Smart Energy: Competitive landscape and collaborative business models.

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***Abstract*—During the recent years several technologies and services based in Internet of Things (IoT) and Machine-to-Machine communications (M2M) have appeared in many different sectors, like healthcare, transport, logistics, media or utilities.**

When new technologies (like Smart Grid or Smart Energy) appear two types of challenges can be defined: technical and business challenges, therefore innovation has to be applied in both of them. Too often innovation is focus on the technologic evolution and underestimated on the business field, however it is a key aspect for new technologies and services to reach commercial success.

Traditional business models in the energy sector will suffer big changes in the next years, as the Smart Grid concept is developed.By the advent of new services and applications, horizontal and vertical partnerships with competitors and other actors will take place. In this context collaboration between actors, partnerships and agreements will be of key importance.

This paper investigates the different actors involved in a Smart Energy ecosystem, its possible activities and suitable business models for the different Smart Grid building blocks or milestones.

I. INTRODUCTION

During the recent years several technologies and services based in Internet of Things (IoT) and Machine-to-Machine communications (M2M) have appeared in many different sectors; where IoT can be defined as the idea that any device that can be benefited by being connected will be connected and M2M communications is defined as the kind of communication between devices with minimal human interaction. According to the Ericsson report Ericsson vision everything that can benefit from a connection will be connected and there will be over 50 Billion M2M connections by 2020. [1]

IoT and M2M solutions can be applied in many sectors, like healthcare, transport, logistics, media or utilities. In every sector the motivations to implement this new services is different, as each sector has different final objectives and different actors and business models. When talking about utilities in this context, over the last years Smart Grids has been discussed and developed. Smart Grid is the concept of having connection over the complete electric Grid in order to be able to monitor, manage and control its state. Electric Grid is all the service connections, transformers, transmission infrastructure, substations, generation plants, and everything required to manage the generation and distribution of electrical power. [2] The Smart Grid can be defined as an electric system that uses information, two-way, cyber-secure communication technologies, and computational intelligence in an integrated fashion across the entire spectrum of the energy system from the generation to the end points of consumption of the electricity. [3]

When new technologies (like Smart Grid) appear two types of challenges can be defined: technical and business challenges, therefore innovation has to be applied in both of them. Too often innovation is focus on the technologic evolution and underestimated on the business field, however it is a key aspect for new technologies and services to reach commercial success.

From the technological point of view the state of research on Smart Grid applications and services is quite advanced, while authors consider that innovation in the business part is one of the biggest challenges for Smart Grid technologies to reach success. The goal of this paper is to propose business models suitable for the Smart Grid ecosystem.

The paper is outlined as follows: related work is discussed in section II while section III discusses the methodology of the paper. In section IV, main actors in the Smart Energy ecosystem are introduced where it continues by section V that discusses business models for Smart Grid building blocks. Section VI shows conclusions on the paper.

II. RELATED WORK AND CONTRIBUTION

Business challenges of IoT and M2M technologies have been addressed, analyzing them in the context of E-Home Care, Smart Access Control, Smart Cities and Homes. Using case studies from real projects like the Stockholm Royal Seaport, where the need of innovation on the business side is stated as a major need for the success of these technologies. [4]

Regarding innovation on Smart Grid services, some research has been done about the integration of web-services in Smart Homes, where Smart Grid is a key enabler. These

services are closely related to Smart Grid as the home will no longer be an extension of a utility or energy service provider, but serve as an autonomous building block in a smart grid and determine autonomously how and to whom it will accept from and deliver energy services on the smart grid. The implantation of these services support implicitly the research gap of business models for Smart Grid. [5]

The new value-model of the utilities industry has been stated and described. In the traditional electricity value chain, energy and information flow in one direction, and all but the largest of customers play a passive role. The introduction of smart grid technologies will add complexity to the network, moving power and information in multiple directions and enabling a host of new participants and business models. Distributed energy resources such as customer-owned renewable generation, plug-in electric vehicles, and energy storage will extend the value chain to include assets operated closer to the end user. End users themselves, who will be capable of providing a combination of demand response, power, or energy storage to the system, will also be an integral part of the new value chain. Once these changes in the value-model are identified the need of new business models that suit the new situation appears naturally. The value-model using Smart Grid is characterized by: enabling continuous and reciprocal relationship between customers and utilities, inclusion of adding-value services using ICT technologies and new opportunities for third-party service providers. [6]

In this context of change some research has been done studying the behavior of customer in this context and how companies should adapt to the new needs and the business opportunities that come with them. Studies have shown customers willing to participate in the new value-model. The fact that other industries like media or entertainment had followed the same path before utilities supports the idea that major changes will happen in the sector in the next years. [7]

Supporting this hypotheses some studies analyze the reasons why utilities should embrace a customer-centric business model concluding that utility companies need to start adapting and changing its strategies in order to adapt to the new situation in order to achieve customer engagement and maintain its business revenues. [8]

Regarding the involvement of IT companies in this research for new business models, KT the largest Korean telecom describe its research on energy management technologies and home energy management and also provides useful information about the KT Smart Grid business models. Different business models are introduced considering different partners and possible added-value services. [9]

After our literature review we can conclude that the biggest challenge when discussing the roll-out of Smart Grids is what will be new business model for the industry, as it seems clear that new actors will enter and create a new situation. A robust business model is needed in order to enable the development and deployment of Smart Grids technologies and services. In this new situation utility companies should be able to adapt faster and establish new alliances and collaborations with new actors that do not used to be involved in the sector. This means that a new business opportunity appears for companies that can play an important role in the new situation.

III. METHODOLOGY

The primary data for enabling the analysis was collected via a semi-structured data collection method that is individual interviews about business models and partnerships for Smart Energy solutions. These interviews were made with with telecom manufacturers (Ericsson) and Mobile Network Operators (Tele2). The secondary data was obtained from direct collaboration with Ericsson in the context of master thesis work, obtaining insights from different teams involved in M2M and Smart Energy market services and applications.

Academic contributions where supporting the hypotheses of need of new business models specificly for Smart Energy solutions and the need of collaboration and alliances between different actors in order to be able to provide competitive and succesful services.

Smart Grid is quite extensive topic and therefore it is very difficult to approach the business modelling task from only one perspective. Many different activities and tasks are included and because of that the author has chosen to divide the business modelling in the four Smart Grid building blocks: Consumer Enablement, Advanced Distributed Operations, Advanced Transmission Operations and Advanced Asset Management. [10] This way we can narrow down the problem and be more precise in the description of business models. The second factor to be considered is that collaboration is a key factor in the Smart Grid ecosystem [6] [7] and in order to consider that we will identify the main players/actors involved and then propose business models with collaboration between them.

Considering collaboration as a key factor, portfolio from different Smart Grid players, activities from Smart Grid building blocks and Business Model Canvas tool we will propose Collaborative Business models for Smart Energy.

IV. Smart Energy competitive landscape

In this section we will introduce the main players in the Smart Energy ecosystem. This classification is based on interviews with companies involved in the sector i.e. Ericsson and Tele2 and in a portfolio review of the different companies.

A. Utilities provider

Utilities provider is commonly defined as any organization providing services to the general public within the following sectors: electricity, gas, telephone or water. As these sectors are considered of public interest, utility sector

is usually public controled or highly regulated from the governments or public institutions.

In this paper we are considering Smart Energy services and therefore we will refer as utilities provider as the companies providing electricity to the householders. Within this definition differents setups can be possible, where companies can control one or more parts of the electricity business i.e. generation, transmission and distribution.

B. Telecom equipment manufacturer

Telecom equipment manufacturer (TEM) refers to manufacturers of equipment and devices used in the telecommunications industry. [11]

TEM customer base includes organizations, phone/data/cable providers and TV/radio broadcasters. Telecommunications equipment and devices include phones, modems, routers, gateways, answering machines, phone switching systems and data bridges.

In order to understand the size of the business it is important to point out that 50 of the largest Telecom Equipment Manufacturers organizations generate about 75 percent of total industry revenue with two-thirds from wireless communications equipment (TV/radio) and one-third from line-based communication.

Companies like Huawei, Alcatel-Lucent or Cisco are included in this classification.

When talking about the services that can be offfered by Telecom Equipment Manufacturers we can divide them in different types [11] [12] [13] :

- Design & build communications network.
- Grid security solutions.
- Network and data management.
- Field area networks, supporting advanced metering infrastructure or substation automation.

C. Global IT service players

The definition of Global IT Service Players considers multinational management consulting companies that offer technology consulting services and outsourcing. Companies like Accenture, Siemens, IBM, Capgemini or Atos are included in this definition.

Usually this type of company offers full IT services offering related to Smart Metering services. The most important strengths are their recognition as stablished players in Utility sector and their brand and customer relationship that are already stablished.

When talking about the services that can be offered by Global IT Service Players we can divide them in different types [14] [15] [16] [17] [18]:

- Transmission and Distribution asset management. Includes asset investment planning and management, performance management, mainteinance strategies or modeling and information performance.
- Smart Metering services. Includes Smart Meter data management, demand response, efficiency and commercial optimization, Smart Meter data management and revenue assurance.
- Grid Operations. Includes several activities regarding optimize grid operations, improve reliability, increase customer satisfaction and enhance process and workforce efficiency.

D. Mobile Network Operator

A mobile network operator or MNO, also known as a wireless service provider, wireless carrier, cellular company, or mobile network carrier, is defined as a provider of wireless communications services that owns or controls all the elements necessary to sell and deliver services to an end user including radio spectrum allocation, wireless network infrastructure, back haul infrastructure, billing, customer care, provisioning computer systems and marketing and repair organizations. [19]

A key aspect to be a MNO is that a company should own or control radio spectrum licensed assigned by a regulatory or governmental institution.

Companies like T-Mobile, Telia Sonera, America Movil, Telefonica, Tele2, Vodafone or Orange are included in this group.

When talking about the Smart Grid services that MNOs provide, one need to be aware that the main asset they own is a complete communications network infraestructure. Therefore offering services linked directly to its network and its usage is the logic step for an MNO.

MNO service offering can be divided in two types: Smart Grid communications and Smart Metering communications. Smart Grid communications MNO offering commonly provides complete end-to-end communications by using GPRS or LTE existing networks. Regarding Smart Metering the most common offering is providing AMI (Advanced Meter Infrastructure) that are basically systems that measure, collect, and analyze electricity usage, and communicate with metering devices, either on request or on a schedule.

E. Niche point solution players

Niche point solution player is defined as any company providing a specific Smart Grid services. For instance, a company providing specic home service or a company providing specic service/application for smart metering are included in this definition. It is reasonable to think that in a new ecosystem, innovation and new actors entering will play an important role and this idea connects with the Niche Point Solution player concept.

V. Business modelling

In this section we will introduce the business models, using as base the Smart Grid milestones defined by U.S Department of Energy as "the building blocks of the Smart Grid". The complete implementation of these milestones will result on a fully functional Smart Grid. In order to achieve these milestones, deployment and integration of various technologies and applicattions is needed. [10]

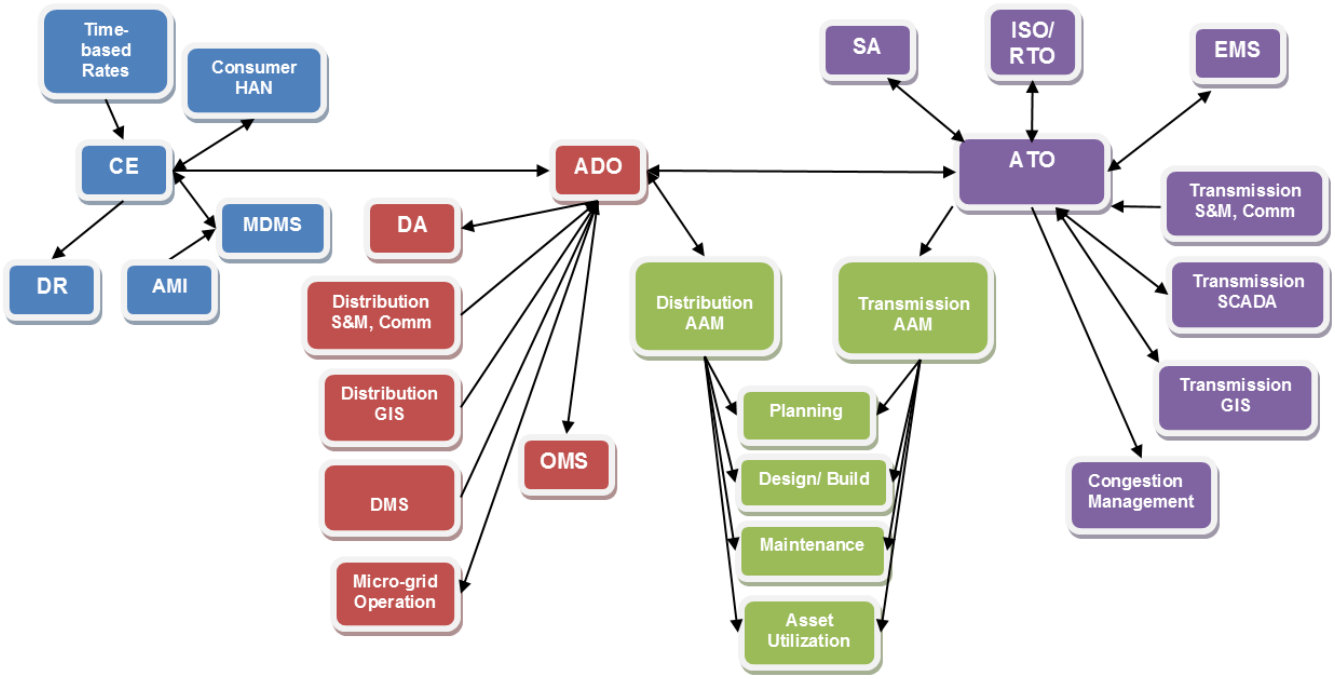

Fig. 1. Smart Grid building blocks [6]

In figure 1 we can see the activities included in each of the four building blocks and the links interconnecting them.

A. Consumer Enablement

Smart Grid will put the customer in the central position of electricity supply services. This empowerment will allow the customers to have new services and information like: advanced metering infrastructure, distributed energy resources, demand response price program and in-home displays and consume control systems.

B. Advanced Distributed Operations

Implement operations with the aim of support two-way power flow and micro-grid operation. This can be done by using sensors or control devices, advanced outage management, distribution and automation systems with the final goal of improve reliability and enable self-healing.

C. Advanced Transmission Operations

Implement transmission systems with the aim of provide a better understanding of present and future operating risks. Advanced transmission operations include Consumer Enablement and Advanced Distributed Operations. Substation automation, integrated wide area measurement applications, power electronics, advanced system monitoring and protection schemes are examples of activities that should be included in this operations.

D. Advanced Asset Management

Asset management allows the utilities to reduce operations, mainteinance and capital costs by optimizing the usage of its assets in a day-to-day basis. This can be done by using all the information obtained by the implementation of the different Smart Grid technologies and applications. Once the systems are deployed the asset usage can be analyzed in a continuous improvement basis, helping in the development and growth of a more efficient power grid.

E. Business models

The tool used to dene the business models is the Business Model Canvas by Alexander Osterwalder. [20][[21] The Business Model Canvas is a strategic management and startup template for developing new or documenting existing business models.

Business Model Canvas is a visual tool that considers different elements in order to describe with accuracy and simplicity business models.

The elements considered in the Business Model Canvas Tool are: Key partners, key activities, key resources, value propositions, customer relationships, channels, customer segments, cost structure and revenue streams.

After having proposed four different business models for the four Smart Grid building blocks in this subsection we will summarize the main differences and similarities between them. In order to compare we will review the nine different aspects considered in the business model canvas.

TABLE I
BUSINESS MODELS BASED ON SMART GRID BUILDING BLOCKS

	Consumer enablement BM	Advanced transmission operations BM	Advanced distributed operations BM	Advanced asset management BM
Key partners	• MNO • TEM	• MNO • Global IT Solutions player • Niche Point Solution player	• MNO • Global IT Solutions player • Niche Point Solution player	• MNO • Global IT Solutions player • Niche Point Solution player
Key activities	• Communication devices management • Communications management • Meter devices management • Reading management	• Services and applications Monitor and Control wide areas • Managing and gathering data • Assess and select technology substation automation internal network • Installation of smart control devices	• Design Communications network • Data gathering and management • Assess and select technology substation automation internal network • Installation of smart control devices	• Communication network operation • Field operation and maintenance • Consulting and engineering • Technical assistance for optimization
Key resources	• Human • Technical	• Human • Technical	• Human • Technical	• Human • Technical
Value proposition	• Saving in manual reading • Reducing fraud • Real-Time monitoring • Enabling dynamic pricing • Enabling improvement in balance load and avoid blackouts • Detailed billing	• Better understanding of present and future risks in the power grid • Enabling advanced system monitoring and advanced protection schemes	• Improve grid reliability • Enable self-healing • Enabling distribution automation • Enabling micro-grid • Availability of data from grid analysis • Improve grid performance	• Reduce operations maintenance and capital costs by optimizing usage of the assets in a day-to-day basis
Customer relationships	• Automated services • Dedicated personal assistance	• Automated services • Dedicated personal assistance • Co-creation	• Automated services • Dedicated personal assistance	• Automated services • Dedicated personal assistance • Co-creation
Channels	Direct relation with utility companies	Direct relation with utility companies	Direct relation with utility companies	Direct relation with utility companies
Customer segments	• B2B2C. Business to business to consumer • Utility companies • End-user / Householders	• B2B. Business to business • Utility companies	• B2B. Business to business • Utility companies	• B2B. Business to business • Utility companies
Cost structure	• Economy of scale • Fixed costs • Maintenance • Value driven	• Economy of scale • Fixed costs • Maintenance • Value driven	• Economy of scale • Fixed costs • Maintenance • Value driven	• Economy of scale • Fixed costs • Maintenance • Value driven
Revenue streams	• Product feature dependent • Volume dependent • Negotiation • Service based	• Product feature dependent • Volume dependent • Negotiation • Service based	• Product feature dependent • Volume dependent • Negotiation • Service based	• Product feature dependent • Volume dependent • Negotiation • Service based

- Key partners. The key partners considered in this business models are three: Mobile Network Operator, Niche Point Solution player and Global IT Solutions players. MNO is considered as a partner in the four business models as it is a key partner in order to provide connectivity services. The fact that MNO owns a network makes them a key partner to join forces with. Regarding Niche Point Solution player

partnerships it is an important potential partner as they are specialized in specic activities and that means competitiveness is enhanced. In addition to that as Smart Grid is fairly new sector it is a good opportunity for new actors to enter and play a specic role in the ecosystem. Regarding Global IT Solutions player partnerships it is important to consider their experience, knowledge and relationships with customer and haveng them as partners will improve quality and competitiveness.

- Key activities. The key activities change depending on the Smart Grid building block considered. This key activities have been defined based on the description of the building blocks and the services portfolio from the different actors provides.
- Key resources. The key resources considered in all the business models are the same: human and technical. Human resources are the employees and technical resources are the hardware, software and any tool required to perform the activities.
- Value proposition. The value proposition describes the value provided to the customer, the problems we are helping to solve or the needs we are satisfying. The value proposition in each of the canvases is closely related to the activities defined, so it completely changes from one block to the other.
- Channels. In this paper we consider the suitable communication channel for the Smart Energy ecosystem the direct relation with utility companies, that can be considered the customer in most of this business models. In this paper we also consider that the actors considered (specially MNO, TEM and Global IT Solutions player) are confortable and have many years of experience dealing with big companies, as utility companies are.
- Customer relationship. The common customer relationship considered has been providing automated services on remote and with dedicated personal assistance ready to give technical and management support to the utilities company. In addition to that when the Smart Grid vision is more developed a new way of customer relationship appear where strategic support and co-creation of mid/long term plans is introduced (specially for advanced asset management services).
- Customer segments. The main customer segment considered is the business-to-business segment, where there is a direct relationship between two or more companies. The only exception is in the Consumer Enablement bloc where the final customer is also using the service. In this case the customer segment is considered Business-to-Business-to-Customer.
- Revenue streams. The characteristics of the revenue streams considered in the business models are common for all of them, based on negotiation between the actors and the utilities company, dependent on the service features demanded, dependent on the volume of managed devices and dependent on the volume of devices managed.

VI. Conclusions and future work

In this paper we have introduced two main contributions: the first one is the analysis of the different actors involved in the Smart Energy ecosystem and, classifying them in five different categories: Utilities provider, Mobile Network Operator, Telecom Equipment Manufacturer, Global IT Solutions player and Niche Point Solution player.

The second main contribution is the design and proposal of business models for the Smart Energy sector, based on the four Smart Grid building blocks proposed by the U.S. Department of energy. Our business models proposal we try to enhance the collaboration feature, maximizing partnership and alliances between the different actors.

This paper can be considered a first approach to business modelling for Smart Energy, therefore we can sketch some future lines of work going deeper in the same approach:

- Deepest and specialized analysis and business design and proposal for each Smart Grid building block.
- Specialized analysis and business model design and proposal for different countries, considering its situation i.e Smart Energy development, specific country drivers or economic situation of the country.
- Specialized analysis and business model design and proposal for specific companies or actors i.e. Telecom Equipment Manufacturer or Mobile Network Operator.

References

[1] Ericsson, "More than 50 billion connected devices," *Ericsson White Paper*, pp. 1–12, 2011.

[2] AAHAM, "The home appliance industry principles and requirements for achieving a widely accepted smart grid," *AHAM*, pp. 1–25, 2009.

[3] IEEE, "Smart grid the electric energy system of the future," *Proceedings of the IEEE*, pp. 1–5, 2011.

[4] Markendahl and Laya, "Business challenges for internet of things: findings from e-home care, smart access control, smart cities and homes," *IMP Conference*, pp. 1–22, 2013.

[5] Warmer, Kok, Karnouskos, Weidlich, Nestle, Selzam, Ringelstein, Dimeas, and Drenkard, "Web services for integration of smart houses in the smart grid," *Grid interoperability forum*, pp. 1–5, 2009.

[6] Valocchi, Juliano, and Schurr, "Smart grid technology requires creating new business models," *Generating Insights*, pp. 1–2, 2012.

[7] I. G. B. Services, "Plugging in the consumer," *IBM Institute for Business Value*, pp. 1–28, 2007.

[8] PwC, "Why utilities should embrace a customer-centric business model to succeed in a smart grid world," *PwC White Paper*, pp. 1–10, 2012.

[9] Jisun, Dae-Kyo, Yoonkee, Young-Woo, and Young-Myuong, "Smart grid solutions, services, and business models focused on telco," *Network Operations and Management Symposium Workshops*, pp. 1–4, 2010.

[10] N. E. T. Laboratory, "A vision for the smart grid," *U.S. Department of Energy Office of Electricity Delivery and Energy Reliability White Paper*, pp. 1–12, 2009.

[11] Techopedia. (2014) Tem definition. [Online]. Available: http://www.techopedia.com/definition/26235/telecommunications-equipment-manufacturer-tem
[12] Cisco. (2014) http://www.cisco.com/web/strategy/energy/. [Online]. Available: http://www.cisco.com/web/strategy/energy/
[13] Huawei. (2014) Huawei smart grid portfolio. [Online]. Available: http://enterprise.huawei.com/en/solutions/trade/electricity
[14] Accenture Grid Operations services portfolio. (2014) http://www.accenture.com/us-en/pages/service-grid-operations-overview. [Online]. Available: http://www.accenture.com/us-en/Pages/service-grid-operations-overview
[15] Smart Metering services Accenture portfolio. (2014) http://www.accenture.com/us-en/pages/service-smart-metering-overview. [Online]. Available: http://www.accenture.com/us-en/Pages/service-smart-metering-overview
[16] Asset and Transmission management services Accenture portfolio. (2014) http://www.accenture.com/us-en/pages/service-utilities-transmission-distribution-asset-management. [Online]. Available: http://www.accenture.com/us-en/Pages/service-utilities-transmission-distribution-asset-management
[17] Smart Grid services IBM portfolio. (2014) http://www.ibm.com/smarterplanet/us/en/. [Online]. Available: http://www.ibm.com/smarterplanet/us/en/smartgrid/nextsteps
[18] Smart Grid services Capgemini portfolio. (2014) http://www.capgemini.com/utilities/smart-energy-services. [Online]. Available: http://www.capgemini.com/utilities/smart-energy-services
[19] Alcatel-Lucent. (2014) Smart grid for power utilities. [Online]. Available: http://www.alcatel-lucent.com/power-utilities/smart-grid
[20] Strategyzer business model generation. (2014) http://www.businessmodelgeneration.com/canvas. [Online]. Available: http://www.businessmodelgeneration.com/canvas
[21] Alexander Osterwalder. (2014) http://alexosterwalder.com. [Online]. Available: http://alexosterwalder.com