M2M: The Wave at Indian Coast

Yogesh Sawant*, Senthil Ganesh Mrurgan**

**Business consultant, Ericsson, India.*

***Lead Business Consultant, Ericsson, India.*

Abstract

India, with a large mobile subscriber base and a high penetration rate, has become a conducive market for offering allied telecom products and services other than just voice and data. Machine-to-Machine communication (M2M) is one such area that has gained enormous significance in developed economies over the past decade. With its potential to connect varied devices and make them talk to one another, M2M has found its application over a large spectrum of industries that include Healthcare, Automobiles, Utilities, Security and monitoring systems, Consumer electronics, Logistics and fleet management and Manufacturing.

After being successfully implemented in Europe and North America, now is the right moment to analyze feasibility and fitment of M2M in the Indian market. Nevertheless, India has always been a unique market in terms of its population size, demographic diversity, agricultural background and industrial reliance.

This paper aims at understanding the differences between Indian and global markets with respect to potential benefits offered by M2M. The implementation feasibility, financial dynamics and distinct advantages of M2M in major sectors of Indian economy are evaluated.Sectors such as Agriculture, Healthcare and Utilities that would benefit most from M2M implementation are discussed in detail. The development of entire ecosystem that would come up as a result of M2M introduction would also be analyzed. In entirety the impact of embracing this innovation on the Indian economy is discussed.

Keywords: M2M, M2M Application

India as a market

According to the report released by TRAI in January 2013, the number of wireless connections in India was estimated at 906.62million with a teledensity of 74.49%("The Indian Telecom Services Performance Indicators", TRAI, 2013). The teledensity, apparently quite less than the regional penetration rates of Middle East, north America and Europe, is quite high for a country of the size of India and its per capita income.39.52% of rural India has cell phone connections now and the urban teledensity has surpassed 150%("The Indian Telecom Services Performance Indicators", TRAI, 2013). It indeed is a huge market for telecom operators who are currently struggling to come up with new offering to push their top line revenues and get ahead of competition.

With the current penetration of cellular network and the advent of smartphones the stage is now set for adoption of advanced technologies. M2M communication is one such technologythat would provide consumers with services that would either improve productivity or prove to be a life saver or both. M2M services can be offered across various segments and industries with applications that suit to varied customer needs.

What is M2M

Machine-to-Machine communication is fully automated communication between two machines without any human intervention. Machine 1 collects data through attached sensors and transfer's it to Machine 2 through a network. Machine 2 analyses this information and responds accordingly. The output of the Machine 2 can then be used to derive specific conclusions and sometimes even suggest specific actions to Machine 1. This concept can be extended to connect several machines that can operate in tandem to give the desired outcome. The data transmitted can be intermittent or continuous based on requirements.

A basic example of M2M is the operation of an automated cash dispensing ATM machine. When an ATM starts running out of cash it sends a trigger to a data center through a wired network. A monitoring system then kicks off a signal for delivery of cash. Based on this signal a van with cash receives a message and is dispatched to the desired location with cash. Now, let's assume multiple ATM's sending signals of depleting cash. The data center accumulates all these and tries to locate a certain van that is already in transit to refill the cash. Once this van

receives information about several ATM's to be refilled it finds out an optimum route through a separate tracking system that informs about latest traffic situation. Thus a fully automated M2M system would work in this manner.

For now the scope of this paper we would be to study the possible implementations implementation of M2M applications in India,primarily in 3 sectors: Agriculture, Healthcare and Utilities. Given that India is still a developing economy, M2M in the aforementioned sectors would prove to be a wider impact. on the country

M2M in Agriculture

The agriculture sector engages 53% of Indian population and definitely is the backbone of the country's economy("SOUTH ASIA :: INDIA", The World Factbook by CIA). India's rural teledensity (wireline + wireless) is 40.36, as per the latest TRAI statistics ("The Indian Telecom Services Performance Indicators", TRAI, 2013). Value added services build around weather forecasts, market rates, live stocks, fisheries, health, education and finance are already quite prevalent amongst farmers. Such acquaintance will enable penetration of advanced technology such as M2M easier and acceptable.Key areas in agriculture where M2M can bring in a revolution are: automated irrigation, equipment monitoring and diagnostics, water table monitoring, remote crop monitoring, fisheries, soil analysis, logistics management, market analysis, information sharing and meteorological updates.

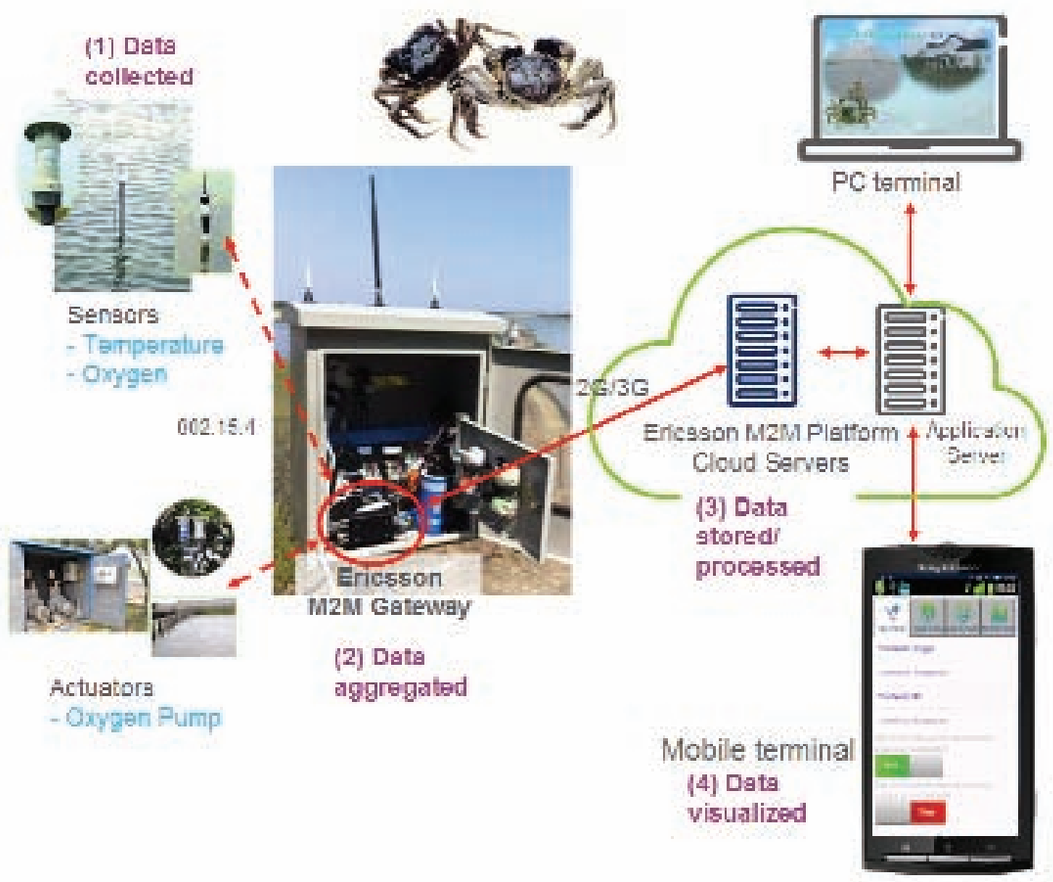
A real time weather monitoring systems can include sensors that are placed in specific geographic locations and the temperature, moisture; rainfall data is continuously collected and sent to a data center. Automated irrigation is one such application that M2M can enable. Implementing an automated irrigation system requires knowledge of several parameters such as: water needs of the farm, water sensitivity of the plants, moisture level, financial factors such as capital expenditures, operating expenditures, availability of power, user friendly technology and many more. Sensors are placed at appropriate distances, throughout the farm that detect moisture level of the soil. The sensors will have M2M units coupled to them that use GSM service to communicate to the datacenter that accumulates processes and transmits information. Datacenter is also connected to another M2M device, with a user interface, through which the farmer keys in the moisture level to be maintained at various parts of the farm, during each farming season. The datacenter processes the feed data from the sensors and decides which part of the farm should be irrigated and how much water should be supplied. The most water deprived part of the farm gets the first priority. The datacenter talks to the pump and pumps the required amount of water to that part of the field. In villages, where the power supply is mostly available in night times, the automated irrigation system works perfectly and avoids the presence of the farmer during odd hours.

Let us also take a look at the "smart fish farming" Project, which Ericsson, together with China Agriculture University, implemented at the Chinese Mitten Crab Breeding Base.

The problem statement is that "Tiny, invisible changes in the living environment are often fatal to crabs, putting crab breeding at considerable risk". It is therefore vital for the farmers to have real-time information of the water quality of their ponds. At the crab ponds, Ericsson engineers have installed a set of water-quality monitoring systems based on wireless sensor network to observe all indicators of water quality, including temperature, acidity and alkalinity, and dissolved oxygen. The sensors will collect and transmit data to the Ericsson M2M Gateway, where the data is aggregated. The oxygen pumps and other water-quality controllers are also connected to the Gateway. The aggregated data is sent to a cloud computing platform, which will then analyze the data, send alarms when abnormal data are found, and give instructions to the Ericsson M2M Gateway that sends appropriate signals to the oxygen pumps and other water-quality controllers, to bring the situation back to normal. Additionally, to facilitate the monitoring of water quality anytime and anywhere, Ericsson has also developed an Android-based Smartphone application just for the local crab breeders. Hence, with the support of Ericsson M2M technologies, local farmers will be able to use their mobile phones to monitor and control the water quality of crab ponds in real-time, and thus lower their energy consumption, save labor, and enhance productivity(Ericsson M2M Solution Supports Crab Farming in China", Ericsson Labs, 2012).

Presently, there is no organized aquaculture for crab farming in India, though natural crab farming is coming up in the coastal belt of Orissa. With the use of M2M technologies mentioned above, scientific crab farming can be made successful in India too. On the other hand, 1.2 lakh hectares are under shrimp farming in India now, spread across 10 states but scientific shrimp farming is still in nascent stages. As there is a number of water parameters such as Dissolved Oxygen, Salinity, water Temperature, pH, nitrite nitrogen, ammonia, Biological Oxygen Demand (BOD), Chemical Oxygen Demand

Figure 1 Ericsson M2M solution supports crab farming in China. Source: Ericsson Labs



(COD), Transparency, Carbon dioxide and Sulphide, to be monitored, implementation of M2M technologies in this scenario is the best act to do. The M2M implementation will take scientific shrimp farming to newer heights and will mark India's place in the global shrimp production market("Fisheries :: Shrimp Culture", TNAU Agritech Portal).The M2M business model for agriculture consists of the key players such as the content providers i.e. agricultural domain experts, the end users i.e. farmers, software providers, service providers and the OEMs. Also, the external players such as the central and state governments, agricultural research institutions and universities contribute to the growth of this business model, in terms of financial aid, research findings and support. All of these forces should work hand in hand, for M2M in agriculture to become a grand success in India.

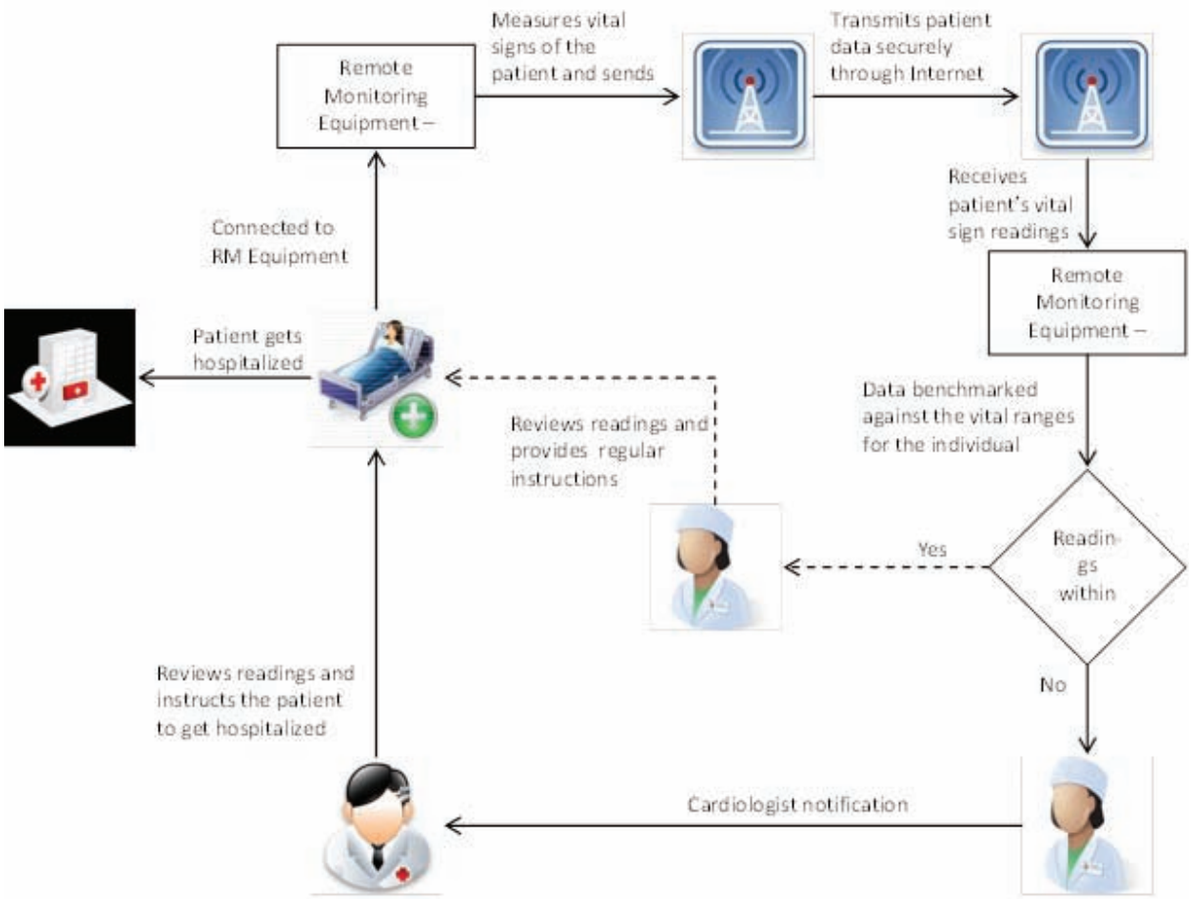
M2M in Healthcare

India as a country presents unique opportunities and challenges, in case of healthcare. Our country is home to 61 million diabetic patients and forecasts show that we will cross the 100 million mark by 2030("One fifth of all adults with diabetes live in the South-East Asia region", International Diabetes Federation Article, 2011)("India's diabetes burden to cross 100 million by 2030", TOI Article, 2011). If that is not enough, cardiovascular diseases result in 25% of deaths annually. Even though it is very difficult to improve these statistics immediately, it is possible to involve technology, such as M2M and thereby, improve the scenario. Devices such as pedometers, sleep sensors, activity sensors and heart beat monitors are gaining popularity in India, as more and more people are interested in building a healthy lifestyle. Some of these devices are integrated directly in the mobile handsets, such as Nokia 5500 Sports Phone and Sony Ericsson W710 walkman phone. These are primarily wearable devices which continuously monitor a specific activity and transmit the data wirelessly, through cellular networks. This data can be appropriately interpreted by the health care providers and relevant action can be suggested. These devices induce enthusiasm and motivate people to be fit.

The next category of services is that of the Remote patient monitoring systems, such as convalescence monitoring, chronic condition and patient parameter monitoring, medication monitoring and activity monitoring. Real-time monitoring systems include monitoring of patient data including foetal heart and maternal contraction patterns, Diabetes patient information management, chronic disease management and Heart health management. The point-of-patient care systems' automated messaging protocols allow case managers to monitor a patient's status, send motivation messages and medication reminders, adhere to treatment plans, and keep doctor appointments, all remotely.

As an example let's consider treatment of chronic diseases done remotely, despite the need forcontinuous monitoring, on a group of 150 patients, at Massachusetts General Hospital (Ambar Kulshreshtha, 2010). In case of remote monitoring for heart patients remote monitoring programs acquire and securely transmit data on patients' HF signs and symptoms to health care teams, alert providers to the early signs of clinical deterioration, and create opportunities for timely intervention. RM also involves patients in their own care and allows them to link behaviors and their consequences (e.g., no adherence to medications and subsequent weight gain). The typical HF Remote monitoring equipment system consists of a Telehealth monitoring system, Automatic digital blood pressure monitoring system, a digital weight scale, blood pressure and pulse rate monitoring system, a pulse oximeter device, to measure the level of oxygen in a patient's bloodstream, telephone service and Internet. Patients, from their homes, monitor their vital signs such as weight, blood pressure, pulse, and pulse oximetry, on a daily basis. The measured patient data are transferred securely via telephone service to the RM nurse. Vital ranges are already established for each patient in consultation with their physician. The RM readings received are evaluated and if they are outside the expected range for the patient, then the RM nurse proceeds with cardiologist notification, referral to the Emergency room, and continued monitoring.

Fig.ure 2 Remote monitoring to help patients with heart failure



In a country where we have 0.6 doctors and 0.9 beds per 1000 people, these systems are real life savers("SOUTH ASIA :: INDIA", The World Factbook by CIA). In remote places where complete healthcare services are yet to reach, the mobile networks have already reached. Hence, these remote patient monitoring systems can be placed in the primary health centers in villages and the information can be sent to the physicians who are sitting miles away. One HF Remote monitoring equipment system can be installed in a Primary Health Center (PHC) in a village, through Government aid. The nurse, who knows how to operate the system and transmit the results, should be present in the PHC. Through telecom service, the results can be sent to the nearest cardiologist in the Government Hospital, who monitors the results of the patients, remotely, and takes appropriate action. In case of symptoms of a worsening condition, the physician can refer the patient to get admitted in the hospital. Thus, the expertise of the cardiologist can be shared with multiple patients remotely and many lives can be saved. Such systems provide benefits such as earlier release of the patients from the hospital post treatment, quick recovery and overall improvement in condition for chronically diseased patients.

All the above mentioned cases advocate clearly for the use of M2M technologies in healthcare, in India, in order to save precious lives. The mHealth ecosystem should bring together medical healthcare professionals, NGOs, pharmaceutical companies, insurance companies, middleware and infrastructure providers, regulatory bodies, telecom service providers, central governments and state governments to deliver affordable healthcare for all, powered by mobile connectivity.

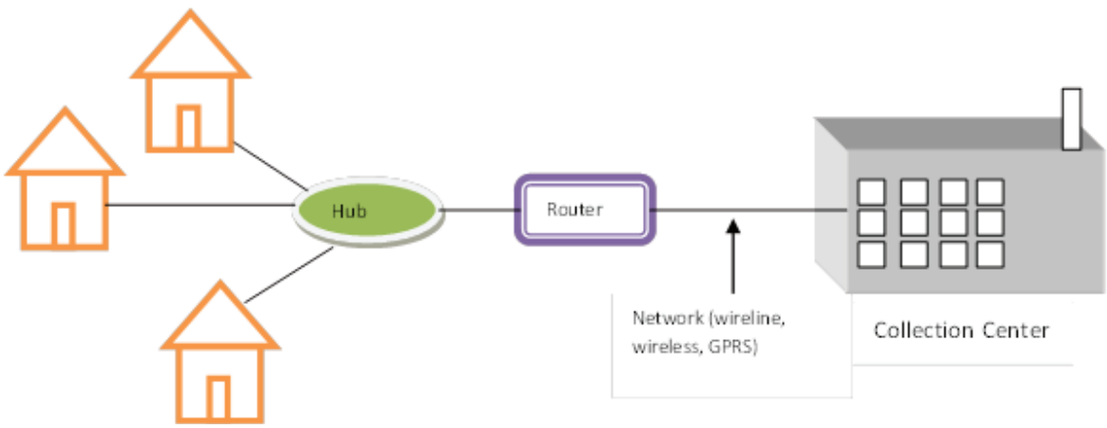
M2M in Utilities

The utility network comprising of supply channels of electricity, water and gas(pipe) that spans pan across the length and breadth of the country. Nevertheless it also means that it is highly exposed to thefts and losses. Moreover, inappropriate distribution of power has left most part of the country without adequate power supply. Rising oil prices shoot up the cost of power and therefore efficient power distribution becomes all the more necessary. Implementing M2M technology in supply of utilities would help curb this to a large extent. Usage of Smart Meters to enable Automated Meter Reading (AMR) is one solution that can be foreseen as the next technological advancement in the Utilities Industry.

A smart meter device combines a state-of-the-art electronic meter with a programmable communications terminal that may interface with multiple networks and devices. Smart grids comprise of a network of smart meters and are capable of doing multiple functions such as load adjustment, demand response support, greater resilience to loading, decentralization of power generation and price signaling to consumers. Smart metering solutions may incorporate a wide range of applications in the fields of remote meter reading, customer relationship management, demand-side management and value added services. (Ryberg, 2011).

Smart grids allow remote monitoring of utility supply and allow moderating the same. Smart grid has the capability to continuously read the demand and supply situation of power for a particular geography where it is installed. At times when power required rises it reroutes excess power from some other grid and vice versa when power requirement reduces. During equipment failure a smart grid detects them and contains them to avoid a major black out. On the consumer side the grid gives a continuous update of energy usage. Going further it is likely that technology would be available to know the energy usage by device/appliance in the house

The present day problems with collecting accurate reading, calculations, billing, problem detection can be



easily mitigated with the implementation of smart meters. Remote meter reading technology enables data collection without visiting the physical location. This allows, metering system operators to collect meter data with higher quality, more rapidly and using less manpower. Remote meter reading may also comprise multiple utilities. Most households have several utility meters, e.g. for electricity, gas, heat or water. If they are all connected to the same communications terminal, the benefits of remote meter reading can be shared among several utilities operating in the same area. Last but not the least smart grids can seamlessly integrate with renewable energy sources that can serve as a back up power source.(US department of energy)

The government of India has initiated 14 pilot projects for smart grid implementation and the success will largely determine further rollout(Power ministry of India). To make smart metering a pan India success an overhaul of the current system is required which in itself is a monumental task and would take years to accomplish.

Feasibility Study

A typical M2M value chain is depicted in the diagram below

It is evident from the above value chain that telecomoperator's and service enablers (companies that offer the service to customers) are only the only two players that can actually take a lead in offering M2M. Even if they do so, the entire ecosystem has to be first developed and then evolve so that offering M2M in any vertical becomes feasible and later on profitable. Huge investments have to be made on infrastructure, application development and manufacturing of devices by various stakeholders. There are devices that enable M2M, the sensors, chips, wireless or wireline connections, the platforms, payment gateways, service provisioning, software development and integration services. All this has to be undertaken simultaneously in order to achieve end to end operations.

Key challenge in offering M2M is uncertainty about the demand and therefore the expected ROI. Moreover the partnership and revenue sharing models are still under investigation. Debate still exists over how the business model should be and which stake holder receives how much share of the revenue generated. Another challenge that any provider would face is the low ARPU of the services offered. Therefore for sustainable business it has to achieve significant economies of scale which still seems to be a daunting task.M2M connections can be offered only in geographies that are connected by wireline or wireless communication. All these things demand lot of due diligence before anyone venture's into the M2M space.

In the Indian context the price of service is a critical factor to consider while entering the market. Educating urban and rural consumers is equally important to facilitate adoption. Impact to the society and profitability of the business hasto be analyzed. If implementing in rural India uninterrupted connectivity has to be ensured and this may invite additional infrastructure investments. There are rural areas in India that are yet to come under the coverage of an operator and therefore agriculture based services of M2M cannot be offered in such areas. In areas where these systems can actually be offered it has to economical. For being economical it has to achieve the scale that is needed. All this looks quite challenging.Government has to step in and incentives such as tax breaks have to be offered to operators who offer rural India. An overhaul of the utilities network although sounds attractive has challenges to cost, ownership, return on investment and perceived benefits. In healthcare the life saving remote monitoring system would not come for a low cost. Educating the masses of its perceived benefits and then its usage is also going to be an arduous task. Penetration of such system will again remain an issue until it becomes cost effective. Till then in areas where basic healthcare is unavailable adoption of M2M still remains a dream

Thus, M2M implementation in the country doesn't come without certain challenges that early entrants will have to face. But early entrants also stand with a chance to capture the market once successful. Everything said, M2M still tops the to-do list of most operators merely because of the potential it has to unlock unattained revenues in an entirely new space. Time has arrived for an emerging economy like oursto put a foot in the right direction and move towards M2M adoption. It is an innovation of the future and a trump card that can get an organization ahead of competition and also aid the country's development at the same time.

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Authors Profile:

Yogesh is a Business consultant at Ericsson working in areas of Strategy and Marketing. He has over 9 years of experience in Telecom and IT service industry in APAC and North American geography. His experience is mainly in the areas of business consulting, technology consulting, customer relationship management and project management.

He holds a Bachelor in engineering from University of Mumbai India, a Master of Sciences in Software Engineering from Birla Institute of Technology and Science India, and an MBA from Indian Institute of Management, Lucknow, India

Senthil is a Lead Business Consultant at Ericsson. He has 8.5 years of experience in Telecom and IT Services Industries, spanning across domains such as Business Consulting, Technology Consulting, Business Process Improvement and Business Intelligence. He has in depth knowledge in functional domains such as Business analytics, CEM, M2M and Mobile telecommunication systems. He is a Green belt certified professional in Lean Six Sigma Process.

Senthil holds an MBA degree, with specialization in Finance and Strategy, from IIM Lucknow. He has worked with Fidelity Investments and HP, prior to his post graduation.