

ADDRESSING THE BILLING NEEDS FOR THE INTERNET OF SERVICES AND THINGS

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ABSTRACT

The deployment of *the Internet of Services and the Internet of Things (IS&IT)* is a challenge that goes hand in hand with the convergence of a global system of telecommunications. This migration, also known as the emergence of the Next-Generation Networks and Services, is based on all-IP enabling technologies. Such networks transfers voice, data, and multimedia traffic over the Internet, providing users with the information they want in any format, amount, device, place or moment. Still, there are many issues to solve until accomplishing a complete deployment of the IS&IT. For instance, one of the main constrains for its deployment is the lack of appropriate business models and enabling technologies such as all-IP. Among the challenges of these constrains, we focus on the problems of billing. In this way, we introduce the problem of billing of Services and Things presenting the aims and motivations for performing this PhD research. We also detail the used methodology, the reason that motivates this work research and the work done so far.

KEYWORDS

Billing, Internet of Services and Things, All-IP, Information Systems.

1. INTRODUCTION

The history of computer engineering and the Internet started in the decade of 1940 and 1950 respectively. This scientific discipline is in its early childhood compared with other sciences as mathematics, chemistry or physics. The last century has seen a tremendous evolution in technologies, infrastructure and working methods. These changes were caused by a reactive approach to face the needs of the moment, being a paradigm working many years.

Nevertheless, the new challenges posed by the Internet of the Future, understood as defined in the declaration of the European Union (Union2008), require new efforts to maintain competitiveness and technological leadership of Europe and other international actors. The main areas of research are the accommodation of all user ideas and requirements (Internet by and for People), the interactive multimedia content everywhere and easy to search (Internet of Contents and Knowledge), the communications of context-aware autonomic objects (Internet of Things) and the consumers enjoying permanent, seamless and confident services (Internet of Services). From the presented work fields, this research focuses on the Internet of Services and in the Internet of Things.

Indeed, the Internet of Services and the Internet of Things rests on different enabling technologies and infrastructures. Our scope will focus on the future network infrastructure for efficient data management coming from many heterogeneous environments, also considering aspects such as security, and energetic and economic sustainability.

These fields are gathering more relevance via the software engineering evolution. It is migrating to the paradigm of the *software as a service (SaaS)* and the software as a thing: tools that were previously executed on a single computer are now being distributed into everyday objects. In addition, services are offered pervasively integrated in every day objects due to the process of convergence between the IT and telecommunications industries. Notwithstanding, the industry is working in services that are composed of standard software components and delivered over emerging network technologies (Ryan2004). This convergence also known as Next-Generation Networks and Services will have an All-IP backbone as underlying medium.

This process has brought new dares for research and development. The industry and academia have many engineering goals to accomplish. Among them, this thesis will focus on the scope of the applied research and the technical development of innovative methods, models and prototypes. Nonetheless, one of the main constrains for this deployment is the lack of appropriate business models and technologies.

Traditionally, services used to be technologically dependent and the service providers needed custom-made solutions, with the costs and efforts that this design implies. Therefore, the studies in the area of billing for the Internet of Services and Things are still emerging. In our research, we understand billing as a full process that includes the service usage, mediating data, rating, billing and invoicing it and securing of it against digital fraud. Each step of this process has many literature and implications to consider and work on.

2. AIMS AND OBJETIVES

This PhD research aims at investigating the methods of billing the Internet of Services and Things. Billing is one of the roots of many different sectors and organizations, such as telephony, multimedia contents broadcasting, digital television, energy or many others. Thus, the economic sustainability and the revenue management of these organizations require improving the billing processes.

Hence, the contribution of this thesis intends to be five-folded. First, it provides with an accurate state of the art regarding billing. We study specifications published by different standardization organizations, research projects deliverables and contributions, commercial products, platforms and frameworks solutions. We also compare the existing work with an empirical measure, considering aspects detailed in Section 5.

Second, it presents different pricing schemes making a full taxonomy and a comparative between them. More accurately, these pricing schemes represent how the client of a service is going to be charged (e.g. pre-paid, post-paid, time-based, volume-based, QoS-based, session-oriented or content-based).

Third, in the implementation phase, we will deploy a generic implementation of a payment system following the directives of the Next-Generation Business/Operation Support Systems. This payment system works as a billing framework and will be the test-bed for testing and experimentation of the next research steps.

Fourth, it brings the traditional energy billing systems to the word of the IS&IT creating a new service specification that achieves the migration. We also consider the implications and how to perform the migration to our model.

Finally, it studies the new Business/Operations Support System possibilities of, for instance, fraud management, customer usage, rating and billing, marketing, client resource management or provisioning. We will especially focus in the fraud management and in the customer usage or experience.

In conclusion, this doctoral thesis contributes to the state of the art of Internet IS&IT through the definition and development of a billing framework that expands the existing work into a new frontier.

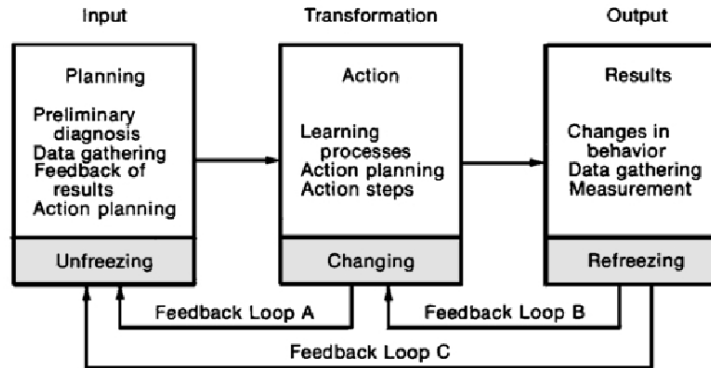
3. METHODOLOGY

In order to investigate on billing for the IS&IT, we have to manage a vast amount of background reading and internalizing of the enabling technologies and infrastructures. Specifically, we also need technical reading, keeping up with daily news, business models and directions taken by the involved actors.

In this PhD research we are using the action research methodology. This methodology is a reflective process of progressive problem solving led by individuals working with others as part of a “community of

practice” to improve the way they address issues and solve problems (Stringer2008). See Figure 1, created by the author (Viktor2009), for further details of this research methodology.

Figure 1 Systems Model of Action-Research Process



In addition, we will use the Scrum methodology (Palacio2008) for the management of the thesis work. Despite it was intended for management of software development projects, it can also be used to run software maintenance teams, or as a general project/program management approach as in our case.

Regarding aforementioned phases (see Section 2); we will begin studying the state of the art of billing and the different pricing schemes. Next, we will start the phase of developing a generic implementation of a payment system. Later on, using this framework, we will define a new service specification to bring the traditional energy billing systems to the world of the Internet of Services and Things. Finally, in the last step, we will study new Business/Operations Support System possibilities.

Throughout the whole thesis and when we have representative results, we will spread these results for the endorsement of the scientific community and industry. Once we have met the original objectives, we will proceed to close the research with the final version of the dissertation.

4. MOTIVATION FOR THE RESEARCH

Billing has been an important research area for many organisations over the past years with many publications, conferences and workshops. Hence, the main motivation for this PhD research is to complement and extend the existing work contributing to the current discussions of billing in the Internet of Services and Things.

This PhD research considers the international strategic line (Vasco2006) of development defined for the Internet of the Future. The project fits into the following specific items of the scientific-technological area:

- Information and Content.
- Technologies for the treatment of content.
- Software Technologies.
- Standardisation.

On the other hand, from the enterprise applications point of view, the research is related to:

- Information systems.
- Communications.
- Fraud detection and prevention and billing.
- Information and Content.
- Intelligent digital environments.
- Advanced software management.

5. WORK DONE SO FAR

We have performed an initial study of the state of the art of the different standardization organizations protocol specifications (e.g. SG3, NGNFG & SG13, AAA, IPFIX, IPDR, Netflow, LFAP, CRANE, and Diameter). The study summarizes a comparative of these protocols using an empirical measure which considers the following aspects: design goal, data representation, protocol flow, meter reliability, sampling capability, overload behaviour, timestamps, time format, flow expiration exportation, information model, flexible flow record definition, congestion awareness, data reliability, IPSec and TLS, application-level security, push and pull mode reporting, regular reporting interval, notification on specific events, anonymization, several collecting process capability, and data model extensibility.

Moreover, we have started a set of experiments creating a first prototype of the billing framework and a fraud management system for Voice over IP services that works as a Business/Operations Support System.

And finally, we have already achieved the following publications on the research of this PhD. The publication BLINDED-A (2009), is a contribution to the service specification of Voice over IP (VoIP) for the IPDR billing protocol. In BLINDED-B (2009) we present an introduction to the semantic web and BLINDED-C (2009) introduces a fraud detection system than can be adapted to any service or domain.

6. CONCLUSION

The relevance of the Internet of Services and Things is going to increase. Its deployment is going to be pervasive and the services will be embedded in distributed objects becoming an extension of real-world applications, leaving the eggshell of traditional computer systems.

The billing of these services is one of the most important factors in order to ensure the economic sustainability and the revenue management of the organizations that offer emerging services. There is a whole area of research in billing: from the service usage, the data mediation, the rating, the billing and its invocation. This PhD research aims to cover all these billing process aspects contributing to the successful establishment of the emerging Internet of Services and Internet of Thinks.

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