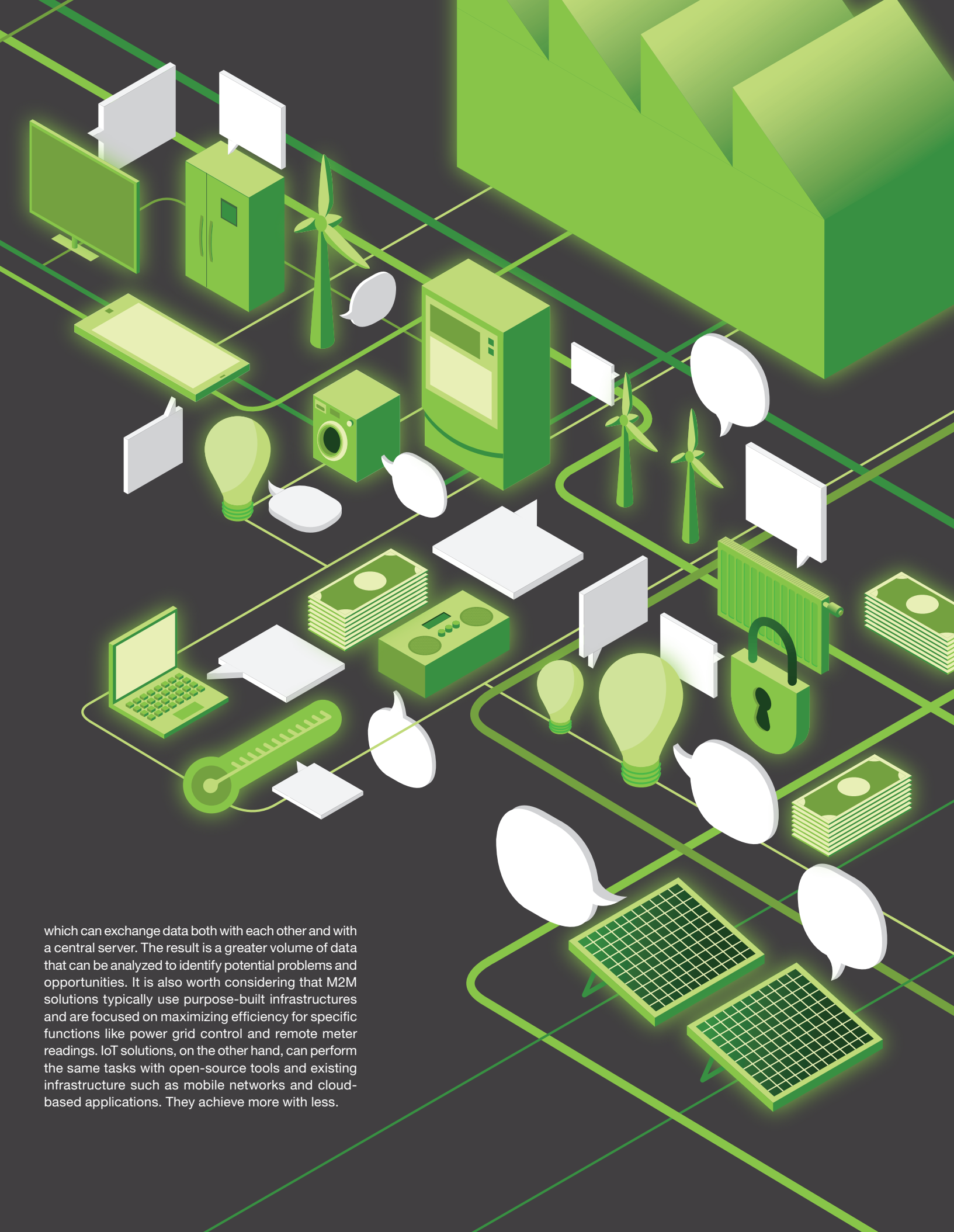
A widely used definition of IoT's starting point is simply the date when more devices became connected to the Internet than people. That threshold has long since been passed due to the explosion in the popularity of smartphones and tablets. According to Juniper Research, the number of devices currently connected to the Internet stands at around 13.4 billion and this is forecast to increase by a factor of between 2 and 5 by 2020, depending on the source of the prediction. Estimates average around the 25 billion mark with McKinsey putting it in the 20–30 billion range[6].

Moving from M2M to IoT

The energy industry is ripe for the application of new IoT devices and technologies. Not least, because IoT may be seen as an evolution of the machine-to-machine (M2M) applications which utilities already employ to manage complex distribution, reporting and management tasks. The smart metering industry in particular was building interconnected networks and applications long before the term "IoT" was coined, and this ensured unprecedented levels of M2M connectivity and data exchange. Today, smart metering is an enabler of the Internet of Things. Recent high volume rollouts across the globe have connected millions of smart metering devices to the grid making two-way communication with utility central systems possible. In effect, smart meters have become intelligent sensors within IoT. What's more, they are future-proof and can be upgraded to meet the coming needs of communication networks, etc. As technology advances, IoT will further strengthen the grid's connectivity infrastructure and extend its benefits beyond network monitoring, distribution and automation into smart homes and smart communities.

Full implementation of IoT will take things to even higher quantitative and qualitative levels. In contrast to M2M systems, where limited numbers of devices communicate between fixed endpoints, IoT can involve massively increased numbers of intelligent devices,

6 McKinsey & Company: Insights and publications: The Internet of Things: Sizing up the opportunity
www.mckinsey.com/insights/high_tech_telecoms_internet/the_internet_of_things_sizing_up_the_opportunity



which can exchange data both with each other and with a central server. The result is a greater volume of data that can be analyzed to identify potential problems and opportunities. It is also worth considering that M2M solutions typically use purpose-built infrastructures and are focused on maximizing efficiency for specific functions like power grid control and remote meter readings. IoT solutions, on the other hand, can perform the same tasks with open-source tools and existing infrastructure such as mobile networks and cloud-based applications. They achieve more with less.

Full control in real time

One key opportunity that IoT offers utilities is the delivery of profitable services using applications enabled by real-time data. A good example would be using data on consumption patterns to create progressive rate structures that incentivize customers to engage in more efficient energy consumption. Real-time usage information enables energy companies to better balance supply and demand and encourage consumption outside peak periods. Applications like this will boost customer loyalty and company profit margins. Not surprisingly, IoT solutions are already available in many energy markets. Dutch energy provider Alliander has developed The Open Smart Grid Platform, to make access to safe, reliable energy more affordable. The platform simplifies the monitoring and control of installations, which can be achieved with any application via any communication infrastructure. For instance, it would enable Dutch municipalities to control and manage their own street lighting systems, without being dependent on a specific supplier. (Read more on page 14)

"Real-time data collection and analytics enabled by industrial Internet protocols, such as iPv6, facilitate simultaneous collaboration between any number of companies as well as the integration of multiple services."

Real-time data collection and analytics enabled by industrial Internet protocols, such as iPv6, facilitate simultaneous collaboration between any number of companies as well as the integration of multiple services.

In addition, seamless system management and service delivery will be possible due to the adoption of universal systems architecture, communication, privacy and security standards. This is a far cry from the traditional approach in which utility-specific protocols determine the nature of operational data exchange. The Internet of Things liberates utilities from these constraints and gives them real-time control over all grid assets. This is particularly valuable when managing renewable energy inputs, such as wind or solar energy, which are influenced by the weather or time of day. IoT can enable immediate and automatic management of input fluctuations to ensure the continuity of power supplies.

Investments in standardized smart grid solutions, that include sensors, energy storage and control systems, are key to realizing the potential of IoT. The same applies to the purchase of technology that can leverage smart meter installations through remote firmware upgrades and advanced lifecycle management services. These are the tools that will empower utilities to enhance operations with negligible disruption of normal business activities. Bearing in mind that some disruptions can damage customer relationships, and may even involve incurring penalties, there is a clear incentive to avoid them. Energy companies can start their journey towards IoT-enabled, intelligent grids by implementing future-proof, end-to-end smart grid solutions, such as Landis+Gyr's Gridstream®. Gridstream's unique suite of proven solutions encompasses big data, infrastructure, command and control applications, and expertise. The suite brings intelligence to all levels of the utility space, from generation to distribution.

For all its promise, IoT is not without possible limitations and data security is the first thing that springs to mind.

7 Smart Grid News: "IoT presents utilities with myriad security challenges"
www.smartgridnews.com/story/iot-presents-utilities-myriad-security-challenges/2015-05-12
8 Hewlett Packard Enterprise: "Internet of things research study 2015 Report"
www8.hp.com/h20195/V2/GetPDF.aspx/4AA5-4759ENW.pdf

"The only reason there have not yet been serious IoT breaches is because IoT has not yet been deployed in large-scale consumer or enterprise applications that make them attractive to attackers, according to Beecham Research."[7] A recent study[8] by Hewlett Packard found that about 70% of today's most common connected devices contain basic vulnerabilities, such as poor password security or a lack of data encryption. Further challenges inherent in using "the cloud" to control and manage business-critical functions involve secure data storage and transmission. However, these problems can be solved with digital security certificates that control access to information and sharing of data, as well as the interaction of people, devices and sensors.

Building a smarter tomorrow

According to McKinsey Global Institute, "Capturing the full potential of IoT applications will require innovation in technologies and business models, as well as investment in new capabilities and talent. With policy actions to encourage interoperability, ensure security, and protect privacy and property rights, the Internet of Things can begin to reach its full potential – especially if leaders truly embrace data-driven decision making."[9] Many innovators in the utility segment are already fast-tracking this predicted evolution. They are working on IoT applications for sustainable power distribution, more effective traffic systems and efficient, intelligent buildings. These factors work together to create what has become known as the "smart city" and Barcelona in Spain is recognized as the first smart city in the world[10]. Barcelona earned this accolade because it already applies innovative solutions to managing public transport and telecare services for its citizens.

Interest in 'smart cities' is growing around the world and this trend has not escaped the notice of the world's leading technology companies. Toshiba and Landis+Gyr are currently pioneering new smart city technologies in the utility sector. Toshiba is looking to create new value by connecting its energy, healthcare, storage products and services using cloud computing, big data and analytics technologies, to implement its vision of building a safe, secure and comfortable society – the "Human Smart Community" by Lifenology (read more on page 10).

The significant changes wrought by ongoing IoT innovations have already had a significant impact on utilities. Research reveals that a third of all major energy and utility companies have 'extensively' adopted IoT and, according to a 2015 report published by the International Data Corporation (IDC), "The worldwide Internet of Things market will grow from $655.8 billion in 2014 to $1.7 trillion in 2020." with McKinsey predicting it may grow as high as $11 trillion by 2025[11]. Even if the latter estimate is out by a trillion or two there is undoubtedly cause for optimism.

As you read this, interconnected devices, that include smart meters and sensors, are cooperating in the exchange of information between utilities, technology vendors and consumers. In turn, this rapidly growing stream of information makes it possible for managers to gain far richer insights. They are using these to assist them in making better decisions, in improving operational processes and in creating more effective business models. There can be no doubt that, as IoT continues to develop, it will create an ever-increasing number of opportunities for business growth. The future is here. ■

9, 10 McKinsey & Company: Insights and publications: "Unlocking the potential of the Internet of Things"
www.mckinsey.com/insights/business_technology/the_internet_of_things_the_value_of_digitizing_the_physical_world
11 Juniper Research: "Barcelona named global smart city 2015"
www.juniperresearch.com/press/press-releases/barcelona-named-global-smart-city-2015

$350 million

Smart grid sensor market is expected to grow tenfold, reaching $350 million in 2021.[12]

36%

36% of energy and utility companies have already "extensively" adopted the Internet of Things.[14]

1.53 billion

1.53 billion connected devices will be managed by utilities by 2020.[13]

12 IHS www.press.ihs.com/press-release/technology/smart-grid-sensors-market-expected-hit-350-million-2021-ihs-says
13 Ericssson report „Transforming industries: How the Internet of Things will transform the utilities industry " 2014
14 HBR Analytic Services, 2014 – http://bit.ly/17HHnsV

the human smart community:
a vision for a technologically sustainable future

Toshiba, together with Landis+Gyr, has developed a long-term strategic vision known as The Human Smart Community (HSC) which envisions a transformation of power supplies and the way we live.

Toshiba is looking to create new opportunities by connecting its energy, healthcare, and storage products via cloud computing, to achieve its vision of creating a safe, secure and comfortable society – "The Human Smart Community" powered by Lifenology (a combination of "life" and "technology"). Toshiba's Lifenology approach will apply the Internet of Things, Machine-to-Machine (M2M) and fog computing[15]. Toshiba originated the term 'lifenology' to collectively refer to its technologies, products and services that will provide people with a new quality of life. In practical terms, this will mean that utilities will be able to monitor, adjust and respond to changes in demand and supply in real time to meet the needs of their customers as required. For instance, being able to respond instantly and provide additional power to heat homes and offices as the temperature drops or additional power to commuter trains during peak times.

By delivering actionable intelligence and connecting a wide range of frequently used everyday products and services, Toshiba and Landis+Gyr aim to help today's energy sector to overcome the challenges posed by disruptive waves of new regulatory and technological developments. Rather than relying on a single product or technology, the companies are using the know-how from their wide range of technologies and services to tackle today's most pressing issues, creating new value for individuals. The 'lifenology' approach is more than technology and more than business. It's about people.

15 A term created by Cisco that refers to extending cloud computing to the edge of an enterprise's network

What does this mean for the power sector?

For utilities, the lifenology approach will bring significant benefits, including improved grid operations by transforming the ability of current load and resource management systems to integrate the intake of increasing amounts of renewables that are needed in order to minimize greenhouse gas emissions. In practice, utilities will be able to spot changes in market demand and supply and also network faults such as outages in real time. This is achieved by placing thousands of sensors throughout the distribution grid to measure load behavior and to trigger automated responses to manage power flows. In addition, smart meters placed in people's homes and in business premises can help utilities to better understand customer behavior and energy usage so as to effectively manage power resources for peak demand. As Andreas Umbach, President & CEO of Landis+Gyr, says: "It is all about energy efficiency, and by being better informed we can provide better services to customers." This intelligent approach is part of Toshiba's overall product philosophy of HSC for the power sector by lifenology. Umbach adds: "We are not promoting technology for its own sake, but for the benefit of people and society."

Load management

Traditionally, utilities had to optimize the network for the highest expected demand peaks by adding more generation to the system to balance electricity supply and demand. The arrival of smart grids together with the installation of smart meters in homes, offices and factories allows utilities to employ consumer-oriented demand response programs and effectively reduce demand on the grid. Demand response energy reduction measures are customized for each facility with the help of smart metering and home automation technologies and can include switching off lighting, air conditioning, heat pumps, and other equipment. Instant knowledge of that change in demand can help relieve congestion in parts of the grid and make more efficient use of power generation resources.

Renewables

The increasing disruptive supply of renewables presents utilities with new data aggregation, command and control challenges. For a start, instead of one large centralized power plant, there can be hundreds or perhaps thousands of power generation plants of various sizes and variable output feeding power to the grid. Such variability in power supplies can make it very difficult to maintain the reliability of power distribution. As a result of the arrival of smart grid technologies, when wind farms cease operating due to calm weather, the utility can instantly switch on standby power generation or battery power to maintain the continuity of power supply to customers. Smart meters not only measure consumption for billing data, but also the quality of the delivered power and whether the voltage is stable. Umbach says: "Keeping everything under control becomes a major challenge, and we do that through introducing many sensors, compiling the data and then analyzing and deriving the right actions from this"

Market

Toshiba has a history of expertise in generating stable energy supplies while reducing CO_2 and greenhouse gas emissions through solutions in hydro, solar, nuclear, geothermal and wind power generation. "While Landis+Gyr's smart meters are not only just measuring consumption, but also feeding back vital information to the rest of the players in the grid, thereby providing a more informative, coordinated, secure and efficient service for utilities customers. It is not surprising that we are trusted partners with many stakeholders in the world's energy industry," Umbach adds. The two companies are further expanding their solution portfolios and services to meet the requirements and applications of the smart grid, driving innovation for utilities around the world. With the acquisition of PowerSense and Gridiant, Landis+Gyr has strengthened its position in the smart grid arena as well and is now able to offer an interoperable, future-ready suite of Gridstream® solutions delivering proven advanced metering infrastructure and also distribution intelligence and customer intelligence applications for today and tomorrow.

Lifenology in action

Landis+Gyr has won a number of high-profile contracts around the world, including a £600 million deal with the UK's British Gas to deploy up to one million "dual fuel" electricity and gas smart meters as well as touch-screen in-home displays. This deal is one of the largest and most advanced smart meter deployments in Europe. It is expected that up to a million British Gas customers could save as much as £200 million on their energy bills by the time the main UK rollout is completed in 2020. In Japan, TEPCO has selected a leading-edge, multimodal metering communication network controlled by Landis+Gyr's head end system. The head end system, coupled with Landis+Gyr's Meter Data Management System (MDMS), offers complete scalability for 27 million endpoints and multiple in-premise devices within a single, highly efficient environment. With the new solution, TEPCO is able to expand its grid reliability, offer value-added services and enable efficient energy use for its customers.

Andreas Umbach concludes: "We know what our technology can do and utilities know their processes – and when you put them together you can develop roadmaps into the future." ■

taking the next step towards realizing the smart grid

Dutch energy provider Alliander is breaking new ground to develop solutions for the energy grid of the future.

Jeroen Scheer, Manager Energy Transition and New Energy Business Models, Alliander

Hans van Egmond, General Manager, Smart Society Services

The Netherlands has the most stable energy grid in the world, and it's something to be proud of. "We have only 19 to 20 minutes of outage per year," says Jeroen Scheer, Manager Energy Transition and New Energy Business Models at Alliander, the largest operator of gas and electricity grids in the Netherlands. "It has to do with the history of the electricity network in this country. We oversized our grid, so we can cope with whatever happens, and we have some fortunate natural conditions." But this very stability is a challenge for leaders like Scheer who are trying to bring innovation and modern technology to energy companies so they can deal with the effects of the energy transition, where many have a tendency to think 'why change a perfectly functioning system?' Innovation and change are traditionally difficult within the framework of large organizations, and so Alliander has come up with an innovative solution for this: create small organizations.

"We have founded a number of totally independent startups, each one to test how a different model works," Scheer says. "There are startups to investigate local energy trading, e-vehicle charging, the Internet of Things and microgrids, to name but a few. It enables the teams to pursue a particular technical idea, and creates the space and freedom to look for brand new solutions to upcoming challenges."

One of these startups is Smart Society Services, founded in 2014 and led by General Manager Hans van Egmond. "This startup began as a spin-off of the project I did as part of my Master's thesis at the Technical University in Delft," says van Egmond. "Within Liander, the biggest Dutch grid operator – operating under the umbrella company Alliander – I did research on the challenges of phasing out the current system for switching public lighting and implementing a new one. I had to take into account the experience Liander had gained installing new systems as part of smart grid projects and large-scale technical rollouts, such as the rollout of smart metering in the Netherlands."

Van Egmond's research showed that it's hard for grid operators and other utility companies to build a positive business case for smart grids. A lot of these projects are driven by external motivators, most prominently legislation and subsidies at a national and/or EU level. "Innovative IoT systems are still in early days of development and in most cases still too expensive," says van Egmond. "The main cost drivers of these systems are the purchase and implementation of the smart devices – in the case of smart meters for Liander: 5 million units – and costs for day-to-day data communication with these devices."

Each system was being installed in isolation to provide functionality from the specific perspective of a single organization (silo systems). For example, smart meters are installed, and only the meter reading functionality is used. “In the meantime, adding more use cases would generate a bigger business value for the company,” says van Egmond. “For example, you might think of demand-and-supply functionality or additional energy supplier services on the same device.”

Smart Society Services developed the Open Smart Grid Platform – an open, generic, secure, scalable and independent Internet of Things platform that can be used to monitor and control different objects using any application. By using this platform, utility customers can easily (re)use the functionality of smart devices for different use cases or combine use cases of different smart devices in a single application. Seamless integration with back office systems is easily achieved thanks to the open architecture and the use of web services. The Open Smart Grid Platform is completely open-source, which allows users to significantly reduce development costs. This approach is unique in the market and creates additional value for less investments as well as preventing a lock-in on proprietary, silo solutions.

The first solution powered by Alliander's Open Smart Grid Platform is FlexOVL, a new and flexible system for switching public lighting. The first pilots were run in three cities in the Netherlands, including Amsterdam, in 2013, and the system is currently being rolled out on a small scale to fifteen Dutch municipalities. From 2016, Liander will begin a nationwide rollout to include 25,000 substations and 800,000 streetlights controlled by the Open Smart Grid Platform. This approach is expected to serve as a blueprint for other, even more complicated projects. “I’m trying to break the ‘silos’,” says van Egmond. “An open-source approach is very common in the software IT-world, with examples like Linux and Android, but in the utilities’ market it is not well adopted yet. Smart Society Services aims to build both a set of solutions based on this approach, and an open-source community around the Open Smart Grid Platform to stimulate innovations. Current developments include smart metering services and distribution automation services.”

The benefits for Alliander are clear. “On the one hand, we can reduce implementation costs and prevent lock-in on proprietary solutions,” says van Egmond. “On the other hand, we can foster innovation and add functionality with the same equipment installed. The platform acts as a link between any grid-connected device and the application domain, and anyone who wants to can develop compatible applications on these services with new use cases. This could be a single person with a brilliant idea or it could be a big company.” Built on this open-source approach, solutions can come from anywhere.

It’s all part of the overall strategy at Alliander, and an acknowledgement of how the industry landscape is changing. For the last hundred years, little has changed in a model based on a few large power plants and a one-way distribution system to the end users. “So in the past we were happy, but rather blind,” says Jeroen Scheer. The system was stable, but there was not much detailed information coming in to the control center. The future looks different. With smart meters installed in every consumer’s home as well as in grid transformer stations, a lot of information is being generated. “And we measure, measure, measure,” says Scheer. At the same time, the grid is becoming more decentralized, with smaller generating plants and a two-way flow of electricity as consumers produce power themselves and sell it back to the grid. New devices, like the smart meters made by Landis+Gyr as well as innovative solutions along the lines of the Open Smart Grid Platform, mean that the grid operator of the future is a very different kind of company. “So we move from being happy, but blind, to being a happy and data-driven operator,” says Scheer. “And it’s all part of the energy transition, where we change from being a fossil-fuel-based economy to a renewable-based economy.” Data can be used not only to look back and analyze performance, but also to perform predictive analytics, to drive change and improvement for years to come.

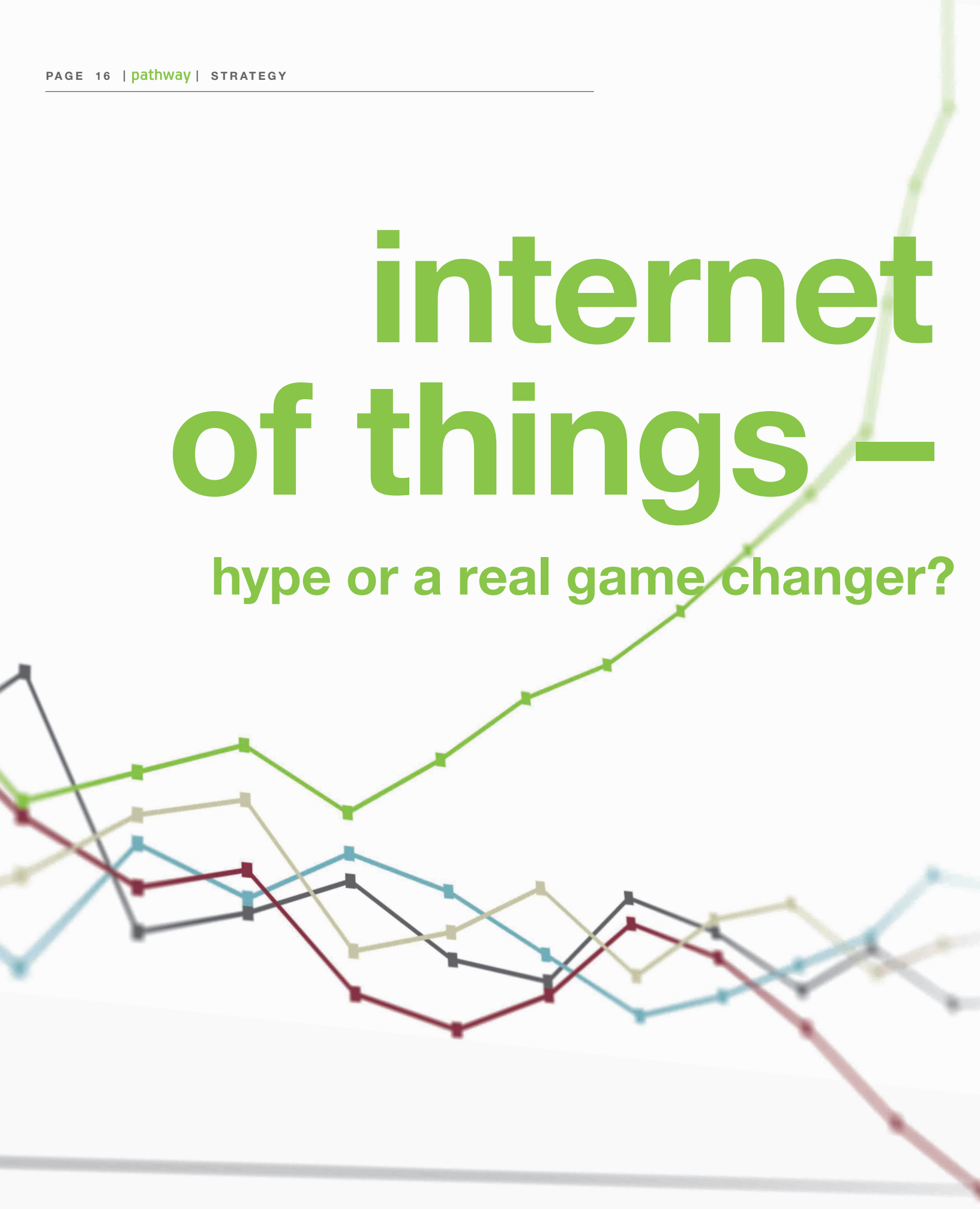
alliander

About Alliander

Alliander operates energy networks which distribute gas and electricity to large parts of the Netherlands, with approximately 7,000 employees and a gross revenue of €1.6 billion in 2014. Alliander has three subsidiaries: Liander, Endinet and Liandon. Liander and Endinet are network operators, distributing electricity to 3.1 million customers and gas to 2.6 million customers in an area covering over a third of the Netherlands. Liander and Endinet are responsible for maintaining, expanding and innovating their networks in the provinces of Gelderland, Noord-Holland and parts of Zuid-Holland, Friesland, Flevoland and Noord-Brabant. Liandon is Alliander’s knowledge center and largely responsible for technical innovations for the transportation and distribution of electricity and gas.

internet of things –

hype or a real game changer?



Across the world, a new field of innovation is opening up, spurred by alliances between utility and technology companies, working with Internet of Things solutions that promise to profoundly change business practices, processes and delivery of services. Both Landis+Gyr and Ericsson are seeking ways to use IoT technologies to bring added benefits to the core business of utility companies and society as a whole. Pathway spoke about the Internet of Things with Bill Lichtensteiger, Director of Communications Technology at Landis+Gyr and Marie Fossum Strannegård, Head of Utilities at Ericsson.

pathway: *Is Internet of Things a game changer?*

Bill Lichtensteiger: The Internet of Things today is still more of a vision than a reality, since there is no clear and commonly agreed definition of what it actually is. In fact, I believe it is becoming over-hyped. This is evidenced by the many research studies forecasting the many billions of devices that will be connected together in this new market of the Internet of Things. My view is that we are at the beginning of a new future, to be delivered by a large number of standards organizations and industry alliances, developing IoT technology for the benefit of industry, consumers and society.

Marie Fossum Strannegård: Every development affecting the value chain can be regarded as a game-changer, especially one as comprehensive as the Internet of Things. IoT is a game changer in the sense that it is revolutionizing the power industry's business practices by making it much easier, more effective and efficient to manage electricity demand. Ultimately, IoT and analyzed data will enable services that enhance customer experience and build consumer engagement.

pathway: *In terms of scale, estimates of the number of installed connected devices vary from a low of under five billion to around 50 billion by 2020, according to various research companies. Whatever the eventual figure, the speed of projected adoption over the next five years is truly incredible. What do you see as the significant trends in IoT development of products, services and usage?*

Bill Lichtensteiger: IoT can be used in a variety of applications including smart grids, smart gadgets, smart homes, smart farming, smart cities, smart transport and smart healthcare. IoT applications can be broadly distinguished in terms of end-user segment, namely industrial or consumer. Prospects for both segments are looking good.

Although it is difficult to predict what the next big IoT success will be, I expect there will likely be several trends. Common application languages will emerge which enable things from different domains to intercommunicate, thereby allowing innovative solutions and services to develop. Another general trend is the intelligence that will be applied to the large amounts of data being collected from things. This intelligence will be increasingly added down at the communication infrastructure level and not just at the head end, as is customary today, which would help improve performance and efficiency.

Marie Fossum Strannegård: Progress is being made in the development of more effective methods of communicating including using cloud platforms, for example. Advancement is also evident with the introduction of more decentralized production and monitoring of energy use. Once smart grids are implemented, enabling services that utilize market and customer data, we are likely to see IoT devices, such as the Apple Watch and Google's Nest thermostat, able to purchase electricity at the "cheapest" time of day, thereby increasing their functionality for both the utilities and consumers. In Europe and the US, we are currently seeing a focus on new IoT-based products and services as a response to stagnant power demand; in Africa and Asia, it lies in reducing power losses in the face of rising demand while in Latin America, it's about how IoT can improve the stability and security of the grid.

Bill Lichtensteiger

Bill Lichtensteiger is the Director of Communications Technology at Landis+Gyr where he is responsible for the global coordination of communication technologies within the Landis+Gyr Group. Bill Lichtensteiger has over 30 years of experience in engineering and business development, managing product management as well as research and development teams, developing hi-tech business and delivering advanced communication technology products and solutions to customers.

pathway: *How do your companies support the policy and regulatory organizations in creating frameworks necessary for IoT implementation?*

Bill Lichtensteiger: Landis+Gyr is progressing its vision of IoT by working with other experts and researchers in the key relevant standards organizations and industry alliances in order to help define the architectural frameworks and application languages for use with IoT. For example, we are part of the IEEE P2413 workgroup and also members of the Alliance for IoT Innovation (AIOTI), which was established by the European Commission with the aim of creating a dynamic European IoT ecosystem.

"IoT is not a product, but more a driver and a framework for new product and solution development. It opens the gateway to a new exciting innovation playground." Bill Lichtensteiger

Marie Fossum Strannegård: Ericsson is working together with governments to push ahead with the adoption and promotion of IoT products by means of regulation and policies. At its most profound level, the IoT is about the convergence between the physical and the virtual. For businesses, we drive the evolution and utilization of IoT by lowering thresholds to create new solutions powered by technology.

As we move into the Networked Society, there will be an expansion in the scale and scope of connectivity. When devices become more capable and connect to the Internet, they will be integrated into vast numbers of different applications across industries.

pathway: *What are your companies doing to ensure that IoT technologies provide a real step-change for utility companies?*

Bill Lichtensteiger: Landis+Gyr is preparing its energy management solutions and communications infrastructure for IoT. Many energy companies have already embraced the IoT concept and started using the same communication networks for different applications such as smart metering, smart grid and street lighting, or connecting a Landis+Gyr smart meter on an AMI network to a SCADA-based distribution management system. In some cases, gas utilities can leverage electricity AMI networks for gas meter reading. We also mine data from smart grid applications to help utilities manage their various operations such as outage management or distributed energy resource management more efficiently.

Marie Fossum Strannegård: Ericsson is transferring knowledge and experiences gained elsewhere in the economy to applications dedicated to utilities and their environment. We are developing new services for utilities by putting together previously isolated divisions to create benefit, improve flexibility and productivity, for energy companies in the delivery of their services in areas such as device management and data analytics. In fact, we are developing these solutions in close collaboration with our customers in so-called Ericsson's consumer labs where we study consumer behavior in order to deliver targeted products that serve their needs. For example, Ericsson is offering new products and technologies to utilities in order to expedite the introduction of IoT technologies, such as enhancements to global cellular networks to improve deep indoor and rural coverage and user service prioritization.

Marie Fossum Strannegård

Marie Fossum Strannegård is Head of Utilities at Ericsson, a multinational provider of communication technologies and services. She is leading a global team focused on driving Ericsson's strategy toward the utilities industry, leading product and service offering development, and advising and shaping customer opportunities together with sales teams in each region. Marie Fossum Strannegård has extensive experience in business development processes.

pathway: *What is the impact of IoT technologies on utilities?*

Bill Lichtensteiger: While it is perhaps too early to determine the financial benefits of IoT adoption, we are likely to see increased openness, greater cost efficiency and flexibility in the way utility customers do things and the entry of new companies providing new services. Hopefully, utilities will welcome their newfound abilities to manage data more flexibly and work with other companies in new ways to drive service innovation. The availability of IoT technologies will enable utilities to provide a richer, wider and more enhanced energy management experience for consumers. Market forces, increased public interest, government regulations and product availability will encourage IoT adoption by utilities as a customer retention marketing tool. In addition, IoT technology will help cut costs, improve efficiencies and reduce grid constraints. By using IoT in smart grids, utilities will be able to mitigate fluctuations in renewable energy generation caused by changing weather conditions. IoT is not a product, but more a driver and a framework for new product and solution development. It opens the gateway to a new exciting innovation playground.

Marie Fossum Strannegård: However, it is always difficult to predict what people want. Ericsson is experimenting with new ideas, concepts and products and seeing what happens. In a sense, it's a serendipity approach. End-users are likely to be more proactive than in the past and hence they are more likely to coproduce a solution. IoT will allow utilities to run their business operations in an integrated decentralized system thereby allowing greater demand responsiveness and, at the end of the day, enable consumer engagement and enhance customer experience.

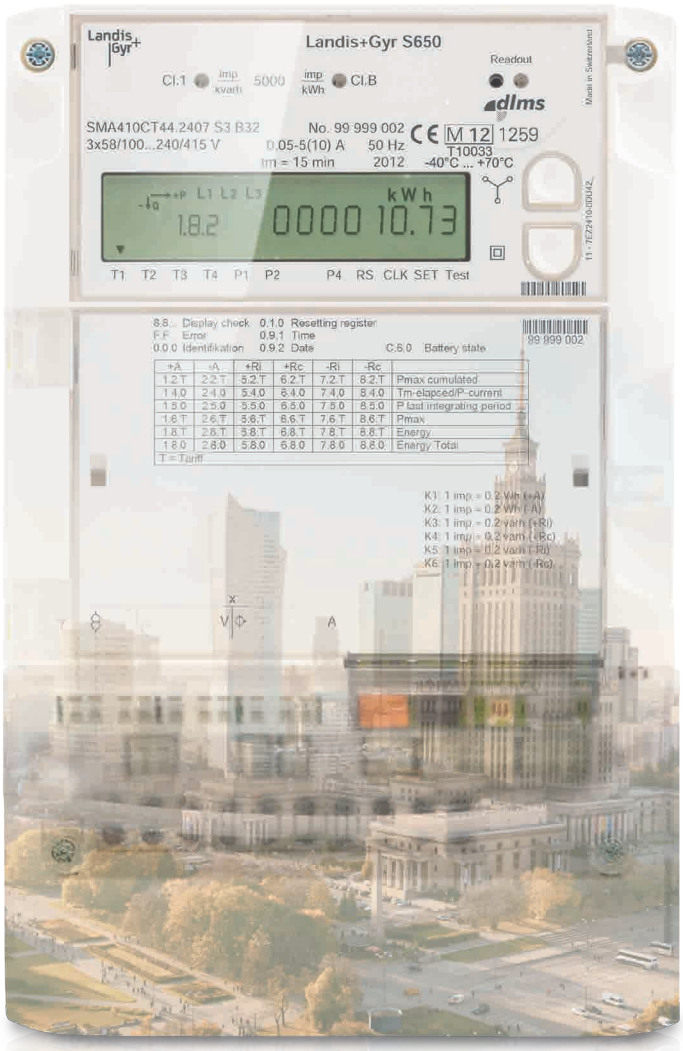
"IoT is a game-changer in that is revolutionizing the power industry's business practices by making it much easier, more effective and efficient to manage demand for electricity."

Marie Fossum Strannegård

pathway: *For both Landis+Gyr and Ericsson, these are exciting times for innovation and the application of dedicated new IoT-enabled products and services especially designed for the global power sector. While for the utilities themselves, a whole new world of opportunities is opening up!* ■

smart grid development in poland

Four leading distribution system operators in Poland are joining forces to modernize their power grid.



In Europe-wide assessments of grid stability, Poland often scores below average, with a System Average Interruption Duration Index (SAIDI) and System Average Interruption Frequency Index (SAIFI), both significantly higher than the EU average. This means that Polish consumers lose their power supply more often than their European neighbors, and the total amount of time without power is longer.

"For one thing, we have a lot of overhead lines," says Andrzej Szymanski, Country Manager of Landis+Gyr Poland. "In urban areas, of course, we run underground cables, but across the country we have a very large number of overhead lines. This means that when we have heavy storms, thousands of people across the country can lose power." In addition, the network infrastructure is very old and requires a lot of investment in new technology. There are also legal barriers to network upgrades. "Following political liberalization in Poland in 1989 and country's transition to the market economy, private property laws were made very strong," says Szymanski. "It's extremely difficult for utility companies to get legal approval to install new equipment on privately owned land."

In spite of these difficulties, change is coming. In May 2015, Landis+Gyr won a major contract with four of the largest Polish distribution system operators (DSOs) to supply a total of 36,000 S650 Smart Grid Terminals for the medium- and low-voltage network. The four DSOs – Tauron Dystrybucja, RWE Stoen Operator, Enea Operator and PGE Dystrybucja – teamed up in October 2014 to launch a single public tender for balancing meters to upgrade their medium- and low-voltage transformer stations. The goal of the joint bid was to identify a single suitable supplier, allowing the DSOs to ensure that a unified data collection standard was possible across their networks.

So far, the project is running on schedule. “Implementation has started and we will see first results by early 2016,” says Szymanski.

This is just the beginning. In total, the Polish DSOs will need to upgrade 250,000 transformer stations with smart grid equipment. And smart grid terminals are just the first device needed. “The terminals’ energy balancing and power quality measurement functions will enable the utility companies to locate problems when they occur. They provide an ‘eye’ onto the network,” says Szymanski. This solution will enable utilities to minimize customer outages and reduce SAIDI and SAIFI. Moreover, by visualizing power quality issues in the network, DSOs will be able to identify areas where upgrade investments are needed. The next step would be to install further advanced smart grid technology, to achieve greater grid resilience and power supply reliability.

The modernization program is not entirely motivated by the desire for increased stability in the network, however. There is another driver in the shape of new legislation, the Renewable Energy Act. From January 1, 2016, small-scale (up to 10 kW) producers of energy from renewable sources, called prosumers (a portmanteau of producer & consumer), will be supported with feed-in tariff (FIT) subsidies, while at the same time new tariffs will encourage utility companies to become more customer-oriented. “Photovoltaic and heat pump technology is already widespread in Poland,” says Szymanski, “and it is only going to grow under this new legislation.” This decentralized grid will need a more flexible and robust network to handle the two-way flow of electricity as well as monitoring energy flow accurately to enable billing while minimizing outage time. The delivery of 36,000 S650 Smart Grid Terminals is just the first step towards a smart grid that can support a variety of Internet of Things devices and solutions.

“It’s a learning curve on both sides,” says Szymanski. “And the project is evolving as we move forward. We expect to see more utility tenders, with new requirements for the new devices and software solutions needed in the next phases of the project.”

It remains to be seen to what extent the DSOs will make the changes necessary to run a single, unified, nationwide smart grid system. At present, the companies run different data collection and management software, with all the cross-compatibility problems this entails. “Our devices are ready for an IoT system,” says Szymanski. “I’m confident that Polish regulations and standards will continue to drive the adoption of smart grid technologies. And IoT-enabled devices will play a key role in building a grid that is smarter and more efficient.” ■

The Polish market in brief

Area: 312,679 km^2 • Total distributed power: 150 TWh

Poland currently generates around 90% of its heat and electricity from coal. EU climate goals mandate that the proportion of renewable energy in the overall energy mix rise to 15% by 2020. In 2012, renewables made up 9.3% of the energy mix.

The Polish DSOs involved in the smart grid project:

Tauron Dystrybucja
Part of the TAURON Group, the second-largest energy company in Poland, delivering 45,000 GWh of electricity to customers across an area of 57,940 km^2 or 18.5% of the country.

Enea Operator
A subsidiary of Enea SA, and one of the four largest electricity providers in Poland, Enea Operator provides electricity to customers in six provinces over an area of 58,213 km^2.

RWE Stoen Operator
Serves 964,000 customers in and around Warsaw, managing the energy grid and operating the distribution network.

PGE Dystrybucja
Supplies 423,000 customers in the southeast of Poland with electricity, covering 15,283 km^2. Belongs to the PGE Polska Group which in total makes up around 40% of the country’s domestic energy production.

building the communicat

IPv6

The key communication enabler for the Internet of Things

Internet Protocol Version 6 or IPv6 is an Internet addressing system developed by the Internet Engineering Taskforce (IETF) to replace the IPv4 protocol. Development was primarily driven by address exhaustion, but in addition to offering a vastly increased number of unique addresses (an IPv6 address is 128 bits long, which allows for a total of approximately 3.4×10^{38} different addresses) there are a number of other important advantages, particularly in the field of utilities infrastructure.

Improved connectivity and automatic configuration

Head end systems and data centers will benefit from improved connectivity as IPv6 enables systems to dispense with network address translation (NAT) on intermediate routers and gateways. IPv6 provides improved bandwidth and a better quality of service for head end systems and data centers as the minimum data transfer sizes required by IPv6 networks are more than double those allowed on IPv4 systems.

Outside the data center in the consumer environment, IPv6-enabled devices are quicker and easier to install in a working Internet of Things environment as automatic configuration allows neighbor discovery and routing discovery without any administration or manual configuration. Networking options such as IPv6 address prefixes and Domain Name System (DNS) server addresses can be automatically distributed throughout the network.

The extensibility designed into IPv6 allows a broad set of routing metrics to be transported. For example, IP routing protocols such as RPL, often used in high-latency AMI networks can carry dynamic network metrics that allow quick adjustments to routes to be made within a multi-hop mesh network. IPv4 cannot be extended or changed because it would break compatibility with the IPv4 standard and interoperability would be lost.

Security

Security is another important consideration for utilities when collecting and transporting large amounts of customer-generated data. IPv6 mandates that IPsec (network layer security) is built into all IPv6 stacks so that it is available for use if required. IPsec includes authentication, encryption and data integrity functions.

Standardization

Landis+Gyr is playing an active role in the future development of networking protocols, and is heavily involved with IETF Work Groups including 6lowpan, 6tish and 6top. The aim is to advance the technology standards for deterministic networks in order to achieve guaranteed low-latency communication in their AMI networks.

The latest G3 PLC and RF mesh technology standards adopted by Landis+Gyr are designed to be fully compatible with IPv6 which means that utility customers can be safe in the knowledge that their solutions are future-proof and can be upgraded as the technology develops further.

ion network of the future

G3 PLC

IPv6-based communication technology for the smarter power grid

Faster

The G3 Power Line Communication (PLC) network is a significant upgrade on the earlier PLAN+ S-FSK systems widely in use today. The speed of these systems is an important factor in Advanced Metering Infrastructure (AMI) and smart grid operations, as frequent communication between installed smart devices and the data center is required. Whereas PLAN+ operates one carrier on two channels, G3 PLC uses Orthogonal Frequency Division Multiplexing (OFDM) to operate 36 carriers. This leads to a huge increase in speed: S-FSK has an operating baud rate at PHY level in the field of 2.4 kbps, while G3 PLC typically offers 20 kbps. Hence, higher volumes of data can be transmitted over electricity networks using G3, either in the low-frequency CENELEC A band (up to 95 KHz) or if desired, in the high-frequency FCC band (150–500 kHz) where even higher data rates of 100kbps–200 kbps are achievable.

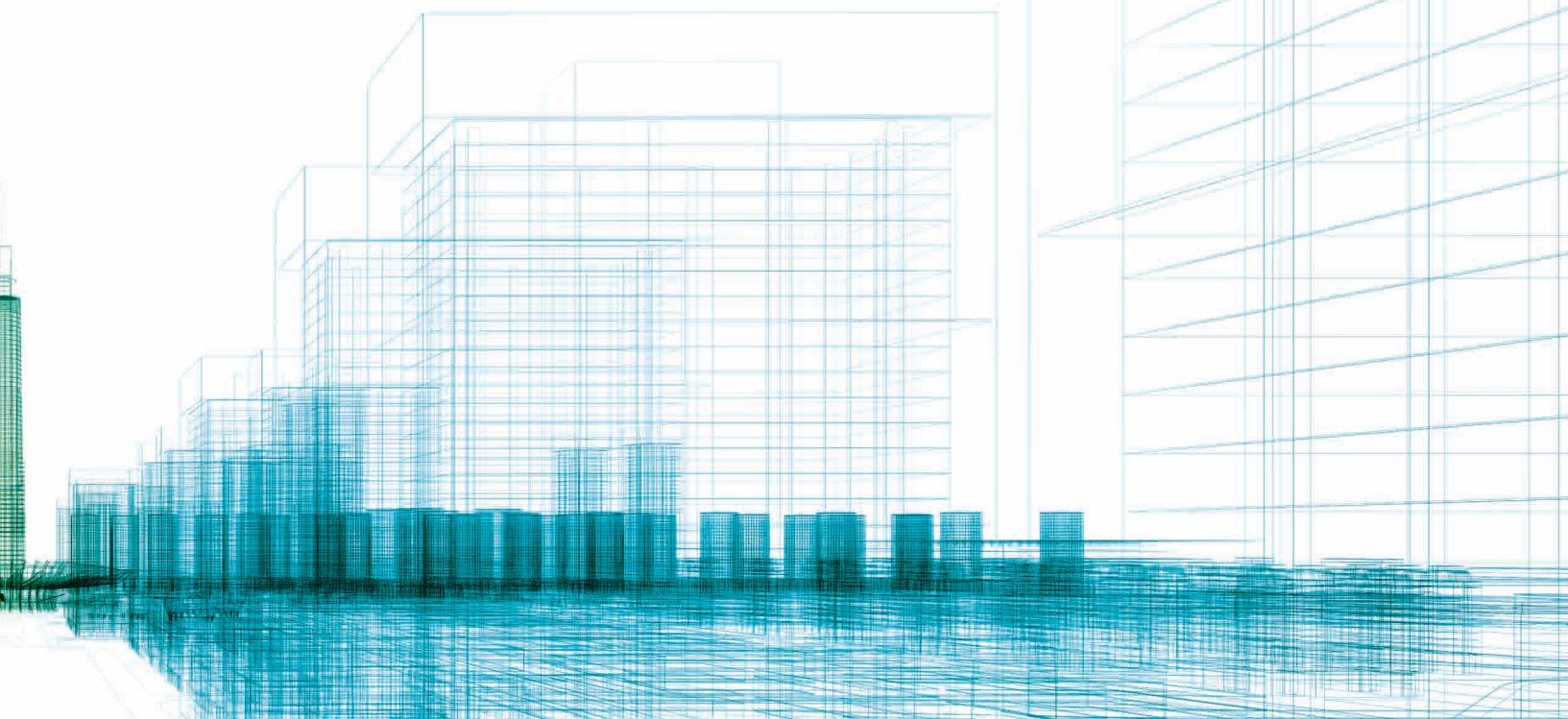
More efficient

Increased speed also means increased efficiency as any given signal can be sent in a fraction of the time, and reduced transmission time means less power consumption by each smart device. Small savings at each device scale across a network to mean a significant reduction in consumption and cost.

More secure

There is a significant security benefit too: G3 is less sensitive to interference compared to other CENELEC A PLC protocols, as it uses forward error correction, interleaving, and spread frequencies to make it the most robust protocol available.

The embedded IPv6 support allows a practically unlimited number of endpoints to be addressed. It also enables direct communication with devices, supporting IoT development and new innovations to improve energy efficiency. G3 PLC is included as one of the communication standards in Landis+Gyr's end-to-end smart grid solution Gridstream®.



progress towards a smart home

Technology companies, social media and Internet providers are pushing towards a multi-billion dollar market.

Very soon your refrigerator is going to outsmart you. The days of spoiled milk are gone. Your smart refrigerator will scan radio frequency identification tags on food items as you fill your fridge. At the same time, it will read those tags on the Internet to identify the food you've just bought, while the fridge LCD screen will suggest recipes for you to make a great meal from the existing contents.

The smart home, made possible by the Internet of Things, is coming to your household. IoT is essentially about connecting devices in the home such as baby monitors, smart meters, motion-sensing cameras and cooking devices accessed via the Internet. In the future, such connected devices will be able to communicate with us, each other and third parties, as well as make autonomous decisions on our behalf, such as determining when is the best time to buy electricity for storage, operate the washing machine and switch on the central heating so that the house is warm when the owner returns home from work.

The choice between IoT service providers is progressively becoming difficult for the consumers as new players come on the market. It is increasingly likely many end users will follow technology by brands they trust and are familiar with, while others will wait until the technology matures enough before making a decision.

The global smart homes market was valued at $20.38 billion in 2014 and is expected to reach $58.68 billion by 2020; the market is projected to grow at an estimated compound annual growth rate (CAGR) of 17% between 2015 and 2020.[16] Connected devices are on the verge of "take-off" with the entry of Apple, Facebook and Google, who have all launched smart home-based IoT operating systems in the last years, aimed at capturing a share of this exciting market.

Apple's HomeKit, Facebook's Parse and Google Brillo and Nest are all aimed at making life easier by monitoring and managing many of the appliances and functions in a home and even updating our diaries automatically or on command via gadgets such as a smartphone or a laptop. For both the gadget-loving young, as well as the increasing elderly segment of the population, this technology has many attractions, by making life more comfortable to use when relaxing, and for many elderly, providing a much safer environment, that will monitor the health of users and raise the alarm in the event of accidents.

Apple launched its HomeKit software aimed at the consumer market last autumn at the Worldwide Developer Conference in San Francisco. With HomeKit's assured compatibility with Apple's iPhone and Apple TV, users can communicate with their home appliances, such as thermostats, light bulbs and garage-openers at any time of day both in and away from home. Apple has carried over its premium segment positioning to this new market by limiting its platform to specific Apple and Apple-approved gadgets.

Technology companies such as Samsung, Facebook and Google have joined Apple for a share of the automated smart home market. Other technology companies are offering a more open approach by promoting interoperability across a wide range of white and brown goods that can be controlled from a range of smart gadgets. A good example of this is Google's Weave (IoT protocol) which provides seamless, reliable and secure communication between devices both locally and through the cloud. It is integrated into Google Play services, so support is built-in to Android and also easily available for iOS (the mobile operating system created and developed by Apple). Another offer is Facebook's Parse (IoT protocol). Its Facebook IoT apps can be controlled from any PC, mobile phone or tablet. Moreover, Facebook's Parse and Google's Brillo work with a wide range of white and brown goods manufacturers of televisions, cookers, radios, washing machines, refrigerators, computers, etc.

All in all, it is the entry of giant social media and Internet solution providers such as Facebook and Google into the smart home market that offers the best prospect of early and rapid adoption of IoT-enabled technologies by bringing them out of the geekish techno-head segment and into the mass-consumer market. ■

Google

The acquisiton of Nest Lab, a manufacturer of thermostats, in 2014 marks Google's entry into the Smart Home Energy sector.

Project Brillo is an Android-based embedded operating system platform by Google.

Facebook

Facebook bought Parse in 2013 for reportedly $85 million, outbidding Google and Yahoo.

Apple

HomeKit is a feature of iOS 8. It is a database that allows developers to make software that communicates with and controls devices for home automation.

16 www.marketsandmarkets.com/PressReleases/global-smart-homes-market.asp

why utilities are using data analytics

Data management services and analytics are the key catalysts driving the Internet of Things innovations now being widely adopted by utilities to transform their operations and managerial capabilities.

Statistics

By **2017**, **45%** of utilities' new investment in analytics will be used in operations and maintenance of plant and network infrastructure.[17]

The U.S. market for utility customer analytics software will surpass **$1 billion** by **2018** and **$2 billion** by **2023**.[18]

In essence, collecting real-time energy consumption information from power plants, distribution networks and end consumers through connected devices over the Internet to monitor, track and share information when combined with business analytical software enhances understanding and responsiveness of the power delivery system. Intelligent grid devices such as smart meters and sensors are providing utility managers with real-time quality data that is essential to improving operational processes – most notably by increasing their ability to integrate renewable energy into their service delivery. Empowered by this information, utilities can respond more quickly to fluctuations in supply and demand, identify energy theft or faulty equipment and assess the operational health of the network.

Leveraging big data from utility systems

Data management and analytics systems such as Landis+Gyr's Meter Data Management System (MDMS) or Advanced Grid Analytics (AGA) provide web-based visualization, prediction, simulation, and optimization analysis that enables utilities to improve insights into energy use and any disturbances in supply and demand such as outages or an incoming burst of renewable energy. Network connectivity models can either be imported through Geographic Information System (GIS) services or directly from planning tools, ensuring seamless integration between customer information and operational data in the utility environment. By leveraging data from advanced metering and other systems, utility professionals can extract business value from the analytical functionality which results in improved operational processes, increased efficiencies in resource utilization and a reduction in costs whilst improving the overall reliability of the power supply. The benefits of MDMS or AGA are quickly achievable and easily accessible by deploying these systems within the utility's own infrastructure, hosted in the cloud or delivered as a service offering. With the fast advance of microgeneration and energy storage technologies, the role of distribution network analytics will only grow in importance.

Improving network operations and planning

At grid level, distribution management systems monitor circuit loading and aggregate data from a large number of intelligent devices such as smart meters, grid sensors and mobile devices being used by engineers in the field that need to be processed to enable operational and business decision making. Collecting and correlating multiple data sources allows organizations to gain insights that individual data alone does not provide. This exponential growth of data has made analytics essential for the energy industry and grid management, in particular. Thanks to grid analytics, network operators are now able to improve grid resilience through outage prevention planning, i.e., carrying out preventive maintenance and despatching crews before there is an interruption to services. Furthermore, smart metering in combination with analytics can detect irregular or changing consumption patterns that could suggest energy loss. To track technical losses, operators can use analytics data from the distribution system that leverages data from Advanced Metering Infrastructure (AMI) systems with feeder-level usage information. Nontechnical losses are easier to quantify (energy delivered minus energy consumed) but they are more difficult to pinpoint without analytics that compares usage data from demographically similar premises, and analyzes changes in historical data for a single premise. Advanced asset management analytics provides comprehensive views of asset health that help utilities to extend their lifecycle, perform risk analyses and calculate the return on investment on potential repairs and upgrades. Analytics can also have a great impact on the the utility's integration plan for renewable energies. It quantifies the potential load balancing and power quality issues that photovoltaics and other renewable energy sources will create for the circuits, as well as the amount and type of grid investments needed to support them.

Enhancing customer relations

On the consumer side of things, utilities are not just using smart meters to collect data for calculating household bills but as a demand response tool to support their marketing and pricing strategies – not only for revenue protection but also to enhance customer relations. The new intelligent networks have opened the door to the collection of real-time multiple sources of data flowing through the organisation while software analytics greatly improve the capability of utility managers to advance grid operations, optimize distribution system and protect revenues. ■

17 IDC FutureScape: Worldwide Utilities 2015 Predictions by IDC Energy Insights

18 Customer Analytics at the Grid Edge: Market Landscape, Forecast and Key Trends by GTM Research 2015

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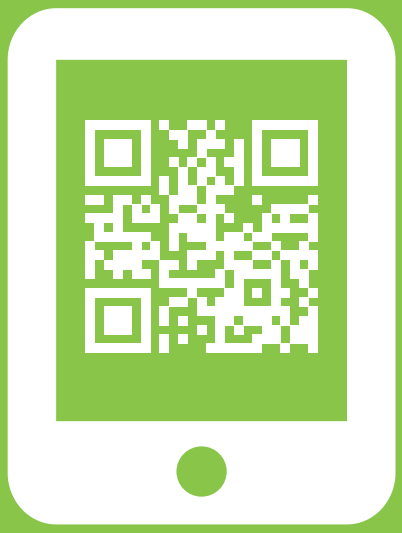

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manage energy better

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