M2M Communications in Developing Countries

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Abstract

M2M sector is an increasingly important source of connections growth for mobile operators worldwide. Operators are looking at M2M as a new business alternative means to reduce the impact of the slowing growth (or declines) in traditional consumer mobile services. As a result, many operators are adapting their organisational structures and business models exploring opportunities to expand their portfolio to emerging markets in developing countries. These markets are still in process of maturing, with M2M implementations at very early stage. On the other hand, the benefits that could accrue to developed countries through the Internet of Things (IoT) and machine type communication (MTC) are numerous. In this context, this paper presents an initial study about the current status of M2M in some developing countries, considering as study cases regions such as Latin America and Asia. Presented information remarks the potential of the considered markets to boost the growth of M2M solutions worldwide. Finally, we show some specific requirements for M2M business models for developing countries and a description of the technical challenges to be considered at the moment of investing in M2M solutions for developing countries.

Keywords

Machine-to-Machine Communications; Developing countries; MTC; M2M; IoT

1. Introduction and motivation of work

Development always incorporated with investing in infrastructure, which means investment for water supply, roads, electricity networks, or human capital. But in modern world ICT is essential infrastructure without which our economy cannot function. ICT is already a significant part of the developing world's economy. Connectivity—whether the Internet or mobile phones—is increasingly bringing market information, financial services, and health services—to remote areas, helping to increase people's living

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standard in unprecedented ways. New technologies are enormously changing the conventional way of corporate business, public service delivery, information accessibility and overall countries GDP growth. For example, with 10% increase in high-speed Internet connections, economic growth increases by 1.3%, according to the World Bank [1]. Virtually majority of the new ICT consumer in the coming years will be from developing countries. Although, developing countries are considered a market at full-growth pace, the matter of fact is that the region's adoption of technology is, in general, much slower than in the rest of the world. Most of these potential live on rural areas, which means that the ICT platform is reaching population with low levels of income and literacy.

In this context, machine-to-machine (M2M) technology is still in the process of maturing and the benefits that could accrue to developed countries through the Internet of Things (IoT) and machine type communication (MTC) are numerous. The most obvious advantage is financial, but equally noteworthy is the efficiency it could generate, especially in terms of managing energy and natural resources. However, the challenge is to find ways to deploy M2M solutions considering the developing countries' constraints, the required M2M ecosystem components (i.e., a high-quality broadband connection, mobile Internet access, stable cloud computing services, and Big Data processing infrastructure, among other requirements) and the potential benefits this technology bring to their societies.

Currently, mobile operators in Latin America and South Asian regions are offering limited M2M services over 3G to LTE networks for simpler device connectivity. IoT solutions are mainly focusing on the vehicle tracking industry [2]. This kind of service and the growing urge of automation and resource optimization (energy) of day-to-day system are anticipated to increase the growth of M2M market in Latin America and South Asia. But, relatively slow adoption of the technology is acting as a major restraint for the growth of M2M market in these regions.

Developing countries like Brazil [3] and India [4] has on-going projects on smart cities aimed to reach its energy objectives and demonstrate the suitability of smart grid technology in the urban environment by utilizing technologies such as smart metering, and efficient street lighting. Nevertheless, rests of the developing countries are in the phase of migration to LTE technology and adoption of M2M technology. For the stakeholders in these markets there is a need for clear description of technical and business related aspects of M2M to plan their deployment.

The focus on this paper is to do a study about the current status of M2M networks and IoT solutions in developing countries, considering as study cases regions such as Latin America and Asia. This initial

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study will allow us to understand technical requirements, and business models for potential market opportunities that can be adapted to the developing countries context. In that sense, we present an initial literature study oriented first to describe the current structure of the mobile market in the chosen regions, while identifying how the M2M market has evolved in developing countries. Then we present a picture of some representative M2M initiatives carried out in Latin America and South Asia. This information provides information about interaction patterns between different actors in the considered markets. Finally, we present suggestions about the necessary requirements to develop business models for developing countries along with a description of the technical challenges and potential market incentives to face at the moment of deploying M2M solutions in the considered regions.

2. Current Mobile market structure

Latin America and South Asia have the world's largest working-age population, a quarter of the world's middle-class consumers, and the largest number of poor in the world [5]. Even though, it is expected that this region will play an important role in the global mobile business with a substantial growth to change global mobile market crescendos in upcoming years. With more than 2 billion inhabitants, Latin America and South Asia are one of the most densely populated areas in the world with majority of developing countries. Latin America, with more than 319 million active unique subscribers and 632 million SIM connections within 588 million natives, now accounts for approximately 20% of the global revenues in mobile market with an average penetration rate of 104%. Wherein, South Asia with 1.5 billion occupants has a mobile consumer base of around 1 billion with the penetration rates on average of 75%. However, both of the market reaches their US$ 100 billion revenue milestone by 2012-2013 [6]. These markets have predominantly low average revenue per user (ARPU), with approximately 90% of connections still utilizing 2G networks. Smartphones contribute less than 10% of total connections, while non-voice ARPU is less than 10% of total ARPU [6].

Mobile industry contributed with on an average of 3.7% to Latin America's and 5.5% to South Asian's GDP in 2012, supporting over 12 million direct jobs and contributed over US$ 39 billion and US$ 40 billion to public funding in Latin America and South Asia respectively. It is expected that with the deployment of new applications and services, and the investments on LTE infrastructures, mobile industry contribution to region's GDP will be over 4.5% by 2020. Even though these markets show a relatively slow adoption of new services and applications compared to some other regions, this trend will change, as the mobile devices prices falling will increase the penetration of smartphones and tablets. In that sense, according to GSMA [7], 8.1% of Latin American Internet users access through mobile devices,

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a figure that has doubled over the last year. At the same time, over 15% of South Asian Internet users have access through mobile devices. This scenario, combined with the trend to accelerate the 4G deployments in these regions, will bring the potential to develop new business models for traditional network operators, while new players emerge and compete to attract new customers.

The mobile markets in these regions are now moving to a more mature phase, but still with significant growth potential in the medium term. A sign of this is the growth in the LTE deployments and the still low penetration of M2M solutions, as it is shown in Table 1. With increasing penetration rates and new network deployments there is the potential for much greater impact in the future. New mobile services and applications can make important contributions in areas such as sustainable growth, health, education and access to financial services for these regions. As the mobile ecosystem evolves, the door is open to innovative and socially relevant business models that go far beyond communications and into the provisions of essential services such as energy and healthcare.

Table 1. *Status of Networks and M2M services in some countries in Latin American/South Asian region*.

Country	2G	3G	LTE/WiMax	M2M Service
Brazil			Partially deployed	Vodafone with Datora
Chile			Partially deployed	
Colombia			Partially deployed	
India			LTE-TDD Partially deployed	Vodafone
Bangladesh	Available in majority of the cities	Partially deployed	WiMAX deployed partially	
Pakistan	Available in majority of the cities	Partially deployed	Partially deployed	
Srilanka	Available in majority of the cities		Partially deployed	

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Regarding M2M solutions, between 2010 and 2013, 120 million M2M connections have been added globally (38% CAGR) reaching a total of 195 million by the end of 2013 [8], as it is shown in Figure 1. In 2013, M2M connections account for 2.8% of total mobile connections in in the world, up from 1.4% in 2010. Global M2M connections will reach 250 million in 2014.
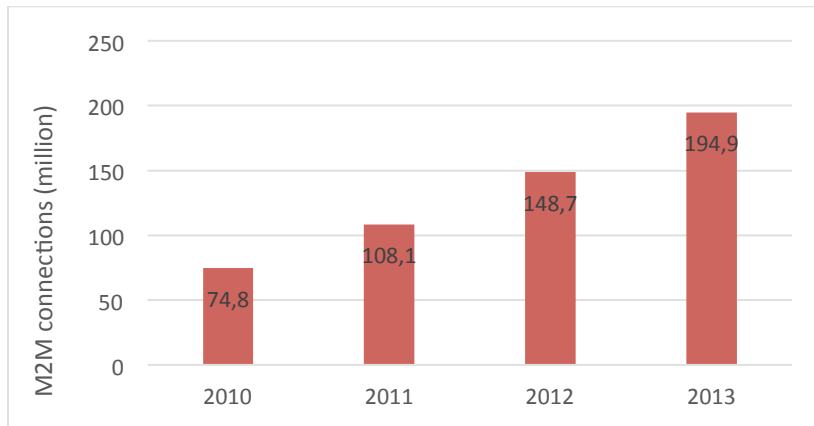

Figure 1. Total global M2M connections (million) [8].

It is important to remark that over the period 2010-2013, most of the growth in M2M connections was in the developing region (standing at 55% CAGR), compared to 25% in the developed region. The fastest growing region worldwide was Asia with a 55% CAGR, followed by Latin America (44%) and Africa (41%). See Table 2.

Table 2. *M2M as a % of total connections by region, CAGR 2010-2013 [8].*

Region	M2M % total connections (2013)	M2M CAGR (2010-13)	Connections CAGR (2010-13)
Africa	1.0%	41.3%	15.0%
Asia	2.1%	55.0%	10.4%
Europe	5.1%	28.6%	2.4%
Latin America	2.1%	43.7%	7.8%
Northern America	9.3%	22.5%	3.6%
Oceania	5.1%	25.8%	5.5%
Global	**2.8%**	**37.6%**	**8.8%**

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In the same line, and as it is shown in Figure 2, Asia and Latin America represent 50% of the total share of M2M connections in the world. In this context, an according to GSMA report [7] [8], Latin America had 19 million of M2M connections at the end of 2012 (See Figure 2). According to the trend presented by GSMA and Machina research [8] and shown in Figure 3, in Latina America the number of M2M connections is expected to growth in the upcoming years, reaching 84M by 2017.
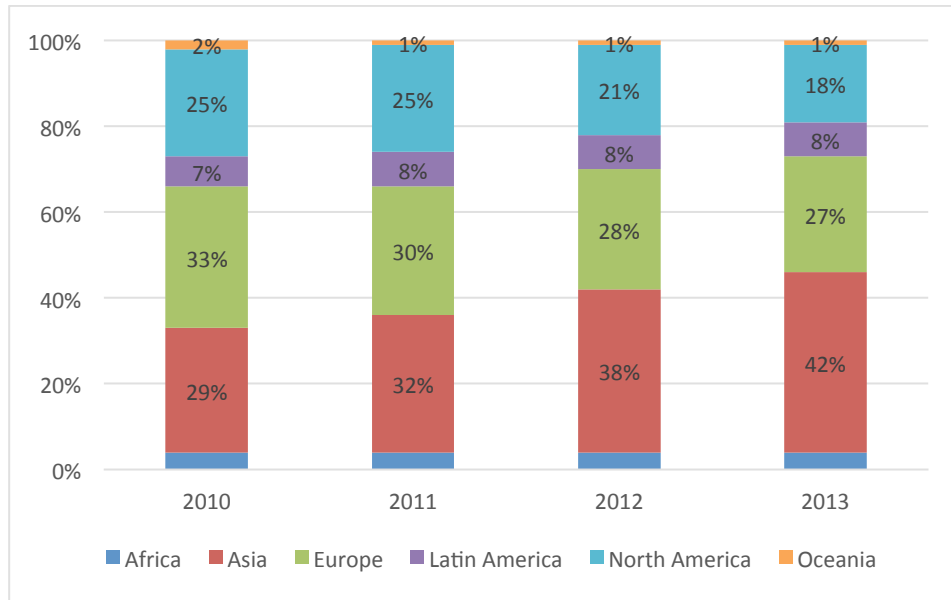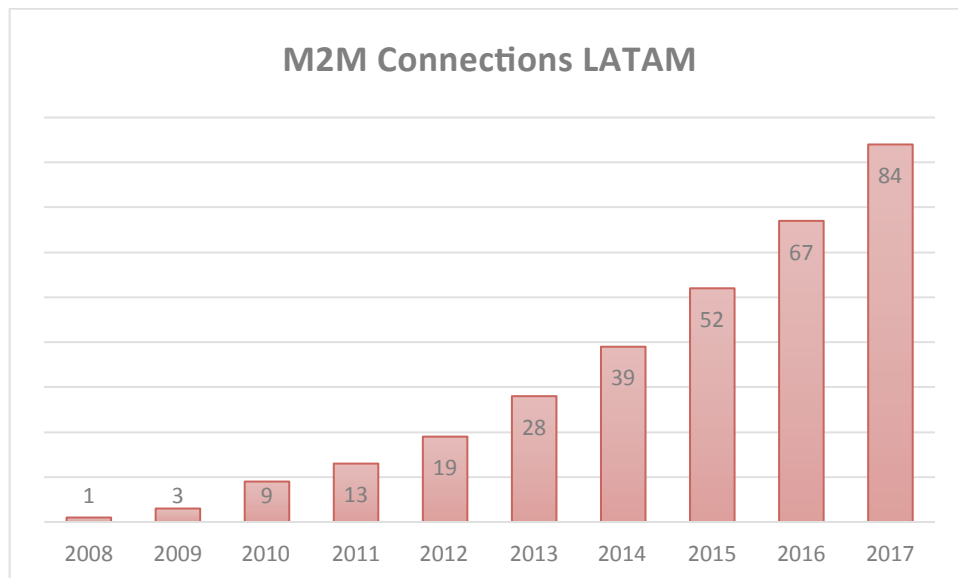

Figure 2. Regional share of M2M [8].

Figure 3. M2M connections LATAM [8].

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The same report indicates that mobile operators might generate revenues about US$ 92B by 2020 [8] as a result of the increase in the number of M2M connections and the provision of associated services. In that sense, potential M2M market growth will be driven by the adoption of new applications, government initiatives to deploy M2M solutions (including new regulations and policies), the migration of 2G networks and greater availability of M2M value-added-services (VAS) provided by mobile operators in partnership with technology vendors, local service integrators and vertical specialists.

3. Current IoT service accessibility and M2M initiatives in Latin America and South Asia

As Latin American and South Asian market adopts new services and applications gradually and as IoT service market are in its early phase so not all the countries in these areas are actively involved into this activity. Still it is noticeable that most of the countries got GSM 2G/3G based telematics/fleet management services to prevent carjacking and ensure road safety. Countries like Bangladesh, India, Pakistan, Brazil, Chile and Colombia are already have this service. Even the government of these countries made fleet service mandatory by law for consumers.

Still many of the other IoT services like smart metering, and smart grid are on their way to be introduced to these countries to mitigate system loss and ensure maximum utilization of resources. India and Brazil are two economic giants among these countries are a bit ahead in these activities compared to other developing countries. Brazilian and Indian government already changed their regulation for IoT and M2M services and other developing countries are on the way to do so.

As Brazil and India are very active to IoT and M2M services in this section we will discuss activities of these two countries.

3.1. Brazil

Brazilian mobile market is seeing particularly strong growth in IoT and M2M services, being the largest market across the Latin American region in the M2M field, representing 70% of the region's M2M device connections [9]. The current M2M base in the country has surpassed 6M connections, implying that M2M connections now represent more than 10% of total post-paid connections in the country [8]. The tax relief provided through the government program "Brasil Maior (Bigger Brazil)" might explain this growth. This tax reduction included M2M connections. Traditionally, these connections have been

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subject to the FISTEL (*Fundo de Fiscalização das Telecomunicações*, or Funds for the Inspection of Telecommunications) tax that applies to all other telephony lines, which is collected upon activation and then annually. However, this tax created a disincentive for M2M lines that typically generate significantly lower ARPU than typical post-paid connections.

On the other hand, DENATRAN (*Departamento Nacional de Trânsito*, Brazil's State Traffic Department) has established that by 2015 all new vehicles produced for the domestic market must have an M2M device to allow vehicle tracking and remote blocking services. In addition, the ANEEL (*Agência Nacional de Energia Elétrica*, Brazilian Electricity Regulatory Agency) approved in 2012 a resolution that states that energy distributors have 18 months to start offering smart meters to consumers, although the smart meter installation is only performed when requested by the consumer. These changes could drive a period of high growth in Brazil's M2M market.

3.1.1. mHealth

TIM launched a pilot project of the MyDoctor@Home solution [10], a remote diagnostics service which allows patients suffering from cardiac, diabetic or lung ailments to measure their clinical parameters from home and transmit this to the e-Health Connecting Platform, using any available fixed-line or mobile network. The results are transmitted from the connected medical device to a gateway that automatically uploads the data to the eHealth Connecting Platform over any available fixed line or mobile network. Then, patients and medical staff can access the information via their smartphone, PC or television. The system can be configured to other uses, such as providing clinical measurement timings and reminders, alerts to take medication and escalation notifications if any measurements are outside the preconfigured safe range.

3.1.2. Fleet Management

In July 2007, the Brazilian government announced that all new vehicles would need to be fitted with an anti-theft system as standard equipment [11]. This program known as SIMRAV (*Sistema Integrado de Monitoramento e Registro Automático de Veículos*, Integrated System of Monitoring and Automatic Vehicle Register) requires that new vehicles (cars, lorries, coaches and motorcycles) are equipped with stolen vehicle tracking systems that enable a car to be located remotely. This provides a revenue opportunity, both in the provision of the embedded SIM and related hardware, as well as from on going service provision.

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In the same line, the Brazilian insurance company Porto Seguro (Sao Paulo, Brazil) launched a service that allows it to track and monitor the driving of its automotive customers [12]. The company started installing SIM cards in vehicles in June of 2012. It is currently providing the M2M service to about 2,000 vehicles owned by insurance customers and aims to serve around 450,000 vehicles by the end of 2014.

Telefonica's Vivo subsidiary in Brazil has launched a cloud-based platform for its M2M services named Smart Centre [13]. The new platform will be used for a partnership with General Motors (GM) OnStar telematics services in Brazil. In addition to the OnStar partnership, the Vivo M2M Smart Centre platform has been developed to support the Brazilian SIMRAV Stolen Vehicle Tracking (SVT) programme.

3.1.3. Smart City

Curitiba in Brazil has launched a Smart transport system. The solution provides electronic ticketing systems and fleet management of public transportation. The system has been praised by the United Nations Framework Convention on Climate Change for their ability to reduce CO_2 emissions, while reducing congestion and improving travelling times. Rio de Janeiro has implemented a system that provides real-time information to the city's 6.2 million users of public transport on the location of buses and average journey times. The city is also using mobile technology to enable the police to levy traffic fines electronically [14].

Ampla an electric energy distributor, owned by Endesa Brazil launched the Rede Ampla project in Rio de Janeiro [15]. This company provides electricity to 73% of the state of Rio de Janeiro, serving over 2 million customers. The rate of urbanization, the nature of the accommodation (slums) and the high crime rate led to an unsustainable level of energy theft and bad credit risk. In 2003, Ampla began to roll out a pilot for a new mode of smart meter. The pilot proved a great success with losses from theft reduced by more than 50%, the number of supply interruptions reduced by more than 40%, and lower operating costs. A wider roll out followed, providing hundreds of thousands of Ampla's residential and business customers with access to the Rede Ampla service.

The National Agency of Electrical Energy (ANEEL) published in 2012 a new regulation indicating that energy distributors will have 18 months to offer electronic energy meters to consumers, while there is a medium term goal of replacing over 60 million meters in the country by 2021. According to a report by

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KEMA for the GSMA [7] [8], Brazil, along with China, India, Japan and South Korea has one of the most ambitious smart meter deployment plans until 2020.

3.2. India

India is one of the largest M2M growing markets in South Asian and in Asia pacific region, representing almost 80% of South Asian's M2M device connections. They introduced vibrant IoT services and many new services are introducing daily. In Delhi, the streetlights are now switched on remotely during dusk and dimmed during daybreak without any human interaction. The electronic toll payment system is getting popular as user can breeze through the traffic avoiding the long queue. Doctors in some leading hospitals using an M2M based healthcare system to monitor the heartbeats of recently operated patients after they have been discharged from hospitals. Instead of going to the field every night to switch on the water pump for irrigation in remote locations -farmers in rural Maharashtra switches it remotely by using the product called "Nano Ganesh" as soon as power is available. At the same time the, A new tsunami warning service based in India has been scheduled for launch in the first quarter of 2015. The government of India already announced to build 100 smart cites in coming year. All these listed activities indicate emerge of big M2M market in India.

Experts predict, the M2M market growth in India will be in key sectors like Energy, BFSI, Automotive, Retail and Healthcare. According to research firm 6Wresearch, India M2M modules market is expected to generate 5.5 billion by 2016, with an estimated compound annual growth rate 33.81 per cent from 2011 to 2016 [16] increased adoption of 3G services and even 4G technologies open up the door to consumers to use high speed data connectivity for M2M application like video surveillance. M2M applications are also can benefit rural India by facilitating automation of agro services, flood prediction, and data gathering for milk and agro-cooperatives, fisheries, poultry, and soil analysis. Indian regulatory board and government are changing their regulation in order to facilitate and coup up with M2M business stream. Major Operators like Vodafone India, Bharti Airtel, Idea and MTS already have M2M platform ready and offering various services like fleet tracking, security solutions, location tracker, asset management, remote worker, tele-health, mobile payment.

Among many initiatives we are going to focus on smart city, smart grid, and fleet management projects as Indian government recently gave high priority to these sectors and in next 6 year timeframe a vast deployment of this services is expected all over India.

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3.2.1. **Smart City**

Recent Indian government is following the footsteps of other countries in Asia including China and Singapore. In recent times, Finance Ministry announced of developing 100 satellite towns surrounding large cities, which will be a pilot smart city. However India has vision to have 2 Smart Cities in every state under phase II of the Jawaharlal Nehru National Urban Renewal Mission (JNNURM). India is building the "Wave City" project on 18 square kilometres of land in Ghaziabad, near New Delhi where all services are managed by smart systems. Kochi Smart City project kicked off in last year January and expected to be completed by 2019.

Apart from that, 7 Smart cities have been announced along high-speed rail Corridors. These are Dadri-Noida-Ghaziabad Investment Region, Uttar Pradesh, Manesar-Bawal Investment Region, Haryana, Khushkhera-Bhiwadi-Neemrana Investment Region, Rajasthan, Pithampur-Dhar-Mhow Investment Region, Madhya Pradesh, Ahmedabad-Dholera Investment Region, Gujarat, Shendra-Bidkin Industrial Park city near Aurangabad, Maharashtra and Dighi Port Industrial Area, Maharashtra [17]. All these cities are planned to have automated energy management, water management, transport and traffic, safety and security and solid waste management system along with healthcare, education, inclusion, participative governance and community services [18] [19].

3.2.2. **Smart Grid**

India's transmission and distributed losses are among the highest in the world. According to ministry of power, on an average 30% loss of the total electricity production with some states as high as 62% including non-technical losses such as energy theft losses as high as 50% [20]. Moreover, the billing and collection efficiency is 33.07% [21]. On the other hand, India is moving more and more towards renewable energy and establishing 25000 MW solar capacities only in the state of Rajasthan. Indian government identified the capacity of Smart city to solve maintenance, theft management and cost effective billing issues. The list of Indian pilot project list is given in table 3. At the same time India will changes the regulation to adopt smart grid for existing system management and extension of renewable energy supply.

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Table 3. *Indian Smart Grid pilot projects [22].*

Title	Description
UHBVN, Haryana	The pilot project covers 31,914 consumers
CESC, Mysore	Project involves 21,824 consumers
TSECL, Tripura	project covers 46,071 consumers
KSEB, Kerala	Pilot is proposed for around 25078 consumers
Electricity Department, Government of Puducherry (PED)	Project proposes covering 87031 consumers
UGVCL, Gujarat	Project proposes covering 20,524 consumers
AP CPDCL, Andhra Pradesh	proposed project area is covered under RAPDRP
APDCL, Assam	The pilot project covers 15,000 consumers
MSEDCL, Maharashtra	Project proposes covering 25,629 consumers
CSPDCL, Chhattisgarh	Pilot project includes installing smart meters
HPSEB, Himachal Pradesh	Pilot project covers 650 consumers
PSPCL, Punjab	The functionality of Peak Load Management
WBSEDCL, West Bengal	Pilot project proposes to take up 4 nos. of 11
JVVNL, Rajasthan	Project proposes covering 34,752 consumers

3.2.3. Fleet management.

Fleet management in India is at an initial stage but is growing rapidly with an average growing rate of 30%. Recently, car tracking is being mandatory (by end of 2013), only 10% of the vehicle market has selected fleet management. Still in coming years steep raise in the number i.e. 70 – 80 % of the vehicles would be fitted with tracking system. Automobile manufacturers like Tata, Mahindra start offering inbuilt tracking system. On the other hand, big mobile operators like Bharti Airtel, Vodafone, MTS, are also offering fleet management system. Apart from that there are many existing GPS tracking solutions available in the market and playing important role in Indian M2M sector [17].

4. Specific requirements for M2M business models for developing countries.

Normally, in the case of mobile wireless services, a user is charged per device/SIM-card, according to the type of subscription they have taken from a network operator. In principle the user does not interact

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with the operator too much. Contact is mostly over a bill, or a configuration issue. The consumer has to accept more or less the parameters (roaming networks, coverage and so forth) of the service as a given and cannot change too much of it. In order to change parameters, a change in provider may be necessary and this can be done, for example, by switching a SIM-card.

M2M users have completely different demands on their communication suppliers. At the moment of evaluating potential investments in M2M infrastructure is important to consider that the requirements M2M providers have, for M2M applications, are significantly different from what consumers and business ask from their communication providers for standard telephony and data for users. First, it is important to consider the users' demands come from a perspective where thousands to millions of devices have to be managed remotely by a limited staff. Some of these demands are operational, others are monetary, and some of these may look the same to consumers, but are different in practical application. Demands that must be taken into account in a future M2M scenario are:

- A full insight into the status of the network, so that in case an M2M device does not communicate it can be verified whether it is a network malfunction or a device malfunction.
- M2M provider should make possible to switch mobile networks at the end of contracts or in case of disputes, but without having to switch SIM-cards.
- A single subscription with one bundle for all devices, instead of a bundle and subscription per device.
- A guarantee on the expected lifetime of the communications technology.
- Controls to stop communication in case of theft of the device (or the communications module).
- Common regulatory measures, to improve competition in the market, such as through enabling lower switching barriers.

If the market, as expected by many players, aims to introduce billions of M2M devices, there will be a need for stakeholders to assess the costs and benefits of existing business models.

Mobile operators are not the only entities in the mobile ecosystem to adapt their business models. Recent analysis of more than 150 corporate announcements since 2008 in the M2M market reveals a high level of partnering activity amongst device and technology vendors in the upstream value chain. Companies from outside the mobile industry should be encouraged that operators are adapting their business models. This increases the probability of commercializing new opportunities.

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In the traditional mobile model, companies in developing countries are gaining newfound business capabilities by shifting from a pure M2M connectivity services model to an M2M VAS model. The speed and efficiency of processing data generated by these systems might be one the key drivers for businesses in the years to come. Even more critical will be the ability to access that information— anytime, anywhere and on any device. Another way to gain competitive advantage is by doing smart business with big data generated by smart machines. Smart companies are building new business models leveraging trends such as M2M, which is simply the direct communication between objects and systems without the need for human intervention. Today the M2M market is an adjacent and incremental opportunity to the traditional mobile market because it has a broad reach and an impact on solutions across all industries.

5. Technical challenges and market incentives.

Use of M2M is shifting the market from one where users have a relatively limited number of communication devices to thousands or, in the case of business users, potentially millions of devices. Therefore, changes to telecommunication policy and regulatory frameworks may be required. Some of the main areas that will need to be evaluated, and implications of M2M assessed, include: opening access to mobile wholesale markets for firms not providing public telecommunication services; numbering policy; frequency policy; privacy and security; and access to public sector information.

Further liberalization, in wireless markets, could enable M2M-users to buy wholesale access to mobile networks, to change mobile networks without switching SIM-cards and to directly negotiate national and international roaming. This would, however, involve changes to current numbering policies regarding IMSI-numbers for SIM-cards and telephone numbers, so that not only traditional telecommunication companies, but also M2M-users could access these numbers. Such changes could lead to a more dynamic market for mobile wholesale access, mobile roaming and a strengthening of competition between mobile network operators.

M2M will make extensive use of wireless communication in both licensed and unlicensed spectrum bands. For licensed spectrum, it is important to consider that M2M has a much longer expected life than traditional wireless communication. For example, the current use of 2G networks for M2M may mean that some mobile networks will not be able to shut down their 2G networks, even if they wish to, because a countries smart metering infrastructure depends on 2G. This could affect the use of spectrum. For unlicensed spectrum, a question is whether there will be sufficient spectrum available, in the future, as

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more and more devices start to use the already crowded globally harmonized 2.4 GHz-band, which seems to be the default for wireless personal area networks using technologies such as Zigbee and Wi-Fi.

Given the use of M2M for health, transport, consumer electronics, energy use, and virtually every other sector, a very large amount of information can be generated. This situation raises issues in relation to privacy. Without appropriate safeguards privacy implications can lead to serious concerns for an M2M-service. M2M will enable the collection, enrichment and distribution of a wide variety of data. Some of these data will be generated by the public sector and will be of use to the general public. Other data will be generated by private M2M-users and will be of use to public organizations. Adequate arrangements to give widespread use of data should be encouraged.

Governments in developing countries might be initiators of M2M use and large scale M2M-users themselves. By requiring the introduction of smart metering, or M2M for emergency assistance to automobiles or by using M2M to better support various public services, they can play an important role. Governments are therefore an integral part of the M2M ecosystem that will develop.

6. Conclusions

Even though Latin American and South Asian market has shown a relatively slow adoption of new M2M services and applications compared to some other regions, this trend will change, as the M2M solutions will increase its penetration in different areas. This scenario, combined with the trend to accelerate the 4G deployments in the region, will bring the potential to develop new business models for traditional network operators, while new players emerge and compete to attract new customers.

It is important to consider that challenges that Latin American and South Asian M2M markets face depend on the type of target population. Zones with large rural mobile market actors will confront difficulties providing access to basic infrastructure and services such as electricity, education, healthcare and banking. In contrast, urban areas face challenges in terms of dealing with issues around congestion, the efficient provision of public services and the need to manage the environmental impact of rapidly growing urban populations.

With increasing penetration rates and new network deployments there is the potential for much greater impact in the future. New mobile services and applications can make important contributions in areas such as sustainable growth, health, education and access to financial services. As the mobile ecosystem

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evolves, the door is open to innovative and socially relevant business models that go far beyond communications and into the provisions of essential services such as energy and healthcare.

Different forecasts suggest that the region will see strong growth in the number of mAutomotive connections over the coming years, driven primarily by security and tracking applications. However, other applications will also see strong growth, including areas such as pay as you drive insurance and in-car entertainment services.

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