SHOPS: Towards a Secure System for Identity Management and Payments in the New Electrical Market

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Abstract. By the year 2010, the liberalization of Europe's utilities industry has created a dynamic market of production, distribution and reselling organizations where quality of service, personalization and smart marketing, as well as an attentive attitude towards ecology and preservation of resources play a major role. Advancement in information technology in domains such as remote monitoring, communication networks, security and control of distributed systems, as well as innovative payment schemes enable new ways in which customers consume and pay for their utility services. SHOPS has developed an open, cross-domain and platform-neutral system for describing the services for different equipment and applications. The developed technology allows the reduction of the cost and time for launching new equipment and applications. SHOPS architecture is based on advanced communication networks and web technologies.

1 Introduction

SHOPS is a European research and advanced development project with the objective to propose an open, cross-domain, platform-neutral system. It will support advanced functions for the payment of home fluids and utilities leading to innovative solutions and opening the door to new generation services.

From a strategic point of view, the main innovations of the project are the design of the global architecture and the definition of common services in utilities (gas, water and electricity). The definition is independent of the used systems (operating sys-

tems, physical resources, networks, etc). The project proposes a framework that evolves towards open architectures and payment standards, promoting the natural integration of domestic services.

From the perspective of the environment impact, SHOPS will help to make a rational use of the energy contributing to a better use of the natural resources through a control over the production, distribution and consumption.

2 Customer Requirements

Customers are looking for easy to use solutions, price and convenience. Some of the services that the system has to provide to fulfill customer requirements are:

Consumption: The system must offer the possibility of buying a punctual consumption or subscribing to a continuous consumption at home or elsewhere. These are the main services provided by SHOPS.

Information services: Information must be able to be received by email, internet, digital television, or SMS sent to a mobile phone, depending on customer preferences. These services could be a basic subscription, an option for information or a dedicated subscription.

Consumption simulation: The residential customer should have the ability to use simulation to buy a fluid more efficiently. The retailer can provide a comparison of the current consumption and the simulated one, and the customer could evaluate if consumption can be reduced modifying scenarios.

Delegation: The customer must be able to hand over the activation of equipment to its Retailer, who can, for example, remotely reduce customer home power consumption during peak hours. Automatic reduction must be defined so that it not reduce the power supply of critical devices. For example, consumer specified priority order should be defined.

Consumption monitoring: The system offers to the customer the capability of monitoring consumption through a web page, a mobile phone or digital TV at any time.

Integrated Invoice: One of the main services increases the user's comfort by providing a standard integrated invoice for some services such as electricity, water, gas and telecommunications applications.

Roaming: The consumer must be able to access the system (such as getting a supply of energy, managing his account, etc) elsewhere than in his usual consumption location with the advantage of adding the price of this consumption to his normal subscription.

Payment: Payment is one of the most important services provided by SHOPS. Payment system must offer a wide set of payment methods. The selected mode must depend not only on the environment or device in use, as it is also important to take into account customer's preferences.

SHOPS integrates differentiation strategies for utilities and push value (competitive pricing, discounted bundles), convenience (single point of contact, one bill, 24-7 multi-channel communications), innovation (new service and pricing packages, ser-

vice management) and simplicity (easy to use, coherency) in its service offerings / functionalities.

3 SHOPS Proposed Solution

In order to fulfill all the new requirements, a new vision of the electrical market was studied and the needed technologies were analyzed to provide the correct solution to each of these challenges.

An important goal of SHOPS was to provide maximum flexibility by means of an integrated infrastructure for new services, especially from a Customer's point of view. SHOPS is attractive enough that services built on top of SHOPS by Retailers will appeal to Customers such that they would like to join SHOPS as a User.

The wide variety of actual electrical networks in various countries makes it difficult to capture in a single model all the business opportunities that can arise, but in order to exhibit the basic opportunities that can lead to actual business cases, some basic rules have been placed by SHOPS on the one-to-one relationships between the actors:

- All queries of Customers go through its Retailers, whatever the matter be;
- All network equipment – meters, circuit breakers, etc. – are often owned by the Distributor;
- The actual business relationship between the Retailer, the Distributor and the Supplier is out of SHOPS' scope;
- The Retailer may only control a Customer's piece of equipment in contracted delegation.

It is important to remark that the user interface has been taken into account and for the final solution, different interfaces have been considered (the user can interact to the system through a PC connected to Internet, through a kiosk, a mobile phone and interactive TV), all of them using a similar interface and then reducing the total amount of time and effort that the user should devote to learn how to use the system.

4 SHOPS Market

In a more and more competitive market, differentiation is decisive. Utility companies see the customer service as the key factor in their differentiation strategies because dissatisfaction is the number one reason for customer churn. In Europe, in the utility scope, deregulation started in 1989 and the situation was formalized with the European Union directives to liberalize markets in gas (1998) and electricity (1999) and further improvements to that legislation. Deregulation of the market has already now increased the offers to customers in deregulated countries and will continue increasing the opportunities to companies that are offering services in this market. This means that different retailers can provide their services to one user getting the energy

from one distributor. This implies that the retailers should differentiate from their competitor with a special offer, which might not be exclusively focused on price. This special offer should include additional services, interfaces or even functionalities. For this reason, services may be determinant for customers when selecting a company.

SHOPS' vision of the future describes a highly connected world in which all customers consume and pay their utility services. As a matter of fact, information technologies specifically those of telecommunications are now widely developed (with increased mobility, growing interconnectivity, emergence of fixed mobile convergence). In this context, open systems such as SHOPS represent a great field of innovation, able to support advanced functions for the purchase and payment of customized utility services as well as propose new and innovative service offerings.

Market Deregulation in electricity and gas opens new perspectives and opportunities for more competition and innovation on the utility market. After almost 50 years of static environment, deregulation is forcing painful and radical changes. While some incumbent utilities are in a position to bar the door and say you cannot install specific technologies connected to the grid, many others are pushing new technologies to leverage their operational performance. Energy retailers will have to offer attractive products to energy end-consumers. Utilities will have to develop both better pricing and differentiation while at the same time being compliant with the regulatory framework.

The major target market for SHOPS is in developed countries where utility markets are both deregulated and competitive (where the incumbent no longer has the monopoly, even though the market is open to alternative suppliers). UK, Denmark, Norway, Sweden are currently concerned and Belgium (all the three regions) and Finland will be concerned as of July 2007.

This market is estimated in terms of energy (gas and electricity) consumption purchase and currently amounts to be $60 billion with 94 million residential with a $28,216 GDP/inhabitant. Among those $60 billion, roughly 10% could currently be captured by SHOPS (10% broadband subscription rate in average for these countries), this is a $6 billion market. With the hypothesis of 5% additional turnover for services linked to the commodity supply and of 15% additional turnover for other services (telephony, etc) the market for SHOPS amounts to be $7.4 billion.

Utilities' interest in SHOPS will then remain the main criteria to define from those $7.4 billion the core target for SHOPS.

A secondary target market for SHOPS is in developed countries where utility markets are deregulated but still concentrated with marginal competition because of the former dominant position of the incumbents, either at a national level (e.g. France) or at a local level (e.g. Germany). In this case, new entrants have entry barriers and have to be very aggressive and customer-attractive to gain market share. Moreover development of dual fuel offerings (e.g. gas and electricity) is an opportunity for creating new dynamics on the market. But in that case, business models have to be considered carefully because of small customer portfolio of new entrants. France, Italy, Germany, Spain and Netherlands are particularly concerned as of July 2007 (date for mass market deregulation in those countries).

This market is estimated in terms of energy (gas and electricity) consumption purchase and amounts to be $171 billion with 290 million residential with a $25,471

GDP/inhabitant. Among those $171 billion, one third may be captured by SHOPS (IDATE estimates that in 2007, one third of European households will have a broadband subscription), this is a $56 billion market. With the hypothesis of 5% additional turnover for services linked to the commodity supply and of 15% additional turnover for other services (telephony, etc) the market for SHOPS amounts to be $68 billion.

Utilities' interest in SHOPS will then remain the main criteria to define the core target for SHOPS from those $68 billion. According heterogeneity of utility markets, there is no common business case for SHOPS. In particular, European diversity of context will have to be carefully taken into consideration as SHOPS is created, marketed and delivered.

SHOPS platform concerns utility companies, service providers or business partners having their own business model and priorities as well as many other industries (telecom, multimedia, security and home automation…).

5 Technical Solution

The issues solved by the solution provided by SHOPS project can be summarized in the following subjects:

- **Distributed architecture and interoperability**: Different actors collaborate in the system in order to provide the necessary functionality. Each of these actors can be located in remote sites and use different kind of information systems. Access and interoperability among all of them must be assured.
- **Customer strong authentication**: Final customer interacting with the system must be authenticated to avoid misuse of system and fraud. Alternative authentication methods are offered for different security needs.
- **Identity and authorization management**: In a distributed architecture, like SHOPS' one, customer identification and services access authorization management is provided in a unified and federated way to facilitate system use to final customers and to simplify service management.
- **Roaming of services**: System final customers must be able to access their local services from a remote location, thus roaming of services among different locations and providers are offered.
- **Payment management**: Payment of services in a secure way are provided. The payment for a service is split among several providers, so accounting, billing and payment services are provided for this option.
- **Metering**: Different fluids consumption is metered for different clients and possibly from different locations. Different kinds of meters with different functionalities are taken into account.
- **Connection with legacy systems**: Most utility companies have proprietary information systems that should be connected with SHOPS systems in order to interoperate. A common interface for connection to legacy systems is provided.

– **Security issues**: Being a distributed system, SHOPS addresses different kind of security issues: communication channel security, data security and integrity, security of the SHOPS system code, authentication of final customers and assurance of the privacy of personal data.

SHOPS has developed a system model to warrantee that all elements are interconnected and have interoperability in a way that the electrical market can offer new services and functionalities to final users.

5.1 Technologies for the development

The different technologies used for the development include:

– **Internet technology and Web Services:** Nowadays, the most used communication network for distributed systems is Internet. This technology gives the possibility of providing services at any site on the network and accessing them from a remote location without the necessity of installing specific client software; customer mobility, independence from the terminal devices and from development platform is assured. In this context web services (WS) allow organizations to use business applications that share data with other modular programs, over the Internet. Besides that, web services are platform-independent applications that can be easily published, located and invoked using standard web protocols. Federated identity is an important requirement for services-oriented architecture (SOA) environments. The ability to enforce, leverage, manage, and control identities across different organizations, while also performing functions such as Single Sign-On with Web services, are driving standards and supporting tools such as Security Assertion Mark-up Language (SAML), Liberty Alliance, WS-Security, and WS-Federation.

– **Metering:** Metering fluid consumption is more than just a question of technique. Meter devices must comply with legal requirements in order to be deemed authentic in case of disagreement on the real consumption. They also must propose a common well-known interface to be used by different utility providers. Best way to achieve these two issues is by conforming to widely recognized electricity metering standards. There are a lot of different standards used by utilities around the world, but most can trace their origins to either the American National Standards Institute (ANSI) or the International Electro technical Commission (IEC) standards. Nowadays, the commercial value of meters depends more and more on their interoperability and system integration. ANSI and IEC propose a set of standards for each concern: electricity metering equipment and communication protocols for electricity meters.

– **Payment:** Web services based technologies offer a way to implement a standard and secured payment service, so all technologies related to Web Services and Web Services Security (WSS) are addressed: XML, SOAP, WSDL. For payment over the Web, security is improved for both customer and merchant without too many constraints. New payment technologies, like VISA 3D Secure ™, will be used for payment by credit card. It provides basis for global interoperability of Authenticated Payments. Payment should be addressed by clients in the same way inde-

pendently of the terminal used (PC, PDA, mobile phone or digital TV), so that not only the use, but also the time needed to learn how to use the service is minimized. In this way, the inclusion of any new device for accessing a service will be considered natural.

5.2 Security assurance

Usually, the security objectives depend much on the used application as well as the position of the user device (home, mobile, public etc.), and of course the used networks.

Single sign-on system requires simpler procedures but different attitude from the user than the traditional systems where the access control is totally distributed between the different servers/services and there is little or no co-operation at all between the services.

End-to-end secure channel, on the other hand, is of pure responsibility of the participating entities (in SHOPS case the user and the service), at least in many of the existing implementations. The threat is how to introduce the user and the service to each other so that they trust each other and can start the communication. The de facto solution for this is PKI (using identity/service certificates) and the password establishment that is done off-line (prior to the actual communication of valuable private information, for example financial transactions). The means of security in end-to-end communication has traditionally been relatively complex, and as such, not very user friendly. However, this is changing as the biometric sensors and their business application are evolving to the acceptable levels of standardization, robustness, quality and price.

When defining the target of security objectives in SHOPS, it could be taken the viewpoint of security of the subsystems, or keep the objectives in general level and regard subsystem security as an implementation issue. There are various networks and involved parties that may have obvious impacts on the security objectives and requirements. The user device also include an important part, a web browser client that provides for the end to end security from the end user device all the way to the service provider or payment broker's server.

Securing of all kind of data must be taken into account from application data to system software code when necessary. Data should be encrypted not only when being transmitted but also when stored depending on its sensitivity. Customer privacy related data should be specially protected to fulfill national and international laws.

Taking into consideration all the regulations and their specific requirements related to user identity and payment management, SHOPS project makes use of Liberty alliance and biometric technologies (by enhancing the level of user's authentication) in a well specified fashion.

5.3 Technology for Identity Management

Liberty Alliance is a global body working to define and drive open technology standards providing specifications, privacy and business guidelines for federated identity management.

In Liberty context an identity consists of traits, attributes and preferences upon which one may receive personalized services that could exist online, on mobile devices, at work or in many other places.

The maintenance of privacy and identity control is paramount in the Internet world, yet customers also demand ease-of-use and rapid access. To achieve this Liberty proposes to create a federated network identity over different circles of trust.

Federated identity allows users to link identity information between accounts without centrally storing personal information. Also, the user can control when and how their accounts and attributes are linked and shared between domains and service providers, allowing for greater control over their personal data.

The Liberty Alliance lays down on Circle of Trust (CoT), which is defined as a federation of service providers and identity providers that have business relationships based on Liberty architecture and operational agreement. Therefore, in this context SHOPS' members will form a CoT, which creates a trusted framework in which user can transact business in a secure and seamless environment.

6 Conclusions

The liberalization of the Electrical Market opens new opportunities to the distributors and retailers that can benefit the final users. SHOPS project has developed an open, cross-domain and platform-neutral system for describing the services for different equipment and applications and the interfaces between the different actors have been defined. The developed technology allows the reduction of the cost and time for launching new equipment and applications, and warrantees the security levels required for different kind of transactions and uses Liberty Alliance for managing the user identity in a federated way. SHOPS integrates differentiation strategies for utilities providing maximum flexibility and considering user requirements.

For the developments, different technologies have been used, and security requirements are accomplished using different authentication levels joined with identity management following Liberty Alliance specifications and more specific common guidelines.

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