

Ghanbari, Amirhossein; Álvarez San-Jaime, Oscar; Casey, Thomas; Markendahl, Jan

Conference Paper

Repositioning in value chain for smart city ecosystems: A viable strategy for historical telecom actors

2015 Regional Conference of the International Telecommunications Society (ITS): "The Intelligent World: Realizing Hopes, Overcoming Challenges", Los Angeles, USA, 25th-28th October, 2015

Provided in Cooperation with:

International Telecommunications Society (ITS)

Suggested Citation: Ghanbari, Amirhossein; Álvarez San-Jaime, Oscar; Casey, Thomas; Markendahl, Jan (2015) : Repositioning in value chain for smart city ecosystems: A viable strategy for historical telecom actors, 2015 Regional Conference of the International Telecommunications Society (ITS): "The Intelligent World: Realizing Hopes, Overcoming Challenges", Los Angeles, USA, 25th-28th October, 2015, International Telecommunications Society (ITS), Calgary

This Version is available at:

<https://hdl.handle.net/10419/146344>

Standard-Nutzungsbedingungen:

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

Terms of use:

Documents in EconStor may be saved and copied for your personal and scholarly purposes.

You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.

If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.

Repositioning in Value Chain for Smart City Ecosystems

- a Viable Strategy for Historical Telecom Actors

Amirhossein Ghanbari*, Óscar Álvarez*, Thomas Casey†, Jan Markendahl*

* KTH Royal Institute of Technology, Stockholm, Sweden

{amigha, oaa, janmar}@kth.se

† VTT Technical Research Center of Finland, Finland

thomas.casey@vtt.fi

Abstract

In a historical business model, Mobile Network operators (MNO) design their own network, own their infrastructure, operate the network and offer services on top of it; a voice-revenue dependent business. Now with the data provisioning, since the revenues associated with data do not comply with the pattern of increasing data usage in mobile networks, MNOs need new revenue streams. As a result, MNOs have started changing their business models by offering services besides their usual competences. This complicated approach has then forced them to think of possible cooperation patterns in order to benefit from horizontal collaboration with others, instead of being vertically integrated. On the Other hand, Telecom Equipment Vendors (TEV) used to design their business models in a vertical manner as well. TEVs would build and manufacture equipment and sell them to their customers in a Business-to-Business (B2B) fashion while in some cases operate the networks on behalf of their customers.

Looking for new markets and revenue streams, the future Smart Cities comprise a good opportunity for MNOs and TEVs. This opportunity then requires a new mindset among these actors. In the new mindset, these actors should accept to reposition themselves in the new value chain. This means that, in order to play a role that can not be overlooked, MNOs and TEVs should perform rather different blocks of the Smart City value chain. This paper intends to provide an analysis of how the traditional telecom actors (MNOs and TEVs) have changed their business strategy and repositioned in the context of the Smart City service provision. In order to do that, we will introduce the traditional telecom actors and the existing value chain, later on, smart city concept and use cases will be introduced, finalizing with an analysis of how the future smart city value chain and the repositioning of these actors.

Index Terms

Business Model, , Horizontalization, Repositioning, Value Chain, Smart City, Telecom Actor.

I. INTRODUCTION

The concept of Smart City, which is the use of Information and Communication Technology (ICT) to sense, analyze and integrate the key information of core systems in running cities, is often considered as a subcategory of Sustainable Smart City (SSC). A SSC is defined as an innovative city that uses ICT and other means to improve quality of life, efficiency of urban operation and services, and competitiveness, while ensuring that it meets the needs of present and future generations with respect to economic, social and environmental aspects [1]. In this concept, Integrated Infrastructures of co-existing involved industries play a leading role since sustainability is highly dependent on collaboration. Furthermore, existence of multiple infrastructures in the same industry is highly inefficient and would lead to lack of sustainability.

ICT as the major enabler of Smart Cities is in the forefront of infrastructure integration. On one hand, Telecommunication infrastructures play a vital role in enhancing the connectivity and sustainability of the cities and on the other hand Machine to Machine (M2M) communications play an important role within ICT for enabling SSCs. M2M communications for Smart Cities refers to the exchange of information between autonomous devices in control and monitoring applications without human intervention [2]. The decline in communication fees, altogether with the massive adoption of real-time access of information is expanding the consideration of new services and applications and solutions based on this type of communication.

Different actors are trying to position themselves in the M2M market by providing different set of solutions, including information management, network deployment, systems integration and so on [3]. Moreover, the pressing situation faced by telecommunication operators, triggered by the saturation of their traditional revenue streams (voice and data) in developed countries [2] is also resulting in an increasing interest in the interconnection of smart devices and sensors by operators. On the other hand there are new actors that are also seeking for strong positions in the M2M ecosystem, targeting different roles. All of these leads to co-existence of many actors whom are competing in the same market while they need to cooperate in order to benefit fully from opportunities. For instance, one evident form of cooperation is sharing resources such as infrastructures.

In this context, this paper aims to provide useful insights in the repositioning of the traditional telecom actors in the new value network redefined for city ecosystems. The final goal of this research is understand and describe how new services and applications are changing the complete industry, forcing the historical actors to adapt and compete in new fields. In order to clarify the topic of the paper, the following research question is introduced:

Where is the place for the MNOs and TEVs in the Smart City ecosystem?

The paper is structured as follows: Section I introduces the context and the aim of the paper, Section II describes the methodology followed, Section III describes which are the considered historical actors in the telecom industry, Section IV describes the traditional value chain for telecom actors, Section V introduces the concept of smart cities and its defining building blocks, Section VI introduces a number of use cases in

order to better understand the diversity of services and how the actors collaborate in a Smart City context, Section VII concludes by describing the repositioning of the traditional telecom actors in the new context.

II. METHODOLOGY

The methodology includes a two-stage approach. The first stage provides information on existing practices for MNOs and TEVs in the existing value chains. The second stage provides an analysis with the objective to identify recurring patterns across the different cases. The analysis is focused on producing insights into how actors cooperate and how they distribute their roles and also to identify and understand the drivers and obstacles for introduction of repositioning and cooperation strategies.

For analyzing data, Analytic Induction and Grounded Theory methods will be used [4] [5]. These two are iterative methods that alternate between collections and analyses. The iterations continue until no cases dismiss the hypothesis or theory. Analytic induction stops when the hypothesis and grounded theory ends with a validated theory. Value Analysis and Empirical Data Analysis will be performed. The value analysis framework consists of conducting content analysis of collected data and studied literature in order to understand the context of the actors' decisions, intention and opinion. On the other hand, Empirical data Analysis framework will be mainly used in order to perceive the current situation in the market and major drawback of implementing a cooperative system.

III. TRADITIONAL TELECOM ACTORS

MNOs are the typical carriers that control and operate mobile networks as well as managing customer relations, where customers refer to end users with User Equipment. Traditionally MNOs used to implement a complete vertical solution handling all different parts of the network as well as the CRM. As it was illustrated in Figure 1, a shift from historical value chains is happening in the telecom ecosystem towards new business models. This shift has made operators think about their possible role in the M2M communications and connectivity. In Figure 1, the hierarchy shift in the telecom/internet sector is shown. It can be observed how MNOs are losing its control and influence in front of OTT services providers.



Fig. 1: MNOs dominance hierarchy and the coming shift

TEVs in the context of Telecommunication imply those manufacturers of the telecom equipment that provision the technical procurement for the operators. Again, according to the shift in the value chain, the

TEVs have recently participated in different roles that historically have been assigned or taken care of by others, mainly MNOs. For instance, it is now quite an accepted concept that TEVs operate and maintain networks on behalf of MNOs, helping them focusing on their core business that is taking care of customers. When it comes to M2M ecosystem, some major TEVs have their vertical M2M solutions that in some cases are considered as the most complete solutions. This can only be done upon diverse capabilities of big NVs globally due to interaction with MNOs as well as being expert as operators of mobile networks.

IV. TRADITIONAL VALUE CHAIN

Here the traditional value chain in the telecom sector is described. A historical value chain in Mobile Telephony provisioning corresponds to two major activity blocks. This has made it clear for TEVs and MNOs where to participate in this value chain; TEVs taking over “provisioning connectivity” and MNOs taking over “End User management” and “Service Provisioning”. The positioning strategy for these actors then have been somehow clear and the value chain made it easy for them to collaborate with each other, while competing in each block with similar entities (i.e. other MNOs and TEVs).



Fig. 2: Simple value chain of Mobile Telephony (top) and Historical Actors' positions (bottom)

MNOs historically obtained revenue by offering wireless connectivity to private users; a Business to Customer (B2C) setup. TEVs on the other side played the role of suppliers for the MNOs. This connectivity in the early days meant cellular telephony, which has evolved during years and now includes Calling, SMS/MMS, and Mobile Broadband. In addition to obtaining revenue by offering retail services under its own brand, a MNO might have also sold access to network services at wholesale rates to Mobile Virtual Network Operators (MVNO) in a Business to Business (B2B) setup. Figure 3 illustrates the major business relations for MNOs and TEVs in the Mobile Telephony case. A Managed Service Partner (MSP) is typically an outsourcee for MNO's network operations (e.g. outsourced NOC). Outsourcees have been either third parties or in most cases the TEVs that operate the networks for MNOs.

Besides minor incentives, three main reasons have driven MNOs to consider changing their position in the Value Network and start to collaborate with their direct competitors in the market: a) Cost reduction, b) Lack of spectrum, and c) Coverage Expansion. In the most common setting, two or more MNOs form a joint venture (figure 4-left) that owns the access network (or parts of it) but the Customer Relation Management (CRM) is still being handled by each operator. When it comes to policy, the telecom National Regulatory Authorities (NRA) has long been the regulator body in this industry. The main role of the NRA is to enable



Fig. 3: Two illustrations of Historical Value Network of Mobile Telephony

“proper” access to spectrum for different MNOs while supervising their utilization of this invaluable resource. Merger (figure 4-right), as a strategy for gaining more market share or a viable exit strategy has also become a common practice among MNOs. This setting highlights the role of the “competition” authorities since the case of merger can directly give or take Significant Market Power (SMP) to a specific MNO.

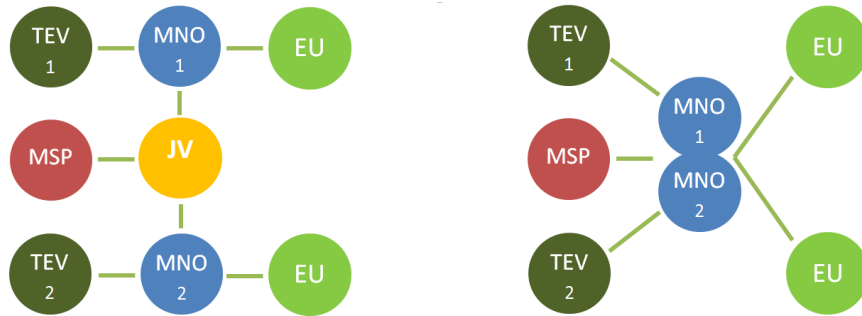


Fig. 4: Network Sharing and Merger

V. SMART CITIES

There is no common and widely accepted definition for Smart City, just slightly different definitions of this concept depending on the implementations. In this paper we will consider the definition from [3], a ” *Smart City is one that is able to link physical capital with social one, and to develop better services and infrastructures. It is able to bring together technology, information, and political vision, into a coherent program of urban and service improvements.*” To start, we need to define which are the main aspects that the Smart City (SC) concept covers. In this sense SC is commonly related to five main building blocks:

- Economic, Social & Privacy Implications
- Developing E-Government
- Health, Inclusion and Assisted Living
- Intelligent Transportation Systems
- Smart Grids, Energy Efficiency, and Environment

A. Economic, Social & Privacy Implications

It is a mistake to think that making smarter cities requires just more investment in development of technical IT (Information Technologies) solutions – technical development should be aligned with the social and economic goals of the society. The most important issue confounding efforts to make cities smarter is not the development of appropriate technologies per se, but to tackle the difficulties in changing organizations and existing ways of working to use these new technologies to deliver smarter cities. Therefore, the provision of services should be focus on improving the current performance of the urban services with the ultimate goal of improving efficiency, efficacy and life quality for the final users-citizens.

B. Developing e-government

The existence of Internet and electronic devices provides the opportunity to implement e-government systems, where citizens would have a voice in every decision make on the city. The implementation of e-government systems is, at the same time, a big opportunity and a big challenge as it will require open minded administrations, committed citizens and technical maturity. Another aspect to consider for development of e-government is the integration of data and IT systems into the public policy and administrative procedures [6].

In this context, a new evolution regarding the public administration and ICT adoption is characterized by incorporate more opening and collaboration, allowing the creation of open innovation processes in connection to the public procurement. Therefore this enables a change from public-private partnerships to public-private-people partnerships, which implies higher level of participation and democracy to the citizens.

This concept is included in the vision of Smart City, where Open Government and governance play a primary role that requires public policies and strategies oriented to achieve social sustainability in benefit of all the society [7].

C. Health and Assisted Living

One of the main concern of developed countries is the fast aging effect on the society, where an increasing percentage of the population is elderly. This situation brings challenges in terms of provision of welfare services and benefits, where health-care is the cornerstone. The concept of Smart City considers ICT-based solutions for home-care, elderly care, chronic diseases and tele-care services, with potential benefits in terms of efficiency for the public health sector [7].

Many existing and potential technologies under development for the maintenance and/or supervision of health and well-being offer a great promise, ranging from health monitoring services and falls detection to “lifestyle monitoring” (detecting changes in behavior patterns). Within this realm, research in ICT platforms for elderly and people with chronic diseases test ideas of generic health monitoring platforms, addressing people with chronic conditions, and assistive mobile devices, among others. Smart Cities need to incorporate these aspects into their overall structure and roadmap [8].

D. Intelligent Transportation Systems

As an industry that has been around for years, Public Transportation has gone through considerable changes with the aid of ICT. World population is expected to grow from 7.0 billion in 2011 to 9.3 billion in 2050 according to an UN prediction [9]. At the same time, the urban population is projected to grow by 75 per cent in the same time period, from 3.6 billion in 2011 to 6.3 billion in 2050. Thus the urban environments will not face only a direct increase in population but also a massive migration coming from the rural areas. A key area that cities will have to address is the mobility issue. More specifically, due to population increase, congestion issues in urban environments might become critical. This means that the current transport systems have to be extended in order to face the increased population. In order to be efficient, the transport systems have to be connected, and here is where the multimodal transportation systems come up front. This concept implies a chain of trips combining different means of transport (personal car, buses, trains, metros, etc.) allowing the user different combination of modes to go from one place to another. In this way, the strengths of different transport modes are combined in order to offer a more flexible and reliable experience to the end users [10].

Users nowadays are looking for the most efficient way for traveling from A to B. By combining different means of transport with their associated waiting and travel times, multimodal transportation succeeds to optimize the current infrastructure and lower the changing time. This increases the efficiency and overall customer experience making it more convenient to use [11] [12].

E. Smart Grids, Energy Efficiency, and Environment

Smart Energy or Smart Grid is one the more important aspects of the Smart City concept, enabling responsible management and operation of energy networks in cities. The integration of communication infrastructure, mathematical modeling techniques and simulation techniques can be a powerful tool in this context. The concept of Smart Grid also includes the idea of “prosumers”, which is the idea of integrating decentralized energy generation in the nowadays centralized energy grid, enabling householders to produce its own energy and sell and buy from the energy grid depending on its consumption. This also holds for the potential storage capacity for both electrical and thermal energy within energy networks, which can be achieved by intelligent demand side management. [13] A major requirement in Smart Cities is to leverage energy consumption between the different producers and consumers, which directly translates into reducing the pollution generated by today’s cities and the emerging mega cities [14]. In this concept, efficiency improvement in water and waste management is included. Such important resources need to be optimized and organized in the most efficient way by using ICT technologies.

F. ICT Integration/Horizontalization

In the business domain these new services related to the Smart City concept require cooperation and collaboration from many different actors; including public institutions, telecom operators, utility providers,

OTT (Overt-The-top) providers or transport companies. The strength of the Smart City concept, gathering the value of data and ICT integration from different sectors, remains also its biggest challenge. The authors consider that the main challenge for Smart City services development is the definition of business models suitable for these services, where all the actors involved would benefit and collaborate from the provision of the services. Another relevant issue when talking about Smart Cities is the communication infrastructure needed; we still need answers to questions like: Which technology to use? Who will be the provider of the network? Will all services run over the same network? Telecom researches have been discussing on the idea of horizontalization of Smart City services, which means the idea of having one common network (cellular or wired) and/or platform for all services related [15] [16].

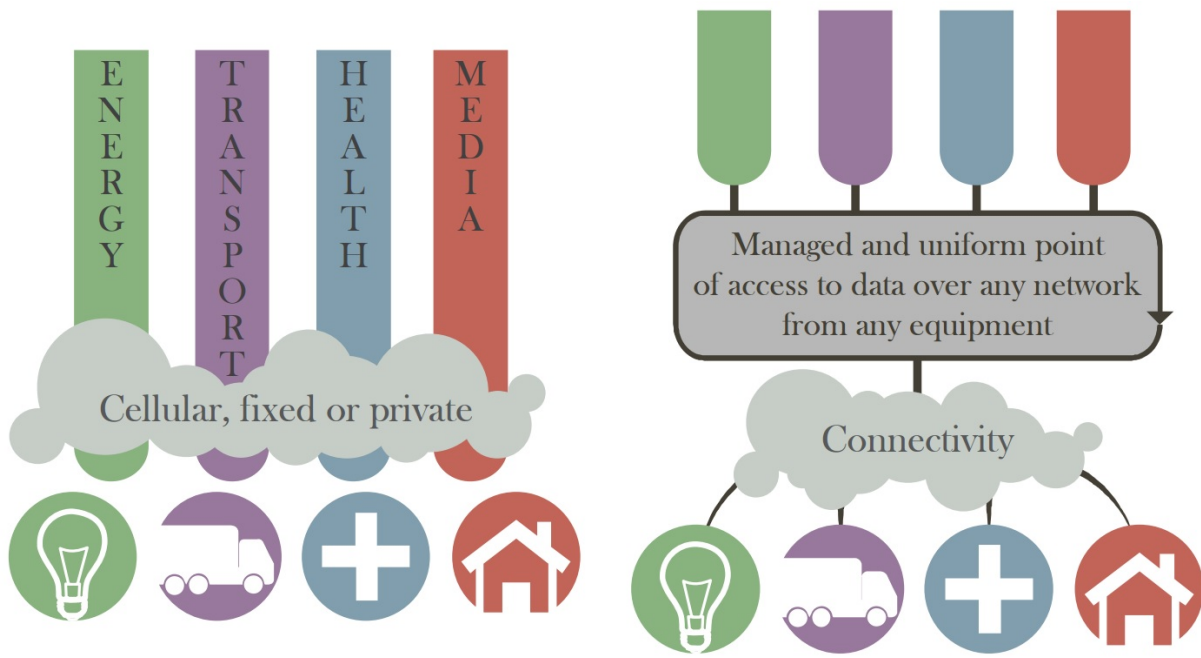


Fig. 5: ICT Horizontal collaboration/multi-actor market [15]

G. Smart City M2M resources

When it comes to the role of ICT in Smart City, a set of resources enable the Telecom actors to participate and perform different sets of activities. The importance of these resources lie in the fact that possession of any of these resources enables an actor to perform a specific activity. By a resource it is meant anything which could be thought of as a strength or weakness of a given firm. More formally, a firm's resources at a given time could be defined as those (tangible and intangible) assets which are tied semi permanently to the firm [17]. Examples of resources are: brand names, in-house knowledge of technology, employment of skilled personnel, trade contacts, machinery, efficient procedures, capital, etc. [18]. Defined pedagogically, Grant [19]

categorizes Resources into six major categories; Financial, physical, human, technological, organizational and reputation.

- MTC Infrastructure
- M2M Platform
- End-user
- M2M Data
- Capital
- Knowledge/competence

1) *MTC Infrastructure*: When providing communication services, the need of communications networks appears naturally. Within communication networks two different types can be identified: Core network and Cellular access network. The core network is the central part of the communications network, facilitating the connection between different sub-networks. The Cellular access network (also defined as radio access network) is the interface between the end-user and the core network, basically using wireless technology connecting to a base station close to the end-user. The communications infrastructure is usually owned by a MNO, which has done long term investments in its deployment with the final goal of providing communication services to individuals, companies and organizations.

2) *M2M Platform*: One major barrier that the development of smart cities is facing is the existence of vertically integrated industries developing its own smart city solutions. [20] [21] In order to tackle this issue the development of a common platform integrating services from different industries is needed. The platform acts as a common ground for the development of services and applications on top of it, providing an open environment for collaboration between industries and supporting innovation in the context of smart sustainable cities.

3) *M2M Data*: One very important resource when introducing smart cities and M2M services is data, data originated for the end-users on the city. Data can be defined as all the information obtained from the usage of a number of services in the city environment; communication/Internet services, transportation services, energy consumption, car-sharing, parking or logistics. The added value in smart sustainable city comes from the obtaining a big amount and data, process the data and extract useful information for the decision making in the city. The data is generated from a number of different sources and stakeholders, going from the MNOs and service providers to the city governance. This data needs to be shared in order to apply analytics and the information obtained needs to be open and usable, first to the decision makers and later on to the other partners involved in the provision of services. Therefore data is considered as one important resource to be shared in this context, being of key importance in the provision of smart cities services.

4) *End User*: The final goal of these services is to provide useful information and services to the end-user, which will be able to make better decisions on how to interact with the city. In the provision of these services, a number of actors are involved and it is not feasible that the end-user has relations with all of them. The usual relations with the user are with either the service provider or the MNO, being both of them in the

front-end of the business activity. In this sense, the different stakeholders are sharing this resource event though not all of them have direct relation with it.

Why is End User/Customer an important asset?

On economic terms, what is important for a firm is higher profit. Profit is a financial benefit that is realized when, in a business activity, gained-revenue is more than all expenses (including taxes, costs) [22]. The source of the revenue gained by the firm is then the price the customer pays.

$$Revenue_{for\ Producer} = Price_{paid\ by\ Customer} * number_{of\ Customers}$$

For a customer, value is defined as the ratio between the benefits they receive and the price they pay.

$$Value_{for\ Customer} = Benefit/Price$$

Considering that the Value for a firm (producer) is reflected as financial profit; value is the difference between the revenues they receive and the costs they incur.

$$Value_{for\ Producer} = Revenue - Expenses$$

So it means that more profit for the producer can be gained by:

- Creating more benefit for customers
- Increasing the number of customers
- Lowering expenses

It could be concluded that customers are the economic resource which are subject to be cultivated by the producer [23]

VI. SMART CITY USE CASES

In this section a number of Smart City use cases will be introduced, with the ultimate goal of obtaining insights on how the value networks and value chains are created in this new context. For this purpose, three sectors where a change from a vertically integrated market to a more horizontal/multi-actor market is already happening or is predicted to happen. This idea of horizontal collaboration is illustrated in figure 2. The three selected industrial sectors are: Mobility, Built Environment and Energy and Clean technologies.

A. Mobility

For the mobility sector we examine the current state and the evolution towards multi-city, multi-vendor real-time information solutions. In addition to that, we consider the case of Mobility-as-a-Service (MaaS), a multi-actor environment that provides seamless door-to-door services for end users by combining several modes of transportation.

In the traffic domain there has been a movement towards collection of various types of traffic related data and utilization of this information in decision-making. The latest trend is provision of traffic data through

standard interfaces in order to enable production of diverse types of services. Currently there are parallel efforts taking place to promote creation of real time traffic information to improve situation awareness of transport users and traffic managers.

The current vision is to create a distributed situation awareness capability to provide diverse inputs to transport users. This capability should emerge over time through development of various interlinked services utilizing diverse sources of data, exploiting different technologies, and provided to a variety of transport users and operators, both public and private. This will require collaboration and interoperability to enable transmission of data between various players.

Taking as a use case the development of mobility services in Finland, we can observe that the cities of Tampere and Helsinki have started a public procurement where research and development services are purchased from multiple vendors. The services to be developed can relate to various types of traffic information such as road transport, pedestrians and cycling, weather and air quality, selection of traffic mode, traffic management, or forecasting. In this tendering the pre-commercial procurement (PCP) approach is used where multiple firms are selected to undertake simultaneous product development in two consecutive stages.

In these initiatives interoperability is an explicitly stated goal. It is promoted by provision of open public data in standard formats. It is also pushed forward by the vision of a marketplace of data, tools and applications which are produced by a variety of firms and public sector actors. Availability of traffic data standards (e.g. Datex II, SIRI) is an enabling factor for development of interoperable services which also have potential to scale up to international markets. However, at this stage of rather early development of real-time traffic information services, alignment of national and regional developments has only been started.

1) *Mobility-as-a-Service*: One flagship example of smart city development in the mobility sector is the evolution towards the so called Mobility-as-a-Service concept (MaaS). The basic idea of MaaS is to provide a seamless door-to-door service for end-users which combines several modes of transportation (e.g. local and long distance busses, trams, taxis, demand responsive public transportation and shared private vehicles) and serve it as one simple package for the end-user. In principle this would mean that the end-user would for example not need to have separate accounts and tools for each mode of transportation for planning their trips and paying.

The evolution towards such a new paradigm is driven by many trends such as urbanization and by the fact that young people are not acquiring drivers licenses as often as before, i.e. do not necessarily want to own a vehicle but would instead like to have access to a better supply of transport services. The underlying driver is also the accelerating development and application of ICT technologies in the field of mobility. Vehicles are increasingly being instrumented with positioning systems and mobile broadband connectivity and linked to cloud services. Furthermore, end-users are more and more equipped with smart phones and applications that provide access to different transport modes.

Over the years there have been major advances in the utilization of ICT by the different transportation

providers. Journey planners have become commonly used tools for end-users to organize their trips. Vehicles are also increasingly instrumented with location sensors. For example in Tampere all busses and in Helsinki all trams and many of the busses are equipped with a location tracker which in principle makes it possible for end-users to dynamically alter their routes. Demand responsive public transportation concepts have also been developed where the leading pilot at the moment is HRT's Kutsuplus.

However, if one looks at the current systems deployed, it can be stated that the related ICT solutions, that are the building blocks for MaaS, are heavily fragmented and tailored for different transport modes and providers. Vertically integrated solutions with limited interoperability are built for local public transportation, long distance public transportation, taxis, ride and vehicle sharing and private vehicles. Most are also tailored to specific regions and not interoperable across cities.

The potential market for MaaS consists of a large group of stakeholders ranging from actors in the public sector responsible for legislation, regulation and organizing public services (e.g. public transportation) to actors in the private sector such as transportation operators (e.g. bus and taxi companies). A wide group of ICT solution providers also exists ranging from large IT companies (such as Tieto, CGI and Accenture) who provide large IT systems to transport operators (e.g. related to ticketing) to SMEs providing systems to Taxi Switching centers (e.g. Semel and Mobisoft) and to individual software developers developing e.g. mobile journey planner applications.

In addition to this private vehicles are also often instrumented with on-board units that enable real-time services (e.g. related to remote diagnostics, driver coaching, driving diaries and emergency call (eCall)). Furthermore many internet based ride sharing communities exist (e.g. in Facebook) and dedicated applications are also emerging (e.g. Ridefy). Therefore, although the sector is rather fragmented, the end-users already now have quite many tools to optimize their transport services.

In order for MaaS to reach its full potential these ICT solutions need to evolve towards more modularity and interoperability across regions and transport modes. Tekes for example defines three types of information to which open access is required from existing transport service providers:

- Timetables,
- Real-time location information, and
- Payment systems.

2) *Connected Vehicle services*: In addition to the previously described MaaS, there is another type of services which can be included in the category of Connected Vehicle Services. Connected Vehicle Services is commonly defined as the set of services based on ICT technologies and provided during the driving experience. This category includes a number of services ranging from:

- Remote diagnostics: Service that provides access to the OEMs (Original Equipment Manufacturer) and allows them to perform proactive remote diagnosis of the vehicle functionalities, schedule service booking, order spare parts in advance and software updates.

- Emergency call – eCall: This service provides fast and automatic communication with emergency services when an accident happens. This communication can be done through SMS or telephonic call.
- Mediaroom-Infotainment: In-car media and entertainment services such as IP TV, video games or streaming music or movies. Companies like AT&T and Ericsson have already developed platforms in order to provide this kind of services.
- Insurance billing: Vehicle connectivity can be used by insurance companies to charge more or less depending on how the drivers use the car. Concepts like “Pay-as-you-drive” or “Pay-how-you-drive” use connectivity to detect the driving style and use this information in the billing process. This kind of systems can detect driving style, usage time, distance travelled or average speed.

In the context Connected Vehicles services provision, a number of activities have been identified. The main activities identified are: Connectivity provision, SIM card provision, Platform management and provision and user management and relationship. Considering these main activities, we can observe different setups regarding collaboration between actors providing these services. In order to illustrate these different setups we will briefly describe two already existing services: Tesla and Volvo connected cars.

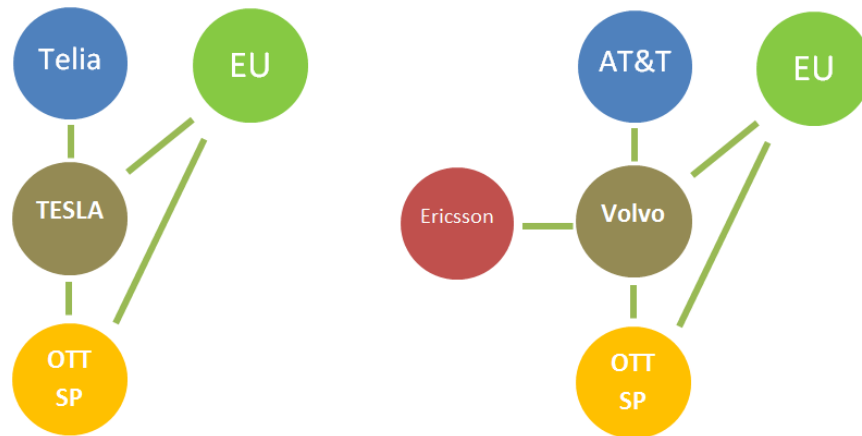


Fig. 6: Tesla VS. Volvo

Volvo Connected Car. Volvo is currently offering a service named Volvo Sensus connect, which basically is a commercial offering embedded in Volvo vehicles that allows the user to obtain services related to and enabled by ICT. The setup for the Volvo Sensus connect has been aiming to enhance collaboration between a number of actors, allowing each actor to focus on its field of expertise. The activities distribution has been as follows: MNO taking care of connectivity and SIM card provision, TEV handling platform development and management and Volvo providing end-user management.

Tesla. Being one of the most innovative car manufacturers in the world and aiming to disrupt how the car industry works, Tesla also has a slightly different approach regarding Connected Vehicle services. Tesla Connected services are taking that concept one step forward, fostering ideas like software updates enabling

autonomous driving in your car.

In addition to be a cutting-edge car manufacturer, Tesla has selected a different approach when developing Connected Vehicle services. Tesla's strategy has been integrating and controlling all possible activities. Therefore Tesla concentrates activities on end-user management and platform development, leaving connectivity provision and SIM card provision in hands of the MNOs.

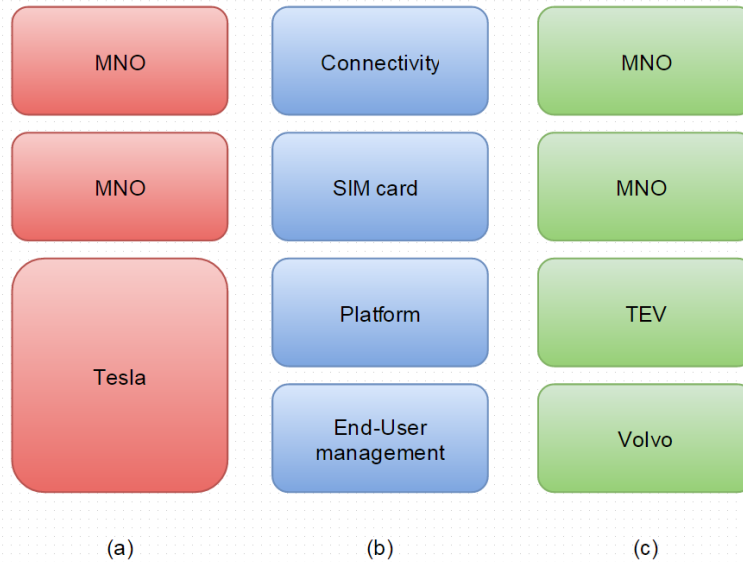


Fig. 7: Activities stack options for Connected Vehicle services a) Tesla setup b) Generic activities stack c) Volvo stack

In this activities stack, it is important to highlight the importance of differentiate SIM card and Connectivity provision. As we are talking about vehicles, roaming plays an important role. Roaming should be implemented between different countries, involving different MNOs with corresponding roaming agreements. The roaming process should be seamless for the end user; hence the actor in charge of the end user management should include roaming aspects in its agreements with MNOs. An example that can be useful is the Amazon Kindle service, where the user can buy books from its device anywhere in the world using cellular connectivity. Companies like Tesla or Volvo should establish similar agreements with connectivity providers. In this sense, SIM card would be provided by one specific MNO while connectivity would be provided by many MNOs. In addition to this approach, we can also envision how the implementation of SIM cards can potentially change in the future. New implementations like soft-SIM cards will have an impact and make a change on how companies or individuals access connectivity services.

B. Digital Urban Environment

1) *Waste management:* Smart Waste is part of the smart city concept. Focusing on municipal solid waste, Navigant Research defines Smart Waste technology as the integration of advanced technologies into

a strategic solution that enhances sustainability, resource efficiency, and economic benefits. The use of these technologies results in more integrated waste management offerings that move beyond the traditional use of labor, diesel trucks, and open pits to discard waste.

As an instance, for the specific case of Finland, Waste management is getting smarter as new technology is implemented in different areas of the country. New incineration or composting plants are directing waste streams away from landfill to higher levels or smarter waste management. Here we will, though, focus on applications of Smart Waste making use of IoT (Internet-of-Things) technology.

Early experiments with IoT type solutions in Finnish waste management industry involve a scale for measuring the mass of waste in the garbage truck before emptying the load at the waste station. Today a few smaller companies, mainly start-ups, are providing Smart Waste solution for container fill level monitoring and waste sorting. Enevo is at the moment receiving a lot of publicity, but also companies like MariMatic Ltd and ZenRobotics Ltd have presented innovative solutions for waste management. Overall, the number of companies involved in the Smart Waste area in Finland is limited and since the use of monitoring technology is only at an early stage little need for integration or interoperability has yet been needed.

The waste management system is seeing rapid changes. The change from landfills to incineration is shaping the structure of the system from municipal into larger areal networks. This will have an effect on how waste management is organized, what technology is used and how business is done. Today there is, however, evidence of new IoT based solutions being developed and implemented is limited. Future needs to increase recycling of products, parts and materials can become the incentive to implement more Smart Waste solutions. Recent discussion on circular economy stresses the fact that raw materials are becoming scarce and that all material need to be re-used and recycled in several iterations. This will probably also create a need for close monitoring of material in the society and industry, thus increasing the need for information from a wide spread of information sources.

C. Bigbelly Solar Inc.

BigBelly Solar, Inc. provides solutions for the management of waste and recycling. It offers solar intelligent waste collection systems to manage the process of collecting solid waste, as well as solar compactors, and companion recycling bins and kiosks; CLEAN, a wireless network monitoring and management software that provides real-time and historical information to managers or workers to plan waste collection routes and pickups; and Connect™, a turnkey smart waste and recycling system that ensures customer engagement and satisfaction. It serves municipalities, cities and towns, college and university campuses, parklands and beaches, government and military installations, and institutional customers [24].

An elaboration on how bigbelly works as a system in the USA is as follows:

- Bigbelly solar compactors are upgraded with wireless hardware.
- CLEAN sends data through standard SMS (text messaging) format to our online server (requires adequate cellular phone signal, currently provided by AT&T).

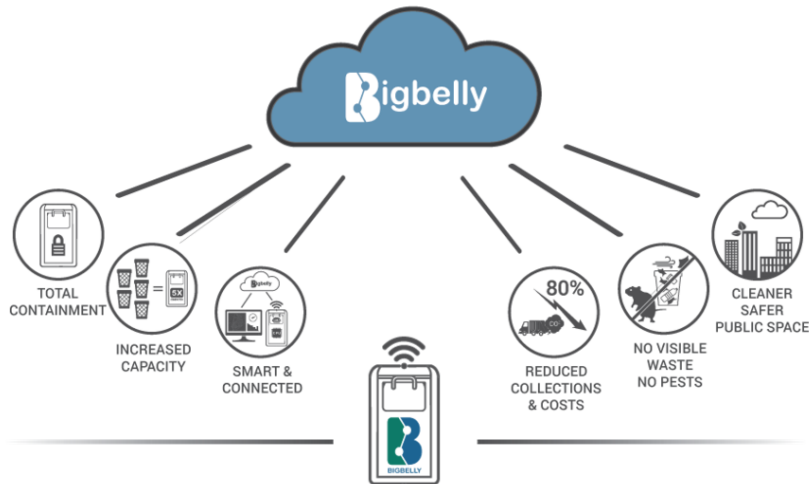


Fig. 8: The Complete Bigbelly Solution [25]

- See real-time Bigbelly operational data right at your desk.
- Monitor collection activity to eliminate unnecessary pickups and free up workers from on-street status checks.

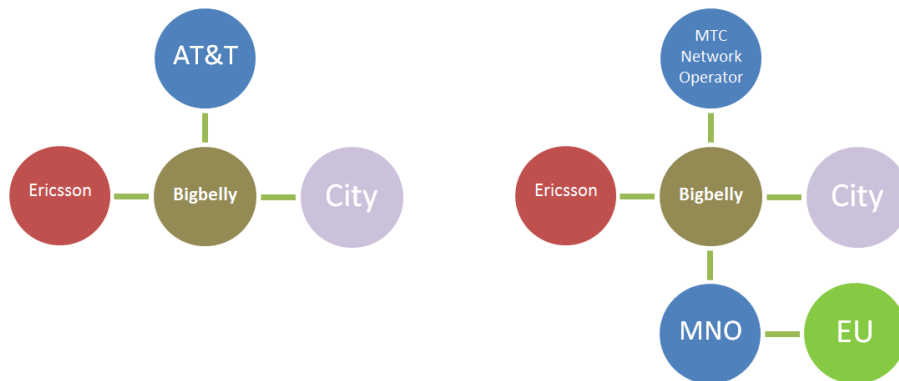


Fig. 9: Bigbelly Solar's Waste Management vs. Connectivity Provision

In accordance with the concept of Digital Urban Environment, Bigbelly also offers cellular connectivity. The company uses its trash bins (consider them urban furniture) as a site for hosting small cellular base stations as well as WiFi access points. The business model then includes offering operators connectivity (cellular), capacity (mobile broadband), and/or carrier WiFi (figure 9 - Right). The idea of utilizing urban furniture for applications beside their prime application is an appealing mindset Smart Cities.

VII. CONCLUSION

According to case studies illustrated in figure 6, figure 7, and figure 9, the Value Chain for the Smart City while offering a M2M solution is somehow different from Mobile Telephony (figure 2). A simplified value chain for Smart Cities is then illustrated in figure 10 (Top). According to the cases studied earlier, we showed that there are other actors who might be even more competent in provisioning any of the blocks besides MNOs and TEVs. For instance, a specialized M2M cellular network operator (MTC network Operator) can be considered a better option to provide “Connectivity”. Many Service providers have also introduced services for the far right block (i.e. end user management); a previously dominant position for MNOs. On the other hand, TEVs and MNOs have shown interest in all four illustrated blocks. This is mainly because they want to get a bigger share of the revenue from this new business. This is based on the assumption that they can acquire the competences needed to do so. Since specialized actors in each block can perform comparatively better than TEVs and MNOs in some blocks, in order to stay in the game as an actor who cannot be overlooked, they need to reposition themselves in the value chain. One example of a possible repositioning strategy is illustrated in 10 (Bottom). This figure shows a case where TEVs and MNOs collaborate differently compared to previous example. In this case, the MNO utilizes the relationship with end-users (i.e. its subscribers), while a service provider offers an OTT service to them (e.g. remote patient monitoring). The TEV offers a M2M platform for this service and the M2M network operator provisions connectivity. Eventually, the same Service Provider offers and manages the M2M enabled devices (patient monitoring devices).

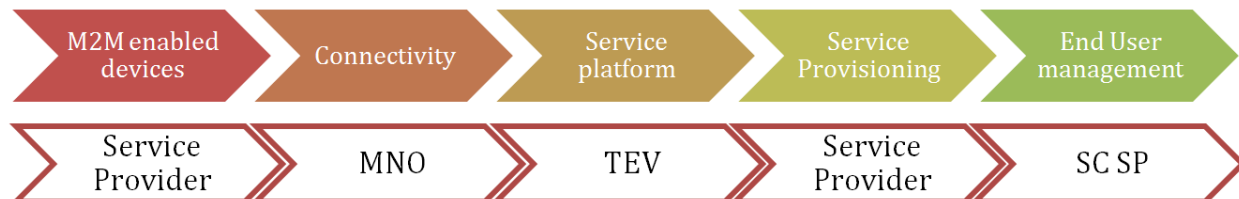


Fig. 10: Smart City value chain (Top) and the repositioned Historical Actors in Smart City value network (Bottom)

Eventually, it could be concluded that different actors are capable of and willing to perform multitude of activities based on their Business Models. Keeping in mind the competence and the resources these actors can acquire and/or have, they will be able to cover different blocks of the value chain in Smart Cities. This would then results to two prime positions form MNOs and TEVs (figure 10 - Bottom). In case these entities can acquire more resources in this matter (as mentioned in Smart City M2M resources), they they will be capable of performing other tasks in the value chain.

REFERENCES

- [1] F. G. on Smart Sustainable Cities, “Smart sustainable cities: An analysis of definitions,” ITU-T, Tech. Rep.

- [2] G. Wu, S. Talwar, K. Johnsson, and N. Himayat, "M2m: From mobile to embedded internet," *Communications Magazine*, pp. 36–43, 2011.
- [3] A. Laya, V. Bratu, and J. Markendahl, "Who is investing in machine-to-machine communications?" European Regional International Telecommunication Society Conference (ITS Europe), 2013.
- [4] H. Hakansson and I. Snehota, *Developing Relationships in Business Networks*. Cengage Learning, 1995. [Online]. Available: <http://books.google.se/books?id=Y0FBAAAACAAJ>
- [5] A. Håkansson, "Portal of research methods and methodologies for research projects and degree projects," in *Proceedings of the International Conference on Frontiers in Education : Computer Science and Computer Engineering FECS'13*. CSREA Press U.S.A, 2013, pp. 67–73, qC 20131210.
- [6] A. Tat-Kei Ho, "Reinventing local governments and the e-government initiative," *Public Administration Review*, vol. 62, p. 434–444, 2002.
- [7] J. Markendahl and A. Laya, "Transformation of home care services, related working processes and business models due to introduction of mobile technology." *IMP Conference Bourdeaux*, 2014.
- [8] S. Brownsell, D. Bradley, R. Bragg, P. Catlin, and J. Carlier, "Do users want telecare and can it be cost-effective," in *[Engineering in Medicine and Biology, 1999. 21st Annual Conference and the 1999 Annual Fall Meeting of the Biomedical Engineering Society] BMES/EMBS Conference, 1999. Proceedings of the First Joint*, vol. 2, Oct 1999, pp. 714 vol.2–.
- [9] U. Nations, "World urbanization prospects: The 2011 revision. new york: United nations department of economic and social affairs/population division." *UN Proceedings*, 2012.
- [10] A. Micheli, "Impact of iot enabled service solutions in the downstream automotive supply chain." *KTH Royal Institute of Technology. Master Thesis report*, 2014.
- [11] K. Mesaikos, "Business models for connected vehicle cloud," *KTH Royal Institute of Technology. Master Thesis report*, 2014.
- [12] E. Commision, "Transport projects: Closer. retrieved from research and innovation," 2014.
- [13] U. D. of Energy, "A vision for the smart grid," *White paper US Department of Energy*, 2009.
- [14] O. Alvarez, "Business transformation based on ict: Smart grid." *KTH Royal Institute of Technology. Master Thesis report*, 2014.
- [15] . L. A. Markendahl, J., "Business challenges for internet of things: Findings from e-home care, smart access control, smart cities and homes," *White paper US Department of Energy*, 2009.
- [16] N. Walravens and P. Ballon, "Platform business models for smart cities: from control and value to governance and public value," *Communications Magazine, IEEE*, vol. 51, no. 6, pp. 72–79, June 2013.
- [17] R. E. Caves, "Industrial organization, corporate strategy and structure," *Journal of Economic Literature*, vol. 18, no. 1, pp. 64–92, 1980.
- [18] B. Wernerfelt, "A resource-based view of the firm," *Strategic Management Journal*, vol. 5, no. 2, pp. 171–180, 1984.
- [19] R. M. Grant, "The resource-based theory of competitive advantage: implications for strategy formulation," in *M. H.*, 1991, pp. 3–23.
- [20] A. Laya and J. Markendahl, "The m2m promise, what could make it happen?" World of Wireless, Mobile and Multimedia Networks (WoWMoM), 2013 IEEE 14th International Symposium and Workshops, 2013.
- [21] E.-J. Kim and S. Youm, "Machine-to-machine platform architecture for horizontal service integration," *EURASIP Journal on Wireless Communications and Networking*, 2013.
- [22] Investopedia, "(2015)," *DEFINITION OF 'PROFIT'*. Retrieved October, vol. 15, 2015. [Online]. Available: <http://www.investopedia.com/terms/p/profit.asp>
- [23] M. Finance, "(2014)," *Customers As A Resource*. Retrieved October, vol. 15, 2015. [Online]. Available: <http://www.type2consulting.com/2014/02/12/customers-as-a-resource/>
- [24] B. S. Inc, (2015. October 20).
- [25] B. L. P., (October 20). Company Overview of BigBelly Solar, Inc, 2015. [Online]. Available: <http://www.bloomberg.com/research/stocks/private/snapshot.asp?privcapId=24739501>