GSMA Intelligence

Cellular M2M forecasts and assumptions: 2010–2020

September 2014

Contents

Executive summary

Our research shows that global cellular M2M connections are currently set to reach close to one billion by 2020. However, we calculate that the market base could be double that amount if a number of growth factors are successfully enabled by industry players and governments over the coming years.

At the current rate of trajectory, global cellular M2M connections will reach 974 million by 2020, growing at 26% per year (CAGR) in the period between 2014 and 2020. We believe that this growth rate could go above 40% a year if a number of favourable market conditions are achieved, leading to a potential two billion cellular M2M connections globally by 2020.

There are a number of areas identified as possible growth stimulators:

- The introduction of additional government policies enabling a wider deployment of cellular M2M in key sectors such as utilities, smart cities, automotive and healthcare

- Significant M2M module cost reduction enabling a wider range of connected products and services

- Low-cost standardised solutions that will enable additional M2M application areas with specific requirements such as low data and long battery life

- Increased standardisation such as for global remote provisioning and APIs, enabling more efficient deployment of connected solutions

- Greater assurance of end-to-end security and deployment of SIM-based user identity and consent management capabilities

- New operator business models in the M2M space

By 2020, M2M connections will account for just over 10% of the global mobile connections market, up from just over 3% today. Our research shows that, at present, 468 mobile operators offer M2M services across 190 countries.

The developing region overtook the developed economies in terms of cellular M2M connections in Q2 2014, and now accounts for 51% of the global M2M base. Over the next six years, Asia Pacific is expected to remain the largest cellular M2M region, accounting for almost half of global cellular M2M connections by 2020. Over the same period, Europe and North America will remain the second and third largest M2M markets by connections, while China will remain the largest market with 355 million cellular M2M connections expected in 2020 - accounting for about 36% of the global total, up from 27% today.

In order to maximise the value opportunity, operators will be required to develop new capabilities and explore new business models that move beyond simply providing the mobile connectivity component. We therefore expect large operator groups to increasingly look to partner with equipment manufacturers (e.g. health device manufacturers, home security device companies) to jointly develop M2M products and bring them to market using their own sales channels, adding value in areas such as end to end security and billing and charging. It is also important that operators collaborate with each other in order to drive economies of scale and provide global interoperability.

	CAGR 2010–13	Rank	CAGR 2014–20	Rank
MENA	57%	1	24%	4
Asia Pacific	54%	2	29%	2
CIS	52%	3	29%	1
Latin America	41%	4	25%	3
Sub-Saharan Africa	38%	5	23%	5
Europe	27%	6	23%	5
Northern America	24%	7	22%	6
World	37%	-	26%	-

Table 1: Cellular M2M connections, compound annual growth rate by region
Source: GSMA Intelligence

	Q2 2014	Rank		Q4 2020	Rank
China	61.5	1	China	355.0	1
United States of America	37.5	2	United States of America	135.8	2
Japan	9.9	3	United Kingdom	43.0	3
Brazil	9.1	4	Brazil	41.9	4
France	7.8	5	Russian Federation	35.1	5
Italy	6.4	6	Germany	31.2	6
United Kingdom	6.2	7	France	31.1	7
Sweden	5.9	8	Japan	28.1	8
Germany	5.8	9	India	24.6	9
Russian Federation	5.5	10	Sweden	19.4	10

Table 2: Cellular M2M connections (in millions)
Source: GSMA Intelligence

	Q2 2014	Rank		Q4 2020	Rank
Sweden	28%	1	Sweden	54%	1
New Zealand	16%	2	New Zealand	36%	2
Norway	14%	3	United Kingdom	35%	3
Finland	11%	4	Norway	30%	4
France	11%	5	France	30%	5
United States of America	11%	6	United States of America	27%	6
Canada	10%	7	Finland	25%	7
Denmark	9%	8	Austria	25%	8
Bulgaria	9%	9	Canada	24%	9
Belgium	8%	10	Belgium	21%	10

Table 3: Cellular M2M connections as a % of total connections
Source: GSMA Intelligence

Introduction

The Internet of Things (IoT) describes the coordination of multiple machines, devices and appliances connected to the Internet through multiple networks. These devices include everyday objects such as smartphones, tablets and consumer electronics, and other machines such as vehicles, monitors and sensors equipped with machine-to-machine (M2M) communications that allow them to send and receive data.

M2M is an integral part of the Internet of Things and describes the use of applications that are enabled by the communication between two or more machines.

M2M technology connects machines, devices and appliances together wirelessly via a variety of communications channels, including IP and SMS, to deliver services with limited direct human intervention. This transforms these devices into intelligent assets that open up a range of possibilities for improving how businesses operate. GSMA Intelligence does not count consumer electronic devices such as smartphones, dongles, tablets and e-readers, as M2M connections. However, consumer-oriented M2M applications, such as connected health devices, home automation equipment and connected wearables are counted.

There are several different types of M2M connectivity besides cellular M2M, such as short-range (Wi-Fi, ZigBee, Ethernet), Powerline (PLC), satellite and fixed network (PSTN, ISDN, DSL, fiber, and cable).

We include only the cellular subset or wireless wide-area network connections. In our view, M2M denotes communication between machines/objects on a point-to-point basis, utilising the mobile network either directly, or using a gateway device. For example, in a smart metering deployment, if the smart meters are deployed using PLC and use mobile network only at the point of aggregation, we count this as one cellular connection.
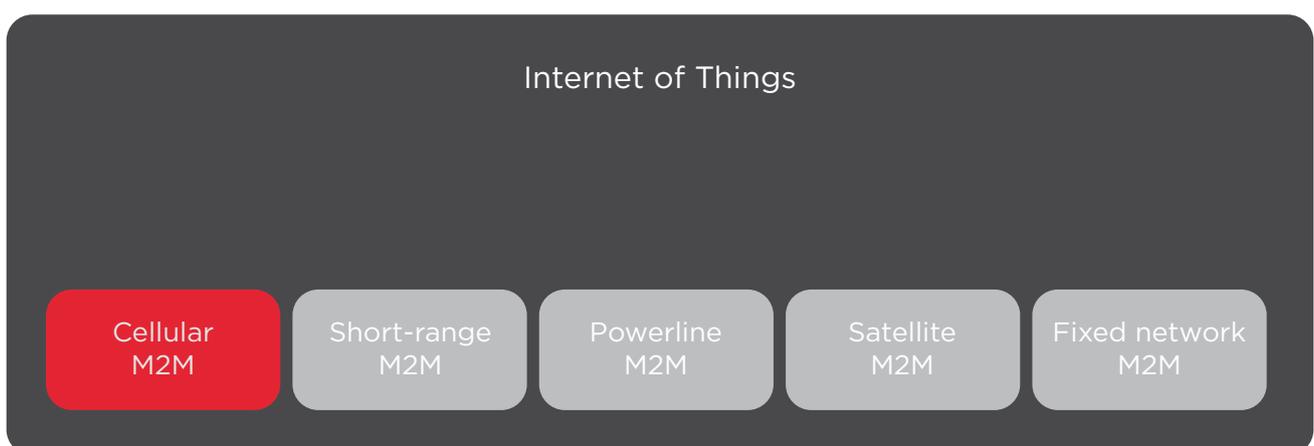
Figure 1: M2M is an integral part of the wider Internet of Things (IoT) landscape
Source: GSMA Intelligence

Cellular M2M forecast scenarios

GSMA Intelligence has developed a comprehensive forecast of the global cellular M2M market, based on extensive conversations with industry players and an in-depth analysis of current and future trends. Our coverage of the M2M market focuses on cellular M2M connectivity and excludes computing devices in consumer electronics such as smartphones, e-readers, tablets, as well as other types of M2M connection technologies that support the wider universe of the Internet of Things (IoT).

Our cellular M2M forecast reflects the current trajectory that the global market is taking, based on known and tangible deployments as well as the potential opportunities and growth inhibitors for each operator and M2M sector. We discuss our forecast assumptions and methodology in the following chapters.

It is important to note that there are upside forecast scenarios that could emerge if a number of the current growth inhibitors are addressed by both industry players and governments over the coming years. To better understand the market potential we have included hypothetical forecast scenarios, which illustrate how the global cellular M2M market could potentially evolve over the coming years if key growth strategies are deployed, notably around government policies, network, pricing, new geographies and operator capabilities.

Higher potential target
2015-17   CAGR 40%
2018-20   CAGR 45%

Stimulated growth
2015-17   CAGR 35%
2018-20   CAGR 40%

Current trajectory
2015-20   CAGR 25%
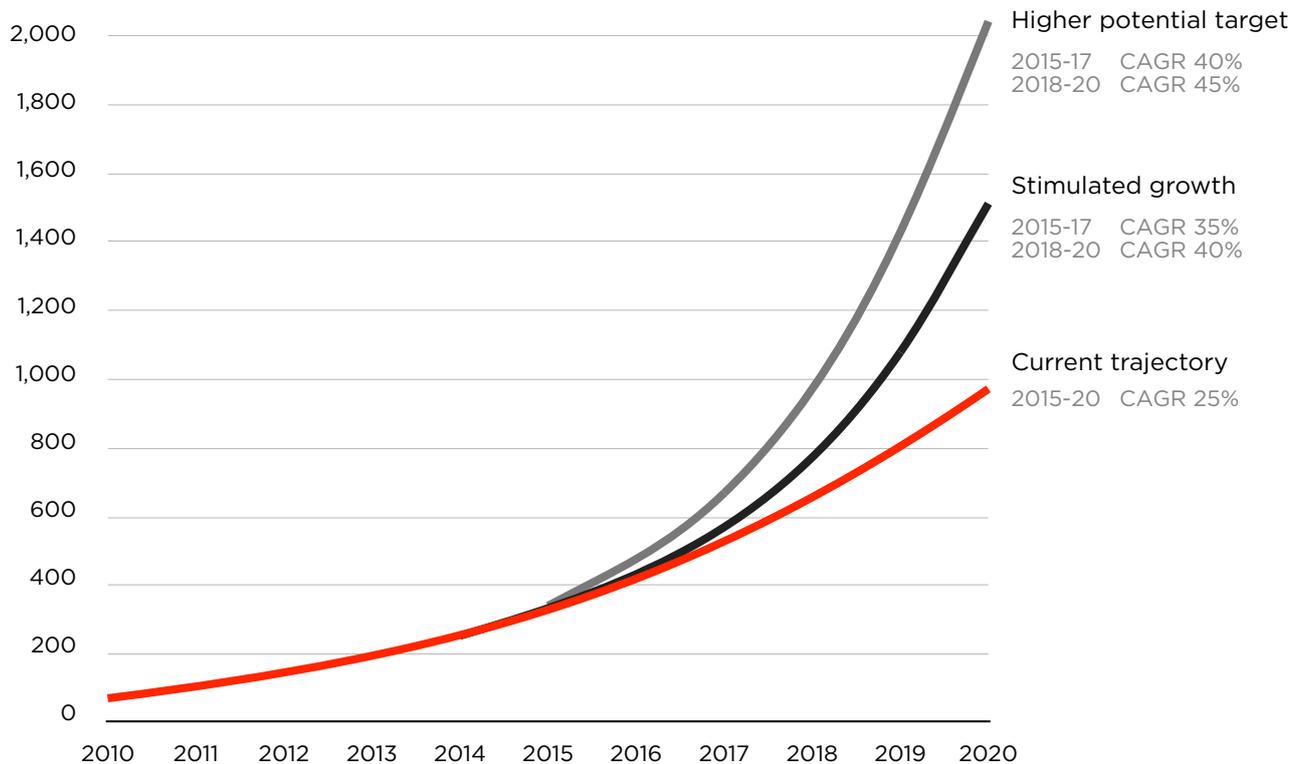
Figure 2: Cellular M2M connections forecast scenarios (million)
Source: GSMA Intelligence

Among the 'growth levers' that could trigger an accelerated growth forecast scenario are:

- The introduction of additional government policies enabling a wider deployment of cellular M2M in key sectors such as utilities, smart cities, automotive and healthcare
- Significant module cost reduction enabling a wider range of connected products and services
- Low-cost standardised solutions that will enable additional M2M application areas with specific requirements such as low data and long battery life
- Increased standardisation, such as for global remote provisioning and APIs, enabling more efficient deployment of connected solutions
- Greater assurance of end-to-end security and deployment of SIM-based user identity and consent management capabilities
- New operator business models in the M2M space

These forecast scenarios consider that the aforementioned growth factors are key to triggering market growth rates similar to that witnessed over the past three to four years. The early enabling of some of these factors could trigger a compound annual growth rate (CAGR) in the 2015 – 2018 period ranging from 35% (similar to that witnessed over the past three years) to 40% (similar to that witnessed over the past five years). In the two upside forecast scenarios, we assume that the growth factors mentioned above are factored in around 2018. At this point, growth rates will accelerate fuelled by the aforementioned initiatives, resulting in an uplift over the current trajectory scenario ranging from 30% to 50%.

Overall, while the current trajectory scenario predicts that cellular M2M connections will reach around 1 billion by 2020, the growth factors mentioned above could trigger an uplift that could lead to a potential market base ranging from 1.6 billion to 2 billion cellular M2M connections by 2020.

Cellular M2M adoption: forecast assumptions

■ Government policies and regulatory initiatives

Supportive regulatory frameworks can stimulate the deployment and adoption of certain M2M applications, usually at a country level (but also sometimes at a regional level). This can be the case in verticals such as automotive, smart metering, remote monitoring of fiscal cash registers, vending machines or gaming machines.

Automotive

Emergency Call (eCall), a road accident alert system, requires an embedded in-vehicle system (IVS) with satellite positioning (e.g. GPS, Galileo) and mobile connectivity (GSM/UMTS) capabilities to be integrated in all new vehicles. The European Commission had initially proposed that legislation for the introduction of the eCall public safety answering point (PSAP) system would be in place by end of 2015. However, adoption by the EU member states has been slower than projected – most recently the deadline for implementation of the eCall PSAP system has been postponed by two years to 2017/2018.

Despite this delay, mobile operators are required to support eCall 'flag' in their core networks to distinguish between automatically and manually triggered eCalls, and route them to the appropriate PSAP before the end of 2014. The SIMs used for eCall can either be deployed using eCall only mode, or eCall + mode (eCall with other value-add services provided on top). This regulation stipulates that all new cars will have IVS, and ultimately they will all become 'connected cars'.

Meanwhile, Russia is also in the process of deploying an accident notification system, called ERA-GLONASS, and both the EU and Russia are working together in order to make the systems interoperable. In 2014, Beeline and MTS tested profile switching using an ERA-GLONASS on-board telematics unit. In August 2014, the Russian Prime Minister approved the roadmap for establishing GLONASS as a public company, and for developing the ERA-GLONASS road emergency response system. In May 2014, GLONASS President Alexander Gurko stated that "Terminals of the emergency response system ERA-GLONASS for private cars will go on sale next year."

ERA-GLONASS presents a vast opportunity for M2M due to the size of the addressable market. According to the International Organization of Motor Vehicle Manufacturers' (OICA) data, there were 2.6 million new passenger cars sold and/or registered in Russia in 2013. According to Sergei Petrov, Vice President of Corporate Business Development at OJSC VimpelCom, "From 1 January 2015, according to the Technical Regulations of the Customs Union, all vehicles first pass type approval procedure shall be equipped with terminals ERA-GLONASS." From 2017, the requirement will apply to all new means of transport sold in the Customs Union (including Russia, Belarus and Kazakhstan).

Another regulation driven telematics project in Brazil is the stolen vehicle-tracking mandate SIMRAV Project ('Sistema Integrado de Monitoramento e Registro Automático de Veículos'), otherwise known as CONTRAN 245/07 legislation. CONTRAN requires that all new vehicles be fitted with the capability to be tracked and disabled in case of theft. The project has been postponed several times already, mainly because vehicle manufacturers do not want to add additional cost to production, but also to enable drivers to choose their service provider. In May 2014, DENATRAN, the Brazilian transport ministry, announced that the project will be delayed by a further two years.

Despite the fact that the mandate has not so far been enforced, our discussions with operators in Latin America indicate that it has had spillover effects, serving to boost public awareness of telematics services in Brazil while also facilitating the creation of an ecosystem for hardware and devices.

Compliance reporting

Another example of a regulation driven stimulus for the M2M market is connected fiscal cash registers – electronic devices used for control of a country's tax revenues, such as those deployed in a number of Southern and Eastern European markets to counter tax avoidance. As a result, some of the markets where these initiatives have taken place boast higher M2M adoption rates than the regional average. In Bosnia and Herzegovina for example, M2M accounts for 4.6% of all mobile connections in the country (36% of contract connections).

In several African countries, tax authorities are also looking to make it compulsory to deploy these services. For example, in Ethiopia the online cash register machine was introduced in 2008 to businesses that are registered as federal tax payers. According to Ethio Telecom, "M2M is mostly used for taxation system. Government uses wireless network and SIM cards to collect data from shops, supermarkets and malls to communicate with server."

A complete sales register system includes a cash register machine, i.e, a point of sale machine (PoS), a GPRS terminal, a GPRS/GSM mobile network connection and a server at the authority data centre. In Bulgaria all coffee vending machines, parking voucher payment machines, snack dispensers and even machines that dispense bouncing balls to children must be linked electronically to the National Revenue Agency. Bulgarian law requires sales outlets to record and report income to tax authorities, with provision for fiscal devices to be linked to the National Revenue Agency so that daily turnover can be tracked.

Smart metering

Smart meter deployments by utility companies are often triggered by regulatory requirements aimed at improving the efficiency of the energy sector and reducing non-technical losses. The market opportunity varies by region but given the right regulatory stimulus, these rollouts represent a sizeable M2M opportunity that operators can tap into either to provide "connectivity only" or as an end-to-end solution provider.

Driven by regulation requirements, millions of residential electricity, gas, water, and heating meters are becoming "smart", which means that they can be monitored, controlled, and managed at pre-set intervals, be it hourly or daily. Under the Third Energy Package, a legislative framework to promote an internal gas and electricity market in the European Union that came into force in September 2009, member states were mandated to commence a cost benefit analysis of smart meter rollout and submit the results to the European Commission by September 2012.

Two thirds of the members that responded gave a positive assessment of the roll-out of smart meters for the electricity industry, while only one third gave a positive assessment for the gas industry. To date, EU member states have committed to rolling out close to 200 million smart meters for electricity and 45 million for gas by 2020, at a total potential investment of €45 billion. The European Commission is targeting 80% smart meter penetration by 2020, however it now expects that 72% of European consumers will have a smart meter for electricity while 40% will have one for gas.

Based on analysis of the recently released paper on preferred communication infrastructure submitted by the member states to the EC, a communication architecture between smart meters and the Data Management System (DMS) is most often based on middleware (i.e. Data Concentrator). As a result, the Data Concentrator (DC), located at Medium Voltage/Low Voltage substations works as a communication gateway between the Data Management System (DMS) and the electricity smart meters.

Power Line Carrier (PLC) in conjunction with GPRS are the preferred technologies for communication between the smart meter and the Data Concentrator, while in most

cases the DC communicates with the DMS using GPRS. This means that only a portion of the above-mentioned electricity and gas meter deployments will utilise P2P cellular connectivity. However, as gas metering companies do not have their own proprietary technology (PLC), this opens up a door for mobile networks to become the connectivity technology of choice.
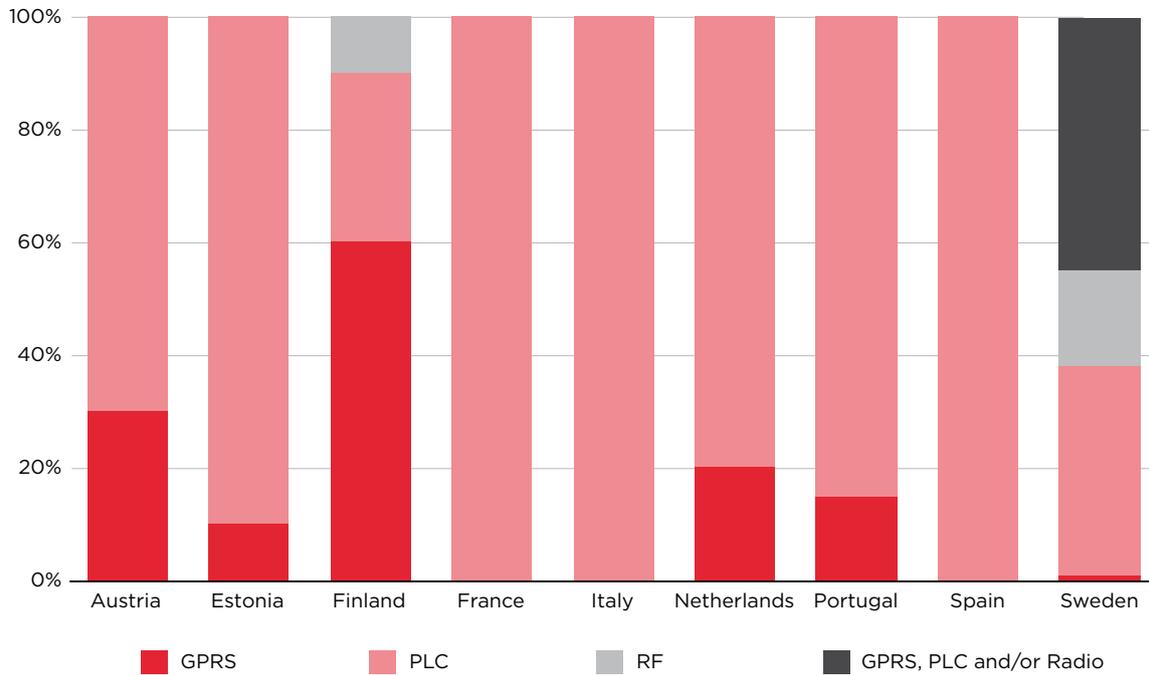
Figure 3: Summary of preferred communication infrastructure for smart metering deployments in selected EU Member States

Source: European Commission

As we highlight above, the role of mobile operators tends to be limited to providing backhaul connectivity (between the DC and the DMS), but the recent smart metering deployment by Telefónica is seen as an example of future opportunities. In August 2013, Telefónica was selected by the UK government to provide communications services across the Central and Southern regions of the UK, a contract worth £1.5 billion over 15 years. Telefónica will deploy and operate the communications infrastructure for 42.3 million electricity and gas meters. The connectivity solution will primarily rely on 2G/3G mobile networks (99.25% network coverage) with RF Mesh infill used for uncovered areas. When completed by 2020, there will be almost 23 million smart meter communication hubs connected to Telefónica O2's mobile network.

There is a potential for smart meters to be integrated into a broader home automation system that enables the householder to use a gateway to remotely control heating, air conditioning, lighting and even individual appliances such as security cameras or burglar alarms.

In Asia Pacific, some large scale rollouts to residential customers are currently underway in Japan, South Korea and China, which will in turn lead to growing adoption of smart metering. China Unicom told us "a growing number of meters have to connect […] we see a shift towards 3G, at the moment there is 50/50 split between 2G and 3G but we recommend 3G as a better choice."

A recent GSMA Connected Life report found that "India's transmission and distribution losses stand at 24%, and it is estimated that these losses cost the country over US$17 billion every year (i.e,) 1.5% of India's GDP." Two thirds of these losses are non-technical, the majority being due to power theft, and can be reduced without major infrastructure changes by deploying smart meters. As one Indian operator told us, "The biggest opportunity [in terms of M2M] in India is utility because of the widespread population, mobile is the best technology, lot of prospects as there are 23 states and every state has a different way of working" and "utilities want to reduce distribution losses."

However, operators in Latin America point to the fact that adoption of smart metering depends on the readiness of the utility companies to make investment to reduce non-technical losses, primarily from energy theft and fraud. At the moment smart metering is at a nascent stage, but given the right regulatory push it offers a substantial opportunity. Despite this, there are instances where activity is already picking up. For example, in Colombia operators are working on a project looking at putting together a "proof of concept" in relation to smart grids while operators in Chile "see utilities as major growth area for M2M." The Brazilian energy regulator ANEEL has started to develop a national plan for smart grids, but has only stipulated that smart meters should be deployed to customers that request them.

As with other M2M applications, operators are also looking to provide more than pure mobile network access and offer end-to-end solutions. For example, in November 2013 Telekom Austria Group M2M launched SMARTify, a SaaS (Software as a Service) solution for smart metering. Telekom Austria Group will be responsible for IT infrastructure, software and maintenance work. Utility providers will use the platform as a service by paying a monthly flat fee, helping them to reduce investment, minimize risk and achieve economies of scale.

Healthcare

Uptake in this sector will depend on the establishment of a positive regulatory environment, as well as effective MNO business models to address health and wellness related issues.

Globally, the population aged 60 years or over is expected to more than double, from 841 million people in 2013 to more than 2 billion in 2050 (according to the UN), while health expenditure accounted for 10.2% of GDP worldwide in 2012 (according to the World Bank). As we explored in our previous report, most operators see the health vertical as a valuable medium to long-term opportunity, but one which has still not entered the growth phase due to a combination of issues.

Establishing sustainable business models in mHealth has proved more challenging than in some other industry verticals, in part as it involves changing existing reimbursement schemes and other established healthcare industry practices. A further challenge is that some mHealth solutions, such as chronic disease management solutions, need a longer timeframe in order to deliver appropriate returns, while many business customers are looking for a return on a shorter timeframe.

However, operators are seeing traction for mHealth solutions in developing markets, such as Latin America and Africa, where mHealth offers access to healthcare services for

currently under-served populations. In these markets, B2C (or direct to consumer) and B2B2C mHealth services are also a big opportunity with some operators, such as Telefónica and Orange, seeing good traction with mHealth offerings. Many operators have dedicated health divisions looking for the best way to provide sufficient healthcare support, which might be via a multitude of technologies including Bluetooth, radio frequencies, SMS and cellular. For example, Turkcell's Smart Health solution, launched in April 2012, uses both Bluetooth and SMS gateway to enable patients to independently monitor a range of chronic conditions. In this business operating model, Turkcell owns the product gateway, connection, device and service platform.

It is also an area where mobile operators need to work closely with government and other regulatory stakeholders at a national level. We have aready seen government-led projects in this sector, e.g, in Singapore and in the UAE governments have are commencing initiatives on mobile health, while in the US government policies are in place to incentivise mHealth, for example ePrescriptions and incentives for hospitals to reduce readmissions.

Furthermore, over the past year in France there has been a number of deployments around healthcare supported by regulatory initiatives. "The first application which is taking off is sleep apnoea, ruled by social security, the device has to be connected by law, send information on how the equipment is used (whether is on/off, how often/for how long it has been used)" said SFR.

Following this development, Telenor Connexion, in June 2014, was selected by French eHealth provider, SRETT to provide a connected solution for remote monitoring of patients affected by sleep apnoea. Meanwhile, Orange Business Services together with Weinmann, a global manufacturer of therapeutic system solutions in sleep medicine and ventilation, developed homecareONLINE, a connected medical device solution for sleep therapy.

These deals give us an indication that, given the establishment and implementation of a positive regulatory framework, there is a significant role for mobile operators to play in not only providing connectivity but also working together in partnership with the healthcare equipment manufacturers to develop a full end-to-end solution.

Governments can directly fuel M2M growth

The GSMA's recent report on M2M in China highlights the role that governments can play in stimulating the M2M market. China Mobile has indicated that the Chinese government has provided "strong guidance" and made available special funds to accelerate the development of the Internet of Things market. In addition, the Chinese Government plans to invest CNY3,860 billion ($603 billion) in the M2M/IoT ecosystem in the decade to 2020, according to China's R&D Center for Internet of Things (CIT-China).

Latin America has also witnessed positive policy moves by regulatory bodies, for example the proposed reduction of the Brazilian M2M tax, the impact of which we have factored into our modelling of the Brazilian M2M market. As we stated in our previous report, M2M connectivity ARPU ranges between $2 to $5, with Vivo Brazil executives indicating that their M2M monthly ARPU stood at BRL5 ($2.20) in 2012.

As a result, a yearly tax of $15.80 on an annual ARPU of $26.40 places a significant burden

on operators' M2M business models, and acts as a major barrier to adoption. It must be noted that when Turkey exempted M2M SIMs from a tax collected on any new SIM connections (which stood at €16.70), there was no discernible uplift in operators' M2M connections, however it did have a positive impact on margins derived from M2M services.

■ Module pricing

Module prices are falling allowing for a new wave of devices and applications

M2M modules are getting smaller and cheaper. Operators have facilitated market development through a number of initiatives: certifying M2M modules (AT&T, Telefónica and Telstra have followed this approach); bulk buying of M2M modules; providing device testing facilities; offering global SIMs; and implementing online marketplaces. Operators have been also engaging with module vendors to develop low cost modules, for example Verizon has partnered with Sierra Wireless and Telit, while China Mobile's dedicated unit, 'China Mobile Internet of Things Co. Ltd.', has developed standardised chipsets and modules. This not only enables operators to lower costs, reduce time to market and increase volumes, but also to speed up the transition to higher bandwidth modules. As some operators, including AT&T and Telstra, do not support 2G devices any longer, encouraging the adoption of 3G/4G modules is important.

Prices of 2G M2M modules currently range from $8 to $13, and 3G M2M modules from $38 to $45 for low volume orders (such as 10,000 units). Based on our research, the average 2G module prices have decreased substantially over the last decade from around $55 to $13 today. However, some operators still view the price differential as a major obstacle; Naveen Chopra, Director Business Services, Vodafone India, underlined that "One of the largest challenges is entry cost, which is a huge barrier to adoption. Till the time device costs can be significantly brought down, IoT and M2M will remain a nascent field."

Since 4G-LTE requires support for several frequency bands and more sophisticated infrastructure, 4G modules are currently priced at a premium, however the prices are decreasing faster than they have done with 3G modules. We believe that 4G module prices will decrease as the market for 4G matures and vendors reach certain economies of scale.

■ Technology migration

According to Sierra Wireless, the majority of M2M services are currently using 2G networks, and "2G-only modules still account for the majority of shipments, although their share has been declining". The majority of mobile operators we have spoken to plan to keep 2G networks operational "for the foreseeable future."

The migration of M2M hardware from 2G to 3G or even 4G remains a challenge for operators that plan to switch off 2G. One interesting example is Telstra's approach. In addition to not selling 2G hardware, the operator launched the "M2M Device Purchase Plan" in partnership with Netcomm Wireless and Sierra Wireless, which allows its clients to spread the cost of purchasing the hardware over a 24 months period.

Telstra also mentioned that "having certified M2M devices was really important to move

from 2G to 3G, to offset the replacement cost." Optus Australia added that "customers are shifting to 3G because of 3G modules becoming cheaper, but they also understand that 2G networks will not be around forever and operators cannot ensure that the network will be in place in five to seven years."

However, more operators are seeing traction for 4G, with Tim Gorman, Associate Director of Technology for the Verizon Innovation Program, notably claiming that there is "A definite trend for M2M going towards LTE," adding that "it wasn't the case a year and a half ago." Verizon now offers a $100 4G-LTE module aimed at M2M applications (Machine Connect). A leading M2M operator asserted that "many companies are looking to 4G to future proof [....] Interesting services can be enabled by 4G, looking beyond the speed component and longevity towards other business models, data analytics and how to monetize that." TDC Denmark shared with us that "some customers spoke about potentially moving directly to 4G from 2G."

In March 2014, Alarm.com chose Verizon Wireless as connectivity provider for its 4G-LTE Connected Home Service. Alarm.com says a "Dedicated, cellular connection offers tamper resistant home security, simpler installation and lower lifetime account management costs than landline based broadband or telephone offerings." Verizon has also reported strong growth in the home security sector on the back of its relationship with Alarm.com, which provides security, video monitoring, home automation and energy services to more than one million properties in the US.

In a number of regions, 4G coverage will exceed the 90% of population mark by 2020, for example Northern America (96%), Northern Europe (97%), Western Europe (91%), and Australasia (90%), while 4G coverage will reach 99% in Japan and 100% in South Korea by 2020. As a result, the ubiquitous nature of 4G connectivity will offer operators and partners the potential to develop new and innovative M2M services that will utilise 4G network's speed and latency advantages.

■ Emerging markets

The role of mobile deployments

Vodafone stated that "there is a lot of activity in Africa because M2M remote monitoring can create value. Also, in Africa, the lack of existing infrastructure means that M2M is not replacing old fixed line solutions but creating new ones."

Due to the limited availability of fixed networks in emerging markets, mobile becomes the technology of choice for a number of M2M services that would have historically used a PSTN line connection such as PoS and security applications. Operators' network coverage is an important credential for enterprises as they chose a provider for M2M services, with one Latin American operator highlighting to us the fact that "Coverage is the main competitive advantage."

In developing countries mobile is often the best and only option. Gustavo Alejandro Bergoc, Claro Argentina said that "Mobile is used for home security because of the big territory - coverage of fixed services is not ubiquitous, cost of landline in remote locations is more expensive. Thus, mobile is more attractive in terms of cost but also offers faster

time to market." In addition, as of June 2014 over 80% of the world's population had access to a 2G network. The only other alternative technology that can offer such a wide reach is satellite, but satellite M2M services tend to come at a high price premium.
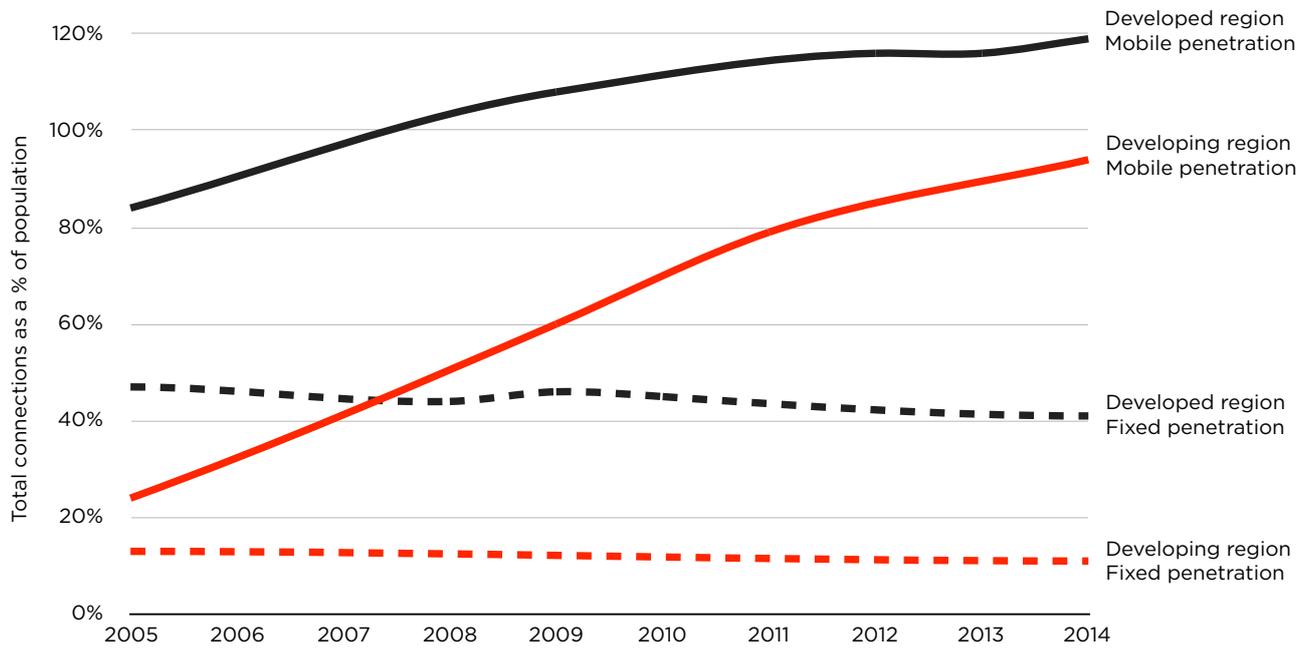
Figure 4: Fixed Line and Mobile Connections, Penetration of Population, 2005-2014
Source: ITU, GSMA Intelligence

Mobile connectivity for PoS offers an immediate opportunity for operators in emerging markets as adoption of payment cards and payment terminals grows but also because these terminals can be used to offer additional services, for example an opportunity to use PoS for provision of ration cards in India. MTN Rwanda said that "The fastest growing market at the moment is the use of SIM for PoS, the market has grown massively in the past year and a half, from 100 to 3,000, and there is a possibility for the market to double by the year end." In Thailand according to True Telecom "recently more banks are adopting PoS, manufacturers are making mobile connectivity available. This hasn't been the case before, low market adoption because mobile was deemed to be risky."

Operators across Latin America and developing Asian countries pointed to PoS as one of the largest growth segments in the near future. "95-98% of PoS are still on fixed but this is moving to mobile" was the feedback that we have received from one operator in India.

Reliance Communication pointed to the role M2M can play in monitoring agricultural processes: "Agriculture has one of the biggest needs, in terms of water pipes - companies have the technology, which enables turning on and off the water pipes." This is echoed by Dundar Ozdemir, M2M Product Manager at Turkcell, who explained that "Agriculture is one of the oldest M2M applications in Turkey because of the importance of agriculture to our economy. Health of more than 30 million animals secured with M2M through Smart Farming. This is mostly telemetry, farming with and without animals, measuring temperature and humidity, and counting stock. We will continue to work on this vertical."

The role of M2M in rural areas

According to the World Bank, 50% of the worlds' population live outside urban and peri-urban areas. Rural populations often lack access to healthcare facilities, clean water and electricity. Low cost 2G-enabled water meters could enhance water pump monitoring and provision of clean water. Grundfos Lifelink (East Africa) and Sarvajal (India) have already developed business models based on the use of M2M connectivity for their clean water services. In the energy sector we see that the "Pay as you go" model is getting more traction, with solar panel systems consisting of M2M and mobile payments such as M-KOPA, which provides solar home systems, coupling M2M with a micro-payment solution.

Cellular M2M could be also used in rural healthcare centres to enable speedy diagnosis and timely treatment. For example, Sequoia Technology has developed a HIV diagnosis communications system using M2M GPRS printers and a dedicated a GSM gateway.

Cellular M2M connections growth could be further stimulated by operators addressing low data application areas, for example utilities and agriculture, which could be driven via the provision of suitable low cost standardised solutions.

These connections could serve a range of adjacent industries (e.g, automotive, utilities and health) that are diverse and cover a range of applications and deployment scenarios in which mobile network technology may not be the best selection to provide connectivity. While mobile technology is well suited to serving applications that require the transfer of high data volumes with low levels of delay (latency), it is not currently best placed to meet the requirements of a significant proportion of new connected devices, which will require low mobility, low power and low cost requirements.

■ Operators' capabilities and M2M business models

Operators experiment with different business models

M2M relies heavily on a B2B sales model, as the majority of M2M contracts originate from existing business relationships. However, operators have also begun to embrace the B2B2C sales model, through the provision of connectivity to such services as insurance telematics and digital signage. Many operators have a large retail and online presence, with strong brand, marketing and CRM capabilities, which they can leverage to sell M2M services. For example, AT&T sells communication and location devices, such as Amber Alert GPS and FiLIP, at AT&T-owned retail locations.

Expanded billing and charging capabilities facilitate new business models that enable different elements of the value chain to be charged for a specific service. It also allows the operator to move from a purely B2B model towards a relation with the end consumer as part of a B2B2C model.

Many of the leading M2M operators - such as Telefónica, AT&T and Telecom Italia - are already providing full connectivity through a management platform, which in addition to network access enables provisioning, activation/deactivation, SIM and device management, and flexible billing/pricing. Many have also invested in offering additional security, higher

levels of reliability through "Service Level Agreements (SLAs)" and broader coverage (for example through global SIMs and operator alliances).

Operators' recognition that they need to be able to provide flexible billing can be best highlighted by recent partnerships signed by Telecom Italia. The operator already has its own proprietary M2M platform and has also partnered with two M2M platform providers, Jasper Technologies and Ericsson. Telecom Italia stated in a press release that "This multiplatform configuration will allow Telecom Italia Digital Solutions to offer the maximum technical and commercial flexibility on the global market for the definition of dedicated offer solutions in the M2M & Internet of Things market, and in particular in the automotive, connected car and manufacturing sectors, and with regards solutions connected to smart cities, smart automation, domotics and metering."
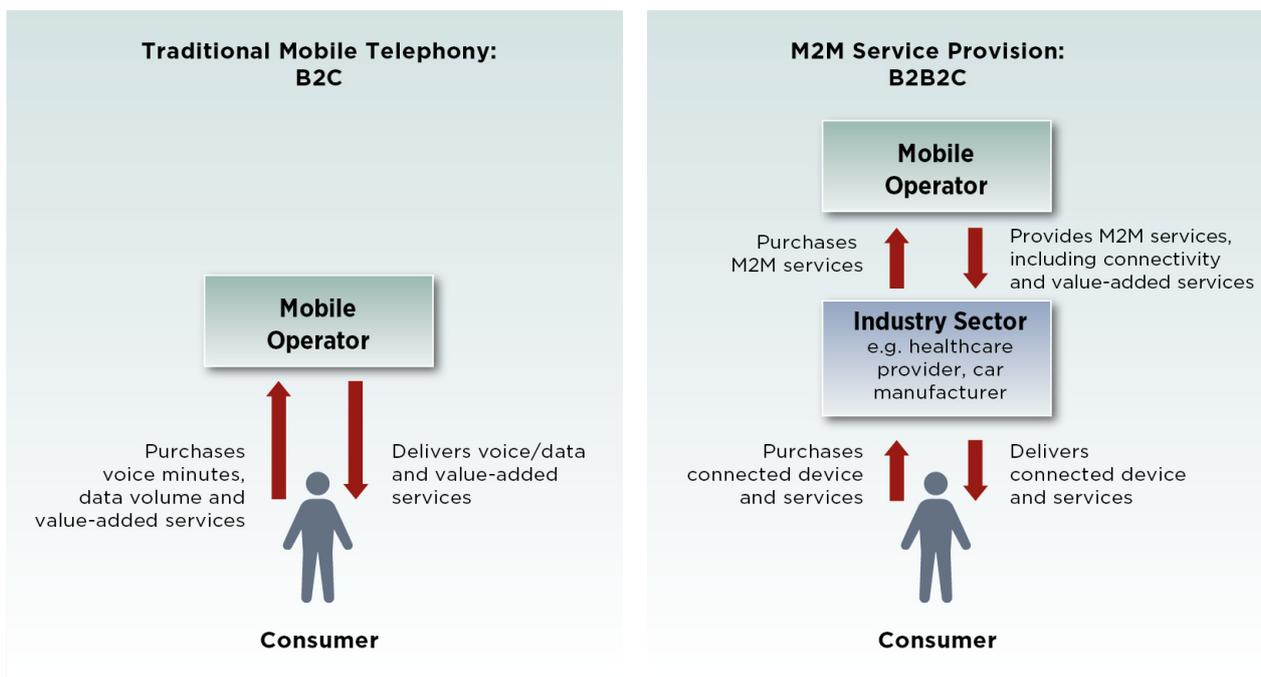
Figure 5: M2M business models
Source: GSMA

Operators are increasingly supporting different business models and working to improve the end-user experience by proposing a range of billing options and capabilities, such as split billing. Split billing enables different elements of the value chain to be charged for a specific service. It also allows the operator to move from a purely B2B model towards a relationship with the end consumer as part of a B2B2C model.

Users can be billed directly for data access and content services only. Connected-car data access can be integrated into shared data plans, which is aligned with operators' desire to increase adoption of shared plans, which in turn increases usage and retention. AT&T is particularly keen to make it easier for customers to add connected cars and cellular-enabled wearable devices to their shared data plans. As such, existing AT&T customers can add a 4G LTE-equipped General Motors vehicle to a Mobile Share Value Plan for $10 per month – the same cost as a connected tablet. Customers can also add cellular smart watches to their shared data accounts, such as the Timex IronMan One GPS+ smart watch, or communication and location devices, such as Amber Alert GPS and FiLIP, both of which have two-way calling. Ralph de la Vega, CEO of AT&T Mobile & Business Solutions

Group, underlined that "Once you have that bucket of data I think it gives us the capability to add all kinds of devices […] I don't think customers want a different plan for their car, a different plan for their home."

Alternatively, OEMs and service providers can be billed for the connectivity element of the services they are offering, which can be free or billed, while third parties such as car dealers can also be billed separately for access to maintenance and diagnostic data.

The role of partnerships

Telefónica has seen more than 250 partners joined its M2M Global Partner Programme since its launch in June 2013, enabling the company to extend its commercial reach by building stronger relatonships with key players in the M2M value chain. For example, in the insurance telematics sector, Telefónica has partnered with Generali Seguros, an insurance company, to offer Pay-How-You-Drive insurance policies ('Pago como conduzco') in Spain. Angel David García Barrio, ex-Head of Strategy and Alliances, Global M2M, at Telefónica commented that "This is a different concept as we are providing co-insurance. Generali is using internal channels to sell insurance, we are working on the technology. We share risk and share revenue." Generali Seguros has contributed over 1,600 branches to the partnership, in addition to its network of agents and brokers which includes over 10,000 professionals.

Turkcell relies on its network of partners for a deep understanding of the market, and sells services in conjunction with those partners: the vendor provides the hardware and software while the operator provides the M2M connection, platform, sales and marketing and billing system for the service. The total revenue from services is shared between the partners. Turkcell also offers its own branded solutions, for example fleet management.

Telekom Austria is working with several OEMs to develop connected products, most recently introducing its Avus security camera. Phat Huynh, Managing Director Telekom Austria Group, M2M, explained that "Connected products are almost always combined with a recurring service and therefore requires in depth-planning of the product's and customer's lifecycle. As M2M Service Provider we bring a lot more assets to the table than just the connectivity. We support OEMs and device manufacturers with all support systems needed to develop, manufacture, distribute and service a connected product throughout its lifecycle. With our experience and know-how in customer experience design we work closely with OEMs to take out the complexity of a connected service and to deliver best-in-class usability."

Trond Are Bjørnvold, VP Telenor Next, highlighted that "M2M connectivity is enabling product companies to offer new services on top of the core product, hence also generating new revenue streams and business models such as selling product function and service levels rather than only hardware/products."

Another major area that M2M cellular connectivity could potentially serve is around consumer connected goods. The majority of activity in this segment is currently centred on consumer use of smart watches and tracking devices for personal use. Cameron Coursey, Vice President, Product Development at AT&T, said that there is growing interest in the use of wearable devices, such as wristbands, to monitor activity levels and other health-related attributes. "Wearables and mHealth could be on the cusp of significant growth as

barriers of size, cost and usefulness are overcome and consumers see tangible benefits for embracing them." Furthermore, the growing size of the world's elderly population presents an opportunity for operators to offer more monitoring services.

Still, it is challenging to forecast how the global M2M consumer connected device market will develop over the years to come due to high levels of uncertainty regarding growth drivers in this area. Using the current market status that we have examined, we believe that this will be a niche segment and that IoT will take a large share of this opportunity. The impending introduction of the Apple Watch in 2015 might prove to be a tipping point for the adoption of smart watches. Today, most smart watches connect only through Bluetooth, but Apple has also included NFC and Wi-Fi (which has impacted the battery performance).

■ Additional M2M market challenges

From vertical to horizontal M2M solutions

M2M delivers proprietary applications which are most often supplied in response to business requirements, and serve the needs of particular verticals, e.g, security. In addition, M2M applications are often custom built, with one European operator explaining to us that "Almost every business solution is unique, specially designed for the client, we have general payment plans and profiles but we tailor fit it to answer customer needs." Jürgen Hase, Vice President M2M at Deutsche Telekom, noted that with time M2M will move away from such separated, siloed approaches to encompass the delivery of horizontal solutions, utilizing Big Data analytics on a more "plug and go" basis.

We see this as a factor that limits M2M reach, as M2M applications cannot be scaled up. However, the right market conditions and the launch of standardised APIs in the M2M space could theoretically boost M2M connections growth.

Promoting M2M adoption

Sierra Wireless, the leading M2M module vendor, has conducted customer surveys across its customer base, including companies such as Cisco, GE, Nespresso, Ingenico, Honeywell, Schneider Electric, Chrysler, PSA Peugeot Citroen, Renault, Fujitsu, Lenovo, Bosch and Veolia Water. It found that the biggest barriers to enterprise adoption of M2M connectivity are limited internal expertise and complex M2M market offerings.

Our conversations with mobile operators echo these sentiments, especially among emerging market operators which have highlighted the need for customer education on the benefits of M2M technology in order to speed up the adoption of M2M solutions. In some cases operators are taking this issue into their own hands, with e.g, SingTel having indicated that "Customer education is crucial to scale" and as a result setting up Customer Advisory Councils and other dedicated sources in order to promote M2M adoption.

Long adoption cycles

Vodafone explained to us that "Selling M2M is a long process; it can take from first point of contacts between fifteen months to two years, from first talking to customer to actually deploying projects, but the upside is that the minimum contract period is three years, on

average 5-7 years deals."

Thus, it is important to bear in mind that M2M services tend to have longer adoption cycles. It took General Motors' OnStar service, which connects vehicles to a range of services and was first launched in 1996, nearly two decades to reach eight million customers in North America and China.

Low Powered Wide Area (LPWA)

Several unlicensed-spectrum LPWA solutions (most notably Neul and Sigfox) are expanding aggressively with a view to establishing their variant of LPWA technology as the de facto standard ahead of cellular IoT and the introduction of LTE-M (LTE for M2M) in the next few years. It would be beneficial for operators to review the opportunity for LPWA as a capability that would allow them to support a greater portion of the IoT market. Operators may want to take a view on how to meet the market requirements for low cost, low power communications for some IoT sensors and devices.

Moving beyond M2M to Internet of Things

The Internet of Things has come to the fore this year as Google, Samsung, Apple and a host of other companies made moves into this space. Notably, during his keynote speech at MWC 2014 Cisco's CEO John Chambers described IoT as being "About connecting things together through sensors in a way that helps the consumers" and that the technology shift to IoT "would have a five to ten times' greater impact on our lives than the impact of the internet." He added that vendors ought to ensure they are constructing products on a consistent underlying architecture because "the trick for winning in the home is to make things easy for the consumer to connect everything."

This IoT ecosystem will revolutionise our customers' lives from multiple perspectives

On the go...	in the home...	in the city...	and beyond
Connected Devices/Cars	Connected Home	Smart Cities	Agriculture
Pervasive **smart connectivity** brings consumers' physical and digital life closer together	Connected **intelligent buildings** bring the benefits home by driving dramatic improvements in (energy) **efficiency and security** and extending benefits of **health** and **education** to the home	**Smart cities** ensures a networked urban society shares in the benefits of **intelligent traffic management, smart energy grids and security**	While spreading the benefits to rural areas by enabling innovation in **agriculture** and improving **access to key services** such as **education** and **health**

Figure 6: Customer Vision of Connected Living in 2020

Source: GSMA

In order to address this opportunity a number of alliances that aim at capturing the IoT market were formed, including the following:

- Thread Group led by Google's Nest, a smart thermostat maker, which includes Samsung Electronics, ARM Holdings, Freescale Semiconductor, Silicon Labs and lock-maker Yale

- Qualcomm's AllSeenAlliance, which uses the AllJoyn platform and includes Microsoft and 50 other companies

- Intel's Open Interconnect Consortium involving Samsung, Atmel, Broadcom, Dell and Wind River

In addition, Cisco is investing in IoT management firm Ayla Networks, while Apple can potentially use AirPlay as a standard for IoT devices. In June, Apple announced plans for HomeKit, its own framework for connecting smart home devices.

Mobile operators are also looking to tap into this opportunity, and are partnering with vendors. The most recent examples of such initiatives include:

- SK Telecom's planned implementation of an IoT based management system at a fish farm. The management system seeks to improve the current farm management process via IoT technologies based on wireless sensor networks. SK Telecom aims to commercialise the IoT-based fish farm management system in the first half of 2015. SK also intends to expand this project to overseas markets including Japan and China

- In August 2014, PLAT.ONE the Enterprise-Grade Application Platform partnered with Telecom Italia Digital Solutions to Drive Connected Industry Solutions to power Telecom Italia's M2M & IoT offering, beginning with vending machines in the food and beverage sector

- Intel has joined forces with Taiwanese operator Chunghwa Telecom to develop technology related to IoT, cloud computing and software defined networking (SDN) with the development focusing on smart homes, fleet management and energy savings

- SK Telecom signed an MOU with Telecom New Zealand for cooperation in business and technology with regard to IoT. The operators agreed to collaborate on developing three core areas: smart car, telematics and smart city, and expand the areas of collaboration to other IoT businesses such as smart farm

- Tele2 and NetComm Wireless have entered into a strategic partnership to create new M2M/IoT opportunities for vertical markets. This is achieved by transforming asset management capabilities in areas such as industrial automation, security, smart cities and healthcare. The alliance forms part of a broader collaboration between leading M2M/IoT ecosystem partners selected by Tele2 and NetComm Wireless to provide end-to-end solutions that can be easily applied to a broad range of M2M/IoT applications across key industry sectors

- ThingWorx, an IoT platform provider, and Telenor Connexion announced a new collaboration designed to make it simpler and quicker for companies to realise the promise of a smart, connected world

Methodology

Definitions and scope

While mobile operators and regulators increasingly report M2M connections, their definitions can vary considerably. As a result, we have standardised M2M connections definition as follows:

A unique SIM card registered on the mobile network at the end of the period, enabling mobile data transmission between two or more machines. It excludes computing devices in consumer electronics such as e-readers, smartphones, dongles and tablets.

To initiate our modelling exercise we have created a tracker where we have collected publicly available information about mobile operators' M2M services to derive the number of operators worldwide that commercially offer M2M solutions and tariffs, telemetry packages, and connectivity-only for M2M applications. In addition, we have gathered information about M2M services launch dates, partnerships, and vertical applications. This tracker has been compiled using primary and secondary research, and inputs into our data modelling and forecasting.

We have identified a number of sectors with corresponding applications groups:

- **Automotive:** cellular connectivity used for telematics services, which includes embedded car telematics (factory fitted telematics used for safety and security, vehicle services, and infotainment), aftermarket telematics: telematics installed by the customer or third party provider. It includes vehicle tracking, fleet management, vehicle insurance, speed camera alerts, and electronic toll

- **Agriculture and environment:** cellular connectivity used in agriculture and environment including applications in the area of (but not limited to) remote monitoring of animals, crops, greenhouses

- **Connectivity only:** MNO has no visibility on type of M2M applications offered over its network

- **Consumer electronics:** cellular connectivity used in consumer electronic devices; excluding tablets, PC and smartphones but including connected cameras, connected photo frames, portable gaming devices as well as pet and children tracking devices

- **Healthcare:** cellular connectivity used in health monitoring, prevention, diagnosis, health worker empowerment as well as and wellness/fitness applications

- **Industrial M2M:** this sector covers use of M2M applications in the Construction, Manufacturing, Transportation and Storage industries. The most prominent applications are asset tracking and management, and remote monitoring of machines

- **Public sector/government:** use of mobile connectivity for provision of services for public sector and transportation infrastructure such as traffic monitoring, parking permit machine, traffic signaling and street light control

- **Retail and finance:** use of cellular connectivity in ATMs, Point of Sale (PoS) devices, vending machines, and advertising

- **Security:** use of cellular connectivity used as primary or secondary connectivity for home and small business security alarms, fire and gas alarms, remote video surveillance, and home automation

- **Utilities:** use of mobile connectivity for smart meters, either P2P or at the point of aggregation in electricity, gas and water sectors

- **Wholesale:** MNO offers wholesale connectivity to M2M MVNO

Data modelling

Our M2M connections modelling methodology is based on a bottom-up approach, aggregating data for each mobile operator that has commercially deployed M2M services. Our data model is based on a set of historic M2M connections reported at any point in time by mobile operators and regulators along with market assumptions based on our large scale survey of M2M operators and vendors.

We have collected data for mobile operators worldwide that reported M2M connections at any point in time. In addition, we have surveyed over 100 industry players worldwide to gather additional data points and gain insights into future plans and expectations with regards to M2M service deployment and adoption.

This pool of data has been reconciled with our definition, normalised and analysed to identify specific M2M adoption profiles. Each 'known' adoption pattern has been clustered based on metrics such as quarterly connections growth and GNI per capita to derive a set of adoption profiles representing the average share of M2M connections within total connections over an indexed time series. These adoption profiles have then been applied to all operators that have commercially launched M2M services but do not report M2M connections.

Once operator's M2M connections for the historical period were estimated (2000-2014) the second step was to tailor operator forecasts, taking into account a number of growth drivers such as:

- Product and service development
- Commercial deals and partnerships
- Regulatory initiatives
- Operator's plans in the M2M space

In addition, we have also conducted a top-down market assessment and held conversations with module vendors to corroborate our market sizing and vertical market assumptions.

Glossary

Machine-to-Machine (M2M)
M2M is an integral part of the Internet of Things (IoT) and describes the use of applications that are enabled by the communication between two or more machines. M2M technology connects machines, devices and appliances together wirelessly via a variety of communications channels, including IP and SMS, to deliver services with limited direct human intervention turning these devices into intelligent assets that open up a range of possibilities for improving how businesses operate.

The Internet of Things (IoT)
IoT describes the coordination of multiple machines, devices and appliances connected to the Internet through multiple networks. These devices include everyday objects such as smartphones, tablets and consumer electronics, and other machines such as vehicles, monitors and sensors equipped with machine-to-machine (M2M) communications that allow them to send and receive data.

M2M platform
M2M Service Delivery Platform provides a range of additional features facilitating delivery of mobile data, such as private APNs, fixed IP, device management, and flexible billing.

Telemetry
Automated communications process by which measurement data is collected at remote or inaccessible points and transmitted to receiving equipment for monitoring, display, and recording.

Geographic segmentation
GSMA Intelligence classifies developing countries and economies as defined by the World Bank. Economies are divided according to 2011 gross national income (GNI) per capita into low-income ($1,025 or less), lower and upper middle-income ($1,026–$4,035 and $4,036–$12,475) and high-income ($12,476 and over) (July 2012).

Countries that fall within the low- and middle-income brackets are then classed as developing markets. Note that this definition is subject to annual change as the income brackets and GNI per capita of each market are reviewed and if necessary, revised, by the World Bank at the end of June.

About the authors

Sylwia Kechiche Senior Analyst

Sylwia is responsible for M2M data and analysis within GSMA Intelligence. Prior to GSMA, Sylwia worked for Pyramid Research where she was responsible for a number of qualitative and quantitative deliverables focused on operator strategies in Europe. She holds an MA with Distinction in Communication Policy Studies and BSc in Sociology from City University.

About GSMA Intelligence

GSMA Intelligence is the definitive source of global mobile operator data, analysis and forecasts; and a publisher of authoritative industry reports and research.

Our data covers every operator group, network and MVNO in every country worldwide — from Afghanistan to Zimbabwe. It is the most accurate and complete set of industry metrics available, comprising tens of millions of individual data points, updated daily.

GSMA Intelligence is relied on by leading operators, vendors, regulators, financial institutions and third-party industry players, to support strategic decision-making and long-term investment planning. The data is used as an industry reference point and is frequently cited by the media and by the industry itself.

For more information, visit gsmaintelligence.com/about/

gsmaintelligence.com • info@gsmaintelligence.com • @GSMAi