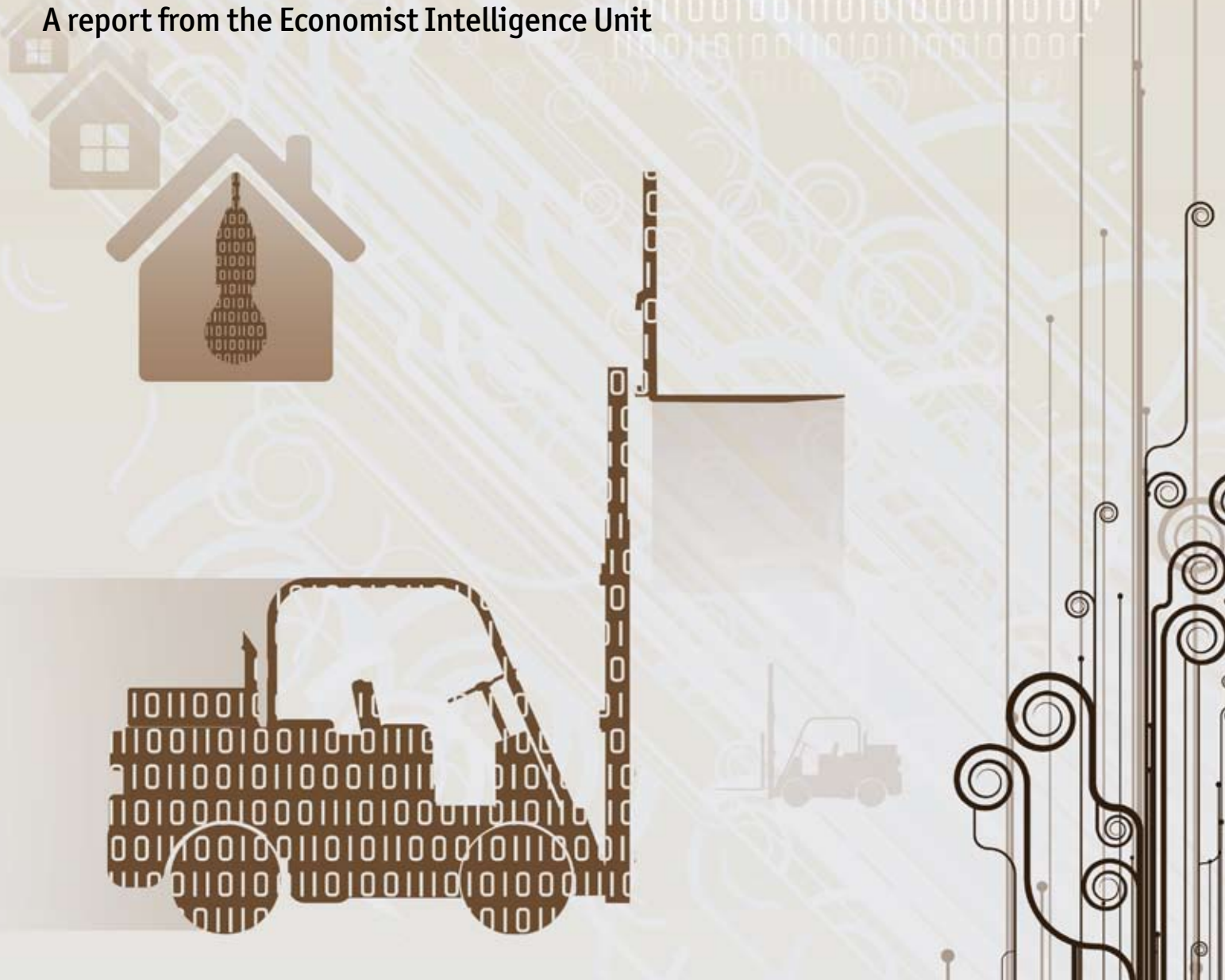


Rise of the machines

Moving from hype to reality in the burgeoning market for machine-to-machine communication

A report from the Economist Intelligence Unit



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Preface

Rise of the machines: Moving from hype to reality in the burgeoning market for machine-to-machine communication is an Economist Intelligence Unit report, sponsored by SAP. James Watson was the report author and Jason Sumner was the editor.

The report draws on wide-ranging desk research, cited extensively in the text, in combination with numerous in-depth interviews with experts and executives in the field. Our thanks are due in particular to the following for their time and insights (listed alphabetically by organisation).

- Scott Kurth, director, Accenture Technology Labs
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- Liz Parminter, energy expert, PA Consulting
- David Stansell, M2M expert, PA Consulting
- Richard Hutchinson, general manager: usage-based insurance, Progressive Insurance
- Carlo van de Weijer, vice president: traffic solutions, TomTom
- Marc Sauter, head of global M2M business development, Vodafone
- John Keough, M2M analyst, Yankee Group



Executive summary

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The promise of a world of connected devices, in which machines of all types and sizes can autonomously communicate with each other, has long been imagined. GM's OnStar business, which provides a growing range of in-vehicle services, has been around for some 17 years. But the past year has seen a surge of interest around the core enabling technology of the connected world: machine-to-machine (M2M) communication. Much of this interest stems from mobile operators, who are eagerly awaiting the possibility of connecting cars, homes, equipment, heart sensors and all manner of other devices to their networks to find new revenue sources.

Another reason for the surge in interest is that costs for the industry's underlying technologies – especially the sensors, processors and wireless connectivity that form the core of any M2M system – have fallen past a crucial milestone, into the single digits of euros or dollars. This is only part of the equation, but it has lowered the barriers to entry sufficiently to make the technology interesting to a wide audience. Despite all this, however, deploying an M2M-based application today remains a major undertaking for interested companies, which must battle with still-maturing technologies and partner ecosystems, among other factors.

This report, based on extensive desk research and wide-ranging interviews, examines the business models behind successful M2M applications across sectors, identifies the factors that will drive further take-up, and puts forward action points for businesses and governments to address in order to overcome barriers to widespread adoption. The key findings are as follows.

M2M market forecasts vary, but all predict big growth potential.

Forecasts by analysts promise anything from 12bn to 50bn devices connected by 2020, up from just 1bn in 2010. Machina Research, an analyst, predicts revenue of €714bn (US\$948bn) by 2020, including hardware and connectivity, a nearly eight-fold increase from €91bn (US\$121bn) in 2010. Although such forecasts can sometimes prove to be overly optimistic, they are whetting the appetite of many eager participants.

Cheaper technology and smaller devices will drive take-up.

Sensors, microprocessors and wireless technologies that once cost hundreds of dollars are now available for as little as the cost of a cup of coffee. Cloud computing and the ubiquity of smartphones will also drive adoption. Regulation

is forcing uptake in some sectors such as energy and automotive.

M2M business models based on proven efficiency and cost savings will see the most growth in the near term.

Energy, automotive, healthcare, retail and manufacturing are just some of the major vertical markets actively deploying M2M-based applications today. Greater efficiency and cost cutting are benefits that attract particular attention during tough times, such as automatic fleet tracking or operating driverless forklifts. Overall, Yankee Group, a technology research and consulting firm, forecasts that market segments focused on cost cutting will see the greatest growth, of some 17% per year between 2011 and 2015. In addition, the most successful business models benefit everyone in often complex supply chains. For example, Vitality GlowCaps, a connected pillbox, benefits patients by ensuring that they take their medicine and automatically ordering refills; pharmaceutical firms, which receive regular orders; and doctors, who are automatically updated on patients' adherence to prescriptions.

Ultimately, long-term growth and innovation will come from experimentation within individual sectors, but many firms either do not understand the technology or have doubts about the true business benefits.

M2M's breakthrough potential lies in entrepreneurs and existing companies using the technology to create wholly new products and services, or in adding better quality of service to existing ones. GM's OnStar offering is now available as a subscription service for its rivals' vehicles, as one example. British Gas, an energy utility, has created a new home security service. However, a recent poll of businesses by Gartner, a technology analyst firm, found many with no plans to adopt M2M, largely owing to lingering doubt over its ability to provide measureable business value. A related challenge is the relatively limited awareness of M2M technology. More agreement over technology standards, a simplified provider ecosystem and the expansion of cloud-based services will all help to establish a platform for creativity.

In the coming decade telecommunications operators will need to standardise platforms, explore new partnerships and advance the sophistication of their offerings, all while making it simpler for end users to compare which packages best fit their needs.

Operators and systems integrators must standardise technology platforms and develop open protocols to allow for tighter integration between sensors, devices and other hardware. Partnerships, sometimes with competitors, will be key in achieving this. Operators and their partners will need to overcome IT challenges

Defining machine-to-machine (M2M)

What does M2M encompass? One common definition describes it as "connections to remote sensing, monitoring and actuating devices"; another is simply "communications technology that allows machines to speak to one another". In both of these, it is usually regarded that there is a device, linked to a network, with some degree of communication and business logic being applied. These connections often happen via mobile networks, but could also simply be via wireless or

other networks. Examples are wide-ranging, as this report will highlight: from scales that transmit weight to a physician's systems to automated forklifts in a warehouse. However, for end-users M2M itself is not the point, it is merely an underlying technology that connects their systems – whether vehicles, factories, homes or otherwise – to enable new products and services.

too, such as ensuring that the new multitude of M2M data flows can be integrated into existing enterprise IT systems. Another barrier in this area is the difference between the lifespan of M2M devices, which can be designed to last two decades, and the type of networks on which they operate, which can have a much shorter shelf life. Telecoms firms will continue to experiment with their own business models: moving away from selling airtime, for example, and instead providing managed services, from transaction platforms through to back-end data analytics. Some of these decisions will drive down operators' margins, but broad market adoption will not come without this.

Governments will need to address growing spectrum congestion, help simplify technology standards and consider streamlining regulations in some sectors to foster innovation.

Although in some sectors, such as energy and automotive, regulations are a driver, in many sectors they are a hindrance to further adoption and innovation. Take incentives in healthcare:

many doctors are reimbursed by the patients they see, not the ones they don't. This hardly helps to prioritise M2M deployments that solve patient problems without a hospital visit. Regarding technology standards, for the sake of industry, this should ideally be done in parallel with other countries, to ensure consistency across borders.

Customer concerns about privacy and security will determine the viability of many M2M applications. Businesses will need to experiment through pilots and close attention to customer feedback to understand what customers will accept.

Just as the emergence of social networking has created a debate about the boundaries of privacy in society, a connected world will also test social limits. So far customers have proven willing to allow personal information, such as present location or driving behaviour, to be shared on a limited basis in return for savings on car insurance premiums, for example, and assurances that their data are protected.

Introduction

The disruptive potential of a connected world

Since its inception, the notion of connecting the physical world to the online one via some kind of wireless communication has been a captivating idea. Connecting a simple electricity meter can enable people to monitor and control their energy use. Adding cars, trucks, tractors and manufacturing equipment to the network allows for optimisation, remote monitoring and new kinds of services. At a personal level, connected devices can monitor our vital signs, automatically notifying doctors of any unusual changes to our health.

A history of rosy futures

None of these ideas are new. But long-time believers in the potential of machine-to-machine (M2M) technology have had to be patient to see such a reality emerge. In 2004 *BusinessWeek* reported on the huge potential for M2M, noting that it could be a US\$180bn (€141bn) business by 2008.¹ The food giant Nestlé was an early adopter, installing sensors in hundreds of ice-cream vending machines to monitor stock levels. Three years later a special report in *The Economist* tracked the ongoing development of the sector, noting the seemingly endless new possibilities it offered.² But it also outlined that progress

was not moving as rapidly as hoped: in 2007 the industry was worth something between US\$25bn and US\$48bn (€20bn–€38bn), depending on what was included in the tally. By 2010 this had climbed to €91bn (US\$121bn), according to Machina Research: a significant market, but some way short of earlier forecasts.

It's real this time

Fast-forward to 2012, and much of what used to be M2M whiteboard concepts can now be found in the field. The Fonterra Co-operative Group, a New Zealand-based dairy company, has set up autonomous forklifts within a warehouse that can work around the clock, with far fewer accidents and reduced wear and tear. US-based Progressive Insurance, one of several insurers providing usage-based insurance packages to drivers, sets rates based on actual driving habits. The OnStar system of General Motors (GM), which provides services ranging from automatic collision notification to remote door unlocking, now has 6m active subscribers. The latest devices from TomTom, a satellite navigation provider, automatically tally traffic information from millions of users to set better routes for other drivers. Logistics firms such as UPS use M2M in their vehicle fleets not only to optimise driving routes, but also to provide live package tracking information for customers.

¹"A machine-to-machine 'Internet of things'", *BusinessWeek*, April 26th 2004.

²"When everything connects: The coming wireless revolution", *The Economist*, April 26th 2007.

The market will be THIS big

Growth forecasts for machine-to-machine devices are usually based on expected revenue or the number of connections.

M2M forecasts by revenue: Machina Research, an analyst, forecasts revenue of €714bn (US\$948bn) by 2020, including hardware and connectivity, a nearly eight-fold increase from €91bn (US\$121bn) in 2010. For mobile operators alone, US-based ABI Research, a technology market research firm, estimates annual revenue in 2016 of US\$35bn (€26bn), with automotive accounting for the biggest single sector. Yankee Group, a technology research and consulting firm, is more parsimonious here: it sees connectivity revenue doubling between 2011 and 2015, but to just US\$6.7bn (€5.1bn).

M2M forecasts by number of connections: Perhaps the most widely cited figure comes from Ericsson, a telecommunications company, with

its vision of 50bn connected devices by 2020, which includes both M2M and other devices.³ Focusing solely on M2M, Machina Research estimates the total number of devices will expand from 1bn in 2010 to 12bn in 2020.⁴

Individual company targets: Individual companies, both providers and end users, are guarded with their own financial targets and often do not disclose them at all. However, as an indicator of expected potential, Logica, an IT consultancy, has set annual growth targets of 25% to 30%, with an expected revenue pipeline of £120m (US\$191m) for M2M solutions in the next year, according to Craig Wood, Logica's global head of M2M. On the end-user side, Ideal Life, a manufacturer of wireless health tracking devices and the subject of a case study later in this paper, has published return on investment figures of US\$7.57 (€5.71) for every US\$1 (€0.75) invested in its M2M devices.

³More than 50 billion connected devices, Ericsson, February 2011.

⁴M2M global forecast and analysis 2010-20, Machina Research, October 2011.

Broad reach

A snapshot of M2M's diverse potential

Sector	Example applications	Major driver
Smart buildings	Automated monitoring of heating, ventilation and cooling	Reduced energy costs
Smart cities	Street lights that dim when roads are empty	Cost savings
Automotive	Emergency calling and accident alerts	Regulatory requirement
Leisure	Leisure vehicle and boat tracking	Safety and security
Consumer electronics	Connected satellite navigation devices to monitor traffic jams	Product innovation
Health	Remote monitoring of patients and personal health monitoring	Cheaper, home-based care
Utilities	Smart meters and energy demand response	Regulatory requirement
Transport and logistics	Fleet optimisation and supply-chain tracking and tracing	Cost savings
Retail	Wireless payments	Retail innovation
Manufacturing	Predictive maintenance through improved system monitoring	Reduced maintenance costs
Construction	Monitoring usage of equipment to improve efficiency and cut fuel usage	Cost savings
Agriculture and extraction	Remote monitoring of farm or mining operations and equipment	Proactive maintenance
Emergency services and national security	Disaster response and critical infrastructure protection	Faster response times

Sources: Machina Research; Economist Intelligence Unit.


Proven deployments

In short, in a range of applications the merits of the technology are now increasingly proven. Depending on the sector, these typically include one or more of the following: more cost-effective processes; greater efficiency; the possibility of new business models; and better quality of service (see table). Gartner sees “enormous” cost reduction and business growth prospects from the technology.⁵ The biggest potential currently appears to lie within automotive and fleet management, healthcare, consumer electronics and energy. This has resulted in another blizzard of growth forecasts, which try to call the potential size of the industry by the end of this decade - all of which are variations of “big” (see box).

Towards widespread adoption

But various barriers still need to be overcome to spur M2M’s wider uptake. Despite these encouraging examples, relatively few have hit the mass market. Issues vary widely by sector, too, making it hard to deliver uniform progress. Healthcare gives one clear example. Despite huge potential to enable automated remote monitoring of patients, for example, challenges can be hard to overcome. Take incentives: many doctors are reimbursed by the patients they see, not the ones they don’t. This hardly helps to prioritise such deployments.

Nevertheless, positive progress on costs, standards, partner ecosystems and more are all helping to develop the potential of a connected world, as highlighted in the next chapter.



⁵ 2011: *The year of M2M and a new outsourcing frontier*, Eric Goodness, Gartner, June 9th 2011.

Sector in focus: Automotive

Share of M2M market (in terms of total connections): 8% in 2010.

Key sub-sectors: Remote unlocking, satellite navigation, in-car entertainment, on-board diagnostics.

Main drivers: Regulatory requirements, from on-board diagnostics to proposed eCall legislation (automated emergency calling); ubiquitous cellular networks; proven opportunity for new services to be developed; shrinking technology footprint and cost.

Primary challenges: Need for wide-ranging partners to support related services; crossborder connectivity for vehicles; legal considerations over road safety.

Example M2M application: TomTom, a provider of satellite navigation devices, uses two-way M2M communication with its millions of users to build a real-time map of traffic across 22 countries, which it then uses to calculate more accurate routes for drivers.

Case study: GM OnStar

M2M advocates looking for an exemplar of its creative potential need look no further than GM's long-running OnStar business. First developed some 17 years ago, it has gone through nine generations of hardware development - a far faster rate than its parent automotive business. During this time, the technology has shrunk steadily from some 50 different parts that took a week to install (at great expense) to something that can be provided within the size of a rear-view mirror, which GM now sells for third-party vehicles in exchange for a monthly or annual subscription. Although the company does not disclose revenue figures, it has over 6m active subscribers, major brand recognition and a platform that has helped give it a specific competitive advantage.

Diverse partnerships: police to doctors to mapmakers

Partnerships have been a crucial element in the company's ability to bring new services to market, which at times has required it to team up with unfamiliar organisations. Early on, it worked with US emergency services agencies to ensure that crash data could be transmitted

accurately, including the development of a custom database of public-service answering points. Various map providers are needed for the latest road information and navigation support. More recently, it has partnered with medical specialists to launch a "digital crash signature", based on wide-ranging vehicle sensor data, which aims to help inform doctors about the passengers' potential injuries. It also works with the police to hone its vehicle theft-prevention functionality when needed.

Fostering new apps

Most recently, the GM OnStar ecosystem has opened up further, by creating new programming interfaces (or APIs) that allow third-party developers to build applications (apps) that use its underlying system. One app, Remote Link, gained over 250,000 users in its first 12 months, allowing people to confirm remotely that they have locked or unlocked their car, or to start or stop it, or receive diagnostics on it. Expect more innovation to continue.

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M2M drivers for the next decade

Approaching the tipping point?

For M2M advocates, the dawn of 2012 offers much hope, as many of the vital building blocks for the technology have steadily been falling into place. So what has changed to mark this transition, and what will drive take-up in the next decade? Marc Sauter, the head of global M2M business development at Vodafone, a mobile communications firm, argues that there has been an “inflection point”, with a range of developments helping to make the technology less complex, while costs have fallen. Future drivers vary across vertical markets, but are likely to include one or more of the following:

- Falling costs, wider connectivity and maturing technologies
- Regulatory mandates
- A growing range of successful applications and business models
- Efficiency returns in an age of austerity
- A maturing provider ecosystem
- Rise of the cloud.

Each is explained in more detail below.

Falling costs, wider connectivity and maturing technologies

Perhaps the most important driver will be the hi-tech industry’s sustained ability to increase

the underlying technology’s capabilities while simultaneously cutting costs. “The fundamental economic reason why M2M’s potential has appeared, relatively suddenly, is that the cost of introducing communications technology to other electronic devices has gone below the threshold required to make it viable for many applications,” says David Stansell, an M2M expert with PA Consulting, a consulting and technology firm, who describes a general fall from “tens” of dollars or euros a few years back to just single-digit costs. “It’s approaching an order of magnitude cheaper now.”

In line with this, the number of intelligent devices in the field is rapidly expanding, with their physical size getting consistently smaller, which in turn opens up more possibilities. At the same time, the costs of network connectivity have also fallen, while coverage - whether cellular networks, wired or wireless local networks, or some form of point-to-point network - has steadily widened. Meanwhile, the introduction of new, high-speed networks, such as fourth-generation (4G) mobile networks, will start to allow new kinds of high-bandwidth applications.

A related technology trend has also taken hold in the marketplace, with major implications for M2M: the spread of smartphones and tablet devices, along with hundreds of thousands of

Sector in focus: Healthcare

Share of M2M market (in terms of total connections): 6% in 2010.

Key subsectors: Telemedicine, remote monitoring, assisted living, connected medical environments.

Main drivers: Healthcare reforms; rising costs of healthcare; ageing societies and greater emphasis on home-based care; growing proportion of “worried well” consumers keen to monitor their health.

Primary challenges: Identifying workable business models that fit with healthcare

incentive schemes; long lead times to get regulatory approval on new devices; highly complex ecosystem to connect between doctors, hospitals, ambulances, care homes and more.

Example of successful M2M application: Vitality GlowCaps, a connected pillbox that tracks patients’ usage and phones them if they forget a pill, automatically orders refills from their pharmacy and updates their doctor on their adherence to the prescription. The business model succeeds by benefitting all parties: patients adhere better to prescriptions, pharmaceutical firms sell more products; doctors achieve better health outcomes.

Case study: Ideal life

Ideal Life, a manufacturer of wireless health tracking devices, gives a useful example of the potential. One of the company’s devices is a wireless scale for congestive heart failure (CHF) patients, of which there are some 5.3m in the US. Treatment is costly: the US spent US\$34.8bn in 2008, largely on hospitalisation. The scale uses M2M to transmit patients’ weight data back to their doctors’ servers, which in turn automatically flag any changes in weight that could be symptomatic of a looming problem, in order to address it before hospitalisation is required. Patients require no training, and there is no need to plug in or set up any devices; they simply need to weigh themselves once a day.

Clear return on investment

Compared to telephone-based self-reporting of data, a more typical approach, Ideal Life’s product has shown clear reductions in hospital admissions, later re-admissions and related costs. It reports a return on investment of US\$7.57 for every US\$1 invested.⁶ “The striking difference is not only the healthcare savings and reductions in costs around re-admission rates to hospitals, but the high adoption rates of individuals using our platform,” says Jason Goldberg, the company’s founder and president.

apps. This has driven user awareness and demand for apps that allow people to monitor and control aspects of their lives or businesses, whether the temperature of their home or the system-uptime of their production equipment.

Regulatory mandates

For two specific vertical markets, regulation will be far and away the main driver. One is

energy, where the EU has mandated that 80% of European homes need to have a smart meter installed by 2020. “This will drive adoption faster than any commercial imperatives,” says Matt Hatton, a director at Machina Research. Another is automotive: the European Commission aims to have “eCall” functionality built into all new cars by 2015, aimed at providing an automated emergency calling service in the event of an

⁶White paper: Congestive heart failure, Ideal Life, June 2008.

accident. Outside the EU, Russia is considering its own eCall legislation, and the Brazilian government has begun steps to require telematic anti-theft devices in all cars. Healthcare reforms, especially in the US market, will also help. While not directly related to M2M, some aspects of reforms seek to change the focus towards better healthcare outcomes, to curb spiralling inputs.

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The early adopters are starting to come forward with the success of their deployments, and many of them have a complete return on investment within a year-and-a-half to two years.

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John Keough, M2M analyst, Yankee Group

A growing range of successful applications and business models

Imitation is a powerful driver, as successful applications are proven in the market and then rapidly copied. One useful example comes from Amazon's Kindle ebook reader. Its third-generation (3G) model ships with free connectivity anywhere in the world, a cost which Amazon absorbs within the price of the device itself. "It shows the interesting dynamics at play here, about who bears the risk. If you take a mobile broadband package, it's clear that you pay for the data usage. But with M2M, where the connectivity is opaque, you don't see that," notes Mr Hatton. In the manufacturing sector, many of the remote monitoring services on offer are built into the price of the equipment being bought. Brands such as Caterpillar, AGCO and John Deere have long incorporated telematics into many of their high-value vehicles and equipment, to automatically monitor and proactively advise on the need for maintenance.

Efficiency returns in an age of austerity

Impressively, M2M applications have thrived through several years of restrained capital spending, given the fragile economy. The reason lies in M2M's ability to help trim organisational fat. "The early adopters are starting to come forward with the success of their deployments, and many of them have a complete return on

investment within a year-and-a-half to two years," says John Keough, an M2M analyst at Yankee Group. Overall, Yankee Group forecasts that market segments focused on cost cutting will see the greatest growth, of some 17% per year, between 2011 and 2015.

A maturing provider ecosystem

One of the basic challenges for many prospective end users has simply been in working out who to turn to for help: the sensor manufacturers, systems integrators or consultants, or telecoms firms directly? Such decisions will be easier in the near term, not least owing to a major push from mobile operators to set up packaged offerings. Nearly all major telecoms companies have now set up dedicated M2M units to help businesses implement various kinds of related applications. The aim, at least for some, is to switch from being a utility capacity-based model to a service model. In trying to deliver this, partnerships are crucial, and so ecosystems of companies are emerging - encompassing device makers, telecoms providers and consulting firms aiming to stitch offerings together.

Rise of the cloud

A final technology trend that is serving to boost M2M is cloud computing. Until the advent and proliferation of the cloud, any new application required a suitable back-end server infrastructure, often with little certainty about the potential scale of use or volume of data flow. But the spread of low-cost cloud-computing vendors is helping to ease the rollout by providing flexible and scalable technology platforms to support them.

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Path to progress

Action points to overcome M2M barriers

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M2M is a building block. The question is what you can do beyond that.

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Scott Kurth, director at Accenture Technology Labs

M2M's advocates have had much to celebrate in recent years, but numerous challenges remain on the path ahead. Some are applicable across all industries, while others are specific to a particular sector. But in order for M2M to deliver on its true potential, a number of stakeholders - including end users in the industry verticals, service providers and regulators - need to address the following action points.

- Firms need to innovate within sectors, but many sceptics remain to be convinced.
- Telecoms operators need to continually develop their own business models and customer offerings.
- A complex ecosystem can benefit providers at the moment, but it will need to be simplified for widespread take-up.
- To win new business and convince sceptics, the provider community needs to agree technology standards, develop open protocols and establish network technology that will last over long deployment periods.
- Governments will need to address growing spectrum congestion, help simplify technology standards and consider streamlining regulations in some sectors to foster innovation.
- Customer concerns about privacy and security will determine the viability of many

M2M applications. Businesses will need to experiment through pilots and close attention to customer feedback to understand what customers will accept.

Firms need to innovate within sectors, but many sceptics remain to be convinced.

Ultimately, firms will need to experiment within their target areas to see which applications prove fruitful. “M2M is a building block. The question is what you can do beyond that,” says Scott Kurth, a director at Accenture Technology Labs, a consulting firm. Some applications, such as fleet management, are relatively well established; others within healthcare, for example, remain less certain. In manufacturing the steady spread of connected devices is helping businesses experiment with new services on top of their existing physical products. A manufacturer selling a specialist printer or other industrial machinery might first incorporate M2M to monitor performance, before then adding a service contract. Later, it could even use this to switch its business model towards simply leasing machines on a per-use model, taking a share of the revenue of that business. “There are still a lot of people who are essentially describing M2M as a Swiss army knife and getting terribly excited about how

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Business can see the potential of M2M. But then there are so many questions about what you do with it... and we're very much at the beginning of that phase of exploration.”

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David Stansell, M2M expert, PA Consulting

⁷ *Machine-to-machine and the Internet of things in 2012: Big on hype, addressable market potential and pain, Eric Goodness, Gartner, January 11th 2012.*

many blades it has got [but without knowing how to make use of these],” says Craig Wood, the global head of M2M for Logica, a technology consultancy.

In addition, there is still a relatively limited awareness of M2M in general. “Users need more education in terms of what you can do with M2M, how they adjust the business model, and how much cost they can save, or additional revenue they can achieve by launching new services,” says Vodafone’s Mr Sauter. And a recent Gartner poll of businesses found many with no plans to adopt M2M, largely owing to lingering doubts over its ability to provide measureable business value.⁷ “Business can see the potential of M2M. But then there are so many questions about what you do with it, how you roll it out, what the benefits are to end users, and we’re very much at the beginning of that phase of exploration,” says Mr Stansell of PA Consulting.

More agreement over technology standards, a simplified provider ecosystem and the expansion of cloud-based services will all help to establish a platform for creativity. In the coming decade, highlighting possibilities will also need to be a key target for mobile operators and others within the provider community. Some work is already under way: in the US, AT&T, a telecoms operator, has even run a television advert highlighting how its network can help firms manage stock levels in vending machines, for example.

Telecoms operators need to continually develop their own business models and customer offerings.

While many operators are eagerly awaiting the spread of billions of new devices to add to their networks, the reality is that the dynamics of M2M-based usage are strikingly different from normal mobile-phone users. This can make it harder to identify profitable niches and bring standardised offerings to market. Many connected devices transmit minuscule volumes of data: smart meters, for example, sometimes

use as little as 50 US cents per month, compared with approximately US\$45 for a usual mobile-phone user. This can make it challenging to find a profitable approach, while potentially giving deep-pocketed operators the best chance of capturing certain markets.

In response, telecoms firms are changing their own businesses: moving away from selling airtime and instead providing managed services, from transaction platforms through to back-end data analytics. Analysts see huge potential here. Machina Research estimates that the revenue potential for operators is ten times higher than what they get from traffic alone. But few operators can hope to deliver an end-to-end solution: this makes partnerships crucial.

A complex ecosystem can benefit providers at the moment, but it will need to be simplified for widespread take-up.

For any aspiring executive hoping to develop a new M2M-based offering, a daunting ecosystem awaits, of which mobile operators are usually just one part (see box). Depending on the application, specialist sensor manufacturers might be needed; systems integrators and software developers have to link various platforms and build applications; cloud providers may be needed; and so on. This raises many thorny questions: which partner should take the lead on all this? And how can the complexity be managed across multiple third parties, given natural partner rivalries?

Right now, such complexity serves to benefit operators, by providing scope for higher margins. However, what will be crucial in the coming decade will be for telecoms firms to advance the sophistication of their offerings, while at the same time making it simpler for end users to compare which packages best fit their needs and payback requirements. This will drive down operators’ margins, but broad market adoption will not come without this.

Energy-sapping: M2M's complex supply chain

As this report has highlighted, bringing an M2M solution to market often involves dealing with a complex supply chain of partners. Even a relatively mature application, such as smart meters, can require lots of help. British Gas, for example, is in the midst of a major rollout of smart meters in the UK. One of its headline partners is Vodafone, a telecommunications firm, which is providing the connectivity for over 1m such meters. As part of the deal, a range of partner companies are involved in providing the necessary components and skills, including Logica, a consulting firm, and Landis+Gyr, a provider of smart meters. In turn, Landis+Gyr will likely partner with other

specialist providers, to handle issues such as data management.

To help simplify such rollouts in future, both utilities and mobile operators are actively lobbying energy regulators, such as Ofgem in the UK, to try and create more standardised and centralised systems. For other sectors, operators are even forming partnerships with rivals, to help provide co-ordinated offerings to customers. Welcome to M2M's diverse supply chain.

Sources: Ovum; Vodafone.

To win new business and convince sceptics, the provider community needs to agree technology standards, develop open protocols and establish network technology that will last over long deployment periods.

Any major technology deployment requires a robust back-end platform to support it. But M2M can raise unique challenges in this area, including integrating data flows from millions of new nodes into existing enterprise IT systems. Indeed, M2M applications are often cited as one of the key issues relating to the rise of the "big data" challenge, a big concern within the technology sector.

Integrating IT systems

For more ambitious M2M applications, technology complexity can quickly spiral, not least when IT systems need to be integrated with suppliers and other third parties. A connected vending-machine application is a good example. For a soft-drinks machine, systems need to be linked between distributors, bottlers and logistics networks for the system to work at its best. "That isn't an out-of-the-box solution," says Bruce Thompson, the senior product manager for M2M solutions at AT&T. "It has to be integrated with dozens of

IT systems and interchanges between partners. It needs a strategic initiative to do something that complex." The further expansion of cloud computing (see previous chapter) will help with standardisation. Early M2M applications sought to connect devices directly to each other, perhaps linking a toaster to the fridge in the kitchen, with little sense of why or how this could be useful. Now, all devices can simply report their status to the cloud, while custom applications or analytics can be performed at a higher aggregate level. "Pushing data to the cloud got us out of a mindset that saw this as a point-to-point integration problem," explains Mr Kurth of Accenture.

Establishing standards and protocols

As with other technology developments, the creation of more advanced IT software platforms, with open protocols for linking in with other systems, will aid the development of M2M. Although many such systems exist today, too many deployments are still being done with proprietary systems created from scratch.

There has been some progress on technology standards, but more needs to be done. One is the introduction of Internet Protocol version 6 (IPv6), which removes a simple barrier of there

M2M's varying drivers and barriers

An overview of some of the key issues enabling and hindering rollout in key M2M growth markets

Sector	Major enabling factors	Major hindering factor
Automotive	eCall regulation, falling connectivity costs, potential for new services	Complex crossborder connectivity
Consumer electronics	Greater consumer appetite, spread of smartphones, the cloud	Choosing a business model, setting appropriate connectivity tariffs
Health	Spread of smartphones, falling costs of devices, the cloud	Regulatory delays, finding appropriate business models
Utilities	Regulatory requirement, falling costs of devices and connectivity	Developing viable value-added services, sourcing technologies that will last over long deployment periods
Transport and logistics	Falling costs of devices and connectivity, the cloud	Complex crossborder connectivity

Source: Economist Intelligence Unit.

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Increasingly we're seeing industry groups collaborating to form a standard because universal development practices and protocols will benefit all parties.

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John Keough, M2M analyst, Yankee Group

⁸“Global standards bodies put focus on M2M standards”, iTWire, 17 January 2012.

being too few unique IP addresses to support the spread of connected devices. The European Telecommunications Standards Institute (ETSI) recently announced a partnership with several other standards agencies to create a global M2M standard.⁸ “One of the problems now is everyone is promoting their own type of protocol or standard in the hopes that it becomes the industry standard,” says Mr Keough of Yankee Group. “It’s not really developing consistency across the industry. Increasingly we’re seeing industry groups collaborating to form a standard because universal development practices and protocols will benefit all parties.”

Harmonising lifecycles between devices and networks

Mobile operators also need to be clear about their longer-term technology roadmaps, to ensure that a proposed connectivity approach will be available over the lifecycle of the deployment. There is often a disconnect between the rate of network innovation of the telecoms sector and the proposed lifespan of some applications. A smart meter device, for example, may be intended to last for up to 20 years, while the second-generation (2G) communications network it uses could change or even disappear in that time.

Governments will need to address growing spectrum congestion, help simplify technology standards and consider streamlining regulations in some sectors to foster innovation.

Growing spectrum congestion and clearer technology standards are issues to which governments will need to give greater consideration to in the coming decade. For the sake of industry, this should ideally be done in parallel with other countries, to ensure consistent standards across borders. Similarly, further progress is needed around the development of international standards for M2M-related communications protocols, to help standardise offerings.

And while regulation is perhaps the most powerful driver in some markets, it can also serve as a barrier. Healthcare, in particular, faces challenges: regulatory approval for new systems can easily take the best part of a year – a long timeframe for firms in the hi-tech industry that are used to iterating far more rapidly. Similarly, while regulation in some areas can be inherently sensible – such as the rollout of smart metering to help with future energy demand management – implementation cycles can sometimes move ahead of the market.

The UK's smart-meter rollout, for example, is coming under increasing pressure to demonstrate that the benefits will outweigh the costs, given that the technology has had no time to prove itself. Technical considerations also come into play, not least about finalising wireless spectrum allocation for relevant devices, to ensure available capacity and not interfere with other signals. In the US, for example, about 200 customers in Maine who had smart meters installed discovered that the devices interfered with others, such as garage-door openers or baby monitors.⁹

Customer concerns about privacy and security will determine the viability of many M2M applications. Businesses will need to experiment through pilots and close attention to customer feedback to understand what customers will accept.

A connected world opens up not only new opportunities, but also new risks. Some of these have been overblown - there is little risk of hackers remotely destroying national

infrastructure, as one urban myth has it - but caution clearly needs to be exercised as the physical world gets merged into the virtual one. "In the past, people typically connected systems first and thought about security second," says Mr Kurth of Accenture. "Today, we're at a point where a curious college student as part of a class project might be able to find a way to take over different pieces of equipment around the world."

Just as the emergence of social networking has stimulated a debate about the boundaries of privacy in society, so too will a connected world test social limits. This usually plays out well in advance of any regulation that tries to control it, but there is a clear need for regulators to keep pace with developments here. "Are you happy for the insurance company to potentially know where you are in your car at any time of the day or night?" asks Mr Wood of Logica. Or, more to the point, your current energy usage, sleep patterns or overall health. Such considerations will be an inevitable part of the growing pains of a burgeoning industry.

⁹"Smart meters interfering with home electronics", Security Week, 23 November 2011.

Sector in focus: Energy

Share of M2M market (in terms of total connections): 12% in 2010.

Key subsectors: Smart metering, demand management; smart grids; support for electric vehicles; decentralised energy management.

Main drivers: Regulation mandating smart-meter rollout; interest in developing smart grids; falling deployment costs; rising energy generation costs; greater pressures to reduce energy emissions.

Primary challenges: Matching long-term deployment goals with short technology lifecycles; developing consumer

interest and awareness; integrating M2M on the network with back-end IT systems; lack of standardisation in key technologies; varying guidelines and approvals for smart-grid deployments.

Example M2M application: Enabling smart grids. Implementing M2M across electricity distribution networks, including intelligent switches and sensors that can detect faults in the line. Allows for live switching and rerouting of energy when a fault is detected. Also enables stable supply from renewable energy installations, by automatic switching from, say, solar generation when the sun is shining to battery supply when it is cloudy or the sun goes down.

Case study: British Gas & Duke Energy

Recent regulatory mandates have driven the rollout of wireless M2M-based smart meters to millions of homes, which are being deployed by companies such as British Gas in the UK or Duke Energy in the US. These are a useful first step, which will deliver some efficiency gains in terms of automated meter readings and better load balancing.

Commodity to service

But Duke Energy and others in the sector have far more ambitious plans for how M2M might help enable them to evolve their businesses away from being commodity energy suppliers towards energy service providers. "In the future, it may be that we offer customers something along the lines of 'If you pay us X dollars per month, we'll provide fuel for your electric vehicle, we'll power your house, we'll give you these comfort and convenience parameters, and here's your bill for this'," explains David Mohler, vice president and chief technology officer for Duke Energy.

Closer ties with customers

British Gas has similar aspirations. It sees the UK's mandated rollout of some 53m meters as an opportunity to build closer ties with customers and generate revenue from a range of new services. These vary widely, such as servicing and repairing

heating systems, installing energy micro-generation and fitting insulation. Indeed, by installing smart meters, the company generates masses of data that it can then analyse to identify opportunities to sell such services - from spotting a poorly performing geyser to identifying bad insulation. "The data allow you to deliver quality insights to the consumer that perhaps gives you new revenue streams," says Dean Keeling, director of smart homes at British Gas. This is driven by supply pressures that are causing the business to find ways to differentiate itself, including rising energy costs and the need to invest in cleaner, but more expensive forms of energy generation. Ahead of investing in additional supply, Mr Keeling sees great scope to generate new revenue from helping customers to cut their demand.

Piloting new services

But a more exciting part of this vision is the enablement of smarter homes. A first stab at this is a package that British Gas now sells, dubbed Safe & Secure, which opens up a wholly new line of business. The wireless system lets people remotely control their homes' heating, check if appliances are off, and includes a home alarm and remote camera monitoring for safety, among other things. It provides a compelling insight into how energy companies of the future might start to look.

Conclusion

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Once machines are networked, we’re only limited by our imagination.”

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Yiru Zhong, senior industry analyst, Frost & Sullivan

Setting the stage for innovation

Just as the mobile Internet has challenged firms to rethink their businesses, so too will the merger of the virtual and the physical world through machine-to-machine communication. “Once machines are networked,” says Yiru Zhong, senior industry analyst at Frost & Sullivan, an international marketing consultancy, “we’re only limited by our imagination.”

The big question-mark is about how quickly the connections will happen. Given the diverse applications of M2M, some sectors will inevitably move faster than others, but the great joy of such innovation is that it is inherently difficult to predict what might emerge next. Coming up with such innovations in the first place is down to the individual imagination of executives and their companies. “It’s the creativity of the business to figure out where they’re going to apply this to a problem they already have,” argues Accenture’s Mr Kurth.

Just as Apple’s iOS acts as a platform for smartphone development - and the diverse ecosystem of apps that run on it - M2M will arguably realise its greatest potential once it becomes a more open platform which acts as a foundation for others to build on. Progress has

been made in this direction, as the example of OnStar highlights, but much more development is needed. Innovators and entrepreneurs need a stable foundation from which to launch new ideas. That foundation for innovation includes many of the points examined in this paper - clearer technology standards for the interface with core sensors and various wireless communication protocols; better defined partnerships and customer offerings; the expansion of cloud-based services; and support from governments in setting crossborder standards and streamlining regulations.

Success means solving human needs

As Martin Cooper, a pioneer of the cellular telephone, has remarked on various occasions, successful technologies typically have two great attributes: they are invisible to the customer, and they solve a fundamental human need. As an enabling technology, M2M already excels at being invisible to the ultimate end users; but its continued success will lie in its ability to help improve people’s lives. Some brave firms will be rewarded for early insights by discovering new ways to help solve human needs, although clearly not all. The 2010s will surely see the long-forecast rise of the machines, but in an exact form that cannot be guessed at today.

While every effort has been taken to verify the accuracy of this information, neither The Economist Intelligence Unit Ltd. nor the sponsor of this report can accept any responsibility or liability for reliance by any person on this white paper or any of the information, opinions or conclusions set out in this white paper.

LONDON

26 Red Lion Square
London
WC1R 4HQ
United Kingdom
Tel: (44.20) 7576 8000
Fax: (44.20) 7576 8500
E-mail: london@eiu.com

NEW YORK

750 Third Avenue
5th Floor
New York, NY 10017
United States
Tel: (1.212) 554 0600
Fax: (1.212) 586 1181/2
E-mail: newyork@eiu.com

HONG KONG

6001, Central Plaza
18 Harbour Road
Wanchai
Hong Kong
Tel: (852) 2585 3888
Fax: (852) 2802 7638
E-mail: hongkong@eiu.com

GENEVA

Boulevard des Tranchées 16
1206 Geneva
Switzerland
Tel: (41) 22 566 2470
Fax: (41) 22 346 93 47
E-mail: geneva@eiu.com