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INTERNET OF THINGS

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The 'things' are smart and will work for us

A global network of interconnected devices linked to the internet is about to revolutionise the way we live and work

OVERVIEW

CHARLES ARTHUR

Interconnectivity changes things. You can control the temperature in your house while sitting in an airport. Your car can update the maps for its navigation system while sitting in your garage. You can monitor the water levels of rivers in Oxfordshire or reservoirs in California from your couch. You can see pollution levels in the biggest cities in China or Europe on your smartphone.

These are all examples of what can be done with the internet of things or IoT – the network of interconnected physical devices such as sensors and actuators in cars, oil pipes, meters, buildings and other infrastructure, linked to the internet so they can exchange data to create new ways of understanding and controlling the world.

The IoT holds huge promise, according to multiple studies. Research company Gartner says that by 2020 it will comprise 26 billion devices, up from 900 million in 2009. By contrast, there will be about 7.3 billion PCs, smartphones and tablets.

"Connectivity will become a standard feature," says Peter Middleton, research director at Gartner. "This opens up the possibility of interconnecting just about anything, from the very simple to the very complex, to offer remote control, monitoring and sensing." By 2016, Gartner says, about 43 per cent of large businesses will have implemented IoT in some way.

The beginnings of today's widespread use came from work in the late-1990s at the Massachusetts Institute of Technology, which was investigating how devices and sensors could interact and identify themselves using radio-frequency identity (RFID) devices. The British entrepreneur Kevin Ashton, who worked there, says he coined the phrase "internet of things" as the title of a presentation for Procter & Gamble where he was working in 1999.

"Linking the new idea of RFID in P&G's supply chain to the then red-hot topic of the internet was more than just a good way to get executive attention," says Mr Ashton. "It summed up an important insight."

That insight, he says, is: "If we had computers that knew everything there was to know about things, using data they gathered without any help from us, we would be able to track and count everything, and greatly reduce waste and cost. We would know when things needed replacing, repairing or recalling and whether they were fresh or past their best."

It's a grand vision, but it could be realised. Gartner reckons the IoT will generate $300 billion in incremental revenue, mainly from services built on top of software, which will run on cheap hardware that might cost a pound, yet be able to run internet services and exchange data.

The key to the IoT's success is scalability, building on those cheap devices which will also have low-power demands and could remain in place for years. By using well-known free software such as Linux and connecting to the internet, they can quickly create webs of interconnected devices; the only problem then becomes control, comprehension and security.

Some use IoT interchangeably with machine-to-machine or M2M connections. But, explains Tom Rebbeck, who leads the digital economy research practice at the consultancy Analysys Mason, they're different. "M2M implies closed systems; IoT is more about sharing and opening of data. So M2M might be a smart meter, which only communicates with the utility company, whereas IoT would be something like a smart city system, bringing together weather and transport and event data to give you travel times," he says.

Mr Rebbeck names three key drivers of IoT uptake: regulatory measures, such as the European Union mandating installation of smart meters, capable of reporting meter readings over the internet; well-defined use in large businesses, such as monitoring systems ahead of repair, as happens with lifts and street lights; and growing consumer interest with smartphones and apps that connect to thermostats, heating and alarm systems.

Implementations of IoT systems are already widespread. British Gas's Hive system, which allows remote control of heating and hot water systems, is installed in more than 100,000 households. The utility company bought AlertMe, an IoT maker which powers Hive, for £44 million in February 2015. That points to uses beyond heating, such as security, smoke detection and lighting, among others. Google-owned Nest internet-connected thermostats and smoke alarms are growing in use.

British Gas has also installed one million smart meters in British homes, which show the householder how much energy is being used at any time and send meter readings back via the internet.

However, the rush to deploy IoT systems carries risks as well as rewards. Michael Oh, chief technology officer for TSP, based in Cambridge, Massachusetts, warns that the biggest-ever known hack – of the US shopping chain Target, in which 40 million debit and credit card numbers, and personal information of 70 million people was stolen – was enabled via the internet of things. The hackers accessed Target's computer network via the internet-connected HVAC (heating, ventilation and air conditioning) systems controlled by an outside contractor.

He says current IoT systems are being built with too little regard for security: "It's like when the Wright Brothers were building planes – they just threw stuff together and they had accidents, but they learnt. And lessons will be learnt in the next five years."
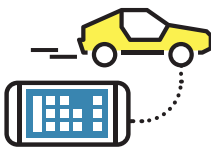
26bn
devices will be connected to the internet of things worldwide by 2020, up from 900 million in 2009

Source: Gartner 2014

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Get ready for a major generational shift

As the fifth generation of mobile networks and wireless systems is being worked on, it's important to keep up to speed with developments to gain full benefit

PREPARING FOR 5G

EMMA WOOLLACOTT

With all the buzz around the internet of things, it's important to remember that these miracle applications fundamentally depend on connectivity. And with potentially hundreds of billions of connected devices on the way, current technology just won't cut it.

High bandwidth will be needed to accommodate the vast amount of traffic, and communication will need to be super-fast and reliable. Just imagine, for example, a driverless car depending on clunky 3G for its traffic updates. For many applications such as this, low latency is key.

The answer is 5G – significantly faster than 4G, with a theoretical download speed of 10Gbps and latency of as little as 1ms end-to-end. It should support up to 100 times as many devices as 4G over any given area and have high-energy efficiency, with battery life extended by ten times and core network energy consumption cut by 90 per cent.

5G has been on the way, in one form or another, for several years. In 2013, Japan and South Korea started to work on 5G requirements; Samsung, Huawei and Ericsson began prototype development, and NTT Docomo carried out the first 5G experimental trials a year later.

And it is, naturally, going to come into commercial service at different times around the world. South Korea's SK Telecom is planning a demo of its 5G technology in 2018 at the Pyeongchang Winter Olympics, and Ericsson and TeliaSonera plan to make commercial service available in Stockholm and Tallinn by the end of that same year.

Japan's target is to launch 5G for the 2020 Tokyo Olympics and, in the UK, Ofcom has set a target for commercial service of the same year.

In its early stages, 5G will be mostly about faster connectivity for PCs, tablets and phones, bringing challenges and opportunities compara-
ble to those that arrived with 4G. In the longer term, though, its features are being seen as the key enabler for the internet of things (IoT).

"5G will eventually provide us with much faster networks with lower latency, which we believe will become the backbone of IoT. Additionally, the flexibility from 5G networks will be better suited to handle all the diversity of data generated by the IoT," says Frank Palermo, executive vice president of digital solutions at IT services provider Virtusa.

"Also 5G has the ability to act as a unifying framework that combines short-range communications such as RFID [radio-frequency identification], Bluetooth and cellular while at the same time exploit new spectrums in the high-frequency millimetre wave and microwave bands."

According to the Next Generation Mobile Networks Alliance, 5G is defined as a network supporting data rates greater than tens of megabits per second for tens of thousands of simultaneous users. While it will be based on the IEEE 802.11ac broadband standard, which is enough for vendors to work with, it has not yet been fully standardised and quite probably won't be until 2019.

In the meantime, vendors are continuing to test their various systems and are investing heavily in IoT-friendly technologies such as new air interface transmission schemes, higher frequency bands and advanced antenna technologies, such as Massive MIMO and beamforming, to try and make the most of limited spectrum.

Rather than broadcasting signals from a base station in all directions, beamed signals can be sent between individual terminals and a base station as required, eliminating interference and making more efficient use of bandwidth. Meanwhile, Massive MIMO involves using multiple-antenna technology to increase data rate and link reliability.

"It's important for businesses to be aware of the work being done on the road to 5G," says Asha Keddy, vice president in Intel's Platform Engineering Group and general manager of Next Generation Standards and Technology.

"Currently, there are innovations being introduced to expand capacity and capability within standards bodies and underutilised spectrum.

> "
> Japan's target is to launch 5G for the 2020 Tokyo Olympics and, in the UK, Ofcom has set a target for commercial service of the same year

These innovations will have an impact on an enterprise's network and infrastructure, and close collaboration with their service providers and technology enablers will be key to embracing new capability as well as new use cases."

Because of the uncertainty over standards, it isn't easy for businesses to plan ahead in any detail. They should, though, be following developments, according to analysts at 451 Research.

They say: "Our research suggests that 5G will potentially have an energising and catalytic effect on a whole array of technology and services in IT. But as one might expect from a major project, the overall picture is nuanced and confused. The move to 5G will be multispeed – some quarters will perceive threats, some opportunities, and some a mix of both."

Most of us are now aware of the headline applications for IoT and 5G – self-driving cars or fridges that order more milk when you run out.

But the advent of 5G and the internet of things will bring major changes to businesses of all types, potentially affecting everything from manufacturing to marketing. Businesses will have access to enormous quantities of information that can help them make better informed decisions, increase efficiency and save money.

For example, insurance firms will be able to base their premiums on actual driver behaviour or doctors monitor their patients' vital signs remotely.

For some applications, it will be low latency that's crucial; for others, it could be mobility, network reliability or resiliency. But IT departments will need to evaluate how 5G and the internet of things are set to affect everything from real-time analytics, datacentre design and location-based web services to social networks and digital currencies.

BANDWIDTH AND LATENCY REQUIREMENTS OF POTENTIAL 5G USE CASES
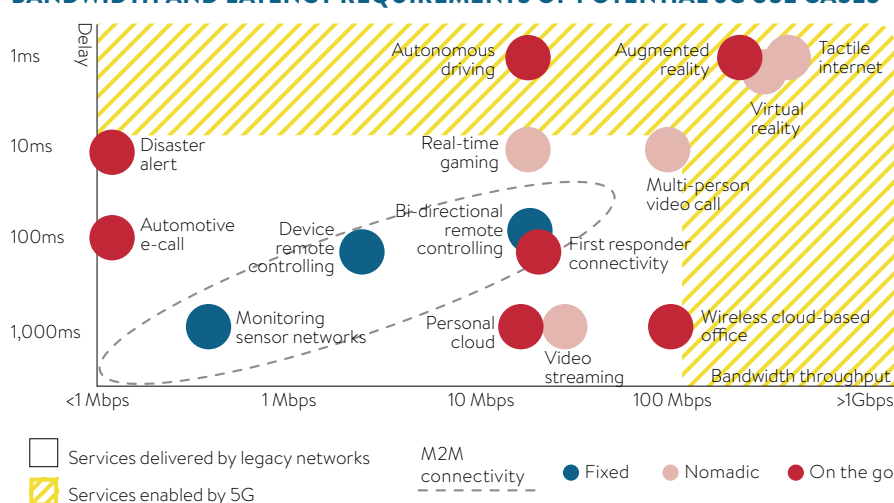
Services delivered by legacy networks
Services enabled by 5G
M2M connectivity
Fixed   Nomadic   On the go

Source: GSMA Intelligence 2014

"IoT allows businesses to gain actionable information to help them make faster and more informed decisions, increase efficiency and save costs using 'smart' things such as sensors, machines, engines, robots and more," says Ms Keddy.

As with every new technology, however, organisations will to a certain extent be forced to start running in order to stay in one place.

"The impending arrival of 5G will also surely make mobile network operators revisit their approach to 2G and 3G networks," says Matt Hatton of Machina Research.

"Up until now most operators around the world, most notably in Europe, have been silent on the issue of the sun setting on 2G or 3G networks. With the impending addition of a fourth air interface, we would expect more mobile network operators to make the leap and switch off the older generations."

This could start happening as early as 2020, he says, which means that any organisation still using these services will have to begin making plans.

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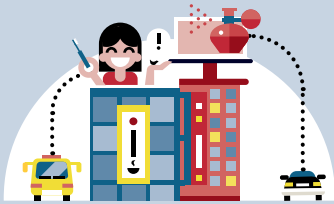## FIVE WAYS 5G WILL TRANSFORM BUSINESS

01 LOGISTICS

According to statistics organisation Statista, there will be 1.8 million connected vehicles on the UK's streets by the end of this year, rising to 8.6 million by 2020. The advent of 5G will see real-time, detailed monitoring of journeys, with vehicles able to exchange information with each other and roadside sensors about traffic conditions and local weather, for example.
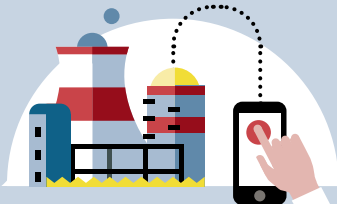
02 MARKETING

When entire cities are connected by 5G and the internet of things, it will be possible for advertisers to target customers based on their location, their buying habits – or anything else. Meanwhile, 5G holographic projection will let users view 3D video without 3D glasses. Customers might be able to test-drive a car virtually or walk through a virtual showroom.
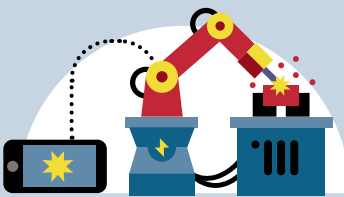
03 REMOTE CONTROL

With the increased speed of 5G, remote automation of critical machines in dangerous work environments, such as mines, power plants, construction sites or oil platforms, will be made easier. Ericsson has already created a fully remote-controlled excavator and ABB has developed a way of operating harbour cranes remotely. Safety can be improved, and staffing and infrastructure costs cut.

04 MANUFACTURING

With 5G there will be scope for more automation in factories, with real-time monitoring of plant and process conditions. Manufacturing robots need only to include low-level controls, sensors and actuators. Having their intelligence in the cloud will mean they can access almost unlimited computing power in real time. This will make robots more flexible, adaptable and cheaper.

05 CONFERENCING

One millisecond latency and high throughput mean that people on opposite sides of the world will be able to use virtual reality to meet and collaborate as if they were in the same physical location. Remote collaboration will save time and cut costs, and could dramatically improve the effectiveness of customer service, distance learning and trouble-shooting.

CHANGING MICRO AND MACROECONOMICS WITH THE INTERNET OF THINGS

Call it the internet of things, machine data or sensor-driven analytics, but the world has an untapped natural resource – a rich seam of data that can transform every aspect of operational performance

The challenge companies face is to access the resource of machines that pre-date internet of things (IoT) concepts and deliver tangible value, not only to their business, but to the wider economy. Right now, however, companies are being asked to shoe-horn IoT into existing cloud-based technology infrastructures, citing the benefits of centrally managed big data analytics.

Yet while pattern-matching and big data trending will without doubt offer significant benefits through improved strategic decision-making, this approach misses the real benefits of IoT – namely real-time, automated decision capabilities that respond to events to transform efficiency and cut costs.

For example, IMS Evolve is working with global retailers to harness sensor information from refrigeration and building management systems, legacy equipment and many other machine types, through the combination of edge-based analytics, standards-based integration strategies and real-time decision capabilities. The results have shown massive reductions in food waste and comprehensive energy management strategies incorporating an exciting new range of different metrics.

This business transformation requires the management of millions of dynamic data points actioned at thousands of locations every minute of every day. By creating genuine analytics, the retailers can understand the underlying condition of each machine's contribution and through continual assessment ensure performance is not compromising food quality or the customer experience.

It is clearly not realistic to attempt to relocate such huge volumes of data across corporate networks to house it centrally in a data cloud. Existing networks would have to be massively upgraded if the organisation was to avoid critical issues, such as data gravity and data latency, which could affect key corporate processes.

Instead, enhancing the existing infrastructure with an IoT software layer creates processing capacity at the source. Decisions are made and executed at the edge, in context with other local data if required, and only the actionable insight shared with the central resource. This approach is cost effective; there is no requirement for prohibitive infrastructure investments and organisations can build in local rules that reflect the specific demands of the environment to refine operations further. It is this local analytic and diagnostic capability that is key to delivering the operational benefits that can be enabled by IoT.

The value of this real-time activity extends far beyond the financial benefits derived by a single organisation. Indeed, it is the collaborative potential offered by IoT that is so compelling on a macroeconomic level, from reducing food waste to transforming energy consumption. Collaborations between energy producers and energy consumers, for example, can support highly sophisticated demand-response models that will be key to reducing consumption and building flexibility into the UK's ageing power network.

By changing the profile of energy consumption in any given physical location or asset to respond to the overall capacity within the grid, while still ensuring devices are operating efficiently, organisations have the chance to reduce consumption and become easier to supply, resulting in reduced power costs. This potential is recognised at national level, with IMS Evolve currently leading a project co-funded by Innovate UK within the cold chain, which consumes 15 per cent of the UK's entire energy production.

With the practical application of IoT, we are transforming essential operations and creating new business models. It is by leveraging real-time machine data to reduce energy consumption, manage waste and transform the cost of asset ownership that both businesses and governments will attain tangible, long-term value from this new, essential data resource.

INTRODUCING IMS EVOLVE

IMS EVOLVE
BETTER CHOICES **MADE POSSIBLE**

IMS Evolve was founded with the clear mission of developing the latest technologies to make businesses work better, understanding the importance of using limited resources wisely. Since before the internet of things, IMS Evolve has been delivering cloud connectivity for all machines, from refrigeration to cash machines and from legacy machines to the latest technology.

IMS Evolve has now matured into a trusted and essential partner, working with some of the world's leading brands. Their technology and expertise has become essential to the upgrade, maintenance and evolution of hundreds of thousands of machines throughout the world.

With teams of experienced strategists, software developers and technical engineers, they deliver unique solutions and uncover the true potential of any machine network. Their skills combine to deliver a variety of tangible business benefits, from cost-savings and energy management to automation, monitoring, ticketing and facilitating auditable internal communications.

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Starting from the ground up r

Building a smart city from scratch avoids the costly retrofitting of technology, including internet of things ca

SMART FROM THE START

FINBARR TOESLAND

Constructing a new smart city from the ground up may seem like a mammoth undertaking, until you consider the complexities involved in retrofitting already established cities. The challenges posed by legacy infrastructure, labyrinthine bureaucracies and, perhaps most importantly, altering the day-to-day processes that citizens rely on, can quickly scuttle grand smart city projects.

The all-encompassing nature of new smart cities gives them a real edge over traditional cities with isolated internet of things (IoT) solutions. As every possible device is connected to each other, the difficulty of dealing with multiple separate systems is eradicated.

"This simplification can be done with all manner of siloed services, including traffic management, transportation, waste management and lighting. This is key to dramatically reducing the complexity, costs, operations and the time required for deploying smart city solutions throughout a city," according to Stuart Higgins, head of digital impact at Cisco UK and Ireland.

Developing countries are well positioned to take advantage of the benefits smart-from-the-start cities offer. The lack of sufficient infrastructure, from roads and energy to water supply, has long hampered Africa's development, but starting from scratch levels the playing field.

Tanuja Randery, president of Schneider Electric in the UK and Ireland, believes that a city with a blank canvas in terms of existing infrastructure would be an ideal scenario, as it could be built from the ground up, starting with the community in mind.

"The city would be designed to create a specific experience for its residents with systems and services set up to achieve efficiency and sustainability goals. Starting from scratch allows these to all be fully integrated on a single network, forming the backbone of a city. Everything would hang off it – each sensor or system monitoring water or traffic flow, public lighting or security," says Ms Randery.

Urban populations are expanding rapidly worldwide, nowhere is this more apparent than in Asian and African nations. According to United Nations figures, 90 per cent of the growth in urban populations is expected to come from these two

> ❝
> Simplification can be done with all manner of siloed services, including traffic management, transportation, waste management and lighting

regions. It is, therefore, no surprise that some of the most ambitious smart city projects are to be found in developing countries, from Konza Technology City in Kenya, advertised as "where African silicon savannah begins", to India's $30-billion mega-project Lavasa.

Whereas new smart cities will be starting from scratch in terms of data collected, historical cities with long-running infrastructure systems will be able to utilise reams of data accumulated over many years. This lack of practical, in-the-field data highlights the importance of flexibility in the design of a smart city, which can easily adapt to changing circumstances. A hallmark of a successful smart city is its ability to add new functionality and scale as the city grows.

"It's important to consider how to future-proof the smart city capability, for example by building in infrastructure that can cope with increased data over time through more storage or processing capability," says Mr Higgins.

Getting all stakeholders to agree on the scope of a new smart city can be a challenge in itself, especially in developing countries that have volatile political environments. But who's going to pay to turn this plan into a reality?

Mr Higgins says that a combination of public sector and private sector organisations sharing both risk and reward can work well. "The city gets the smart solutions it desires without necessarily paying the full cost up-front. At the same time, the supplier gets to provide its solutions and is rewarded for successful delivery and ongoing maintenance through the public-private partnership agreement," he says.

"Investing in smart solutions like lighting and car parking will not only save a city money, but can also generate much-needed revenues. But without the funding to begin this digital journey, many cities will miss this opportunity and be left behind."

The Chinese government is actively working to move citizens from rural villages to newly built cities, with the goal to bring around 70 per cent of the population, close to 900 million people, into cities by 2025. While this may be a laudable target, major Chinese cities including Shanghai and Beijing are bursting at the seams. This is where, China hopes, smart cities come in.

"China's smart city initiatives are very broad in scope – they encompass everything from smart grids to 'public participation', with most other things to do with the IoT and

SMART SOLUTIONS FOR SMART CITIES

Smart monitors and controls across all aspects of city life are set to transform the urban landscape

- ● Transport
- ● Infrastructure
- ● Environment
- ● Utilities
- ● Buildings
- ● Life

01 GREEN BUILDINGS
Rooftop gardens or vegetation on the side of buildings to help insulation, absorb CO_2 and produce oxygen

02 BUILDING MA
Automation and of services such energy usage, lig ventilation

23 FIRE SAFETY
Fire detection and intelligent extinguishing tailored to each room

22 STRUCTURAL HEALTH
Monitoring vibrations/ material conditions in buildings and infrastructure

21 ELECTRIC TRANSPORT
Electric vehicles and public transport, with charging stations across the city

20 SMART LIGHTING
Intelligent and weather-adaptive streetlights

19 TRAFFIC CONTROL/ SMART ROADS
Monitoring vehicles/ pedestrian levels to optimise or divert traffic according to conditions

18 FAST LANES
Intelligent, adaptive fast and slow lanes for walking and cycling
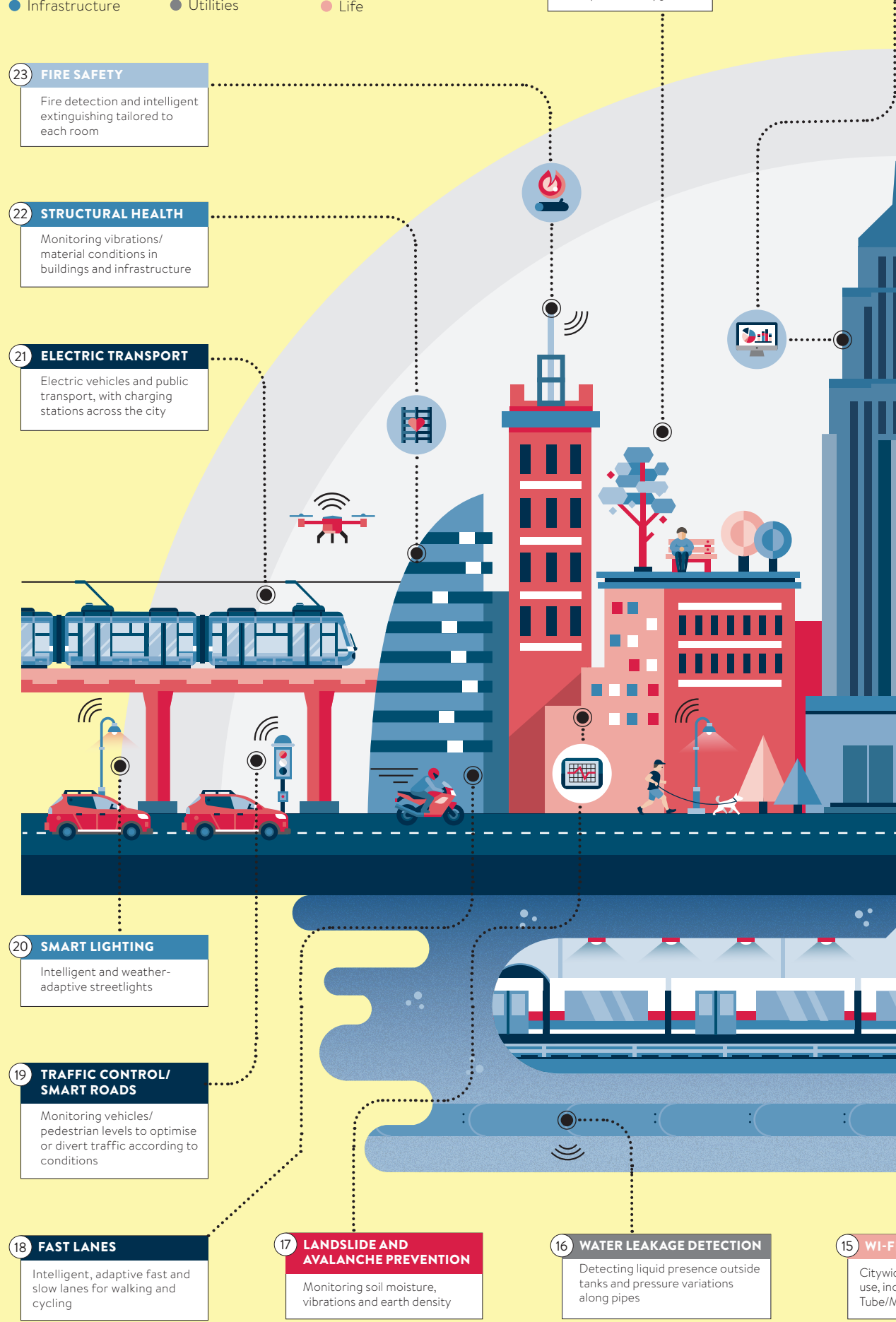
17 LANDSLIDE AND AVALANCHE PREVENTION
Monitoring soil moisture, vibrations and earth density

16 WATER LEAKAGE DETECTION
Detecting liquid presence outside tanks and pressure variations along pipes

15 WI-FI
Citywid use, inc Tube/M

may be the smarter approach

apability, and sparks new ideas and innovation

... MANAGEMENT
... optimisation
... as heating,
...ghting and

03 PERIMETER ACCESS CONTROL
Controlling access and monitoring of restricted areas with CCTV, intruder detection and alarms

04 ROOFTOP WIND TURBINES
Wind turbines built on top of high-rise buildings or integrated into the building design itself

05 AIR POLLUTION CONTROL
Controlling CO_2 emissions of factories and monitoring car pollution

06 BUILDING-INTEGRATED PHOTOVOLTAICS
Solar panels integrated into the building fabric to replace conventional materials

07 SMART GRID
Energy consumption monitoring and management

08 CHEMICAL LEAKAGE DETECTION
Detecting leakages and waste of factories in rivers

09 REAL-TIME UPDATES
Instant traffic updates sent to smartphones to help route-planning and avoid congestion

10 VERTICAL-AXIS WIND TURBINES
Helical twisted wind turbine towers across the city for efficient use of space

11 WASTE MANAGEMENT
Monitoring rubbish levels in containers to optimise refuse collection routes

14 POTABLE WATER MONITORING
Monitoring the quality of tap water across the city

13 EARTHQUAKE EARLY DETECTION
Monitoring specific places susceptible to tremors

12 SMART PARKING
Monitoring availability of parking spaces across the city

...de free wi-fi for public
...cluding wi-fi on the
...Metro

urban governance thrown in," explains Jeremy Green, principal analyst at Machina Research. "China is urbanising on a scale and at a pace not seen anywhere since the Industrial Revolution in England, and with all the disruption that such a transformation necessarily entails."

Machina Research estimates that China accounts for 40 per cent of global spending on smart cities, with total spending forecast to grow from about $8.3 billion currently to almost $16 billion by 2024.

India, too, is looking to smart cities for effective solutions to meet the needs of the swelling urban population, which is projected to total 840 million by 2050. India's government announced a bold plan last year to develop 100 smart cities and intends to spend $7.3 billion on this project by 2020. Billed as India's first smart city, Lavasa, built near tech-hub Pune, is a clear example of the country's tall aspirations.

"Emerging smart cities, which are greenfield projects, give birth to new ideas, innovation, models, in-

telligent infrastructure and friendly working environments. Most new technologies and social innovations dramatically reduce time, cost and risk to build sustainable cities," says Ashwin Shetty, assistant vice president of media relations at Lavasa.

With close to 1.5 million people joining the global urban population each week, the growing influence of IoT has the power to unlock the potential of smart cities and boost living standards across the developing world.

"We're at a time when the cost of connecting city infrastructure is declining dramatically. The lowered costs of 'things' and the data those 'things' generate, make it possible for cities to innovate new solutions for citizens. With IoT offering a raft of new possibilities, citizens can expect to live in a smarter, more responsive city," concludes Kurtis McBride, chief executive of Miovision.

> " Emerging smart cities, which are greenfield projects, give birth to new ideas, innovation, models, intelligent infrastructure and friendly working environments

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SONGDO INTERNATIONAL BUSINESS DISTRICT

South Korea's $35-billion Songdo smart city, built on 1,500 acres of land reclaimed from the Yellow Sea, sits a mere 35 miles west of the capital Seoul. Songdo International Business District (IBD) borrows from iconic cities around the world with pocket parks based on the design of Savannah in Georgia and a 101-acre Central Park, modelled on the original in New York. About 70 per cent complete, with 36,000 residents living in Songdo IBD, the city is beginning to look like the high-tech urban Utopia it was intended to be.

"When we started in Songdo back in 2010, much of the vision didn't exist as a product. We

had to build it from scratch – and we did – but it was pretty challenging," says Bas Boorsma, director of internet of things, Cisco North Europe.

Cisco was heavily involved in the creation of intelligent buildings in Songdo, with more than 3,000 Cisco TelePresence units already installed in the city and, according to Cisco, a further 17,000 will be fixed in homes by Songdo's completion. These personal video devices can connect residents to doctors, tutors, schools and other innovative services.

Tom Murcott, executive vice president, international, of Gale International, co-developer of Songdo IBD, believes that IoT solutions can have a fundamental impact on citizens' living and working experience. "Songdo's success as a smart city should be judged by how well those aspects deemed 'smart' contribute to the quality of life of its inhabitants. We want to provide residents of Songdo supportive technologies that will truly assist and improve their lives, not overwhelm them with gadgetry."

Just how smart do we want our homes to be?

What's next after controlling central heating with your smartphone and switching on the lights before you get home?

01

02

SMART HOMES
STEPHEN ARMSTRONG

The smart home aspect of the internet of things is, like most hot new ideas, actually very old. In the 1959 Rock Hudson and Doris Day romcom *Pillow Talk*, Hudson's bachelor pad comes with remote door-locking, record player and lights dimmer to help the playboy seduce the ladies.

And at this year's Consumer Electronics Show, the world's largest fair of its kind, held in Las Vegas every January, the smart home ideas hovered around terrain the Hollywood star would have been familiar with.

Samsung showcased a fridge that can play music and check the weather, LG announced a wardrobe that steams and smooths your clothes, while Intel's Tiny House included a touchpad to control music, TV and weather news. Which are great, but essentially versions of stuff we've seen before and, in some cases, the answer to questions the consumer simply isn't asking. The smart home is still waiting for its killer app, although that may now be here.

"Once you separate out the gadget enthusiast market, which is a significant one, the main reason consumers express an interest in the smart home and the main function they're looking for is saving money," says Andy Stafford-Clark, IBM engineer and early champion of the internet of things, who invented the open source internet of things protocol MQTT some 20 years ago.

He outlines an attractive energy-saving hub where homes with heavy electrical use prepare a washing cycle, tumble dry and electric car charge then barter with the grid for the cheapest time slot available to run. Extended to a community, say a residential estate, this could enable homes to join the STOR system, where large companies can sell their negative use of power back to the grid for cash.

Controlling your heating is currently the front runner in smart home installation. Figures for 2015 from Berg Insight show companies such as British Gas and Google have installed more than three million devices like Hive and Nest across the United States and Europe. As Mr Stafford-Clark points out, this can save some people some money, but often not enough to justify the high cost of the item and installation. And they might be storing up trouble for the future.

"If you have a smart air-con system and a smart radiator system controlled by a computer, it could hit 18 degrees through judiciously alternating between the two or it could turn both on full blast inching them up and down accordingly," he explains. "We know which is the sensible path, but for a computer there can be two equal solutions to an equation."

One problem is the issue of standards. At the moment, there are three global bodies setting smart home protocol standards – the Industrial Internet Consortium (IIC), the Open Connectivity Foundation (OCF) and the All-Seen Alliance (ASA). The IIC includes Cisco, General Electric, Olympus, Intel and IBM, the OCF includes Electrolux, Qualcomm and Microsoft, while the ASA includes Canon, Sony and LG.

CONSUMERS' MOST DESIRED SMART HOME DEVICES

71%
Doors that can be locked from a remote location

72%
Self-adjusting thermostat

65%
Automatic adjustable outdoor lighting

68%
A master remote control for all householder preferences

65%
Home-monitoring cameras
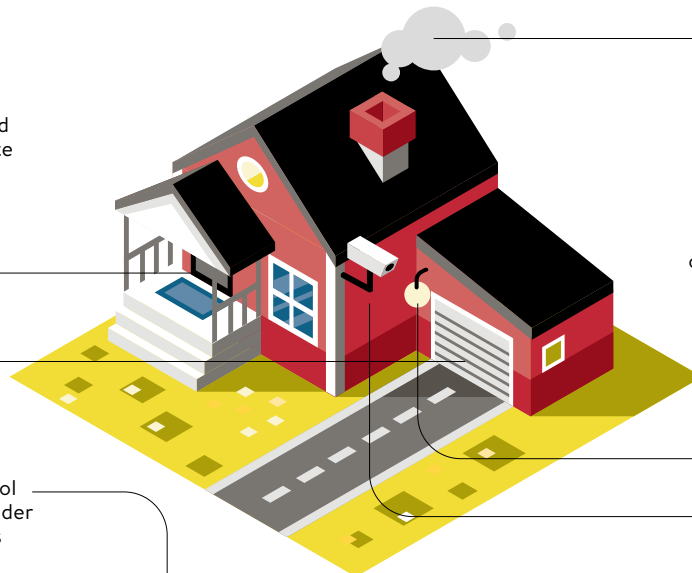
Source: Icontrol Networks

01
Amazon Echo voice-control smart home device

02
Screenshot of AT&T's Digital Life home security/automation app

03
Nest Cam can turn on automatically when you leave the house

is your device knowing how far you are from home and exactly when to turn the heating on."

There's fierce competition. Amazon's cloud-based voice assistant Alexa attached to its Echo home hub is essentially a Siri for the home. Alexa can connect security cameras, lighting systems and even Ford cars. You can order paper towels and snacks out loud and Alexa will buy and ship them for you – from Amazon, naturally. Earlier this month, however, Echo systems in American homes tuned into NPR radio, heard the trigger word Alexa during a programme, so switched on and began performing tasks their owners hadn't asked for.

All of which highlights one underlying fear – what if our smart homes turn against us? US director of national intelligence James Clapper recently told Congress that smart homes give intelligence agencies ample opportunity to spy on targets. If your smart TV is watching you, isn't that literally a scene from George Orwell's dystopian novel *Nineteen Eighty-Four*?

Frank Palermo, executive vice president of digital solutions at Virtusa, argues that the security opportunities of a smart home are actually potentially profitable to the homeowner. "Smart locks, which were at the startup stage last August and now part of the mainstream, are a perfect solution for Airbnb hosts, for instance," he says. "You can control access and even, with tiny cameras, make sure your home is safe."

Mr Palermo believes the change will be comprehensive and that it's almost here. He points to If This Then That (IFTTT), a free web-based service that allows users to create chains of conditional statements as in "if this, then that". BMW is using IFTTT to set up systems that, for instance, text children as a parent approaches school to pick them up or switches on the heating as their car nears home.

It all sounds very *Jetsons*, the space-age counterpart to *The Flintstones*, created in 1962 with automatic doors, sensors to raise and lower the lights, kitchen appliances that prepare food and robots to clean the house. Despite all these improvements, however, the Jetson family still proclaimed how exhausted they were pretty much every day. No matter how high our tech, some things clearly remain the same.

Presently, consumers have to ensure they buy within a protocol group to ensure the new smart lamp they bring home will work instantly with the smart light switch they have installed or hope for a home hub that talks all three languages.

The battle to own that hub has just started. Some offers, such as Logitech's Harmony Home Hub, have disappointed reviewers, who found it great for home entertainment, but less successful at other things. Interestingly, despite white and brown goods giants such as Samsung and Sony directing research, product and marketing into the area, it's companies less used to building boxes who have the lead.

Over the summer, mobile phone provider O2 is launching O2 Smart Home, which is a version of AT&T's US platform Digital Life. It's a single app that can handle any protocol and, using a geo-aware smartphone app, can automatically sense when nobody is at home, meaning the heating system can be switched to a savings mode.

"When it comes to our homes as a whole, the experience is mostly stuck in analogue," says O2's digital director David Plumb. "Where there are smart devices, often these operate independently of each other making the experience disjointed and complicated to manage. The overall experience isn't smart. Where 'digital' is turning radiators off via your mobile, 'smart'

> " Once you separate out the gadget enthusiast market, the main reason consumers express an interest in the smart home and the main function they're looking for is saving money

COMMERCIAL FEATURE

UNLOCKING AN ADVANCE IN HOME TECHNOLOGY

A technology firm has replaced physical keys with smartphones and embedded intuitive systems inside traditional door locks

UniKey ERA

Smart home technology is still in its infancy. Operating a high-tech stereo system, lighting array or appliance no longer requires getting up off the sofa to manage settings. Some of these devices can now be controlled with an app or voice command. But none of them can anticipate a homeowner's needs and truly simplify mundane tasks – yet.

This next evolution of the internet of things (IoT) is burgeoning from the gateway to a home, office, even hotel room, from the front door. Instead of a key or key card, people can now securely access their home, workplace or holiday rental with nothing more than a simple touch of a lock. And with that touch, other events in the home can be triggered.

This is possible as a result of technologies developed by UniKey. The technology firm has replaced physical keys with smartphones and embedded intuitive systems inside traditional door locks.

"The technology is passive; it runs in the background," says Dirk Wyckoff, vice president of sales and marketing at UniKey. "There's no need to search for a key or take out a smartphone to open an app. A simple touch of the lock starts the transaction; the lock looks for an authorised smartphone and then opens the door in a flash."

Homeowners in the UK will soon be able to upgrade their homes with next-generation smart technologies. UniKey has recently partnered with ERA, a lock manufacturer that has been securing Britain's homes since 1838, to introduce new ERA TouchKey smart locks.

Will Butler, marketing and innovation director at ERA, says homeowners can expect the same reliable security from this new connected lock as they expect from ERA's traditional products.

"With today's busy lives, what people crave is simplicity, convenience and peace of mind," he says. "The use of Touch-to-Open® technology, so you don't have to fumble with keys, plus bulletproof security encryption means the locks on your home can be smart, and also

meet the latest security standards and insurance requirements, so you really can have the mix of peace of mind and convenience."

> " A simple touch of the lock starts the transaction; the lock looks for an authorised smartphone and then opens the door in a flash

Enhanced security features in the ERA TouchKey smart lock powered by UniKey also enable the lock to know on which side of a door an authorised electronic key is to prevent unwanted access. This means the lock will not be triggered to open, giving access to someone outside when an authorised device is with someone at the spyhole on the inside.

Further conveniences of smart locks operating on the UniKey system include the ability for the lock to interact and communicate with other IoT devices within a space. This feature is what Mr Wyckoff believes will help drive smart home technology beyond flashy gadgets controlled by an app to intelligent device ecosystems that are able to change how they act based on particular circumstances.

For example, when a user taps a lock to open a door, a lock powered by UniKey sends a signal to a smart thermostat, such as Nest, alerting it to an arrival so settings can be adjusted automatically to each individual's comfort preferences.

As smart technology continues to advance, homes will become more environmentally friendly and efficient, and enhance the lives of the people living within by anticipating their needs. It all begins with a simple upgrade at the front door.

For more information visit www.unikey.com or www.erahomesecurity.com

Don't let the kettle take over

Security surrounding the internet of things needs tightening if hackers are to be stopped from hijacking a tech revolution

SECURITY

CHARLES ORTON-JONES

There are two main points to make about security of the internet of things. The first is that it's terrible. Abysmal. This is a fact. No one disputes it. "IoT security is in the dark ages," is how Ken Munro of cyber security company Pen Test Partners puts it.

"Many IoT devices are hitting the shelves that simply aren't secure and can easily be compromised and used to launch attacks on the home network or the mobile device they connect over," he says.

Mr Munro's company has made a name for itself by hacking internet-connected devices. It has hijacked kettles in order to gain control of a home network. It has demonstrated how to watch CCTV footage without the owner's consent. It's depressingly easy. A survey by HP suggested 70 per cent of IoT devices are insecure. Even amateur bunglers can hijack some mainstream products.

The second point is that consumers don't seem to care. At least, not yet. Despite the deluge of bad publicity about security, the industry surges on.

The question for the future is when this carefree attitude will turn sour. Consumers are blasé today. In the future, when it becomes clear that hackers and bored teenagers alike are seizing control of IoT devices for nefarious ends, the mood may change. And the industry needs to take action before that negative reaction becomes a threat to its viability.

We've already had a few warning shots. Last July, Fiat Chrysler recalled 1.4 million vehicles after two security researchers demonstrated how to hack the Uconnect dashboard computer system of a Jeep Cherokee. The hack provided wireless control over the steering, transmission and brakes. The incident triggered a rash of articles in newspapers and magazines speculating about the harm that could be done in a similar attack.

At the DEF CON hacker conference in Las Vegas, a hacker by the handle Zoz said: "I'm a huge fan of unmanned vehicles. I love robots. I think they're the future. But, like everything else humans ever made, it's going to get hacked." The possibilities for mischief are terrifying. Terrorists could use cars as missiles to smash into targets. Thieves could steal driverless cars from garages – they'll just drive off, never to be seen again.

Home networks are the current focus of hackers. Not a week goes by without a fresh vulnerability being disclosed. Research teams amuse themselves by finding the most improbable angle of attack.

Kaspersky Lab found a way to exploit a coffee machine to gain control of a home wi-fi network. Canadian privacy lobbyist Open Effect wrote a report on how to snaffle data from personal fitness devices. There have been hacks on smartfridges, internet-connected kettles and children's toys.

Research suggests consumers are slowly waking up to the danger. A survey by Fortinet suggested 68 per cent of homeowners are concerned about a data breach from a connected device. Fortunately, sales do not yet seem to have been harmed.

So what does the industry need to do to guarantee a satisfactory level of security?

According to the leading names in the industry, it seems there is a huge amount of work to do.

It starts with the industry thinking about security from product inception. This will be a big shift. "Unfortunately, security is often an afterthought," says Chris Boyd, an analyst at Malwarebytes. "This is largely because it's expensive to ensure a reasonable standard of protection on a product, but also because there still seems to be a genuine lack of knowledge around basic cyber security precautions for IoT device manufacturers."

The industry needs standards. Simon Heron, chief technology officer of Redscan, points out that the current situation is a bit of a shambles. "There are many IoT protocols in the market, such as advanced message queuing protocol (AMQP), digital data service (DDS), the constrained application protocol (CoAP), ZigBee and others," he says.

"These do not lend themselves to a coherent security posture, especially as the protocols are being extended to cope with the requirements of implementation."

Often even simple things are missing. Passwords are too short or don't lock accounts when multiple attempts are made, making it possible to crack via a brute force attack. Mr Heron points to the Nissan Leaf electric car, which had a vehicle identification number stencilled on the windscreen. "It was only the last five digits of this number that varied, so an unattended car could be controlled remotely," he says.

Devices are often on the same network. So when one device is hacked, the whole ecosystem is exposed. The solution? "Network segmentation is a practice we need to start seeing in homes," says Paco Hope, principal security evangelist at Cigital.

"It should impose isolation so no device on that network can see any other device on the network and they should not be able to connect to any devices on the home wi-fi networks in the house. And frankly, a third 'guest' network for visitors and their phones would be a good idea."
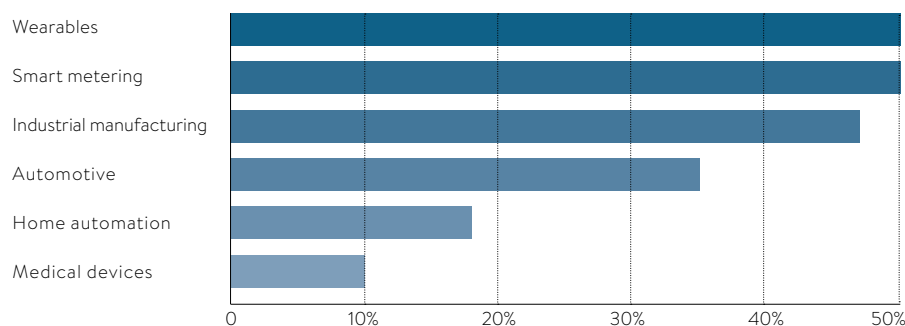
Firewalls will play a big part. Manufactures should offer bounties to hackers, just as Facebook does to white-hat, ethical hackers.

In the end, consumers may hold the solution. "Given the apathy of vendors, the user currently needs to be proactive when buying an IoT device," advises Mr Munro of Pen Test Partners. "Ensure you change the default settings and configure the device securely by implementing a PIN; don't publicise your purchase online; use a unique password for your user account, not the same account passwords as you use for other sites; and, in the case of RFID [radio-frequency identification] tech, shield the device when not in use."

Consumers should only buy from vendors who take security seriously. This revolution is too exciting to be halted by hackers and teenage saboteurs. The companies who understand that should be rewarded with your custom. And those that don't – good riddance.

> **Thieves could steal driverless cars from garages – they'll just drive off, never to be seen again**

Getty images

Fiat Chrysler recalled 1.4 million vehicles last year after researchers demonstrated how to hack the Uconnect dashboard computer system of a Jeep Cherokee

RESILIENCE OF IoT PRODUCTS TO CYBER ATTACKS

Percentage of IoT professionals who rated the following products highly resilient

Product	
Wearables	
Smart metering	
Industrial manufacturing	
Automotive	
Home automation	
Medical devices	

0 10% 20% 30% 40% 50%

Source: Capgemini 2014

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Securely control your devices

IoT demands secure and seamless connectivity between devices.

Simulity introduces their next generation embedded SIM (eSIM) and remote provisioning platform enabling the secure control of devices.

To find out more about Simulity visit www.simulity.com or contact us info@simulity.com