MARKET ANALYSIS OF M2M COMMUNICATION FOR HOME AND BUILDING AUTOMATION

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A thesis submitted in partial fulfillment of the requirements for the degree

Master of Science in Business, Innovation and Technology

ATHENS
2011

Declaration

I Maher Fathi Alhesen declare that the work presented in this thesis is original and no part of it (including the document, the implementation code, etc.) has been copied from other sources. Work related to this one is cited appropriately.

Maher Alhesen

12/Oct/2011

The work contained in this thesis Market Analysis of m2m communication for home and building automation by Maher Fathi Alhesen has been carried out under my supervision.

Gregory Yovanof

12/Oct/2011

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Abstract

Nowadays, when talking about the advancement of technology, we have in mind the tremendous number of applications, by which some of them at least are used in almost every nook and cranny of human life such as but not limited to homes, businesses, factories, restaurants, and so on, which in some situations those applications became ones of the critical requirements for such a place.

Modern technologies are used for the sake of comfort, security, savings, entertainment, safety and the Preservation of environment, currently there is no obscurity about the technology itself, but it is the way how the technology is implemented into everyday life activities.

Security Systems, HVAC, and the Lighting Control are some of the applications that have been exist a long time ago, but they were an autonomous industries, and it comes a time that all these aspects comes into one term called the Building Automation, this kind of communication is done by the machine to machine communication, which has expanded beyond a one-to-one connection, and changed into a system of networks, and the increase in the implementation of the M2M technology is relating to the expansion of the wireless networks which in term have decreased the amount of power, and the time needed for communication between machines.

My work tries to provide an analysis and clarification of this field, technologies used, Market segments, key players, and market drivers and barriers, which may affect the adoption of this trend, most of the work concerned about the European market, and the conclusion of the emerging trends of mobile control, and what will be the role of the operators and service providers later on, as the relative value of fixed and mobile networks has been changed, in addition to the influence of the latter on the implementation and the use of machine to machine technologies and applications.

Acknowledgements

I would like to express my gratitude to Allah (God) for providing me the blessings to complete this work.

I am indebted in the preparation of this thesis to my supervisor, Professor Gregory Yovanof, whose encouragement, patience and kindness, as well as his guidance and support through his great academic experience, have been invaluable to me from the initial to the final level, which enabled me to develop an understanding of the subject.

My parents, Fathi and Huda, have been a constant source of support-emotional, moral and of course financial during my postgraduate studies, and this thesis would certainly not have existed without them. It is thanks to my father that I first became interested in Business; it is to him that this thesis is dedicated.

Lastly, I offer my regards and blessings to all of those who supported me in any respect during the completion of the project.

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1. INTRODUCTION

For years, the machines used to assist in the operations that human should do and make our life easier, and it becomes smarter as their operations are conducted properly, because it is already programmed and guided carefully by its internal computer processors and software based on the parameters and settings we provide.

The approach by which the machines “talk” or communicate is called “Telemetry”, this concept indicates remote machines and sensors collecting the data and sending it to a central point for an analysis process, either by humans or computers which is not new trend, starting from this point a new level has been revealed with implementing this idea by applying modern-networking technology, Machine to machine communications or M2M.

That emerging concept which is created by the combination of three technologies, wireless sensors, the internet and personal computers, which are very common technologies, all together creating that concept which has a great promise in using and promoting the telemetry’s use by business, government and private individuals, the use of telemetry will be expanded through the M2M communication, and its role will lie beyond its traditional use in science and engineering to many fields and in everyday activities, the use of M2M is already exist, and the applications will increase and there are many potential applications on the way as long as the wireless sensors, networks and computers are improving.

Machine to machine communication, For example, can be used to monitor the condition of critical public infrastructure, without human intervention, such as water treatment facilities or bridges, it can help businesses maintain inventory or make it easier for scientists to conduct research. Because it relies on common technology, in another case it could also help a homeowner to create a shopping list at a button's touch.

Talking about the consumer devices, 70% will be connected to the internet by 2014, according to the consumer electronics association [1], which is more than 800 million consumer devices according to Park associates [4], and that is an incentive for the development of the m2m applications.

The term M2M is not a new trend, and have been in existence for the past many years, also the applications are many, starting from small applications to a very complex ones, but in this thesis, and as my thesis is talking about the home and building automation, I will try to make a general review about the use of M2M for home and building automation, the industry and Market players involved in that field, and I will talk about one use case of smart home

implementation, to clarify and represent how the M2M and its applications will be useful in serving the society.

2. M2M COMMUNICATION

Machine-to-Machine (M2M) communications is the communication and enabling flow of data between two or more entities no matter the type of machine or data, and most likely without the human intervention. The information usually flows from a machine over a network, and then through a gateway to a system where it can be reviewed and acted on. M2M services intend to automate decision and communication Processes.

M2M is exist since more than 50 years ago, it was used in the beginning during the second world war to prevent pilots from hitting friendly targets, for example M2M is used in the traffic lights to organize the traffic automatically without human intervention, or make scheduling for the transportation system, but all these applications were closed systems, and there were no interaction with another systems, the thing is that now it can be networked all together, and the communication and control will be based on information and data, instead of depending on wires.

M2M is defined differently depending on the case that it is deployed upon, but we can conclude a general and a broader definition, which is the remote control of machines and monitoring and/or collecting data from machines.

There are many different ways to connect the machines, and what type of communication is used, also how the data is used, sometimes it seems that it is a sophisticated operation, but once the company knows the purpose of the data and in which mean they will going to do with those data being transmitted, then how to set up the application will be straightforward.

Also there are a lot of different options to be used as how the machine is connected, and how the resulted information is used. Even though it can be sophisticated, when a company got the idea specifically of what it wants to do with the information and the data that have been received, then the matter of applications creation is straight forward and does not need any invention.

There are almost a limitless number of fields and industries that M2M can be implemented, whether we are talking about the energy branches, health monitoring and e-health applications or the automotive, and more applications of the machine to machine will be introduced and

briefly described, and to show the main areas that M2M can be implemented in high efficiency and tangible outcome in term of money or time.

There is an evolution in the connected machines in term of their increasing number, and that the estimate number of people worldwide are 7 billion [5], while there is about 5 billion mobile handset or mobile subscription [2], although these numbers are huge, but comparing to the number of the connected machines that could reach about 50 billion within the next 10 years according to some analyst firms like the Cisco [2].

The expansion of M2M is increasing globally, because of the advancement in the technology, the improvement and growing of hardware and software components of the diverse applications of the M2M technology, besides the rising of the coverage in the network broadband, another important factor is the addition of appliances and devices like the smart meters, vehicles, vending machines, and appliances for instance that have not been connected to a cellular networks are now getting into the network and get connected.

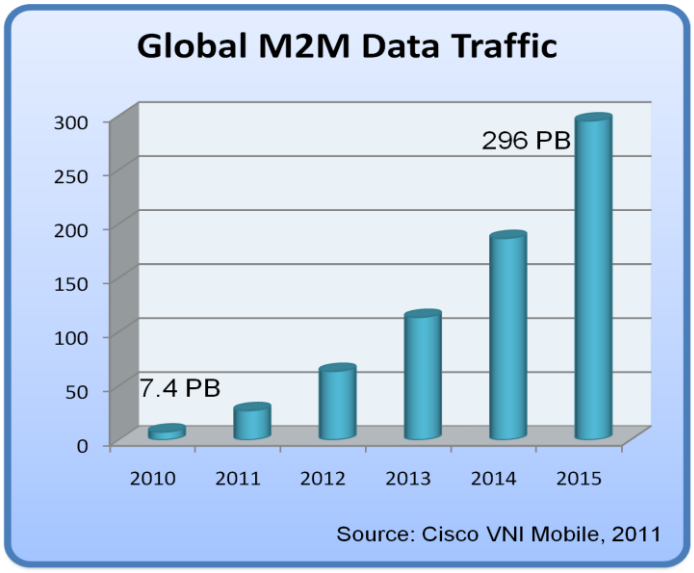


Figure 1_Global M2M Data Traffic

The global demand is predicted in the years of 2010-2015 in Figure 1 showing the increase of the demand, and the data traffic on the mobile networks that is expected to reach 296 Peta-byte in 2015, while it was an approximate of about 7.4 PB in 2010, the high bandwidth is required for many cases including the business, and consumer security and surveillance, healthcare sector, Inventory and fleet management, navigation, vehicle management [6].

2.1. HOW DOES IT WORKS

There are a number of applications of m2m which uses the wire-line connection network, for example a number of companies which specialized in medicine, they make the patient able to read the prescriptions and the data from a device, that could be a PC or a mobile device using a reader that is supported by the company, which could reduce the number of visits to the officer, another feature that is extremely helpful for the m2m communication is the ability for anything to be instrumented by the use of the antenna and the battery, any instrument can have the power to work and communicate via the wireless connections approaches from any place, and we can see these days that there are many outcomes from the use of this technologies like using the tickets, fares booking, mobile payments no matter the place as we have the connection to reach anywhere we want, the M2M applications and outcomes varies in use, and who uses them, like the businesses or countries and governments like the projects of smart grid, smart city or the transportation infrastructure management, which make a very good results, and having a strong potential for growth in the future.

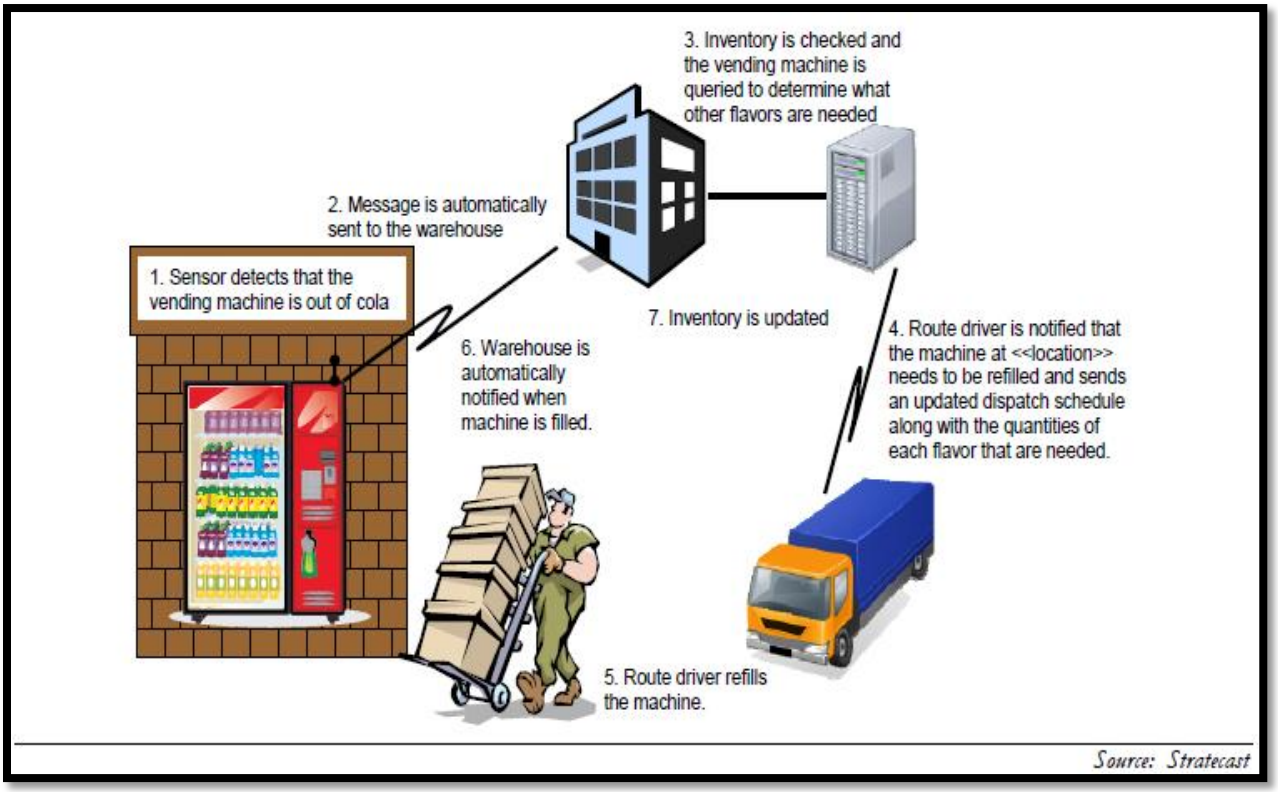


Figure 2_The way how M2M works (Vending Machine)

In Figure 2, I am giving an example that shows the processes that happened in the vending machine, and what steps that occurred when it is out of cola, there is a sensor in the vending machine that activates a light on it indicating that it needs to be filled, and at the same time it sends an alarm to the dispatcher, the dispatcher check the inventory and query the vending machine to see if there are more needs, then notifying the driver by the machine's location, then he takes the necessary flavors to refill the machine, once the vending machine is filled, a notification is sent automatically to the warehouse that the machine has been filled, then the inventory in term is updated, if we try to look at the big picture of this specific example, and how can this vending machine in addition to the other vending machines makes fewer trips by the driver, as he will not know by himself that a machine need to be filled or not, and there will be more improvement on the inventory management, and understanding the market and customers perceptions, by knowing what they prefer, so that there will be more focusing on the patterns that are more used by the customers, and that in term improve the sales of the company, and reduce wasting time and money [8].

2.2. APPLICATIONS OF M2M COMMUNICATION

There is a wide variety of applications of machine-to-machine communications, and with better wireless networks, sensors and the increasing of the computing capability, using m2m and deploying it in their usage and applications will be the best to take into consideration for many industries.

The use and the need for m2m communication by interconnecting the wireless networks can be very helpful for many areas, like using these wireless networks for the sake of harvesting energy products, monitoring systems, improving the production and many other applications that I will briefly mention in this document to clarify the importance of the m2m communication, and the tremendous usage and applications that deploy this technology, and the potential of using this technology in many sectors.

If we want to classify the applications according to the general purpose of these applications

1) Manufacturing

Can be used in manufacturing for remote monitoring of the equipments being produced and detect the faults in advance to avoid maintenance, also to track the amount of consumption of packaging chemicals as an alternative of a manual inspection.

2) Facility Management

Monitoring the energy consumption by the smart metering, or the equipment operation can be done in order to manage the operations and reduce the costs, in addition to the monitoring of fire extinguishers, and also eliminating the need for manually verifying the pressure gauge.

3) Transportation

Adding a mandated alerts to more than one sign at the same time instead of doing it manually, also like the notification of a problem if happened with a vehicle can be sent automatically in order to manage the situation faster, and nowadays it become commonly exist in the luxury cars.

4) Oil and Gas

The ability for the customers to remotely get the data on flow rates, pressures, temperatures, and equipment status that are produced by a manufacturer of well sites instrumentation.

5) Healthcare

Remote diagnostic equipments can be used for the data to be collected like the blood pressure, the weight, or glucose level for a patient at home, or getting a prescription without the need to go to a medical facility, and this fit more to the elderly and the disabled, which is a case that have more concerns nowadays as of aging societies specially in Europe, and some developed countries.

6) Insurance

Using a network of sensors in case of burglary or intrusion, or any other security issue, and generating an alarm that is sent to the homeowner or the specific property owner to notify him that the system has been breached, also the cars insurance are using the GPS to detect and determine the actual position of it.

7) Fleet Management

An example is monitoring the luxury vehicle shipments when they are shipped, or using them at the airport for remotely shutting down the vehicles in case of emergency.

8) Time and Attendance

The use of M2M for time and attendance systems is started to be mostly used in the companies, as it let the company's owner to manage the employees working hours, and the payroll reports, and having more analyzing of employees efficiency.

9) Vending

These vending machines are started to appear which is unique by its smartness. They are spreading around more and more, and the automatic features that it has by accepting credit, or sending a reports to the warehouse in case of any malfunction or about the current stock, which will reduce the number of visits of the operators, resulting in saving time and money.

10) Home and Building Automation

The home and building automation actually is a collection of many subsystems, which includes the HVAC, climate control, access control and many others, which are all using the M2M communication, and when looking at the big picture, the smart home is emerged, and that will be my core topic.

11) Security Systems

Although it is one of the home and building automation applications, it also can be used for other fields, and that is why it is mentioned separately, most of the security tasks are about the surveillance and the CCTV, and the access control systems.

There are a vast number of industries and markets that M2M can be used within and each market segment has its own needs and demands, and to address all the demands, one network must exist.

2.3. M2M Market

We have discussed how much is the global mobile data traffic, and how much could be the global demand for mobile data traffic for the M2M applications, The M2M market is growing gradually, and the dominants players in the market may change by the time, on a geographic basis, the most three regions that are having the largest consumption and anticipated to have the largest demand of mobile data traffic are North America, Western Europe and Asia Pacific.

In the following figure, it shows a detailed data from Cisco VNI Global Mobile Data traffic forecast, these data relies on some data published by Informa Telecoms and Media, Strategy Analytics, Infonetics, Datamonitor, Gartner, IDC, Dell'Oro, Synergy, Nielsen, comScore, and the International Telecommunications Union (ITU) [6].

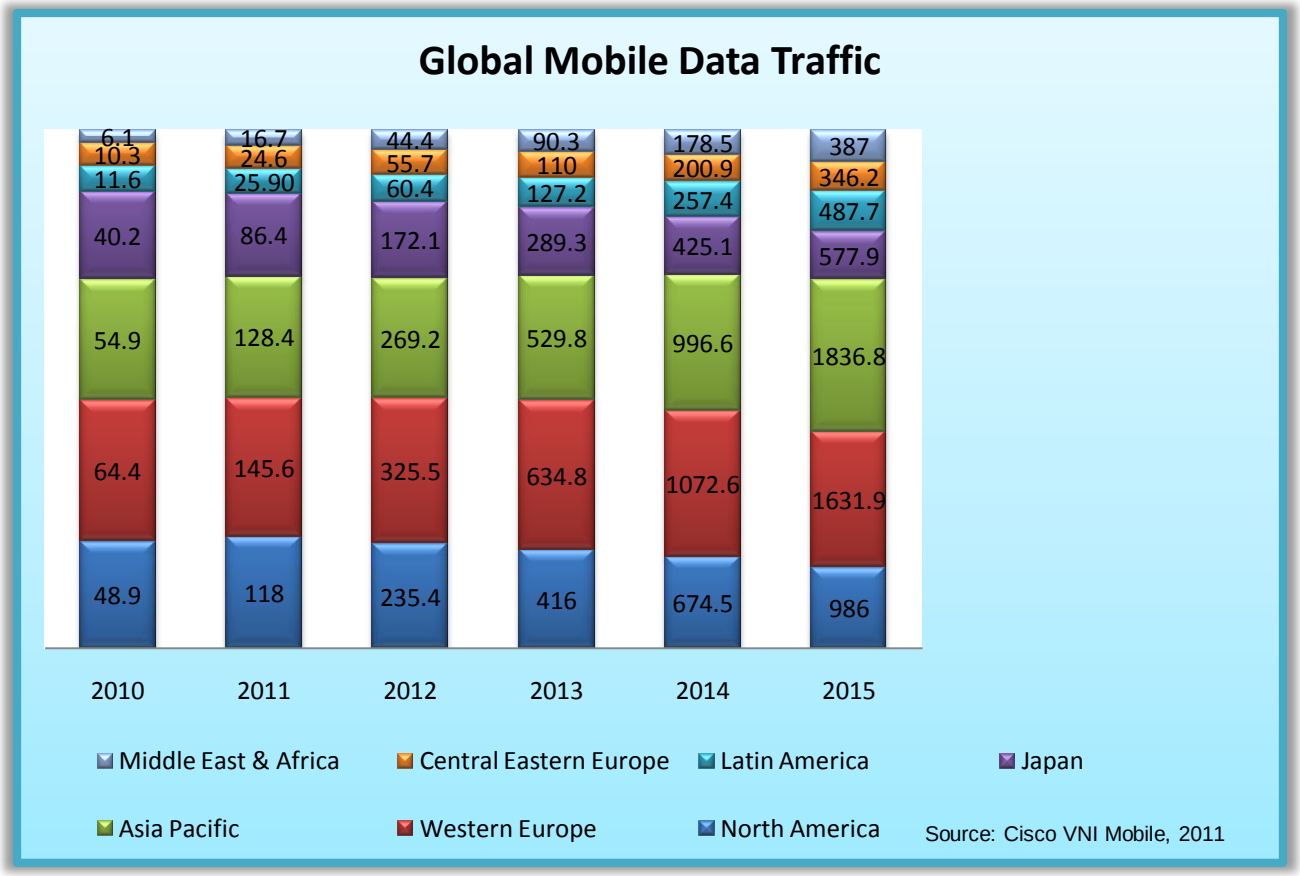


Figure 3_Global Mobile Data Traffic in Term of Geographic Distribution

The highest growth rate in the machine to machine market is in the utility, security and health sectors, Worldwide, North America led the building automation technologies market with a share of 40% in 2010, while the EMEA region is going next with a share of about 34% of global building automation technologies market in 2010.

On the other hand the Asia pacific is expected to exceed North America's data traffic by almost 25%, due to the having the highest level of broadband penetration in the world, and that is according to a study from Beecham research which anticipates that this could happen in the next 5 years [32].

There is around 880 million new M2M-enabled devices produced in 2010 according to focal point group, also according to Cap-Gemini, the world M2M market will worth about $39.3 billion by 2013 [9].

2.4. AUTOMATION IN BUILDINGS

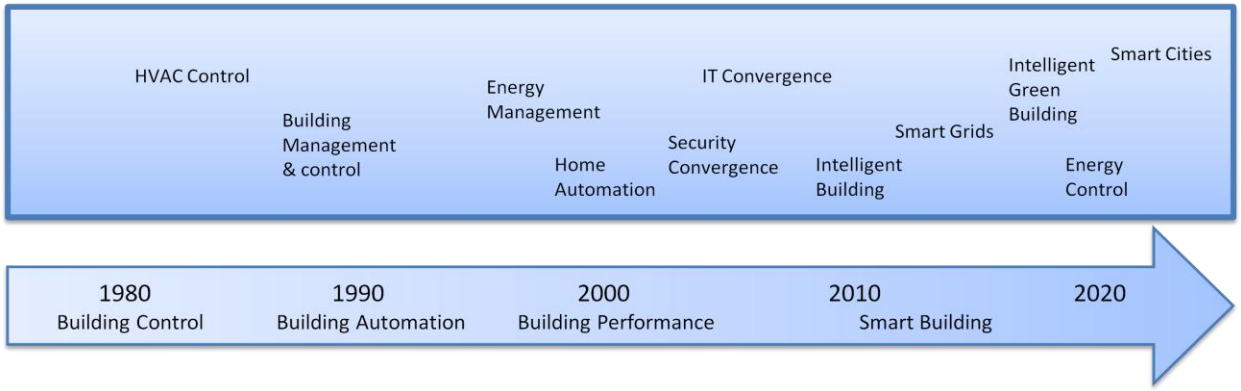


Figure 4_Building Automation Time-line

The evolution started with the control of a separate applications, and the first application was the controlling of the heating, ventilation and air-conditioning, and that was in the 1980s, the evolution continue with the emergence of many fields like the smart metering, and their use for measuring the energy consumption, and monitoring.

Some convergence events have happened, like the IT convergence, which had a high impact on every small element in the building, which then could be integrated in the control process; the improvement in the building automation systems is closely associated with the evolution of the technology and the information technologies.

As there was more technology techniques used more emphasis on the building performance have been taken into consideration, with the emergence of the intelligent buildings, many new terms have been emerge the Green Buildings, Smart Grids, and Smart Cities which some of projects have been initiated to employ these technologies and get new outcomes of integrated networking, green buildings, and energy management, Smart Cities which the implementation of these projects in a small scale, has already started in some countries as some kind of a research in the beginning.

3. HOME AND BUILDING AUTOMATION

Through my research for home and building automation, I have included the building automation market size, the industry drivers and restraints to have a better understanding of this field, the key players in the market, along with geographical analysis.

Also I have divided the term home and building automation into two sections, as every category have some unique variables, but for example I tried to unite some shared variables like the market forces that may affect the adoption of this trend.

3.1. DEFINITION OF HOME AND BUILDING AUTOMATION

In the past, building control systems were a bunch of a number of independent subsystems such as lighting and heating, ventilation, and air-conditioning (HVAC).

The modern companies broke the rules of Building Control of being separated subsystems. It approached the market with a holistic approach instead of treating a building as a collection of use-specific applications, thus every device is treated as equal on a control network. For instance using a single motion sensor for a three systems of lighting, HVAC, and security instead of the use and the need of a three separate motion sensors for these systems, and this is called the open network, or a peer-to-peer network which benefits the building integrators and the users in term of cost, management, flexibility, and the ease of integrating it with future technologies of building automation.

3.1.1. **Building Automation**: it can be identified briefly as A network of integrated computer components that automatically control a wide range of building operations such as HVAC, lighting security/access control, energy management, maintenance management, and fire safety control.

3.1.2. **Home Automation:** in fact, it is a subset of the building automation, so it is almost the same, For some people “Home Automation” may reflect the meaning of controlling a few lights remotely, Others may consider that the main application is the security, and maybe installing an advanced controllers or using some techniques like the voice recognition or a fingerprint, then it depends on the point of view of the user, but if we want to give the Home Automation a simple definition, it can be identified as the approach by which you can control the things in your home whether it was an appliance, audio/video, lighting control, irrigation, or any other things that have the ability to be controlled remotely, or automatically.

3.2. SYSTEM STRUCTURE AND COMPONENTS

There are three main functions that represent the home automation system, some components which are part of the whole system may perform one function, others may perform a multi functions like the multimedia terminal for instance which can be used to do these three functions, the functions which are shared among many applications and systems specially in the information technology field, they are the input, output, and the control functions, I will try to describe each function separately and mention some examples to clarify these terms.

3.2.1. INPUT PHASE

The input function is mainly performed by sensors, by which it senses the environment around, and as a result entering the proper data to be processed and apply an action upon those data, when talking about data, it varies in describing this data depending on the complexity of the system for which the sensor is used.

There are a lot of types of sensors, but talking about the home automation, I will mention the most common ones such as the switch, motion sensor, humidity or the pressure sensor, light sensor, temperature sensor, video/audio acquisition sensor, smoke detector, and many others.

3.2.2. OUTPUT PHASE

The output function is performed by some components which are called actuators, now talking about the output side; these actions which have to be performed by the actuators are done, depending on some data that are received from the automation system, a signal that will change the state of an object whether electrically or mechanically.

As in the case of the sensors, the actuators also have many types, for example the dimmers, power switches, and the motor controllers are electrical ones, while the linear actuator, solenoid valve, pneumatic actuator, or the motor are in the mechanical part, at the same time there is an actuators which combines the two like the electro-mechanical switches.

3.2.3. CONTROL PHASE

The control function is not as easier to describe as the previous ones, because it can be a lot of things like setting an output after a timer has done or reached a specific level, or as a result of the occurrence of a logical combination and many more, but cannot be described exactly because of the changing in nature of the home automation system, but basically it is a control unit that comprises either a few logical gates or a complex mainframe, but what it deliver is the same thing controlling the system and being an intermediate between the input and the output functions.

3.3. HOME AND BUILDING AUTOMATION INDUSTRY

In the beginning, I will talk about the Building automation industry, which is made up of different of sub-industries like HVAC, security, Information technology infrastructure and more. Each of these behaves as a stand-alone industry by itself; every sub-industry has manufacturers, distribution, products standards, technologies and services.

They also have their own trade events and conferences, but all these sub-industries are related to the buildings industry which is my core topic, and they are associated with each other, and they are one term in the consumer or the end-user's point of view.

The technologies used in this field are segmented based on systems, services and the information technology. The systems as well as services are both considered for facility management, security and safety, while the information technology means the computing hardware and software, and the communication by network means.

The governments are playing a key role in the market growth, as there are many directives focuses on being friendly to the environment, and the restraints on the energy consumption, as well as tax benefits for the ones who are constructing the home and building automation initiatives, also there is a lot of certifications and ratings that have been issued for the buildings, the market players are now concentrating on developing new products because the competition is growing and becoming so intense, there are a tremendous number of technologies that can be implemented in the home and building automation, which leave both the developers and the users (consumers) confused, and that could lead to the lack of awareness which may affect the rapidity of expansion, but with more promotion and education specially in the emerging markets, will help in exceeding this problem and finally drive the overall market of home and building automation.

3.3.1. BUILDING AUTOMATION MARKET

The building automation industry is a fast developing industry, and the importance of the building automation initiative is due to many reasons, one of them is that it is said that the energy consumption in the building is about 40% of the whole energy consumption, heating and cooling, and the lighting [10].

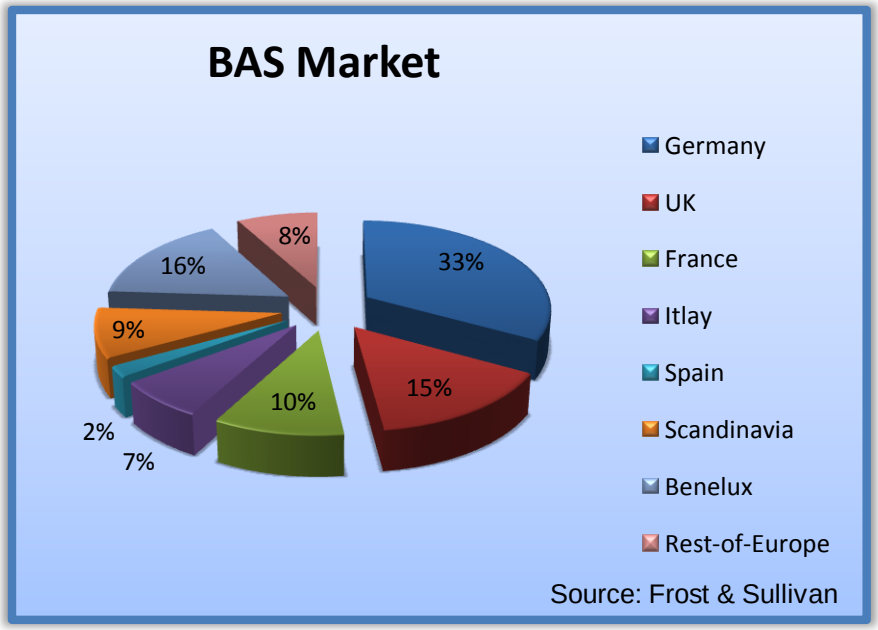


Figure 5_Building Automation Market Share by Region

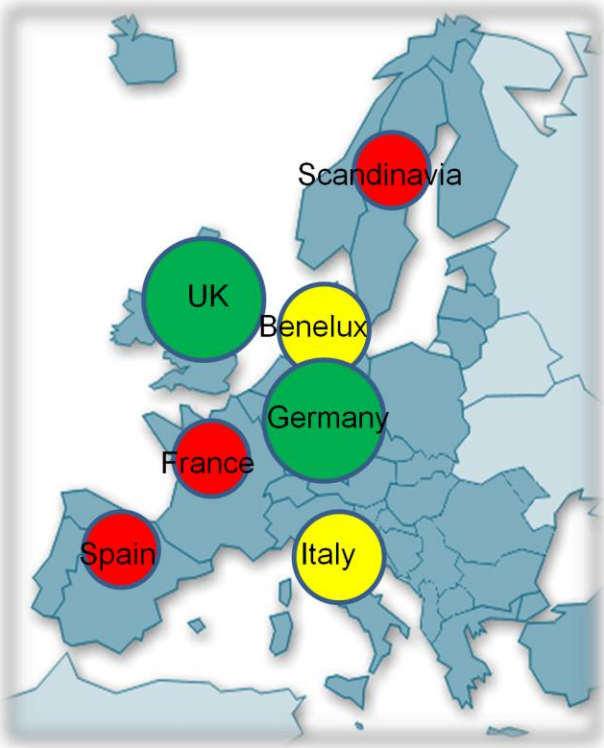
The European BAS market is in an early growth stage, though the recession affects the growth of this field, but the recovery has begun in 2010, and there is a positive indication of growth due to the increase emphasis on energy savings, the European building automation systems market is totally concentrated and there is a high competition, the major four companies that are having about 70% of the market share are Honeywell, Johnson Controls, Schneider Electric and Siemens, and the other 30% are many companies ranging from small to large participants [8], also the highest market share in term of geographical presence are Germany and the United Kingdom, which are having 33%, and 15% respectively, on the other hand France and United Kingdom are some key growth regions, and the areas that are having the highest growth are the lighting, and the energy management systems as well as security, but the most important growth area is the former, as the energy management and conservation is becoming one of the main considerations that need to be specially implemented in the new buildings.

If we want to talk about the market segments, the highest portion will be for the office complexes followed by the industrial, then the Retail and hospitality buildings.

The building automation systems market was valued in 2010 of about 1,769.5 million dollars, while it is expected to reach about 2,123.6 million dollar in 2017 [11]. This sector is growing and expanding due to many drivers that are discussed in this thesis.

3.3.2. HOME AUTOMATION MARKET

The European home automation market is in a growth stage as well, and there is a tough competition and it is more intense competition, for the home automation systems, there are some competitive factors including the price and the ease of installation and programming.



The first two countries in term of market size are Germany and United Kingdom; there is a growth in Spain, France and the Scandinavian countries, but are less than Italy and the Benelux countries which are having more growth, this market actually is divided into two sub-markets which are the luxury and the mass markets.

Every market has its own players with a different number of installations and revenue.

The major participants are Control4, ABB, Creston, Schneider Electric, AMX, Legrand, and some of the participants in this market are operating in both the luxury and the mass market [12].

The European home automation market of both the luxury and the mass sub-markets was valued at about 168.3 million Euros in 2009. [13]

The Home Automation systems shipments will be total of about 1.8 million in this year worldwide, and that number is expected to rise soon, to be more than 12 million in 2016 according to a recent study from ABI Research [3].

Next I will analyze these two sub-markets with more details, showing the companies participating, market share, number of installations and the revenue generated.

- **The Mass Market**

The Mass market is so intense, there is around 154 companies are operating in this market [14], having different backgrounds, the majority are operating in the building automation and electrical distribution component markets, the market is very fragmented, and the largest three players are Schneider Electric, Siemens, and Legrand that holds about 14%,11%,8% respectively but if we deal with them as a group, then legrand which has strong presence in France is the

leader as it has another brand which is Biticino, which are together will count up of about 15% of the market share.

This market in general is having 63% of revenue in the home automation market, and there are around 57,000 installations in Europe [8].

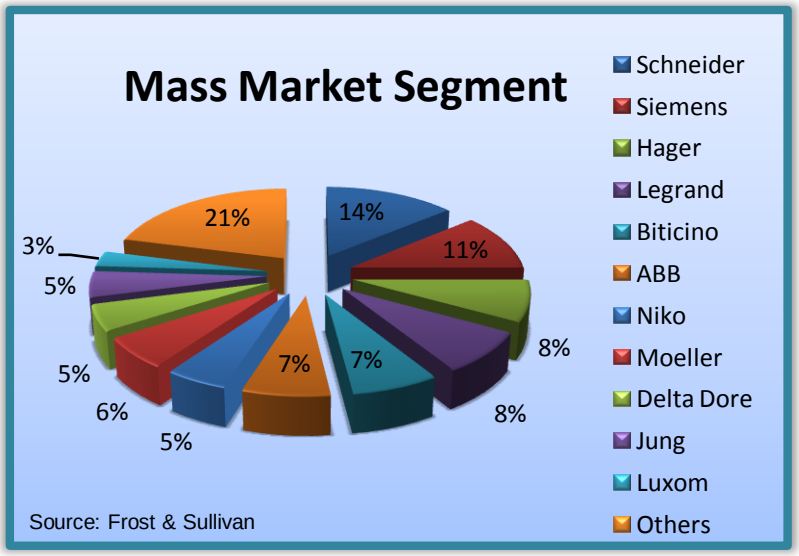


Figure 6_Mass Market Share By Company

- **The Luxury Market**

The Luxury market is more concentrated and less players are exist, it is actually dominated by an American players who hold about 50% of the market share, those are Creston and AMX, on the other side, the European companies are having smaller market share like Teletask, Visiomatic, Vantage, and Control4, and the latter is a new player in the European market and tends to introduce a competitive prices to get more market share, the remaining companies are some manufacturers including custom installers, and some other players who are operating in both the luxury and the mass market.

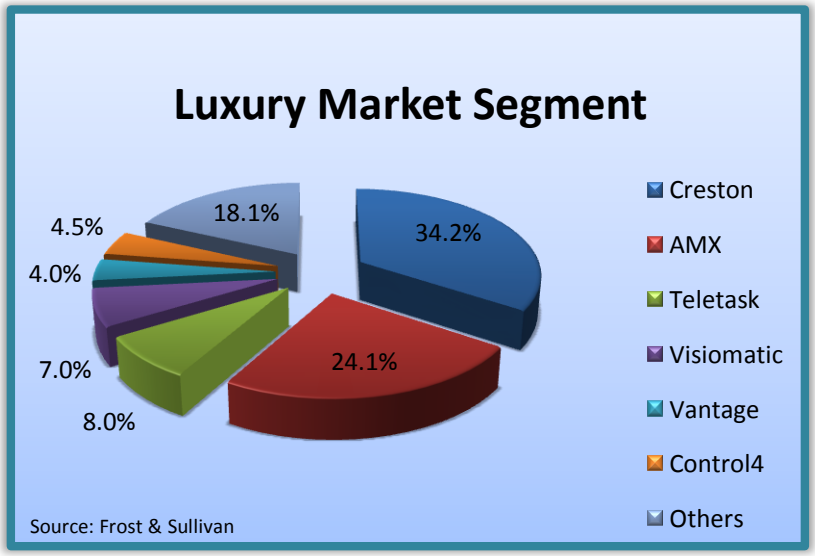


Figure 7_Luxury Market Share By Company

This market represents about 37% of the home automation market revenue, and there are about 4,000 installations in Europe [8].

3.4. APPLICATIONS AND BENEFITS OF HOME AND BUILDING AUTOMATION

There is an insight about saving the energy, due to the rising costs in addition to the effects on the environment that is because of the gas emissions. Building automation is an effective solution to reduce the energy costs and environmental costs of operating a building. Nowadays because of these issues, most systems have started to automate the heating, ventilation, cooling and air conditioning or as it is known the HVAC, also another thing for the sake of energy gains efficiency is done through automating the interior and exterior lighting. Besides the other features like the remote monitoring, alert capabilities, and the remote access via the internet, as well as providing some security features like the fire alarm or the surveillance cameras and many more.

Figure 8_Building and Home Automation Applications

The number of applications and tasks are almost unlimited when talking about the home automation nowadays, the only limit that we can define is how much money the customers can pay. The applications can range from outdoor to indoor, starting from the exterior systems, an automated parking systems with an outdoor surveillance cameras for security, outside lighting for safety, and irrigation and a landscape systems can be exist for more safety purposes.

The commercial buildings are concerned about security and access control more than the comfort and entertainment systems as in the home automation systems, tracking the time and attendance, credentialing enrollment, visitors' access, and managing the fire and life safety, alarms are also another elements that are used a lot in the commercial buildings [33, 34].

Heating, ventilation and air conditioning are some important requirements for a commercial or the residential buildings, the gas and smoke monitoring are done by some detectors and sensors that can detect the occurrence of such an accident, The elevators which most of the times are used in the commercial sector can also have an interface for real time monitoring and maintenance.

The use of interior lighting applications for energy efficiency and more safety in some situations, scheduling light times for more comfort use, maximizing the daylight harvesting for more energy conservation, for the sake of energy savings, the smart metering approach can be used, by analyzing the rates, it can reduce the cost and managing the energy budget will become easier, the utilities of electricity, water and gas can be monitored and more savings can be achieved [15].

The ability to control the facility systems via the network can be done through, by connecting these facility systems to the network and then can be remotely controlled by any IP-connected device, Monitoring the restrooms and the water consumption during occupied and un-occupied periods, tracking the consumables, and checking the suitability of the restrooms by monitoring the maintenance alerts to ensure that everything is going fine.

Some recent trends in addition to the intelligent restrooms, is the intelligent kitchens where the equipment and systems of the kitchen can be monitored to ensure more safety and hygiene, monitoring the ovens, refrigerators, and the hoods to be sure that all the equipments and devices are running well.

3.5. HOME AND BUILDING AUTOMATION MARKET FORCES

There are some drivers and restraints for the adoption of the home and building automation initiatives and applications, though there is a distinct between some features of both systems, but because the two systems are almost the same and are very close, I tried to make an aggregation of the drivers and the restraints in one list [17, 39].

3.5.1. DRIVERS OF HOME AND BUILDING AUTOMATION

- **The European Union Directives**
  The most effect of these directives will be on the new buildings for the sake of energy savings, the most expected market to be involved and following these directives and legislation is the Building Automation market, and as more countries are getting into this field, the more value it will worth.

- **The New Construction Operations and Renovation**
  Even with the recession happened recently, and the slowdown in the construction activities, still the new homes construction and the renovation is a key driver for the European home automation market, but the market has not been affected by this slowdown too much, as there is the luxury segment that its customers are wealthy to the way that they purchase their patterns without much concerns about the economic conditions, means that it may affect the overall growth levels but the number of home automation installations are still increasing.

- **The improvement in the Safety and Security**
  One of the drivers for the home and building automation is the need for new approaches of security, and more focusing on the safety issues.

- **Energy Savings and Conservation**
  Using the smart metering and the sensors for monitoring the consumption of the energy, and at a result managing and responding to these circumstances upon a specific criteria, in addition to the conservation techniques, and that has more effect on the commercial buildings more than the residential buildings, and still there may be an adoption of this trend because of the energy anticipated prices, moreover the concerns about the friendly environment are increasing, and some customers like to adopt these kind of systems.

- **Improvement and the change in life styles**

  For a niche segment in the market, there are some customers that are willing to spend extra money for more relaxing and comfortable environment, and a personalized space and services, houses are becoming a places where all kind of entertainments must be accommodated, and improving the controls of heating, lighting and security becomes for increasing the comfort and safety levels.

- **The Development and amelioration in Technology**

  The advancement of technology will absolutely contribute in reducing the system costs or providing more features and services for the same money, and the implementation of these systems takes time, and does not become suddenly a source of benefits until it is proven in the market.

3.5.2. RESTRAINTS OF HOME AND BUILDING AUTOMATION

- **The overall cost of installation and operating**

  The cost is still a key restraint to the expansion of the market, though the prices of the systems has fallen over the last few years, the high costs of programming and installation are holding up to 50% of the total cost, but on the other hand the comfort and prestige are provided by these systems which will allow the market to grow, and the system components' costs will be reduced gradually, as long as there is improvement in the technology including chipset and sensors manufacturing, and the growing in the wireless technology.

- **Lack of consciousness and Awareness**

  There is still a lack of awareness about the benefits that home automation can provide, and the faster the market is growing, it indicates a viral growth that is driven by awareness.

- **The Retrofit Market**

  Most of the implementations of home automation systems are in the new construction activities and in new developments and that in term narrowing the potential market growth, because to these systems there is still a need for a wire infrastructure, and that is making the installation of such a systems after the completion of a building, more costly and most likely intrusive.

- **Standardization Issues**

  As some of the standards are proprietary, it will be a restraint for these systems to expand, because with proprietary standards and protocols, there will be a vendor lock-in and as a result no flexibility will be provided, which will prevent the utilizing of other products, and even by using some open standards, still there will be a problem of switching to another products.

- **System complexity and the lack of Skilled people**

  Since there is a large selection of products and controls required for the implementation of home automation systems, it will complicate the interfaces and the user will be confused, moreover, the companies are not specialized in all these highly fragmented products and standards and the manufacturers of building automation systems are offering commercial building systems to residential ones, and that makes them having less skills in a specific systems, this problem exists more in the emerging markets such as Spain and Italy, as the developed markets are much more stabilized and the majority of home automation installers are well acquainted with these installations in a countries like Germany and the united kingdom.

3.6. OVERLAPPING BETWEEN MARKETS

There is an association with a lot of other industries, regarding to its diversity of applications and the ability to control various dispersed products within the home or the building.

Depending on the applications that are provided and produced for the a home or a building, there will be different percentages of the overlapping between these markets, and many factors may change the way how these markets are overlapping or may a new markets gets involved in this association, they can be a technological, economical, or other factors.

For instance the rapid developments in the ICT and networking, may change the way of interaction between these industries, and diminish some others, like the emerging mobile devices of smart phones or tablets, can change some variables in the user interface, which can be an alternate of other interfaces and controllers due to the difference in cost and the mobility.

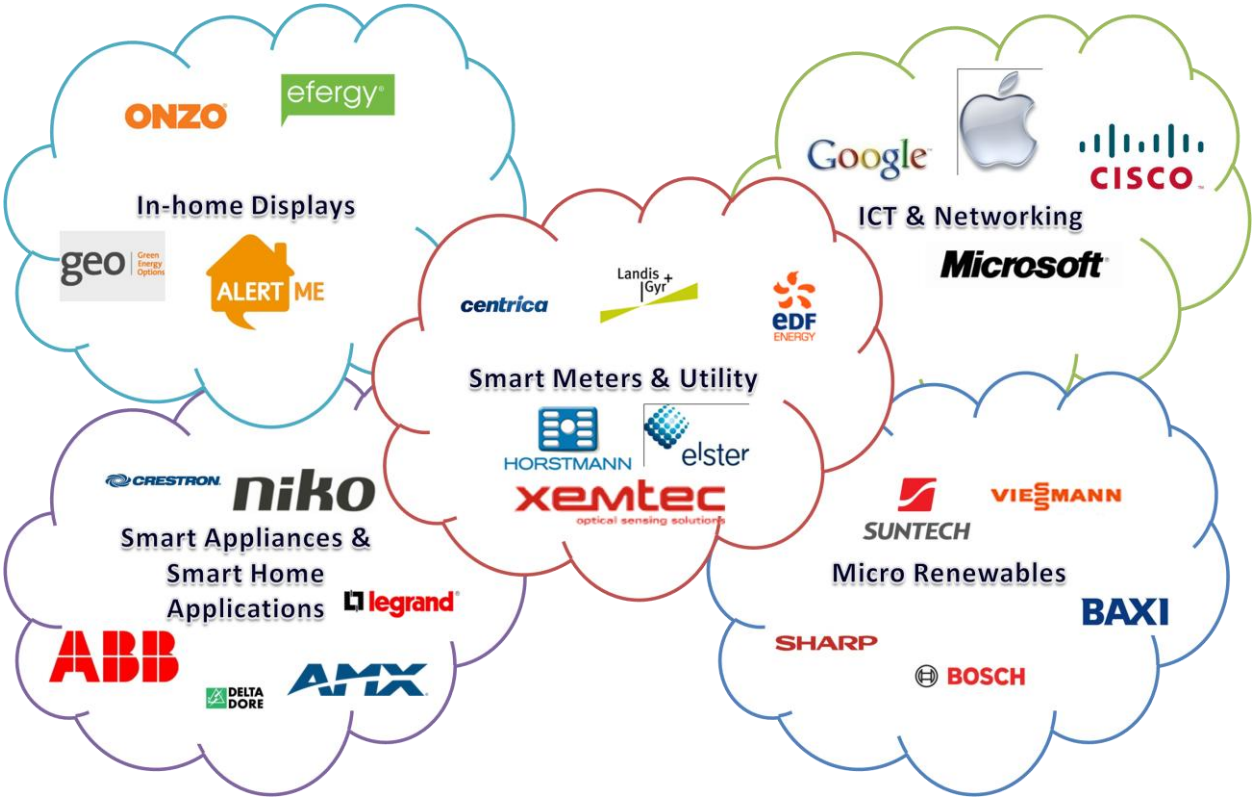


Figure 9_Markets within the Market

Another example is the new directives of green initiatives, and the energy consumption monitoring also adds a new dimension, that home appliances for instance start to follow these trends to be more accepted in the coming markets, other impacts may arise due to the use of some technologies like the smart metering, so in any case there are different strategies for the market participants which are applied immediately for a short term, and some of them having a medium or long strategies, as every side is trying to maintain its position in the market, or try tapping into a new revenue streams [40].

3.7. VALUE CHAIN

Talking generally about the M2M industry, or more specifically about the Home and Building automation industry, we find that the industry is so fragmented, and sometimes there is no any connection between each subsystem, as there was a lack of communication between them, and as we are dealing with one of the "machine to machine" applications, then we have a tremendous number of participants, and the players in the market are many starting from the big companies like Siemens until we get to the small companies that are concerned more about a Niche market for a subsystem or even an application.

Multiple fields and their key players must work together and be gathered and cooperated in order to generate the value of the Home and Building Automation Network starting from the Houses to Businesses, Factories, and large facilities, I have included the key participants in the HBA process, trying to show their roles and what they provide, some examples of this field mentioning the small parts and applications manufacturers, until the final products & systems, the frameworks and platforms, and the applications that are used and developed for that purpose, in addition to the service providers and operators that are currently involved in this process or can be involve in the future, the value chain is presented as the following:

	Hardware	Software	Apps	Controller	Service Provider
Activities	* Producing Physical components (e.g. Chipset, Sensors) * Producing Equipments like System inputs, actuators	* Develop Customized software to enable communication between module and receiving equipment	* develops M2M value-added services for a service operator to be consumed by the end-user.	* Provides an Interface by which the user can control	* Buidling an integrated solutions for deploying the HBA services * Operate Services on behalf of end user
Examples	Chip Manufacturer Sensor Vendors Smart Appliances Surveillance Equipment Security Equipment	MiddleWare Technologies Web Services OSGi Lontalk INSTEON	Building Management Systems Android@Home Customized Applications	Mobile Devices Web enabled devices Proprietary devices Remote Controls Lightswitches Button style interfaces	Power Companies MNO Telcos Companies FTTH CATV Companies
Players	Siemens Creston Sharp ABB Honeywell Legrand	SAP Microsoft OAT Systems Sun Microsystems Smaller Players	Slingbox EchoStar Microsoft Google Apple iTunes Amazon EnOcean	Control4 Creston Google Apple	Vodafone Orange T-mobile Verizon At&t Directv

Figure 10_Value Chain Participants

3.8. NETWORKS AND COMMUNICATION TECHNOLOGIES FOR HBA

In fact the term building automation have two types, the commercial buildings which are more big scaled, and the residential or home automation, that most of the time means the small scaled, and every term has more specific requirements, and every term concerned more about an exact thing, in the case of the building automation, the more focus is about the economical issues, whereas the home automation is more about the comfort and the relaxing features.

The ways of communication and interconnection in the home and building automation are so many, starting from the old style that was used in the early days of home automation systems which is by using a simple copper wiring, as there was no need for high data rates and speed, currently with the new applications there is a need for more capabilities to handle the flow of more bandwidth and high speed, a new approaches has been introduced including the wiring connections, power-line, and the wireless connection, in addition to the standards and protocols that are produced by some companies, which either can be proprietary or open or even shared by an alliance between some companies.

The Building automation's main task is an automatic sensing and control of the facilities of a building, like the lighting, heating and cooling controllers, and the term that is more related to the building than the home like the security, and the access control. The system can be described by three main components which are the sensors, actuators and controllers, and these components have to be connected in order to make the proper control either automatically or manually.

The connection between these elements have some specification and features, that could be differently provided by each type of connection, such as the reliability, the deployment ease, the cost and some other features that will be discussed in every type, in the following tables I tried to introduce these connections with a brief description, and the features that they have:

There are different needs for the communication within the parts in a system, as it may require a higher capacity to connect the higher level nodes and controllers like the PCs, using Ethernet, Wi-Fi and some others, or for connecting a low level nodes and components that needs simple connection, and these type of communications is for small system elements like the Zigbee, parallel, serial, and X10 connections [18].

I will talk about the most common technologies that are used for each of the four categories:

3.8.1. WIRED TECHNOLOGIES

The best feature that wired networks have is that it is the most reliable; on the other hand the deployment cost is much higher, because in this type there is a need for the wires to exist in the whole building, in order to approve the connection and the communication that could be established from a machine to another.

- **RS-232 (Serial connection)**

The RS-232 is a serial standard, which supports only point-to-point communication. If the communication is unidirectional, only 2 wires are needed.

- **Controller area network (CAN)**

CAN bus is initially designed for automobile control, since modern automobile has tens individual micro-controllers. Messages sent with a smaller address have higher priority, and will win a competition when collide with other message.

- **Ethernet**

This kind of connection is a good approach for minimizing the cost of implementation, because it is already exist, but at the same time, there will be some security and reliability issues because it will be open for the cases of internet traffic interference and intrusion.

3.8.2. POWERLINE TECHNOLOGIES

Here the advantage and the unique feature in this type is that it has the ability to be used and deployed anywhere within the building, because the power line infrastructure exists everywhere, it has other features of low cost and the ease of use, but at the same time it is noisy to the limit that it is not so reliable connection, here are some types:

- **X10**

It is one of the most common standards and an old industry standard, used to communicate by the power line infrastructure.

- **Universal power-line bus (UPB)**

The UPB improves the data rate of X10 by using a different modulation method known as pulse position modulation. Also it is said that the reliability can be much higher than X10.

- **INSTEON**

INSTEON is designed to address the inherent limitations in X10. It communicates via both the power line and RF.

- **Lon-Talk / Lon-Works**

Lon-Works is a building automation platform by Echelon Corporation.

3.8.3. WIRELESS TECHNOLOGIES

Wireless networks are easy to deploy and the cost is also low. The main problem with wireless network is the range limitation.

To overcome this limitation, multi-hop network can be deployed. However, this requires several repeaters to always stay alive. Wireless network also have reliability and security issues. Wireless networks are often used in home automation or as the access network, connecting sensors and actuators to a backbone network.

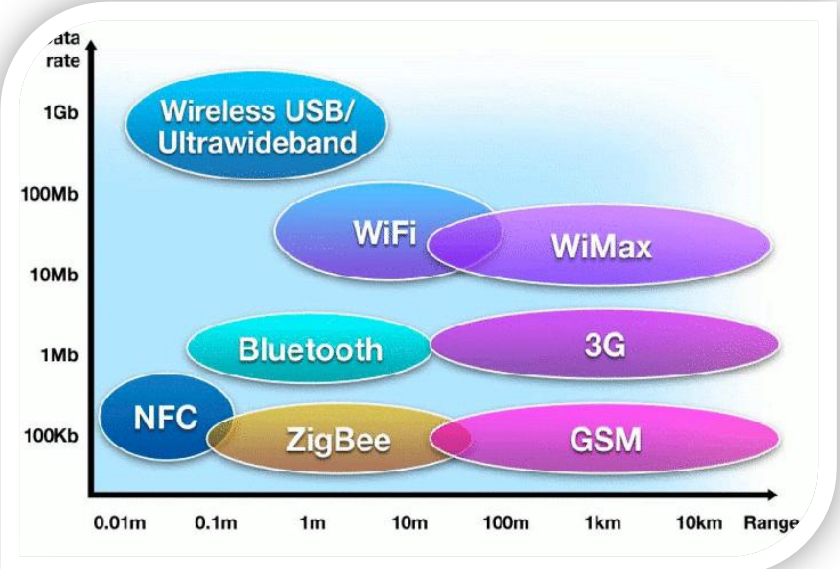


Figure 11_Wireless Technologies Source: NFC Forum

- **WIFI**

WIFI has the same concept of Ethernet; its network can be used to pass building control data, but there is a real problem of reliability, the control data might not pass before of the deadline, as it is mixed with the internet traffic.

- **ZigBee**

It is a low cost communication technology, this wireless technology is used for low power applications, and it is designed to be simpler than the Bluetooth technology, and it is widely used in the wireless sensor networks (WSN) and the small elements in the home automation systems' components.

- **Z-Wave**

Just like the Zigbee, Z-Wave is a low-power wireless technology and it is designed for remote control applications, Unlike WIFI or ZigBee, Z-Wave uses a different band for more reliability for small control signals, Z-wave is one of the proprietary standards, and not open to the public.

3.8.4. APPLICATION LAYER PROTOCOLS

Most of the application layer protocols in current off-the-shelf products are actually proprietary. Here are some common application layer protocols.

- **BACnet**

BACnet or Building Automation and Control Networks is a protocol designed specifically for building automation. HVAC, lighting, and security are some of its applications, has been first published in 1995.

- **Modbus**

This messaging protocol is an open-standard. It is designed to communicate between programmable logic controllers (PLCs).

- **xAP**

Is a message based protocol, and an open standard designed for home automation. it works on any network technologies, and any architectures, xAP works fine for the small scale home automation applications.

- **Smart-Bus or S-Bus**

S-Bus is a proprietary communication protocol by Smart-Home Group. S-Bus is targeting home automation. It supports HVAC, home theatre control, lighting, etc.

- **C-Bus**

C-Bus is a proprietary but open protocol by Clipsal. It is targeting home automation and it was first designed for lighting control, then its use extended to other applications like controlling the heating, ventilation and air-conditioning, audio/video, HVAC, Irrigation and security.

After identifying some of the common standards, which every standard have advantages that are unique but may not fit, or may have a better alternative, and that is according to the case that it was implemented for.

A large number of companies who provides complete building management solutions tends to use their private application protocols, there are open protocols but there is no common standard yet.

The current situation regarding the systems and protocols that are used in the home and building automation is that:

1) There are more than one standard, and actually can be considered a lot of standards
2) As a result there is lock-in regarding the vendor products

3) There is not much flexibility or upgradability for the system as desired
4) The cost of some systems are expensive

The wanted options are to have open, flexible and cost-effective systems.

3.8.5. OPPORTUNITIES FOR WIRELESS AND POWERLINE CONTROLS

There is a migration of the traditional suppliers to IP-based systems and maybe the most important is the entry of key market movers which will make changes, in the perception of some expert in this field that it is time to look at the home appliances and the control systems from another point of view and to take advantage of the recent technologies in the field of wireless and power-line controls systems at this time, likewise the customers are comfortable with the digital technology which has the features of lower costs and high reliability.

There is a demand for non-intrusive installations for home and building automation, meaning that there is more interest in solutions that do not need or require installing new cables, specially that nowadays there are some technologies that technologies and products that can compete with the wired solutions in term of the features that it have, the flexibility, and the performance outcome.

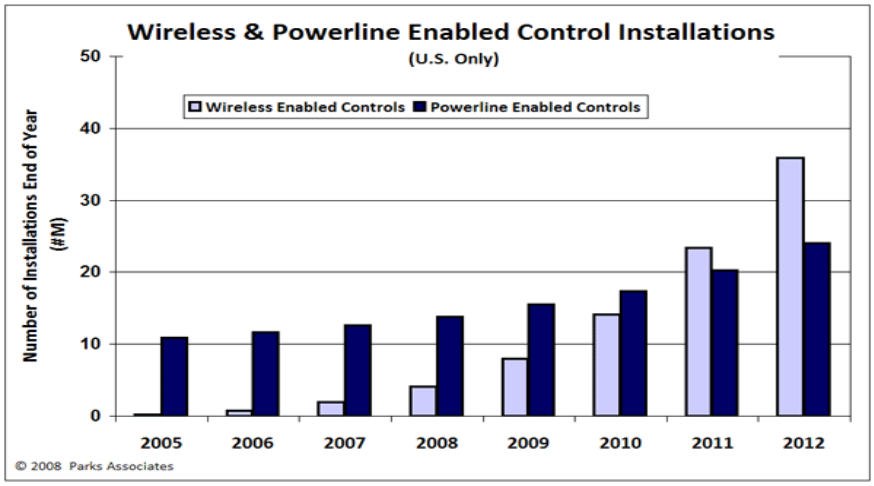


Figure 12_Wireless & Power-line Enabled Control Installations

In a U.S study for showing the wireless and the power-line enabled control installations, we can find in figure 12 that the number of installations are increasing which means that there is an appetite for the adoption of these technologies, and as we can see, it is clear that the wireless installations are rising heavily, and that in a result shape a good future promises for the use of wireless controls [19, 31].

3.9. HOME AND BUILDING AUTOMATION SENSORS MARKET

The sensors represent the input element of the home automation system structure, the use of sensors in building automation applications has increased, and there is a greater focus on having more comfort indoor. There is a wide use of sensors in many industries like the commercial buildings, manufacturing, hospitals, and airports.

The global sensors market in the home and building automation industry applications generated revenue of about 1.2 billion dollars in 2010.

On a geographic basis, North America is the dominant player in the sensors market currently, it has the lion's share of the market of about 37%, followed by Europe of about 25%, Asia Pacific about 23%, and the remaining is for the rest of the world [8].

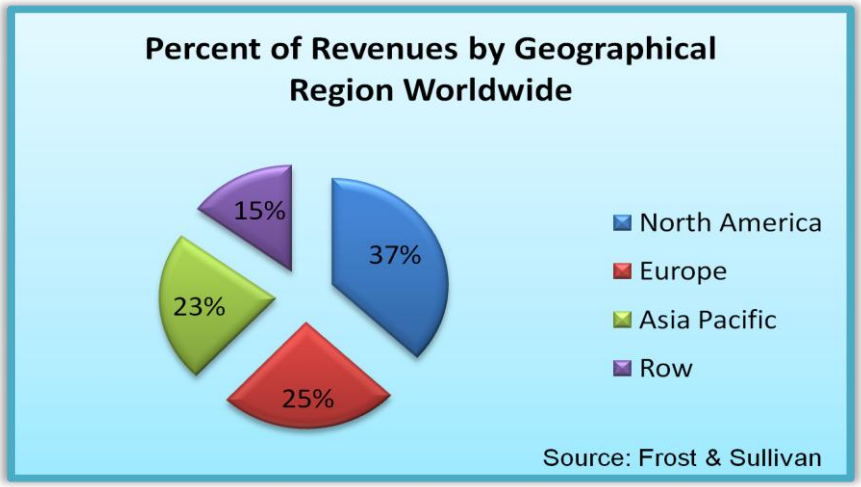


Figure 13_Sensors Market Percent of Revenues by Geographical Region

It is expected according to many forecasts that Asia Pacific region is most likely will have a large growth in the heating, ventilation, and air-conditioning due to the wide use that will be in the new retail malls, and the hospitality buildings in addition to the growth in the building industry, and the industrialization nowadays, also there is an expansion in the penetration of the building automation systems.

There are some major companies operating in the sensors market, like Honeywell, Siemens, and Schneider Electric, all of which alone holds about 51% of the market share, BAPI holds 5% while GE Sensing holds about 8%, the remaining 36% is distributed to a number of diverse companies [8].

Looking at the worldwide sensors market, It is expected to increase to $62.8 billion in 2011 and then to nearly $91.5 billion by 2016 [30].

3.10. WIRELESS SENSORS IN CONSUMER APPLIANCES

With the rapid evolution in the wireless technologies, and the increasing demand of wireless connectivity, this trend extends to the consumer devices and appliances which is one of the incentives for the development of the home automation systems.

The wireless sensor network as a term can be described as a group of independent devices that can communicate with the environment around, and monitor the physical and the environmental conditions such as motion detection, temperature, sound detection, pressure and many others, in order to apply a specific function, and even they communicate together and send the data, all these are done by the wireless sensors which is integrated into each device, this emerging trend is increasingly integrated in the devices and the home appliances for the sake of automation, starting from the simple appliances till the most complex ones.

According to some studies about the wireless sensor network chipsets, there are about 8.5 million shipments of the wireless sensor network chipset worldwide, and it is estimated to exceed 242 million a year by 2015, the standardization of the chipsets and the increasing use and availability, will undoubtedly take place of the proprietary wireless chipsets, reduce the cost and will provide greater control over the home appliances which will generate more comfort and energy savings.

As we can see from this Figure, the main three regions in term of growth in the wireless sensors network chipset shipments are North America, Europe, and Asia pacific.

For North America, there is an increase of approximate of $140 million dollars within the period of 2009-2015, whereas the Europe market increased from $15 million to $130 million and the Asia Pacific from about $8 million to $120 million during the same period [20].

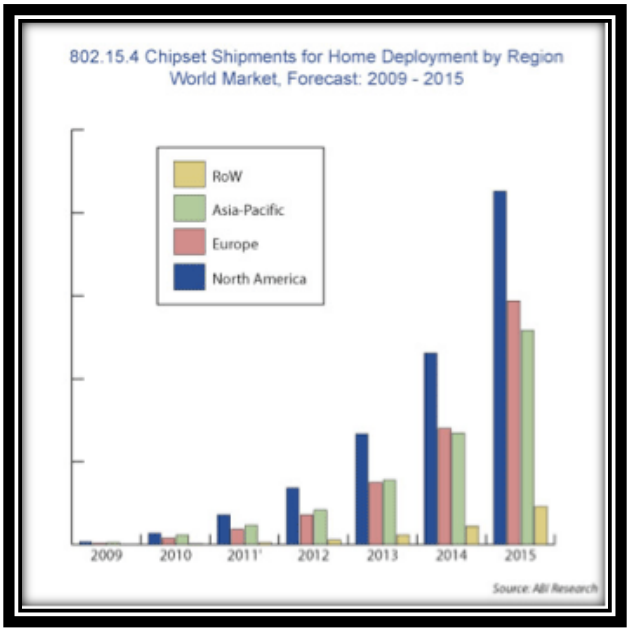


Figure 14_Chipset Shipments by Region Source: ABI Research

3.11. SWOT ANALYSIS FOR THE EUROPEAN MARKET

Depending on the previous description of the drivers and the restraints that the worldwide home and building automation market is facing, and the specific points related to the European market, and by analyzing the current situation, and the finding that we have in addition to the data about the European market in term of the challenges, competition, or the strength points and the opportunities of the European market, its SWOT analysis can be characterized by the following points:

Strengths	**Opportunities**
1) Increasing competition benefiting product and price developments 2) Young and dynamic market with high growth levels 3) Resilient market to economic downturns (luxury Segment)	1) Opportunity in the refurbishment market 2) High growth in emerging markets. (Eastern Europe) 3) Embedding ICT into Home Automation 4) Open and upgradeable systems
Weaknesses	**Threats**
1) Complex software and programming 2) Limited installation know-how 3) Unknown product features to end users 4) High upfront cost 5) Installers lack Marketing, ICT and management skills	1) Increasingly globalised market with more US players entering the Market 2) Risk of overlooking new technologies from adjacent sectors 3) Lack of synergies between applications

There are some points that have major impact on the market like for example the rising intrusion of the outside players, and may have a long term impact like the integration and the use of ICT in the home and building automation applications, which may emerge new opportunities with this rapidly developing industry, on the other hand it can have an impact for a short term like the shortage in the skills in this market, as with more installations and more specialized companies joining the market, it will diminish this weakness, the table above is the abstract that I could get, concerning these variables.

4. HOME AUTOMATION CASE STUDY

In this study, I had included a case study showing the benefits that can be achieved through the implementation of smart home, there are various applications that can be used within the smart home and a real value can be generated, the following are the main advantages:

1) Comfort: these systems and applications are concerned about the luxury control, and using some stuff for more relaxing and convenient environment, there are some customers that they are willing to pay extra money to have more comfort, home automation systems can make the living more comfortable, and having much more efficiency in the heat supply, some of the applications that comfort can be achieved from are the following:
   A) Blind & Curtain Automation
   B) Intelligent Light Solutions
   C) Remote Monitoring & Control
   D) Bathroom Automation
   E) Appliance Automation
2) Entertainment: the increase distribution of the media sources on the internet, has been a driver for the development of the entertainment inside the home automation systems, there is more caring about the media nowadays, and the sources of media are distributed and not united, the home automation systems can provide a one unit control of almost all the sources of the entertainment in the home in addition to some other features that are presented in the following:
   A) Home Cinema Rooms
   B) Home Audio & Video Automation

C) Multi-room Home Entertainment System
D) Scene Control

3) Security: the security was not an important requirement in the past, but due to large increase of demand on the security applications, and that is because of the rise of intrusions and the need for protecting the properties, a lot of attention has been paid towards having more secure environment.
   A) Access Control
   B) Intrusion Detection
   C) Alarm System
   D) SMS Notification
   E) Occupancy Simulation
   F) Video Surveillance
4) Safety: the modern houses and buildings are having many safety systems, to ensure having a reliable environment for either residents or employees.
   A) Fire Detection
   B) Wetness/Flood Detection
   C) Gas leaks Detection
   D) Medical Alert Systems
   E) Carbon Monoxide Alarm
   F) Disability Automation
5) Savings and Ecology: many drivers arise for the sake of energy savings and protecting the environment, one is the European directives and legislation, also by having an insight on the transport and power generation, the building technology has the largest rate in the consumption of energy, heating and cooling, and the lighting which all make up to 40% of the energy consumed in both the residential and commercial buildings.
   A) Climate Control
   B) Home Energy Monitoring & Management Smart Metering
   C) Garden watering system
   D) Water Management System

I have included a chart showing the consumption of the energy in the traditional home, what we find is that the most consumption in the energy is in the field of heating, cooling and the lighting.

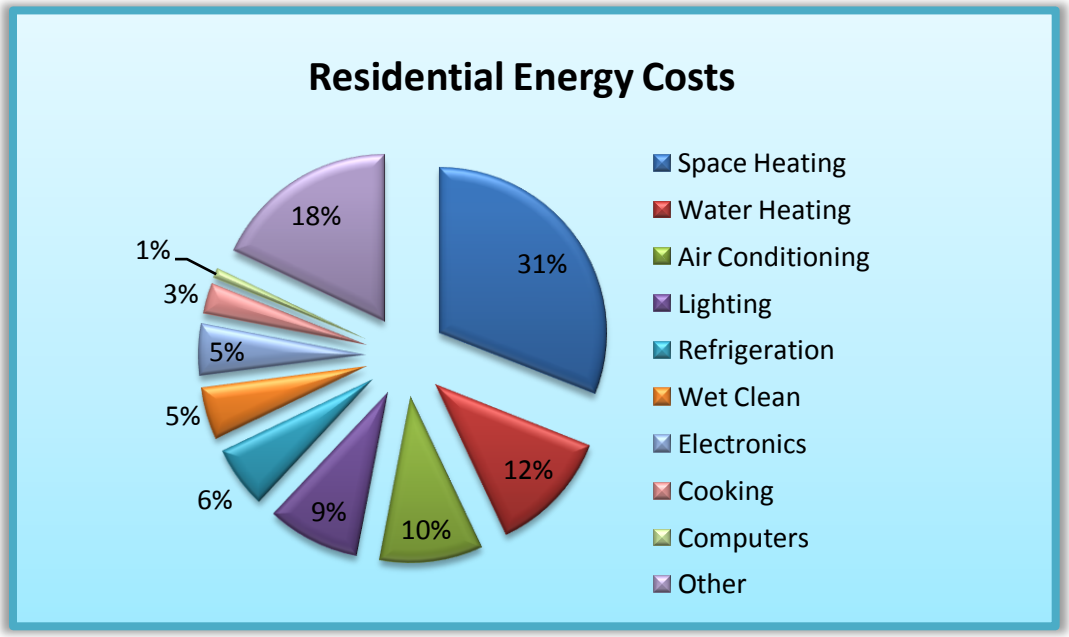


Figure 15_Residential Energy Costs in the U.S Sources: U.S. Department of Energy

There are many functions that can be done to reduce the consumption of every element in the home or the building, but just to clarify how can we implement some of the functions, the following steps and applications can give an insight about some approaches to preserve the energy in the heating, air-conditioning and lighting, which all represent that most power consuming elements in a building [20, 38].

1) Room Temperature Control by timer which can save up to 10%.
2) Room Temperature Control by Presence Detectors which can save up to 25%.
3) Night Cooling & Automatic Blind Control according to temperature and solar altitude/angle which can save up to 15%.
4) Constant Light Control by presence detection which can save up to 50%.
5) Using Dimmers (dimmed to 25%) which can save up to 58%.
6) Energy consumption display system which can save up to 15%.
7) Daylight harvesting controls and automatic window shade systems which can save up to 40%.

In general there are three principles on how to reduce the energy consumption, and consequently having a more friendly environment, the first is to use the energy just when it is required and that justifies the purpose of the sensors and their role, using the amount of energy that is actually required, no more no less, and the last step is to use this consumed energy in the highest efficiency that we can get, for instance by using the LED lighting, we can dim the lights for the suitable level, and having a very good lighting efficiency, and the using of these kind of lighting is a trend that will be widely used, and it will have a great impact on reducing the power consumption in the lighting.

At the end the home and building automation systems can introduce up to 60% energy savings, which sounds very reasonable to implement these applications for the long term [22].

5. HOME AUTOMATION ROADMAP

Up to this point, we found that the M2M Market is growing and the home and building automation represents a promising sector in this industry, on the other side the service providers' market is saturated and they may consider some improvements in order to maintain their position in the value chain, and this can be through having some new roles in serving the customers and by providing new added services, if we look at the chart below, it shows the difference in growth ratio between the fixed telephone lines, fixed broadband subscribers, in opposite of mobile cellular telephone subscriptions, and the mobile broadband subscriptions, Overall, the expansion and growth of the mobile cellular and mobile broadband subscribers is growing much faster than fixed telephone lines and fixed broadband subscribers respectively.

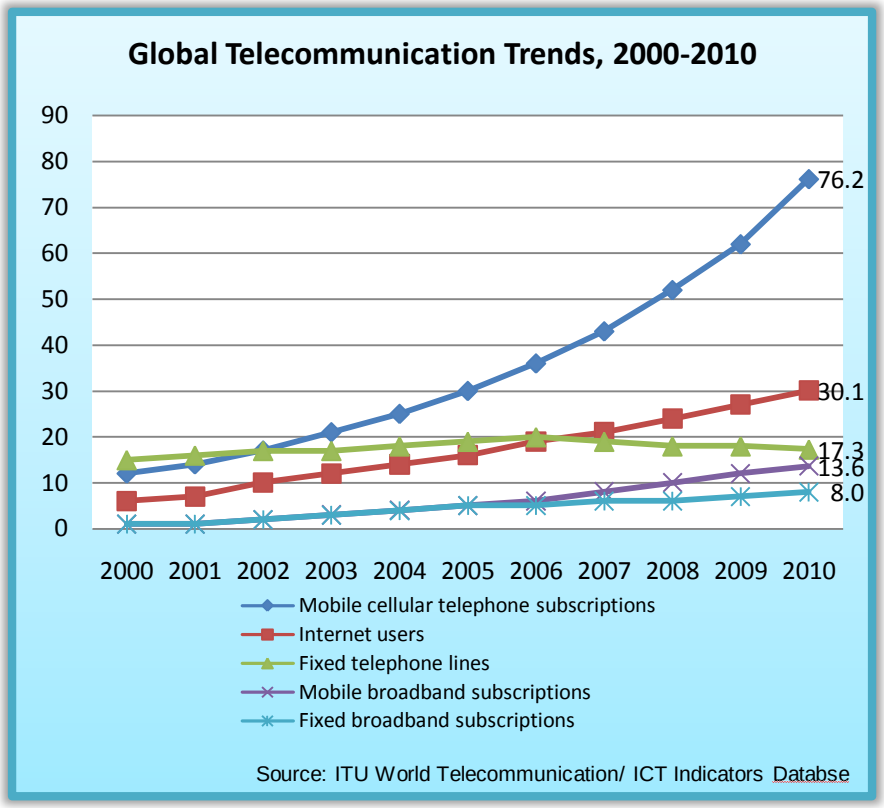


Figure 16_Global ICT Developments 2000-2010 Source:ITU

As we can see in the figure above, there is a decline in the Fixed Telephone lines and it actually dropped to 17.3%, and a small increase in the Fixed broadband subscriptions, while on the other side there is an tremendous increase in the Mobile cellular telephone subscriptions which has grown up to 76.2% in 2010, and more increase in the mobile broadband subscriptions than the fixed line subscriptions, and that makes the mobile network a hot spot that it most probably will have a very important role in the M2M communication, in addition that the internet users are expanding, and will grow from 2 billion in 2010 to 2.7 billion in 2015, when at that time almost 40% of the world's populations will have the ability to access the internet, and exploit the enormous resources that it has, which also will affect the adoption and the growth of the M2M applications, and specifically the home and building automation, as this is the heart of my topic [23, 35, 37].

Generally the fixed line telephony have been used in the past as the communication system for the earlier M2M systems, but nowadays the trend is to use the mobile network as the communication medium, and actually Europe leads the world in the mobile broadband penetration with about twice the adoption of the Americas.

There are many machines and devices that are joining the network, becoming connected and network-enabled devices, the mobile data is on its way to become a very necessary thing nowadays, both the internet users and the mobile subscribers are increasing, a greater bandwidth is in demand as there is an expansion in the entertainment side, both the audio and the video, there are more and more M2M connections.

The next generation of the mobile networks need greater service portability and mobility, there will be a need for networks, in order to allow these devices to be connected to the network, as a result enhancing the mobility feature and getting more bandwidth to be much enough to improve the real time video and multimedia, this in term will broaden and widen the range of applications that can be used, also the services will be more enhanced, a high efficiency can be achieved through the use of the mobile networks.

The mobile technology has changed a lot of aspects in our lives, a lot of users are now transforming their way of approaching the internet and the web, instead of using the traditional PCs, there is a shift to the mobile devices and those numbers will increase more and more, especially with the growth of the smart phones and to an even degree, the tablet growth which will have a great impact on the internet access approaches.

There is a great acceptance of the GSM-based mobile technology, due to the features that it has and what it provides the customer of mobility, greater security, and more bandwidth as a lot of applications are improving and they are in need for more efficient communication medium, In the United States, it is predicted that 40% of the M2M connections could be able to run on GSM technologies (3G, 3.5G, and 4G) by 2015 [7], regarding these predictions and the specifications that GSM-based mobile technology provides, it is most likely will be the right decision to employ, and the natural choice for many M2M applications.

We have talked about the growth of the smart phones and the tablets, which is an incentive for using the mobile networks for accessing the web, there are some advantages of using such devices, instead of using the proprietary devices of some companies like Control4, or Creston, or even using the touch screens and the In-home displays, the price is playing a key role in addition to the flexibility when comparing to the special remote controls produced for specific controls and applications, there are some innovative companies who created a new applications based on Android platform for instance, and can be run on any Android-device, these are small price applications, and does not force the customers to buy new equipments or devices, but instead their own smart devices [35, 36].

Figure 17_Moving From Proprietary Remote/Touch Screens Control to Smart Devices

The distribution of streaming media sources on the internet, like the U-tube or some services like the internet radio, and the online TV enhance and enrich the entertainment side of the home automation systems, and made them new points that could be targeted by other sources [24].

The telecom industry is becoming more than an approach of transporting the data, it has the opportunity to become a trust center for the means of security, and user authentication, as there is many choices in the home automations' industry.

There is a problem that the service providers and operators are facing, is that their market is saturated besides the competition which is extremely intense, and the possibility of being dis-intermediated from the value chain, by what we called the "Over-the-top" (OTT) players, even with this competition and the risk of getting out of the value chain, the digital home represents a real opportunity for those operators to secure and maintain their position in the value chain, and that can be done by creating a new revenue streams, it can provide the consumers by a solutions that will help them manage the

Figure 18_Service Providers Opportunities

contents of their home, one of the interesting things that the operators must look at, and must have a long term view of the market, in order for them to position themselves again in the value chain, so to capitalize on opportunities that may arise in the future, and that strategy should be taken into consideration so to maximize their income [26], here are some opportunities that can be exploited:

1) The Entertainment (Video on demand, Gaming, Music)
2) Home Management
3) Energy Management
4) Health

There can be a lot of similar opportunities, but I want just to have an insight on the health, as the need for the elderly care is crucial, due to the increasing in the elderly population, so there is a great need for an easy-to-operate home automation to provide comfort and security, as the elderly and the disabled would prefer staying at home more than moving to a healthy facility, the home automation is now valuable, and a very good option for them [28, 29].

6. CONCLUSIONS

The M2M growth is increasing day by a day, due to the increase number of connected devices, that is anticipated to reach about 50 billion in 2020 which is also considered to be one of the key emergence factors of M2M, there are many anticipations of an extreme growth in some sectors like the Utilities, Security, and the Health, the three highest growing regions are north America, western Europe, and Asia pacific which is expected to exceed the demand of mobile data traffic of North America by about 25% according to a recent study for Beecham research, many forecasts predicts that there will be a large increase of the M2M devices, and the revenue generated, and one of the promising fields in this industry is the home and building automation, which is now in evolution, and its market is expanding and growing every day, there are some obstacles that are in need to be solved like the issue of standards and protocols, and some other restraints that we have discussed, but still there are many advantages and benefits that we can get through the implementation of the home and building automation applications such as, but not limited to Comfort, Entertainment, Security, Safety and Savings, which also we have discussed about in the case study, at the end the market of the operators and the service providers is saturated for now, and there is a possibility for those players to get out of the value chain, unless they try to create new revenue streams, and consequently maximizing their income, and that could be done by having new roles and making a new-added services, specially the entertainment and home automation and management.

7. REFERENCES

[1] http://tia2011connected.com/stories/carrier-m2m-opportunities-all-about-connected-devices0223/

[2] http://www.tekelec.com/tekelec-blog/index.php/category/m2m/

[3]http://www.abiresearch.com/press/1633-Home+Automation+Systems+Revenue+to+Approach+$12+Billion+Worldwide+in+2015

[4] "Mary Cronin", "Smart Home | Smart Home Automation Breakthrough? Vendors Must Connect These 5 "I"s", August 13, 2010"

[5] http://www.worldometers.info/

[6]http://www.cisco.com

[7] "Rajani Baburajan", "Next-Generation M2M and Connected Device Market in the U.S. Will Touch 87 Million Endpoints by 2015", August 10, 2011

[8] "Frost & Sullivan's" http://www.Frost.com

[9] http://m2mworldnews.com/2011/06/29/97145-machines-talking-to-machines/

[10] http://www.levolux.com/L_Misc/40%25_energy_consumption.htm

[11] "Smarter and Energy-efficient Buildings Create $2-billion European Building Automation Systems", 07 September 2011

[12] http://www.constructionupd8.com/2010/10

[13] http://hiddenwires.co.uk/resourcesnews2011/news20110324-05.html

[14] http://www.surfaces.com/article.aspx?articleid=2223&channelid=12909

[15] http://www.alternegy.com/tabid/283/Default.aspx

[16] http://www.frost.com/prod/servlet/market-insight-top.pag?docid=125588054

[17]http://www.businesswire.com/news/home/20110922005119/en/Research-Markets-European-Building-Automation-Systems-Market

[18] http://www.wutj.info/building-automation-network-survey

[19] http://www.parksassociates.com/report/opportunities-for-wireless-powerline-controls

[20] http://www.abiresearch.com

[21] http://www.frostgreenchoice.com/index.jsp?path=lighting-control

[22] http://www.abb.com

[23] http://www.websiteoptimization.com/bw/1102/

[24] http://comcom.uvt.nl/e-view/02-1/vliet.htm

[25] http://www.ericsson.com/campaign/opportunitysupportsystems/newsfeed/posts/15/

[26] "FTTH Business Guide", Version 1.1, 11 March 2010

[27] "Home Energy Management, Health Management Top M2M Wish Lists", 8 Sep 2011

[28] "Trends and Markets in Malaysian Mobile Service", Industry Report 2007, Volume 5

[29] "The Changing Role of Mobile Operators, snap by Beecham Research", M2M.World.News, 1 August 2011

[30] http://bccresearch.blogspot.com/2011_06_01_archive.html

[31] http://www.cea-thm.com/2011/01/21/product-trends-2011-home-automation/?lang=en

[32]http://www.lantronix.com/news/2011/08-03_Lantronix-Continues-Asia-Pacific-Growth-with-Hong-Kong-Office-Expansion.html

[33] http://www.4homecontrol.com/MoreInfo.htm

[34] http://www.anglia-m2m.com/Cinterion/applications/tracking.asp

[35] http://www.techjournalsouth.com/2011/09/more-users-will-go-online-via-mobile-devices-than-pcs-in-four-years/

[36] "The iPad will make touchscreen universal remotes obsolete tomorrow", "Matt Burns", 2 April 2010

[37] http://www.telecompetitor.com/report-mobile-broadband-to-outpace-wireline-broadband-by-2015/

[38] http://www.legrand.com/EN/energy-efficiency-solutions-for-home_12552.html

[39]http://www.marketsandmarkets.com/PressReleases/intelligent-building-automation-technologies-market.asp

[40] http://www.homecontrols.com/manufacturers_list

[41]http://www.analysysmason.com/Research/Content/Reports/RRB07_Digital_home_Jan2011/

[42] http://www.ericsson.com/campaign/opportunitysupportsystems/newsfeed/posts/15/