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WHO IS INVESTING IN MACHINE-TO-MACHINE COMMUNICATIONS?

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Abstract

Machine-to-Machine (M2M) communications refers to the automate exchange of information between devices for control and monitoring applications. This type of communication is not new since automated systems have been present for more than three decades. However, miniaturization of device's size, reduction of production costs and drop in communication fees (altogether with the massive adoption of real-time access of information in current society) are expanding the set of applications and solutions currently under consideration. The real complexity relies on the fact that M2M is not only an add-on communication solution, like the case of traditional human-centric broadband communications. M2M usually entails a change in the core business of an industry, since the relationship with external partners and the internal tasks can be radically modified

In this paper, we anaylise the players involved in M2M communications and how they position themselves in a market which requires them to adjust their traditional business approach. The main question addressed in this work refers to "which players are investing in M2M, which is their view and how could their approach affect the current ICT sector?" We highlight the dominance and relationship between different actors and also look at barriers that prevent investments, regulations in the area and standardization efforts.

Using data from interviews, use case analysis, and expert workshops we place our analysis in a real-market context. It can be concluded that there is a consensus about the potential benefits of services based on M2M communications and key succes factors are partnerships among different actors, re-thinking of roles, e.g., transition to a service provider and defining the right type of value added service.

Keywords

Machine-to-Machine communications; M2M; Internet-of-Things; Techno-economic analysis; Service provisioning;Investment.

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1. Introduction and motivation

Due to the pressing situation faced by telecommunication operators, largely triggered by the current saturation of their traditional revenue streams (voice and data) in developed countries [1], there is a growing concern to target new markets and, during recent years, there has been an increasing interest in the potential opportunities that can be attained with the use of smart devices in order to gather data or automate processes. This type of communications between devices with minimal human intervention is referred to as Machine-to-machine (M2M) communications and can be applied to optimize resources and improve service delivery applications [1].

There are other incentives that motivate M2M solutions. For example, potential adopters of such solutions can appreciate declining costs in hardware and network connectivity while the coverage of mature communication technologies continues to expand. Additional motivations are specific to each application and depend on the needs found on each market. For example, in the healthcare sector, remote access to information will allow changing the care provision from episodic-services to continuous-services and to furthermore, minimize costs by remotely taking care of people at home instead of the traditional assistance at hospital facilities, while providing the same quality of service [2]. Moreover, nowadays large scale applications related to smart grids, smart metering, automotive, sustainable cities and e-Health count with strong incentives from public funding in Europe.

Available information and communication technologies are capable to work as service platforms in order to provide M2M solutions. Even so, there are research challenges that still need to be considered and current research studies are focused on providing solutions to deal with the new traffic and its particular characteristics which are fundamentally different from human-centric type of traffic (originating from personal computers, tablet and smartphones). For instance, the amount of data transmitted by most M2M devices is considered to be infrequent and only conveying small amounts of data. However, the expected number of M2M devices will be very large compared to traditional devices, i.e., forecasts published by Cisco Systems suggest that, by 2017, roughly 5.1% of the total mobile traffic will be M2M-related but, at the same time, it will constitute as much as 17% of the global number of mobile connections [3].

The effect of M2M on current and future networks has been a topic of discussion in international organizations, such as the 3GPP [4], where it has been highlighted the need to efficiently provide connectivity for large number of devices, provide energy-efficient mechanism for autonomous devices and develop charging mechanisms suitable for M2M. All this enhancements have to be accomplished without deteriorating the services offered for human-based communications.

Even though there are M2M solutions and services in the market, the number of alternatives is still limited. And this is mainly because the adoption of automated services based on M2M communications requires a need to reform the business thinking, due to the transformation of the value network. Business studies in this area are focused on understanding the role of new and existing firms and determining effective business models to create value from M2M [5].

Nonetheless, there are challenges that need to be overcome [6]. For instance, current deployments are performed to sustain a single application; leading to higher application development cost and slower market adoption [7].

All these new conditions are reshaping the panorama surrounding ICT, adding a new level of complexity and fostering stronger relationships among every actor involved in new M2M solutions. In general, an M2M solution cannot be understood as isolated relation between providers and consumers [8] (The service provider understood as the actor providing the core service, e.g., energy company, health care provider, transport company). As can be appreciated in Figure 1, this solutions it require the active interaction between several actors. In fact, when analyzing the overall circumstance, M2M is also generating deep changes in the utility, automotive, retailing and service providers sectors.

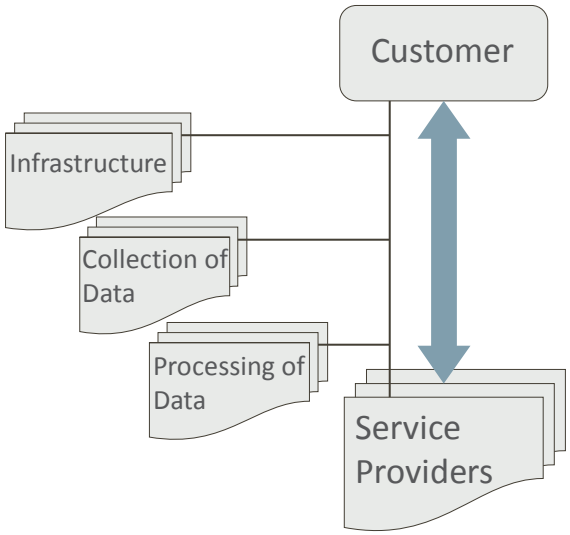

Figure 1. Generic relationship among actors involved in M2M service provisioning

Adding connectivity to a plethora of device for such diverse purposes is not a straightforward activity; for this reason, an interesting group of new players are trying to position themselves in the market by providing different sets of solutions, including information management, network deployment, systems integration and so on. The aim of this paper is to understand the distribution of roles and activities that can be appreciated in the M2M ecosystem and more importantly, which are the key players driving the innovation in M2M communications. By analyzing the current regulation framework surrounding M2M and studying application cases in Sweden it is possible to answer the following question:

- Which players are investing in M2M, which is their view and how could their approach affect the current ICT sector?
    a. What is the role of each actor in the service provision?
    b. What is the key factor that enabled the services based on cases of study?
    c. Which investment options are available for different services?

2. Research Framework

2.1. Methodological Framework

The center of this study is based on inductive reasoning to understand the relationships in the market. By using analogies with similar changes in the market (such as the mobile telephony deployment in Sweden) it is possible to compare the structure of the market. Case-based reasoning is used for applications and services provided in Sweden related to M2M. In order to gather appropriate information, data has been collected from different markets involved in M2M communications; including utility companies, network integrators, service providers, telecommunication operators, equipment manufacturers and research institutions.

The analysis of the current environment around M2M will be based on industrial networks [9], [10], i.e., instead of analyzing the relationship between two companies in isolation, the whole context surrounding their relationship is considered. This type of analysis typically provides information about the distribution of activities among actors, activities that provides a certain type of value and the interaction patterns between different actors. The business modeling framework proposed by El Sawy [11] is also used to understand the interaction among actors, and more importantly, it allows highlighting what actor controls the customer interface and the service platform. The analysis will also be supported by the contributions in [12], [13] where "value networks" are presented. In this contribution, M2M solutions are going to be analyzed in a Business-to-Business (B2B) and Business-to-Business-to-Consumer (B2B2C) contexts.

2.2. Data Collection Activities

Primary data has been collected from interviews and experts workshops in recent years; these activities include:

- Workshops on business models for M2M and IoT: Organized by The Marketing Technology Center (MTC) in December 2012 and April 2013. The workshops brought together representatives from multinational Swedish companies: AssaAbloy, Electrolux, Ericsson, Sandvik, Volvo, ICA Banken, PostNord, Kinnevik and KTH and generated valuable data regarding current barriers and drivers for investment in M2M.
- Expert workshops on business models for smart cities and houses were organized in November 2012 and May 2013 within the Stockholm Royal Seaport project. The participants represented Acreo, e-Centre, Ericsson, the city of Stockholm, Swedish ICT, SICS, Stockholm School of Economics (SSE) and KTH. At these workshops, useful results from projects on e-buildings were presented [14].
- Interviews on home care services in 2010 and 2013: with the mobile operator Telia and the solution provider Phoniro [15]. Additional interviews with the home care authority in the city of Malmö and the solution and service provider IntraPhone.

In addition, secondary data from building automation in Halmstad [14]and Volvo Connected Vehicle [16] has been used.

3. Key actors and stakeholders related to M2M

There is a traditionally fixed and clear relationship between different actors in each industrial sector, including product manufacturers, service providers and customers. The emergence of new technologies, which can either enable new types of services or transform their provisioning, could disrupt these relationships, create new actors or force existing ones into alter their roles.

Lessons can be learned from the mobile operator business, where the introduction of affordable mobile broadband combined with the availability of high performance mobile devices created a market for Over the Top (OTT) services and applications, creating a new set of actors that currently dominate the market, bypassing the traditional structure and control of the telecom operators. Some of these applications tapped into the traditional revenue streams of mobile operators, i.e., voice and messaging, and have been forcing changes in their business models in order to adapt to the unavoidable circumstances.

M2M communication has a similar "game changing" impact as mobile broadband, however this time the impact would be seen across a wider range of industries. A "smart" device or machine will need to be provided, at a high level, with at least three types of services: connectivity, remote provisioning and maintenance, and the application specific functionalities.

The main question is who will provide these services and what would be the relationship between the different actors. Next, those actors that constitute the "M2M ecosystem" are presented.

3.1. Device Manufacturers

In the context of M2M, device manufactures can cover a wide range of stakeholders. Taking the phrase from Ericsson's white paper [17] "Everything that can benefit from a connection will have one"; every device can become part of the M2M ecosystem, granted there is a feasible business case to motivate the required investment.

When analyzing M2M devices as a product, a difference needs to be made between manufacturers of communication modules and traditional product manufacturers which are looking to incorporate M2M functionality in their products.

For the former, the drivers are obvious: the possibility to expand their trading relationship to cover a completely new demand level. For the latter, there are two main drivers related to the investment in "smart" connected devices:

- It will enable information gathering about the product during its life cycle, e.g., performance, faults, usage patterns, thus improving design or streamlining maintenance and service;
- Consumers will benefit from better customer support, management of spares and consumables, but more importantly from new value added services. However, the main question is what would be enough of an added value that would justify the price difference between a "smart" device and a traditional one;

3.2. Telecommunication Operators

Telecommunication (Mobile) Operators are one of the main stakeholders that are looking to capitalize on M2M. With decreasing profit margins from traditional services, such as voice, SMS or mobile data and also with mobile penetration rates above 100% in developed markets, M2M represents an important growth opportunity. The challenge is that providing connectivity alone will not be sufficient to generate revenues, since typical M2M applications transmit small volumes of data. Some mobile operators aim to position themselves higher in the value chain by becoming also service providers [18]. This means that they need to develop new competences that will enable them to deliver complete, end-to-end solutions, from M2M modules or devices to connectivity and value added services.

Creating solid partnerships is therefore essential, and two directions are currently observed: cooperation between different mobile operators and cooperation between a mobile operator and other actors, e.g., module manufacturers, platform providers. In the first case, the main driver is the need to offer a global service that will go beyond conventional roaming agreements, together with interoperability between devices and seamless integration of services. The second case constitutes specific alliances to provide services and products with embedded communications; partnering across different sectors adds the required competence to address customers in specific vertical markets. This type of relationship is analog to the Amazon's Kindle case, where Amazon reached country-wide agreements with operators to provide connectivity to the devices and the end consumer don't need to pay for a separate monthly fee.

3.3. Service Platforms

A service platform is the enabler for horizontal integration of different M2M applications. From a layered architecture perspective, it is positioned between connectivity and applications. In short, it represents the Service Capabilities Layer that will be further described in Section 4.2. Service platforms are being recognized for their potential to generate new business and revenues. Notably, service platforms help reduce the deployment costs and time for applications. Also, they provide the necessary interoperability to support applications at a global scale, which is a mandatory requirement in some cases, e.g. logistics or connected vehicles.

Consequently, service platform providers are becoming a vital piece of the M2M landscape and, since their appearance, have gained relevance in the market. They provide the necessary linkage between developers and users, what makes then indispensable mainly because:

- Developers count on Service Platforms to reach the pool of costumer;
- Consumers count on Service Platforms to access different services.

The diver for this type of actor is to "connect" large-scale customer base with services and to further allow the interaction among developers. A good analogy can be made here with "Google Play" or Apple's "Apps Store" and examples of this type of approach applied to M2M are Deutsche Telekom's M2M Marketplace or AT&T's M2M Application Platform.

3.4. Service Providers

Probably the most important benefit of M2M is the vast range of new services that it can enable, since it is the service that will create true value for end-users or companies, rather than the product itself. On one hand there are new players trying to enter the market and on the other there are companies who are looking to enhance their services or products, through the added functionalities provided by M2M communications.

The second category can include conventional service providers, for example insurance companies (with new detailed services such as pay-per-drive), healthcare companies (e-Health), cargo or transportation (real-time tracking of assets), road administration (services related to traffic report, traffic management and maintenance), parking providers (real-time payment and free spot location). In addition, this category can be represented also by companies that traditionally are product oriented and are looking to re-think their role and complement their business through value added services.

However, the complexity of deploying an end-to-end M2M solution can turn out to be an entry barrier for some smaller service providers. Thus, the advantages provided by M2M Service Platforms, become even more evident for smaller actors and can facilitate investments.

3.5. Information Processing

The heart of M2M is to make relevant use of data but, considering the interconnection of billions of devices, raise the immediate challenge of how to handle all this information appropriately. “Big data” is a hot-topic and attracts more and more attention both for the opportunities in can provide and also for the concerns it raises.

Moving beyond the fact that it is ranked the number one tech buzz-word of 2013 (Global Language Monitor), undoubtedly “big data” will play an important role in the M2M world. While in some areas, e.g. connectivity and even service platforms, established players are already emerging, information processing is still relatively unexplored. This is partially due to that fact that analyzing very large amounts of data is a highly specialized process, that requires vast amounts of storage and processing power and partially because currently there is no structure for interpreting data generated from M2M applications. Furthermore, the full potential of “big data” in M2M can be exploited only when cross-application information sharing will be achievable.

Considering the particular nature of the process, it can be foreseen that information processing will most likely be done by specialist companies and provided as a service, rather than by each individual M2M solution provider. Even so, there is still a high entry barrier to become this type of actor and players with experience in big data analytics, such as IBM probably have a head start in the competition for this role [19].

Platform providers could be in a good position to take advantage of the value of data, since they represent an aggregation point for different services, however this will conditioned by the evolution of data semantics.

3.6. Physical Infrastructure Owners

In order to enable efficient integration of services, there is a separate set of actors that become extremely relevant to M2M; the "infrastructure", understood as the place where devices and networks will be installed and services will be provided. This type of actors should seek proper deployment and advocate for neutral network provisioning to avoid monopoly.

M2M infrastructures can span from private homes, to buildings and up to entire cities. While for private homes it could still be feasible to have fragmented networks, similar to LANs, moving up in scale, it can be seen that this becomes highly unpractical.

A fragmented approach in this case can be compared with the early years of mobile networks, when each operator would build its own individual sites, and sharing of towers or shelters was not even considered [15]. Surely, it was confirmed to be an inefficient solution and lessons from that experience can be applied to M2M infrastructure also.

The ideal solution would be a shared and neutral infrastructure, on which different services can be offered. However, realistically this will probably not be achieved at a large scale, since infrastructure is a valuable asset and can also translate in service differentiation.

Even so, owners of office or residential buildings, stadiums, shopping malls will be interested in deploying a neutral M2M infrastructure inside their facilities in order to prevent future monopolies and ties with one specific connectivity provider. Furthermore it can be foreseen that, in cities, sector specific infrastructure can emerge, e.g., for roads and transportation, utilities.

3.7. End-users

In the M2M ecosystem, two types of end-users can be distinguished: direct users, who buy and use smart devices and indirect users who buy the M2M service, possibly not even interacting with any device.

A further separation can be made in terms of consumer profile, i.e. private or business. Considering private users, one of the challenges is to correctly identify what is the added value that justifies the investment in a potentially more expensive product or service. Examples of products developed by Electrolux such as "Screen fridge", "Unattended Delivery Unit" [20], [21] or the iRobot's "Roomba" [22] show that an innovative product is not enough for mass adoption.

However, for businesses, the benefits are more clear and easier to quantify, translating into reduced operational costs, faster decision making, streamlined processes, among other. Therefore it is safe to say that the delivery channel in M2M will still be dominated by B2B relationships.

Nonetheless, there are some key sectors, such as e-healthcare or security services, where the added value is strong enough in order to attract private consumers and some solutions are starting to appear in the market, like the AT&T M2M service for home security in the US.

4. Regulatory framework surrounding M2M communications

4.1. Regulatory Landscape

Regulations and policies are ever-present in the world of electronic communications and are necessary to ensure fair competition, protect the end-users and sustain the development of technology. With the advent of M2M communications, which can be seen as a basis for building the Internet of Things (IoT), the question of regulating, or not regulating this area become inescapable.

On one hand it is argued that, at the moment, there is no need to create specific regulations, since the technology is not yet mature and inappropriate policies could hinder development and innovation and interfere with its natural evolution. Moreover, the IoT can be seen as an extension of the Internet and existing governance rules can be applied and will suffice. On the other hand, the concept of "everything connected" raises new challenges, in particular regarding data use and sharing, ethics or privacy and security that might not be addressed by existing legislation. Furthermore, the highly varied nature of M2M and IoT applications makes it difficult to develop a one-size-fits-all framework.

The regulation on M2M raise the following paradox: on one hand, the lack of proper regulation in the market is likely to end in a new set of oligopolies. On the other hand, heavy or improper regulation can reduce the incentive to innovate solutions and services related to M2M. Through public consultations, the European Commission's (EC) IoT Expert Group identified several areas in which specific policies could be developed: identification, privacy, data protection and security, architectures, ethics, standards and governance.

However, there is still no consensus regarding the extent and scope of these policies or how they should be applied. While the industry leans towards the use of existing regulations, without any explicit additions, civil society representatives argue that IoT specific regulations should be developed to protect the consumer's fundamental rights [23]. Based on the findings of the public consultation, another study by the EC made recommendations on potential policy options, which could advance the development of IoT, while being consistent with European regulation objectives [24]. In particular, three possible levels for a regulatory framework where analyzed:

- **No change** with respect to the current ICT regulation;
- **Soft Law** to provide guidance by using non-legislative measures;
- **Hard Law** to enforce regulation policies by explicit legislation;

The "No change" alternative implies that no specific intervention should be made by the EU regarding the IoT market. Such de-regulation will allow the market define the evolution of the sector, without setting boundaries that could restrain the potential of future application. With this approach, the development of the IoT sector will be guided mostly by large stakeholders (established industry players, incumbent operators, governments, SDO's). The associated hazards

are the market fragmentation that will slow the adoption process, barriers of entry for smaller actors, lack of interoperability, competing standards or unfair competition.

“Soft law” would involve, among other considerations, monitoring IoT development, supporting research and innovation in areas with high socio-economic impact, e.g., health care, smart grids, participation in standardization bodies and providing an active support to industry. This is regarded as the best alternative at the moment, since it could steer the sector according to EU policies without restricting the evolution of the sector.

However, some areas will require stricter regulation, beyond “soft law”, which lacks accountability or enforcement methods. Notably, with M2M applications, concerns regarding data privacy, security and third party sharing will be brought outside the virtual world and into everyday life through interaction with “smart” devices.

Also, certain application will be targeted towards the public sector. Thus, some aspects of M2M communications and IoT will be regulated using “Hard law”, by make changes or additions to existing legislation, while also creating the necessary mechanism to implement these changes. The extent of regulatory measures varies, depending on the industrial sector and consequently their influence on potential M2M investment decisions differs also.

A report commissioned by Vodafone [25] shows that regulations are considered as the main driver behind M2M adoption for industries which are subjected to stricter legislation. On the other hand, for other industrial sectors which are somewhat less regulated, cost savings or competitive advantages are regarded as the main driver.

Specific regulations are now present in sectors such as utilities and energies or automotive, which also currently have the highest adoption rates for M2M. In the utilities and energy case, two mandates were issued to European SDO’s (ETSI, CEN and CENELEC), one concerning smart metering [26] and the other concerning smart grids [27] with the goal of creating necessary standards to meet the European energy efficiency targets for the year 2020.

In the automotive sector, the European regulatory initiative eCall makes it mandatory for every new car to be able to automatically contact emergency services in case of serious accidents, starting from 2015 [28]. This has a direct impact on the growth of M2M in the automotive sector, since basic M2M capabilities will need to be integrated in all new vehicles. Hence, the requirement of delivering a public safety service can become a catalyst that sparks the development of other value added services, by leveraging new functionalities, e.g., communication capabilities, location data, sensors.

4.2. Global Standardization Efforts

The lack of technical standardization has been pointed out as one of the key barriers that inhibit investment in M2M. Having such a large number of players involved in the standardization process can lead to fragmentation and competing solutions. However, efforts are being made towards creating cohesive, global standards. An example is oneM2M [29], a partnership between

seven SDO's, which aims at defining technical specifications for a common Service Capabilities Layer, that can be exploited by various services and applications. At the moment, standardization work in M2M is mainly focused on three areas (Figure 2):

- Standardization for Wide Area Connectivity (e.g., 3GPP, WiMAX Forum). The main goal of these activities is to standardize the required enhancements for supporting M2M communications in existing cellular networks;
- Standardization for Service Capabilities, (e.g.,oneM2M, ETSI, TIA TR-50, ITU M2M Focus Group), where the scope is to provide standardized capabilities, that can be used by various M2M applications through API's, regardless of the underlying transport network;
- Standardization for Local Area Connectivity (e.g. ZigBee Alliance, IETF, IEEE), focusing on using LAN technologies for supporting M2M applications;

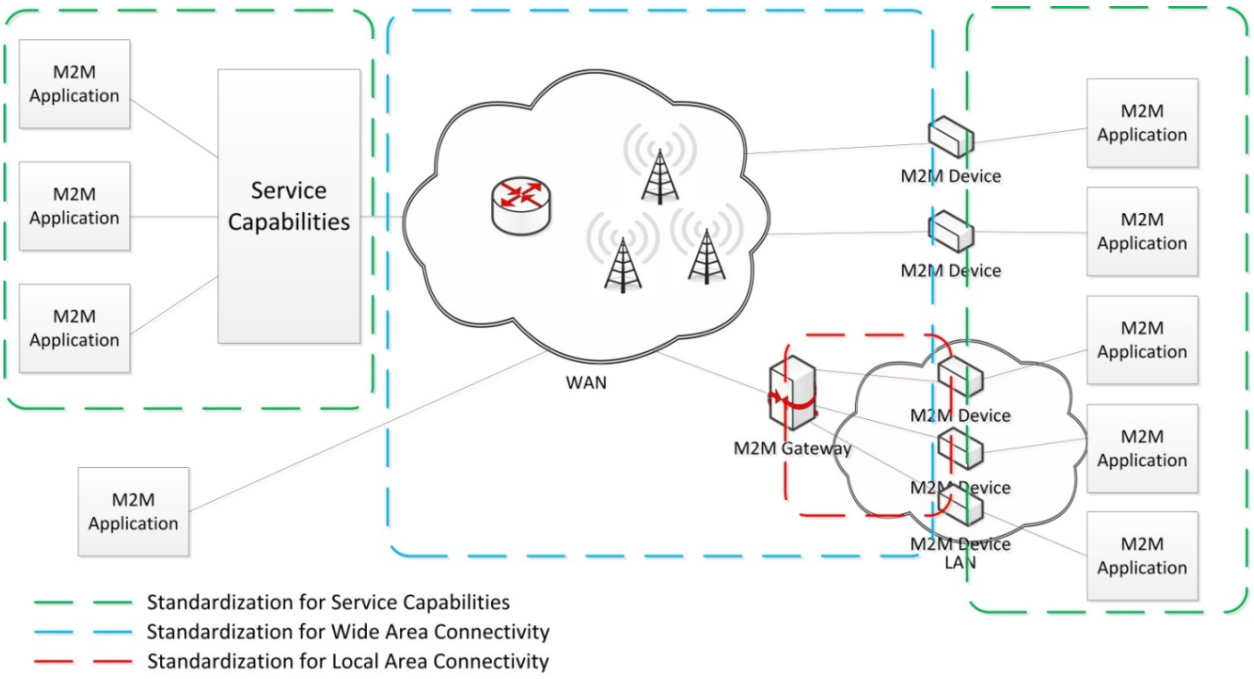

Figure 2. M2M Areas of standardization

Developing common Service Capabilities (SC) is one of the important steps towards providing M2M services beyond current vertical approaches. Essentially, a standardized SC layer will provide technical functionality, e.g., generic communication, authentication, addressing, remote management, that can be shared between applications through open interfaces. This would enable end-to-end service delivery regardless of the underlying IP network, simplify application development by providing API's and protocols and promote interoperability. In turn, this leads to lower investment costs and shorter delivery times.

Another benefit of a common SC layer is to facilitate data sharing. The data generated by M2M applications represents a valuable asset and can open new business opportunities, especially by making data available between different applications. However, at least two challenges can be identified at the moment. First, there is the requirement of discovering, filtering and interpreting

relevant information, while maintaining a generic character, i.e., creating a level of abstraction in which data cannot be linked to specific individuals or devices. To address this ongoing work is being carried out on defining semantic support for M2M data [30].

The second challenge lies within the regulatory domain; in particular defining what type of data can be shared or brokered by the owners of M2M applications. While for commercial services, e.g., consumer electronics, logistics, the owners of the M2M platform should retain full ownership of data, there are applications where this data becomes of public or national interest, e.g. smart metering, smart cities. In this case, a separation between commercial data and publicly available data should be made.

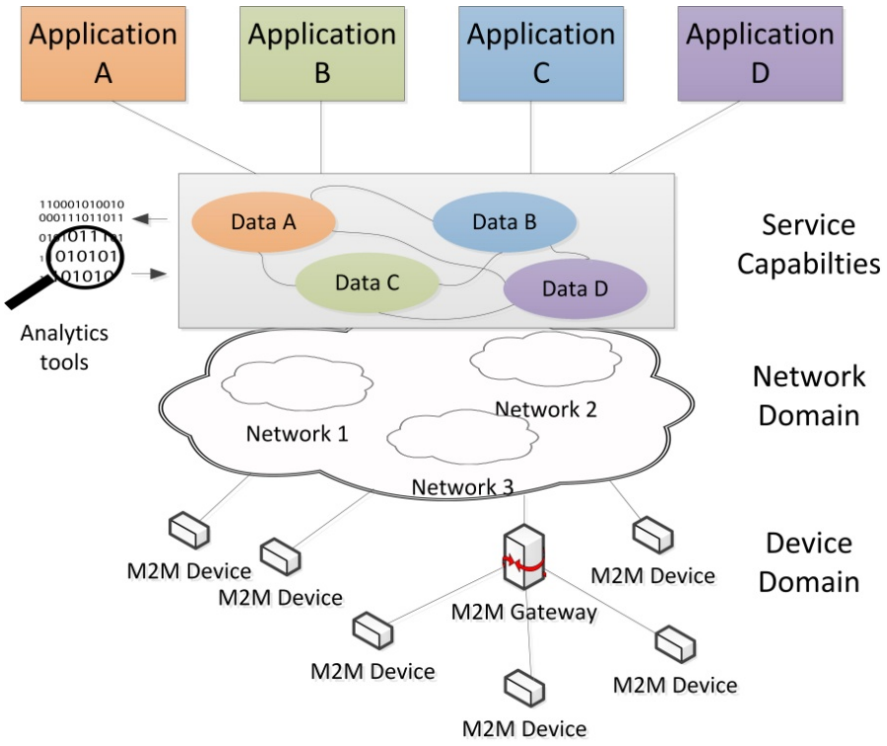

Figure 3. M2M Applications and ownership of data

In Figure 3 it can be seen that, with the right mechanisms in place, ownership of data–which is equivalent to controlling a Service Capabilities Server (SCS)–becomes a driver for investing in M2M. Looking at the 3GPP architecture enhancements for Machine Type Communications (MTC) [31], a SCS could be controlled either by a mobile operator or by a third-party service provider. This opens the opportunities to various stakeholders that are willing to invest in creating a solid M2M services platform and, therefore, it does not guarantee a secure position in the value network for mobile operators.

Nevertheless, mobile operators still have the advantage of ubiquitous wireless coverage and management of control plane signaling, the second offering extra functionality to M2M applications, e.g., device triggering (the ability to send information through a 3GPP network from a SCS to devices, and trigger them to perform application specific actions).

5. Description of Study Cases

5.1. Mobile Solution for Home Care Services

There are two main issues that home health care providers in Sweden must struggle with:

- Key management: each time an employee needs to make a round of visits, it can only take one customer's home key at the time (for security reasons), therefore, a considerable amount of time is devoted to collect the keys at a central office.
- Reporting the visit times and assuring to the relatives of the care taker that the service is being properly provided.

A solution developed by Phoniro[1] uses mobile phones as keys to open doors, by using Bluetooth communication between the phone and an electronic lock. This solution is in use in over 30 municipalities and towns in Sweden. The electronic module is added to the existing lock without damaging the existing door and without any cabling, since is battery-powered. The health care staff types a password on the phone to open the door; this automatically records in the identification of the person and it is also used for time reporting. In addition, a web portal service allows relatives to monitor who enters the home of the care taker [15].

For some years, the mobile operator TeliaSonera promoted the services, combining electronic keys in mobile phones and time reporting. However, all the services related to time registration and reporting were handed over to Avista after 2010; the motivations to do so included low sales, lack of suitable phones, complex product for the sales force and long sales cycles in the public sector. In February 2013, a new partnership was established between Phoniro and Tieto[2] to enhance the care services for elderly and home care; including planning tools to optimize working times, mobile documentation and registration. Additionally, Tieto is a key partner that works as a solution integrator in many of TeliaSonera´s M2M offers.

The authorization for the staff to access the locks of the customers, and the processing of time registration data are managed by the Phoniro Admin software. The mobile phone keys can be managed and issued by Phoniro, Tieto or directly by the home care authority. The actors and relations are shown in Figure 4.

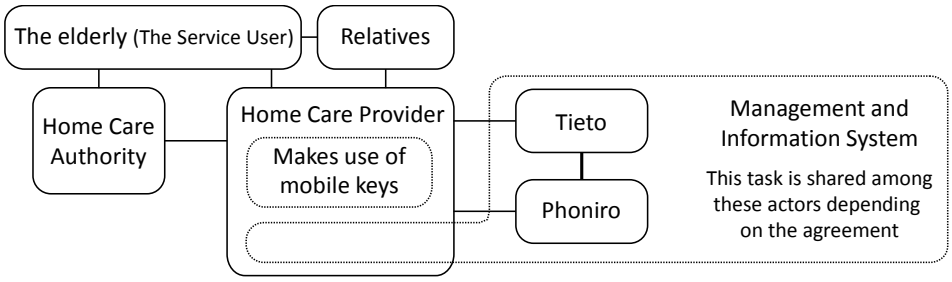

Figure 4. Actors and relations for home care service with time reporting and portal for relatives

[1]Phoniro Systems AB website: http://www.phoniro.com/en/

[2]Press release: http://www.tieto.com/news/tieto-and-phoniro-creates-mobile-solution-home-care-services

5.2. Connected Vehicle Cloud – The case Volvo and Ericsson

Ericsson's "Connected Vehicle Cloud", which received the M2M Evolution Product of the Year[3] award and also the CTIA Emergency Technology Award[4], enables car manufacturers to offer innovative value added services while at the same time provides a channel through which third party actors, e.g., content providers, app developers, road authorities, can reach the end-users (drivers). Traditionally a network infrastructure vendor (Ericsson) positioned itself as with a dominant position in the value network and took the role of a horizontal service platform provider. With the following values for the solution:

- For automobile manufacturers: deliver new value added services across all markets;
- For drivers (end users): gain access to a whole new range of applications and services, completely integrated in the car;
- For third-party actors: can directly reach end-users to offer various services and also could, in turn, use data generated by the car or the driver;

Currently, the platform is being offered in partnership with Volvo, in all markets where the automobile manufacturer is present. In the initial phase, connectivity shall be provided through the driver's smartphone, one of the reasons being that a separate data plan for the car would add more complexity. One example of a service delivered by a third-party actor is Spotify[5].

This re-thinking of roles, performed by Ericsson, brings up the challenge of how the company positions itself within the ecosystem and how it balances the product-oriented side, as an infrastructure vendor with the service-oriented side. This was highlighted also during the MTC Workshop and a concrete example which was given is the relationship with mobile operators. On one hand, they deliver equipment to them, thus supporting their business, on the other hand they can become a competitor on a services provisioning level, as shown in Figure 5.

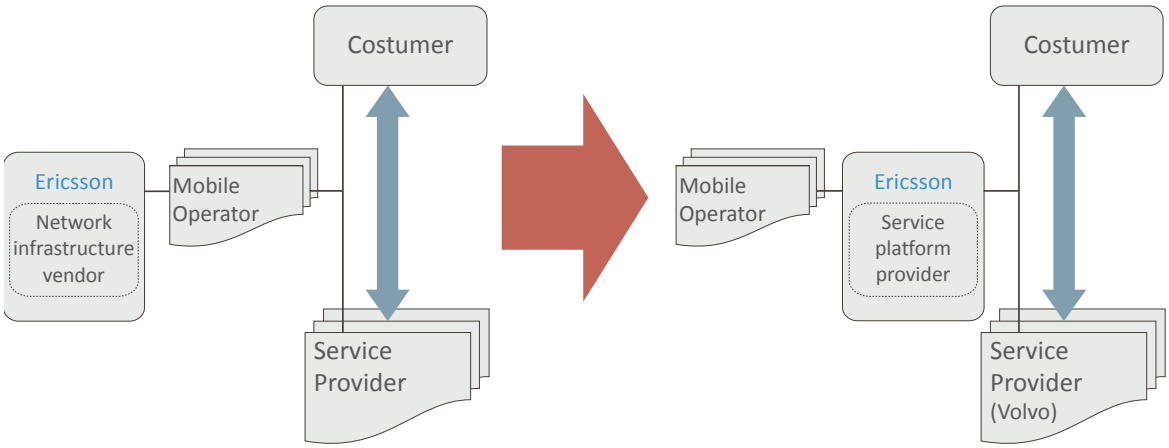

Figure 5. Change in traditional roles and relations for the actor involved in the connected vehicle case

[3]Ericsson News, August 2013, "Ericsson wins M2M Evolution Product of the year award"
[4]Ericsson News, June 2013, "Ericsson Connected Vehicle Cloud named CTIA E-Tech winner"
[5]Volvo Is Bringing Spotify to the Car: http://www.wired.com/autopia/2012/12/volvo-ericsson-spotify/

5.3. Smart Houses and Facility Management – The case Halmstad

Most of the current solutions for automation correspond to parallel services that are provided with separate and independent systems, infrastructures and services providers. The Swedish e-home project in Halmstad is attempting to resolved the challenge related to parallel ICT infrastructures within buildings [14], usually referred to as "stove pipe" solutions (every solution is implemented with absolute independence of the other).

A "stove pipe" approach is ideal it term of control of the consumer interface but it usually leads to elevated entry costs for new services and reduces the willingness to adopt services, since the installation procedures are expensive and the permanence contract with one service tend to be long and exclusives.

The independent solutions are shown on the left side of Figure 6, where several parallel applications are present, such as utility meters, elevator monitoring, fire and security alarms, triple play service, electronic locks and access control to commons areas. In this case, different services are provided with entirely vertical technical solutions to handle network deployment and operation, connectivity, billing and customer relationship.

The proposed solution for the project is a horizontal and open business model using a shared common infrastructure. Any service provider can offer services using the common communication infrastructure that is operated by a neutral actor, a communication operator, as shown on the right side in Figure 6.

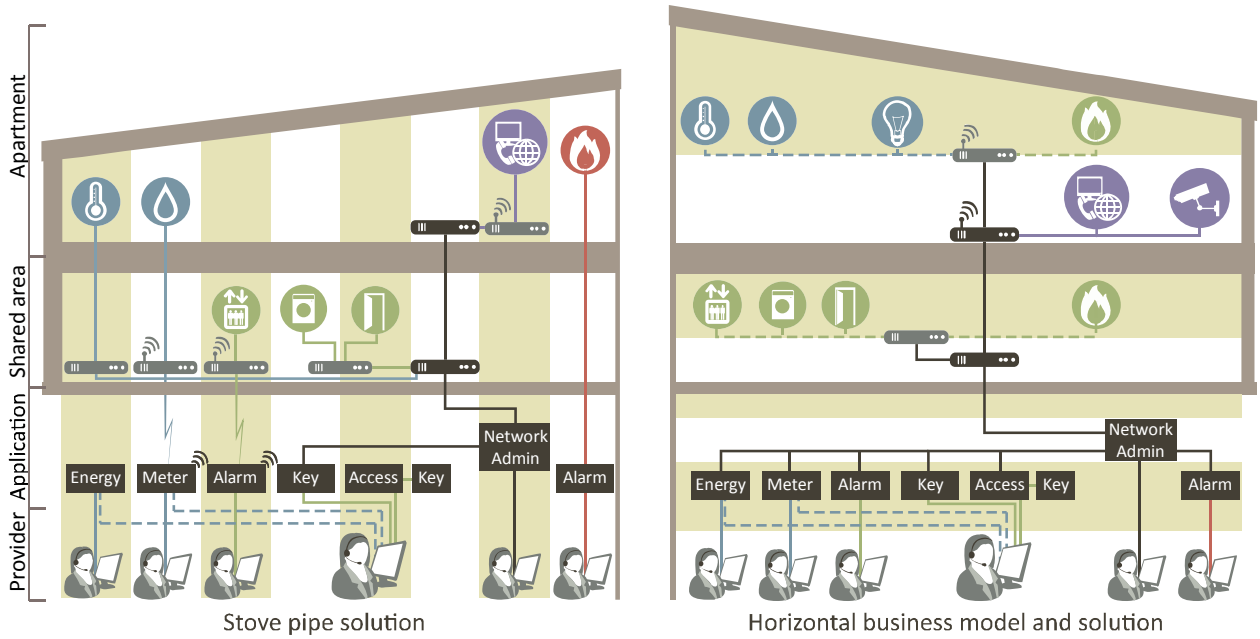

Figure 6. Solutions for facility management in smart houses and homes. Independent solutions (left) Horizontal business model with a common infrastructure (right).

6. Analysis of the Cases and the M2M ecosystem

With a clear view of the different actors (described in Section 3) that are usually involved in M2M solutions and the description of the cases presented in Section 5, it becomes clear the differentiated investment opportunities that arise in M2M communications.

6.1. Concerns regarding the manufacturing of connected products

It is understood that for these services to happen, devices are indispensables, but the cases highlight that selling M2M devices to end users is not the proper way to address this opportunity. During the MTC Workshop, it was discussed how product manufacturers have not been able to define a profitable structure to place connected–smart–products in the market and, even if companies like Electrolux are technically capable of doing so, it is claimed that there are no strong drivers to build intelligent things and market them as standalone products. Instead, the focus should be on the services than can be offered on top of these products, where devices are just a tool to allow the delivery. That is the main reason why smart products are scarce in the market for end consumers.

An additional concern is the roles that should be covered by those product manufacturers that decide to develop connected products, that is: why products manufacturers should provide services? There are different opinions; for instance, companies that have a very specific product understand their limitation to become a service provider. They can benefit from partnerships that provide the missing competence and take care of the service provisioning. An illustrative example is given by AssaAbloy, a company that provides door-opening solutions. In their point of view, when it comes to security solutions involving smart-locks, it is better to establish a relationship with security companies, since they have both the expertise and the manpower to offer this particular service to customers.

On the other hand, not all services have requirements that are completely outside the manufacturer's skill. Successful examples can be found on connected consumer electronics, where the main challenge corresponds to the creation of added value for customers so as they will buy the smart devices, given that the cost will be higher compared to the classical alternative. Provisioning the service itself does not pose particular challenges and probably the most difficult aspect is to provide global connectivity for the devices. Going back to the Amazon's Kindle 3G however, even if not an M2M product, it can be seen that there are feasible business models for providing connectivity directly out of the box, without any sort of subscriptions and data plans, of course, with certain limitations on the data plan.

6.2. Tensions in the positioning as service platforms or service enablers

Network infrastructure vendors and operators have made the attempt to provide services in order to seek for revenues streams beyond their traditional one, e.g., selling equipment, selling communication services or communication provisioning. The transition to a service provider is

mainly driven by the need to seek alternative sources of revenue, due to declining equipment costs, increasing competition, declining revenues from data and the threat of OTT players.

Although, the high level goal of both players is the same, in the M2M case, the challenges are quite different. In particular for network infrastructure vendors, the problem of balancing the product oriented side with the service oriented side of the business is of interest. In a traditional market structure, they sell equipment and sometimes services, e.g. Operation Support Systems (OSS) and Business Support Systems (BSS) to mobile operators. However, when it comes to providing M2M services, there is an emerging tension between these two actors since both of them could attempt to position themselves as service enablers and that leads to competition in one area, and collaboration in another.

An additional issue for network vendors is the lack of delivery channels, which is not the case for mobile operators. Considering that the value of the enabler lies in the application, partnerships become mandatory for them in the last step of the delivery process, i.e., reaching customers. The options are, bearing in mind also the discussion above, also:

- To partner up with mobile operators, respecting the traditional value chain and let operators deal with applications;
- To partner up with service and applications providers, therefore bypassing operators;

6.3. Relationship and dominance between actors

Dominant actor is the one attempting to deliver an innovative service. In the Hamlstad case, there is no precise service to be delivered, so there is no clear definition of dominant actor besides the Swedish Association of Public Housing Companies (SABO); the organization of the municipality owned public housing companies in Sweden that is leading the project.

For the Connected Vehicle solution in general, Ericsson can be seen as the dominant actor. However, for specific implementations of the service, e.g., the Volvo partnership, it is the car manufacturer that moves into a dominant position, also because it has the necessary delivery channels to reach the target customer.

From these and previous studies [32], [33], we can appreciate that services that are successfully implemented are not dependent on network operators or internet service providers, beyond the connectivity provisioning, and their role becomes more of a supporting actor to enable the service delivery.

6.4. Regulation implications

Due to the variety of industrial sectors in which M2M services can be developed, solutions might have to comply with different regulations pertaining to specific sectors. Limiting the discussion to the presented cases, there are no significant regulatory barriers or incentives for investment.

The facility management example raises the question of communication infrastructure sharing, which is permitted on all levels in Sweden, but is not the case in all countries. In the mobile

solution to open doors, the current ICT regulation fully allows the service delivery. Possible issues might arise on the topic of privacy and security. However, currently they are covered by existing legislation, since in this case there is no particular difference from a traditional service. However, with the evolution of the M2M application ecosystem, new legislation might be required. An analogy can be made with the growth of Internet or smartphone applications. Initially, there were not so many privacy concerns in this area, but the advent of new services, (e.g., social networking or location based services) brought a different set of challenges.

In other industries, the most limiting regulation is not necessarily the ICT regulation, instead, the regulation that comes from other industries makes cumbersome and sometimes unviable to provide certain types of solutions. For instance, the strict regulations related to the utility sector slow down projects related to building automation, especially when it comes to a public or shared telecommunications infrastructure, given the fact that each industry must comply with its own set of requirements.

6.5. Investment opportunities

The question "*who is investing in M2Mcommunications?*" can be rephrased in another way: *how to invest in M2M communications?* There are many tasks to cover in order to provide a service and, as seen in some of the cases, there are also different setups to reach the same objective. Even if activities can be distributed, big players have the intention to cover as many and profitable roles as possible, since dividing the tasks in many actors also divide the revenues and diminish the potential gains; which has a negative effect in the willingness to invest.

Looking at the connected vehicle case and the main activities related to it (shown in Figure 7), the car manufacturer, Volvo, had two major options: to develop and provide an end-to-end solution themselves (options 1 and 3 in Figure 7) or to rely on partnerships and adhere to a M2M platform, in this example Ericsson's Service Enablement Platform[6].

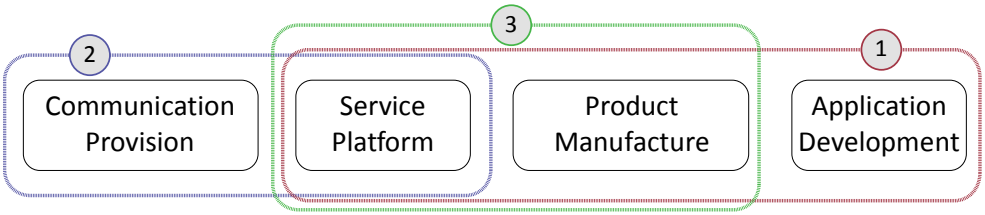

Figure 7. Distribution of activities in the Volvo connected vehicle case.

In more traditional services offered by car manufacturers, such as worldwide road-side assistance, the first alternative can certainly provide differentiation in the market. However, in M2M, a proprietary solution has more disadvantages than benefits, especially when considering services offered directly to end-users (B2C). The key-words here are "*interoperability*" and "*diversity*". That is, as a consumer it would be more desirable to have access to a wide-range of services and as a developer or third-party provider, it would be beneficial for the applications to

[6]Ericsson website: http://www.ericsson.com/ourportfolio/products/service-enablement-platform

be “hardware” independent. Going back to Volvo’s connected vehicle, using a platform that can be also used by other car manufacturers, means that they become part of a larger ecosystem.

Connectivity, in particular roaming, is one of the major challenges for connected products. As stated above, in the first phase, the driver’s smartphone provides the data connection. However, this is still an OTT solution, with no direct involvement of mobile operators. But there is also the possibility that Ericsson takes care of the communication provision, by reaching international agreements with mobile operators (option 2 in Figure 7). Of course, for infotainment or navigation services relying on the QoS provided by public mobile networks is acceptable, but considering road safety applications, such as response in case of accidents, QoS guarantees are required. This has to be considered when asking “*who*”, meaning that mobile operators have to be included in the value network, either by partnering with the platform or service provider.

7. Conclusion

The potential of M2M communications to enable innovative products and services is recognized across different industry sectors, even though the adoption rates vary. Beyond technical challenges, the successful implementation of these services requires a new business approach, where stakeholders, e.g., module suppliers, device manufacturers, connectivity providers and application providers, would need to be integrated in the traditional value chain.

Adapting to new business models might be easier for new comers compared to larger, established companies. Therefore “re-thinking” of the roles becomes an important step towards a more efficient positioning in the M2M ecosystem. The transition from a product provider to a product and service provider could be one solution to secure a place on the M2M market. However, making this step requires additional competence and resources. This is why partnerships between companies can be a solution for adding the missing competence. Furthermore, through partnerships, services could be supported at a larger, global scale.

Combining the appropriate service together with the product is a key requirement to justify additional investments by providing a strong added value. Especially at a consumer level, the incentive to transition to a new type of product has to be strong and it is somewhat dependent on individual behavior. Hence, SMEs could be a better initial market to introduce new services.

While existing M2M services are deployed for specific applications, there are independent to a large extent. Integration of different services could help create a larger eco-system and expand this market. This is where standards and possible open platforms can contribute.

Acknowledgment

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[7] More information available in the website: http://www.wireless.kth.se/m2m/

References

[1] Geng Wu, S. Talwar, K. Johnsson, N. Himayat, and K.D. Johnson, "M2M: From mobile to embedded internet," *Communications Magazine, IEEE*, vol. 49, no. 4, pp. 36-43, April 2011.

[2] Kijl B, Nieuwenhuis LJ, Huis in't Veld RM, Hermens HJ, and Vollenbroek-Hutten MM, "Deployment of e-health services - a business model engineering strategy," *J Telemed Telecare*, vol. 16, no. 6, pp. 344-53, 2010.

[3] Cisco, "Cisco Visual Networking Index: Global Mobile Data ," in *white paper*, Feb 2013.

[4] 3rd Generation Partnership Project (3GPP), "Study on Facilitating Machine to Machine Communication in 3GPP Systems," Mar. 2007.

[5] Sulabh Sharma and Jairo Alberto Gutiérrez, "An evaluation framework for viable business models for m-commerce in the information technology sector," *Electronic Markets*, vol. 20, no. 1, pp. 33-52, 2010.

[6] OECD, Machine-to-Machine Communications:, 2012.

[7] IERC - Internet of Things European Research Cluster, *3rd edition of the Cluster Book*, Ian G Smith, Ed. Halifax, UK: Platinum, 2012.

[8] Seppo Leminen, Mika Westerlund, Mervi Rajahonka, and Riikka Siuruainen, "Towards IOT Ecosystems and Business Models," in *Internet of Things, Smart Spaces, and Next Generation Networking. Lecture Notes in Computer Science*, Sergey and Balandin, Sergey and Koucheryavy, Yevgeni Andreev, Ed.: Springer-Verlag, 2012, vol. 7469, pp. 15-26.

[9] Håkansson H and Snehota I, *Developing Relationships in Business Networks*. London: Routledge, 1995.

[10] David Ford, Lars-Erik Gadde, Håkan Håkansson, and Ivan Snehota, *The Business Marketing Course: Managing in Complex Networks, 2nd Edition*. Chicheste: J. Wiley, 2007, 2007.

[11] Omar A. El Sawy and Francis Pereira, "VISOR: A Unified Framework for Business Modeling in the Evolving Digital Space," in *Business Modelling in the Dynamic Digital Space.*: Springer Berlin Heidelberg, 2013, pp. 21-35.

[12] Richard Normann and Rafael Ramírez, "From Value Chain to Value Constellation: Designing Interactive Strategy," *Harvard Business Review*, vol. 71, no. 4, 1993.

[13] Peppard Joe and Anna Rylander, "From Value Chain to Value Network: Insights for Mobile Operators," *European Management Journal*, vol. 24, no. 2-3, pp. 128-141, 2006.

[14] Patrik Forsström. (2013, February) BoIT 2.0. Lokala projekt 2012 , (in Swedish), presentation for SABO. [Online].
http:// www.sabo.se/aktuellt/Documents/BoIT2%25200%2520_20feb2013.pptx

[15] Jan Markendahl, Mobile Network Operators and Cooperation : A Tele-Economic Study of Infrastructure sharing and Mobile Payment Services, 2011.

[16] Ericsson. (2013, September) Ericsson Connected Vehicle Cloud. [Online]. http://archive.ericsson.net/service/internet/picov/get?DocNo=28701-EN/LZT1381044

[17] Ericsson, "More Than 50 Billion Connected Devices," White Paper 2011. [Online]. http://www.ericsson.com/res/docs/whitepapers/wp-50-billions.pdf

[18] Machina Reserach, Mobile Operator Strategies for Success in M2M: The Role of Cloud Platforms,

Semptember 2012.

[19] Arvind Sathi, *Big Data Analytics: Disruptive Technologies for Changing the Game*.: IBM Corporation. MC Press Online, LLC, 2012.

[20] Electrolux News. (1999, March) A refrigerator that “thinks” – intelligent refrigerator will simplify homes. [Online]. http://group.electrolux.com/en/a-refrigerator-that-thinks-intelligent-refrigerator-will-simplify-homes-4349/

[21] Electrolux News. (2001, March) Electrolux solves delivery problem for Internet shopping. [Online]. http://group.electrolux.com/en/electrolux-solves-delivery-problem-for-internet-shopping-4327/

[22] iRobot. iRobot Roomba Vacum Cleaning robot. [Online]. http://www.irobot.com/global/sv/roomba_range.aspx

[23] European Commission, "Report on the Public Consultation on IoT Gouvernance," Directorate-General for Communications Networks, Content and Technology, 2013.

[24] European Commission, "Europe’s policy options for a dynamic and thrustworthy development of the Internet of Things," European Commission, Directorate-General of Communications Networks, Content & Technology, 2013.

[25] Vodafone, by Circle Reserach , "The M2M Adoption barometer 2013," 2013.

[26] European Commission, "Standardisation mandate to CEN, CENELEC and ETSI in the field of measuring instruments for the development of an open architecture for utility meters involving communication protocols enabling interoperability," Enterprise and Industry Directorate-General, M/441 EN, 2009.

[27] European Commission, "Smart Grid Mandate - Standardization mandate to European Standardisation Organisations (ESO) to support European Smart Grid development," Directorate-General for Energy, M/490 EN, 2011.

[28] European Commission Press Release - IP/13/534. (2013, June) eCall: automated emergency call for road accidents mandatory in cars from 2015. Online.

[29] oneM2M. (2012, July) New Global Organization will Create Technical Specifications to Ensure that Machine-to-Machine Communications can Effectively Operate on a Worldwide Scale.

[30] ETSI, TR 101.584 v0.5.0, "Machine to Machine Communications (M2M); Study on Semantic Support for M2M Data," 2012.

[31] ETSI TS 123 682v 11.4.0, "Architecture enhancements to facilitate communications with packet data networks and applications ," Release 11, 2013.

[32] Andrés Laya, Jan Markendah, and Per Andersson, "Business Challenges for Services Based on New Technology – Analysis of IoT Service and Mobile Payment Cases," in *The 15th International Conference on Electronic Commerce*, Turku, Finland, 2013.

[33] Jan Markendahl and Andrés Laya, "Business Challenges for Internet of Things: Findings from E-Home Care, Smart Access Control, Smart Cities and Homes," in *29th annual IMP Conference*, Atlanta, USA, 2013.