A Network of Complementary SMEs for a Global Infrastructure for Services: the Example of Environmental Urban Services

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Abstract. High-technology SMEs have shown their capacity for creating and developing innovative services. Reduced size often confines them to vertical applications and limits possibilities for broader development. Network strategies are possible but may need a strong leader to ensure credibility. On the other hand, large operators cannot be proficient in all the necessary domains, particularly when applications move very fast. Therefore they very much need the diversity and the dynamics of SMEs to provide service packages within a global infrastructure. Bringing together different SME actors behind a telecom provider is a challenge displaying good promises if the links between the different services are correctly identified and modelled.

Keywords: network of SMEs, PSS, service delivery

1 Introduction

SMEs play an important role in European industry [1]. Small high-technology firms have often proved their capacity for creating innovative services. Their small, flexible structures are well-adapted for converting new ideas into tangible projects that they can deploy rapidly in changing markets. They have core-skills that make them very competitive in specific areas. However they often lack the scale needed to introduce their new technologies and small size can be a handicap for developing complex systems requiring complementary know-how. It is not always easy for them to enter public markets [2]. Cities, for example, often unite to form communities of agglomerations or other structures that deal with such services of common interest and they have often already piled up many technologies and show reluctance to introduce new systems especially when they are proposed by small firms.

On the other hand, large operators cannot be proficient in all the different fields that they need to cover in a rapidly changing world. High-technology applications can move too fast for their slowly matured replies. They need to integrate the diversity

and the dynamics of smaller firms if they want to provide novel service packages within a global infrastructure that would be the heart of their know-how.

Bringing together complementary SMEs into a network to build a complex system will combine market-positioning with adaptable and innovative approaches [3-5]. The driving force of a big operator, capable of gaining the confidence of local authorities and guaranteeing QoS, is a natural leader for such a network [2]. However to succeed it is important that the links between the different service providers and the underlying technical structures be correctly identified, described and understood.

This article takes the case of a network of complementary SMEs behind a telecom operator that seeks to build a telecom backbone for urban services. It will study how service-oriented architecture could help to clarify relations between the partners as they move from vertical applications to the global infrastructure.

2 A Network of SMEs with a Global Infrastructure for Services

2.1 An M2M Enhanced Service from a Single SME

M2M Systems

In Machine-to-Machine (M2M) communication networks, machines exchange data with other machines taking decisions without human intervention [6]. Basically networks of sensors gather information from the outside world and dispatch them towards more powerful machines. These could be service platforms capable of processing data and providing services that can be directly used by human-beings. Potential applications cover areas like environment, safety, public transport and health [7]. One particular application is waste glass collection, experimented in 2006 by the telecom operator Orange/France [8], while a similar, but full-scale, commercial offer, is already proposed by the French SME, BH Technologies [9].

Basic Waste Glass Collection

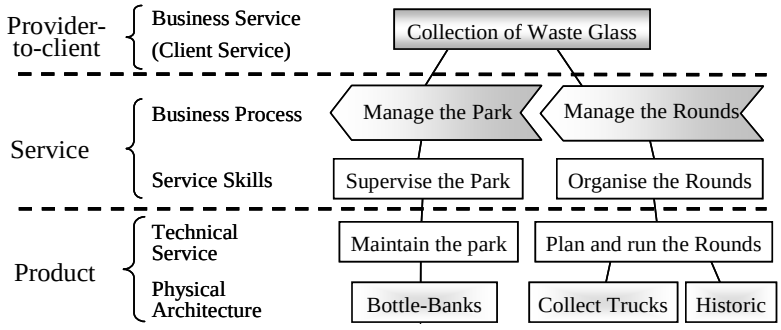

Fig. 1. In the basic waste glass collection service the provider is the waste collection

company and the clients are the city and its residents

A service-oriented architecture is used to describe the basic urban waste glass collection service in figure 1.

Cities provide waste banks to residents for disposal of waste glass. The glass is discarded in bins and collected by dedicated trucks doing regular rounds. In the basic service the truck-driver systematically checks the glass-level in each bin and empties the bin if it is at least half-full. Otherwise he would skip the bin and drive to the next bank.

The figure shows how the service is organized. At the top level, the service is represented on a provider-to-client point of view. The clients are the residents and the service rendered is the collection of waste glass. The service is operated by a private waste collection company or by the local authorities. On the service level, two business processes are operated: managing the waste-bank park and managing the rounds. The first concerns supervision of the park and that basically means adding new bins and up-keeping the banks. The second deals with the organization of the rounds by planning and allocating trucks. This is generally done on statistical (historic) basis combined with the experience of the truck driver. A third level shows the technical services and structure used by the service.

The M2M-Enhanced Vertical Application

Starting with this basic scenario, the collect can be optimized if the driver knows ahead which bottle-banks must be emptied. This is possible with sensors in an M2M network [8]. It is a vertical application because it supports only one specific service.

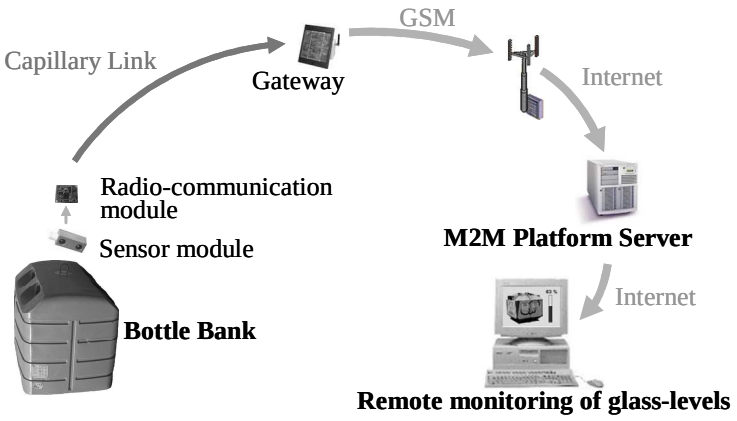

Fig. 2. A vertical service for waste glass collection.

The principals can be seen in figure 2. In the bottle-banks, to measure the glass-level, bins are equipped with ultrasound sensors. Communication modules link them to gateways placed not too far away. The entire park is covered in this way and the data collected is relayed through the telecom network to an urban service platform. Here the information is aggregated and processed to optimize the collect rounds. The results can be seen by the waste collection company. The service is run by one SME

deploying the sensors and running the network alone. The firm will simultaneously operate the urban service platform, collect data and optimize rounds. Organization is straightforward and the data belongs to one company.

Figure 3 shows how the M2M service (shaded) is solicited by the initial service. Only the telecom service (not shown) between the gateways and the urban service platform is not directly under the control of the SME.

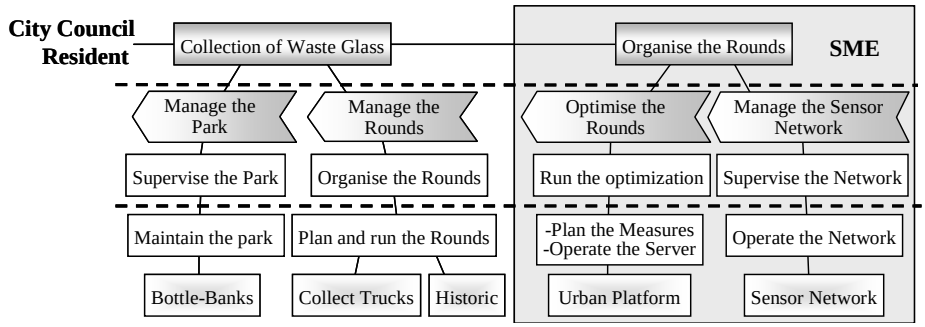

Fig. 3. A new service is provided by the *SME* to the waste collection company.

To optimize the rounds it is necessary to specify what data is needed. The glass-levels must be monitored. Technically it is necessary to plan the measures and collect the data on the urban service platform. Server operation and support also have to be insured. The management of the sensor network requires identification and supervision of the network devices. They must be installed, maintained and operated.

2.2 A Global Urban M2M Infrastructure

An Urban M2M Infrastructure

The vertical organization described above is not optimal in terms of resources. The service provider must run everything alone. Also it must use the telecom network as a client and has no way to insure continuity and security of data in case of network failure. It is proposed to build an infrastructure capable of supporting different services. The services will cover a coherent field of activities, such as city community-services. The glass collection example will be just one of them. The overall architecture of the system is illustrated in figure 4.

In the figure, data is collected on the left. Sensors are positioned in the city to meet service-requirements. Basically the system is the same as before, but this time, before sending information to the service platforms (for each service), a distinct urban collect and command platform must deal with data confidentiality and brokerage. The infrastructure has to know who is allowed to access what data. Additionally, the platform will deal with issues like device-managing, and for example, instructions can be relayed to the sensors to modify measuring times. Detection of new installations will also be done.

Services are deployed on the right. The urban collect and command platform organises the data and safeguards. It takes care of legal issues like access to data, security and privacy. Service-provider platforms are connected to the collect and command platform via internet and pilot different service-offers including web services or SMS alerts. The information is made available to local administrations and residents.

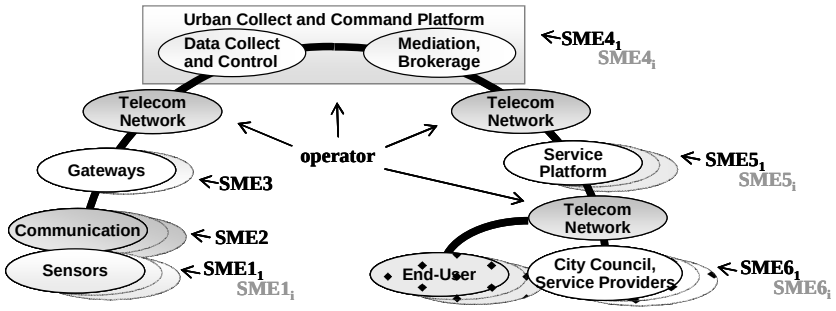

Fig. 4. M2M services with a common infrastructure. The SMEs participating at each level are represented (*SME1$_1$, SME1$_i$, SME2 …)*

Service-Oriented Network

To clarify complex relations between partners, the infrastructure can be understood as B2B services interlinked together.

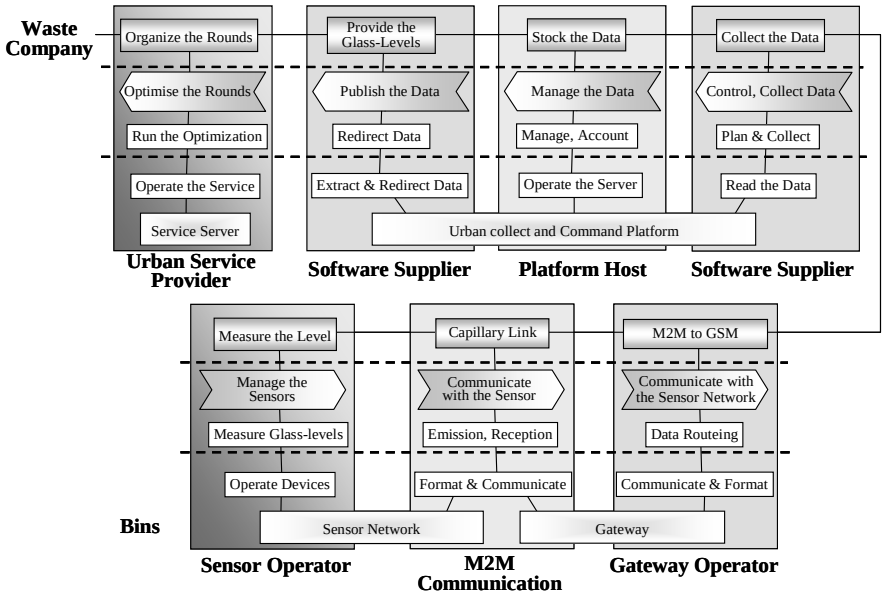

Fig. 5. Simplified diagram of the complementary M2M service with a common infrastructure.

Figure 5 shows the supply chain in the case of waste glass collection. The diagram starts with the waste collection company addressed by the M2M service. The main service provided by the first SME deals with the organization of the collection rounds. To obtain data for optimization, the SME must acquire the glass-levels published by the urban collect and command platform. Within the platform, data must be managed to know who can receive what information and an account of exchanges must be kept for records and billing. And so on, down to the last service that is the measure of glass-levels in the bins.

It should be noted that any one SME can cover multiple services in the supply chain. For instance, the service provider could own and operate the corresponding sensors. Although some of the actors of the chain are more product-oriented they must at the least ensure upgrading for technical, legal or other necessary evolutions.

Of course the full process is more complicated and the schema has been simplified in order to get an overall view. For example, the service provider must exchange information with the system concerning sensor-management, particularly for security and ownership issues, but also when new sensors are added or resets are required.

3 Opportunities and Limits of a Network of Enterprises Providing Environmental Urban Services

Vertical services cannot be considered as optimal from an environmental perspective. This section will discuss some of the implications of the passage from single business vertical applications to a common infrastructure for city services as seen by the project SensCity [10]. This French funded project seeks to build a network of SMEs behind a telecom operator, Orange/France, with the support of university laboratories. Its goal is to construct an M2M backbone capable of supporting a variety of services using data collected through a city-wide sensor network [11]

Environmental Pressure

Pressed by the European Commission, governments and public opinion, new products and services developed today should integrate environmental concerns. As a major operator, Orange cannot ignore the environmental impacts of new services. Its' president-general director stressed "in effect it is essential to review in depth our economic models to favour sustainable modes of production and consumption" [12].

Within the network Orange will incite the SMEs to review their products and services in a move towards eco-design. The SMEs are very receptive to this, and some, like BH and Azimut - two French service companies - have already moved this way at their own initiative. Conditions are good so that mutual stimulation will enhance this trend especially from the more environmentally conscientious partners. It is nonetheless a large step to take with new skills to gain and coaching from Orange and the university partners in the network is much expected.

Optimal Size

From the point of view of the operator, Orange is too big to develop all the

applications necessary to invest new markets like M2M. It obviously cannot pretend, for example, that it will develop solutions internally to resolve the optimization of waste glass collection. Orange has become more and more dependant on its supply chains. It needs some insurance that suppliers meet certain standards and it must have a view of future trends in the telecom network. The success of the network of SMEs would allow Orange to create the conditions for a solid infrastructure capable of quickly adapting to changing markets. In return, the SMEs are capable of rapidly integrating new tools even if their small size does not allow them to penetrate the market alone. They also have a lot to gain in credibility if the project succeeds.

Delegation
When entering the M2M consortium the SME concedes parts of its service to other specialized companies. Instead of having to deal with all the aspects it can concentrate on the real added value of its core skills. For example, communication will be advantageously covered by specialized SMEs. They would be more capable of upgrading to national and international standards and normalizations and ensure long term competitiveness. Issues of security, communication and other such tasks would be assumed by the best partners.

The advantages to be gained by all are evident, but the system has limits that must not be ignored. Dependence on other SMEs is not without risk, for example, communication protocols and technologies may fail to meet expectations. Another point is that large firms like Orange can be long in taking decisions and tend to ignore the imperatives of the smaller partners. There is a large gap between an experimental project and a serious business offer and the small SMEs must take care and continue developing their own markets not to end up trapped by the operator's hesitations.

Territorial Advantages
Instead of continuously piling up new vertical services, each with a new infrastructure, a backbone capable of supporting multiple services could certainly improve environmental performances of cities. When an operator like Orange makes an offer to a town or agglomeration it means that a complete network can be adapted to the city. New services could be added without rebuilding the infrastructure, and that potentially means environmental advantages from sharing facilities. Equipment doesn't necessarily have to be duplicated and catering for many applications simultaneously would be advantageous. Human resources can be engaged when a critical size is reached, allowing for professional intervention for installation, maintenance and end-of-life treatment. Finally the service rendered to its' residents would be both better and more environmentally efficient.

4 Conclusions and perspectives

A service-oriented architecture for a network of SMEs behind a larger-sized operator has been studied. It helps clarifying the passage from vertical M2M services to an infrastructure for environmental services in the city and was applied to the case of the French project SensCity. The main consequences of the infrastructure were identified

and examined for different points: environmental pressure; optimal size; delegation and territorial advantages.

The advantages of the infrastructure could easily be extended to other waste collection schemes. Organised collection of carton and paper, metal or organic waste could be promising. Other environmental services like public lighting, pollution and noise measurement are also concerned. The list of potential environment-friendly applications is long.

Future work should explore the mechanism of the transformation that the SMEs providing such services must go through. It should determine to what extent it would be a necessary evolution for sustainable high-technology environmental city-services and whether it could be a key for successful innovation in other domains as well. In parallel the conditions for obtaining real environmental gains must be pursued.

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