E-BUSINESS FOR THE ELECTRICITY RETAIL MARKET
A Business to Client perspective

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Abstract: In the new deregulated market of the electricity industry the communication and e-Business infrastructure plays a main role for the efficiency of all the entities present in the electricity sector. From generation to the final client there are two markets, the wholesale and the retail market. Specific characteristics of the electricity industry make the communication support a fundamental tool to reflect the changes made by one of the intervenients in the whole value chain. When prices change at the wholesale market it is necessary to reflect them at the final consumers. Without a bidirectional and reliable communication systems several problems could occur, from spikes in the electricity prices that could take retail companies to bankruptcy, to huge blackouts that happened in Europe and in the United States. The goal of this paper is to present a model for the electricity retail market. Several studies have been done about the electricity markets, the grand majority focus their attention on the wholesale market. Our proposal is to analyse the e-Business communication structure in a Business-to-Client perspective.

1 INTRODUCTION

Deregulation brought the segmentation of the electricity industry. From generation, passing through transmission and ending at the distribution sector, all are separated from each other. During the nineties several countries have adopted this structure. Nevertheless, the traditional utility model still exists. Generation, transmission and distribution all belongs to the same entity which have a monopoly or an oligopoly economic structure. Nowadays in the developed countries customers become the focus of energy and energy service providers. This means that generation sells it's commodity in the wholesale market to retailers that distribute to the consumers. Transmission of electricity is usually done by state regulated entity to clarify and avoid market influence.

The aim of this work focus on the development of a electricity retail model that enables market efficiency growth with the existence of the retailer entities, and the importance of a Business-to-Client communication infrastructure to improve better quality of service to the final client.

There are three different types of clients, industrial, commercial and domestic, as a consequence different types of needs and different types of load profiles. Without the impact of price oscillation at the final client, it is impossible to provide profit to the entities of the deregulated market for new generation systems, maintenance and to provide a new set of products besides electricity.

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Studies developed in several countries, where electricity deregulation is a fact, where conducted to characterize the retail clients behaviour (Cunningham,2001). The analysis of this information is of main importance to build a retail e-Business system that answers to clients expectations.

To model the electricity retailer reality we used a UML representation The UML e-Business model of the electrical retail company is presented in Fig. 2 identifying all its components, requirements and interactions.

In this paper an e-Business model of the electrical company is presented, and as demonstrated will improve customer response, company efficiency, and time-to-market response at the wholesale market where is crucial to trade well for a better sell.

This paper is organized as follows. In section 2 three market models are presented and analysed. In section 3, the UML retailer B2C model is presented. A discussion of the model proposed is done in section 4. Requirements for security in this kind of markets are evaluated in section 5. The conclusions and future developments are at the paper end in section 6.

2 MARKET MODELS

The electricity retailer is the unified entity of the e-Business structure that could improve benefits to both sides, generation and final clients. The e-Business can be supported by an e-market entity based on a web platform. At the B2B side the retailer acquires the electricity to sell, by bidding on a power market or by establishing bilateral contracts with the wholesalers. This paper is focused on the B2C side of the e-Business retail model. Consumers will be encouraged to renew the metering structure of the electricity business. Smart meters with web access are the resort of the last mille to implement, allowing a bidirectional communication structure that will permit the access to billing and services, structures all based on a web platform. Considering the web as an open space with multiple market scenarios, what will be the best scenario, most efficient, bringing win-win relations? Three different types of markets are possible to analyse assuming that all clients have a real time price tariff as shown in Fig. 1.

In the first case we have a retailer for a group of clients, where any client could choose his retailer, this structure is used in the countries where deregulation has arrived, it doesn't allow a dynamic change between suppliers.

The second model proposed, allows a dynamic retailer multi-choice. In fact what is proposed is a B2C web market for the electricity retailer. This web structure have several advantages for both sides of the business, clients could get the best price, retailers don't have to support the huge variation on price at wholesale market, where prices could increase more than 100% in one day. Nevertheless it must be defined a time restriction for a change of retailer. This is done to protect retailers investments and discourage unfair clients who won't pay theirs bills and are always changing from supplier, issue that is focus below in the electricity retail market structure security.

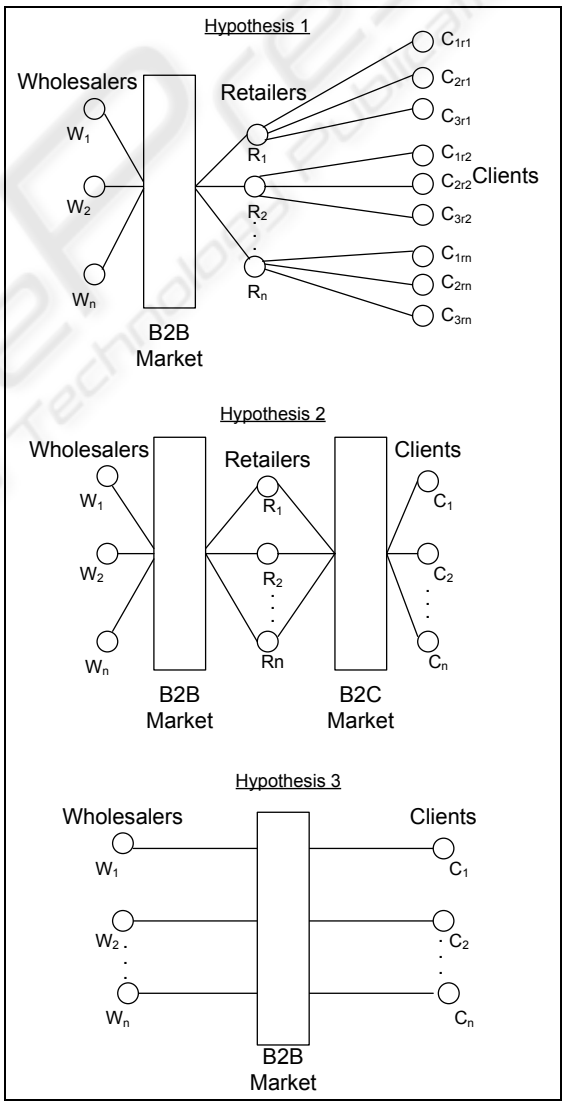

Figure 1: Hypotheses for a B2C retail market

The third hypothesis is an answer to how important is the retailer presence in this type of market, by assuming his overtaking on the electricity wholesaler market. Let's suppose that the final clients with real time price could have a direct access to the wholesale market, what is a fact in same traditional outlets markets (O´Sheassy, 2003). There are some commodities where this happens but the client is forced to acquire great amounts of the product of his interest, in this case electricity. Because it (electricity) is a continuous function in time and couldn't be stored, this must be done by a bilateral contract, where all the parameters, like prices, quantities, date and time periods are previously settled. Besides that the final client could not have the benefits of real time tariffs if he overtakes the retailer. In addition to that fact, electricity retailers could also have the distribution structure to support which in that case a rent must be established for the distribution lines if the final client buys directly in the electricity wholesaler market.

After the choice of the market model it's important to deepen the electricity retail model to understand what modules he must have for is internal business run, and what connections he has to establish with the wholesalers and on the other side with their costumers. For an e-Business development we should to distinguish two sides of the same business, the B2Band the B2C sides. Their interactions are of great importance not only for the retailer but also to their clients. The good deals done at the B2B market are reflected on the B2C services availability.

3 B2C INFRASTRUCTURE

In this section it is presented a UML model of the electricity retailer. The interaction between this model and the external entities are analysed in sub-section 3.2 e-Business transactions. Ending this section the security requirements of the model analysed is discussed.

3.1 Electricity retail model

Fig. 2 shows an e-Business model for the electricity retailer and the connections with the other entities. Besides the wholesalers and the final clients, as could be seen there is also an Independent System Operator – ISO which coordinates the electricity physical structure. From country to country, this entity can have different levels of intervention in the market. He (the ISO) could operate only the physical structure or also the financial market, regulating the transactions schedule in time. Electricity can be traded in different periods of time ranged from fifteen minutes to several months later, before empowering the lines. The ISO acts like a regulator of the commodity and also of the financial systems.

Following in the UML model several modules are presented. The energy management use case, a crucial module in the retail business, makes the analysis of all the impact decisions. They are made after the evaluation of the saving measures that can be taken to avoid new purchases and a rigorous definition of the quantities to buy.

At the clients load management use case, the loads are elected for automatic cut off or rearm.

The client's consumptions are the business beginning, read by the power meter and sent to the automatic meter reading use case. Every service to the final client, besides electricity distribution and sells, are processed at the financial services use case.

On the other hand, the bids at the wholesale power market are done after the information passed from the forecast consumption use case to the energy management module. Bids are executed by the retailer market management use case.

In the next section the transactions to the outside of the retailer model are analyse.

3.2 e-Business transactions

In the traditional electricity industry the company has to support generation, transmission and distribution costs besides maintenance. The company profit is granted by contracts that are made by the distribution sector with their clients. Deregulation brought the segmentation of the electricity industry, all parts from generation to distribution where separated and new markets where created. Retailers buy electricity from the wholesalers which is then sold to the final clients. Retailer business is well suited to be supported by an e-Business structure, where a B2B relation is established between the wholesalers and the retailer, on the other side a B2C platform is the retailer solution to improve their competence and services to the final costumers. Information and communication technologies are essential for optimal performance of a retailer. Retailers acquire electricity in two ways, by a bilateral contract with

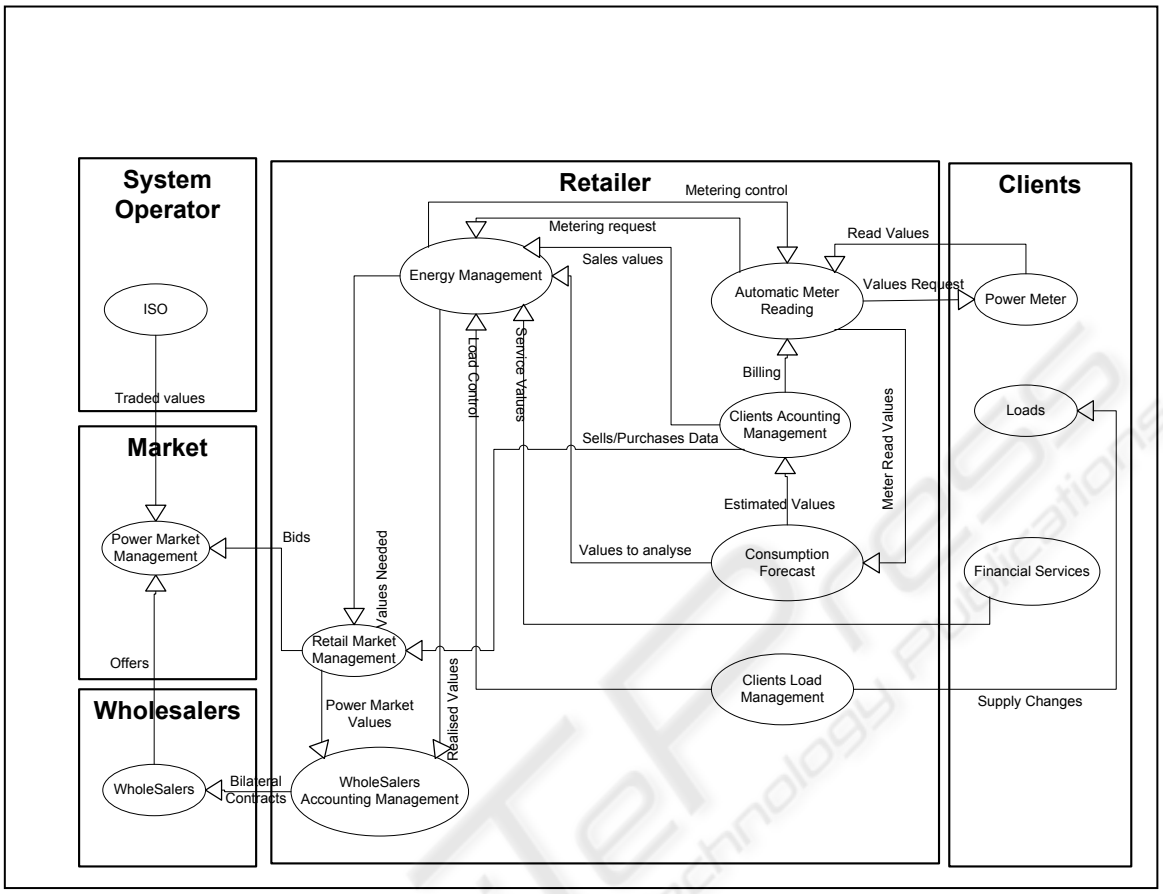

Figure 2: UML model of the electricity retailer system

the wholesalers or at the wholesale market posting bids in an auction (Bower, 1999). As presented in Fig. 3 and Fig. 4 the UML sequential diagrams intends to give a timely perception of the two forms for the retailer get his commodity

Usually at the power market a reverse auction is coordinated by the market operator, trying to match the retailer's bids with the wholesaler's offers. As could be seen in Fig. 3, even in the market where the Independent System Operator is apart from the market operator the trades have to be confirmed by him, usually the day before, because physical constraints could occur.

Bilateral contracts could have several forms, to name a few, contracts of fixed price, fixed quantities, indexed, floating, etc. Nevertheless there are same parameters and operations that are common to all. At first, all contracts are settled between two entities, independent from the system operator. Prices, quantities, dates and period of time, are the usual variables. It is possible to join to the contracts same services for load management, or same different variables like the temperature or oil price (Lafferty, 2001). Besides the fact that the contracts agreements are not revealed, the common parameters above mentioned, must be sent to Independent System Operator before the quantities agreed enter in the power system.

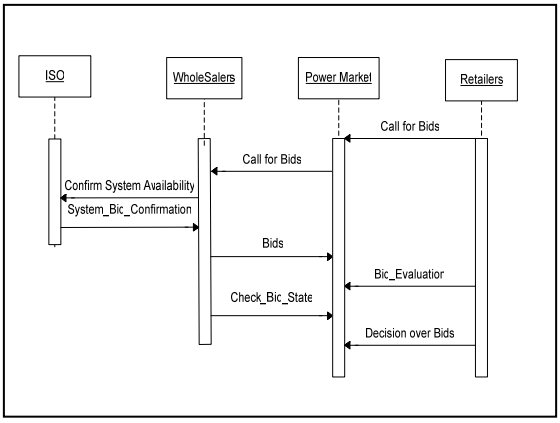

Figure 3: Electricity Power Market

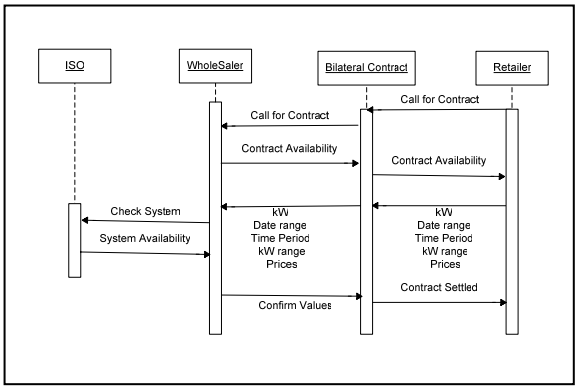

Figure 4: Bilateral Contracts

To the retailer and his client point of view, consumption analysis is relevant information. It helps the costumer to identify his load profile and behaviour, and gives to the retailer important information for energy management services (Gaw, 1998).

The different types of tariffs that could be implemented aren't all supported by the old power meters, but open new possibilities for retailer aggregated services. Real time tariffs are only available for consumers with smart meters and costumers that could have an online communication channel with the retailer. Table 1 presents the four types of tariffs usually available. It is relevant to explain the difference between these four tariffs. Flat tariff is the traditional one. The estimation is based and time blinded, without any variable improvement. It is not possible to adapt for the power market.

On the contrary, Time of Use represents the natural evolution of the traditional power meter here we have a internal clock to distinguished the different periods of a 24 hours day. This way, allows a transfer of the client's loads from peak periods to off peak periods. The price change in a 24 hours day, higher prices naturally at peak periods.

With the evolution of the power metering, the automatic meter reading have is main support in a communication channel. Real Time Price tariff appears and have a direct connection to prices established at the power market (Reed, 2000). The power smart meters responds to inputs readings from the retail centre. This static memory device has internal algorithms programmed to react to market prices oscillation. Besides the direct connection of the Real Time Price tariff, this type is out of phase in time with the wholesale power market.

Dynamic Tariff is the model that in a more realistic way represents a real time pricing tariff varying in periods of half or hour day during the 24 hours of a day. Smart meters could have real time price changes, the communication structure must be bidirectional and have additional algorithms for price adjustment.

To better understand the communication requirements of a retailer, we will analyse the communication process of a client with dynamic pricing tariff. At the first sight, the retailer only needs to communicate once a day, sending the price structure for the next day. A more efficient alternative is to develop a dynamic price web server for this type of clients. This way costumer could access the prices list from the retail web server any time they want.

Table 1: Types of Tariffs

Type of Tariff	Price	Costumers Requirements
Flat	Estimation based. Local meter reading.	Traditional meter
TOU - Time of Use	Prices varying during a 24 hours day where fixed intervals of time.	Traditional meter with an internal clock time periods in a 24 h day.
RTP - Real Time Price	Consumer prices with a direct connection to prices at the power market.	Smart meters that responds to inputs readings from the retail centre.
DP - Dynamic Pricing	Prices varying in periods of half or hour day during the 24 hours of day.	Smart meters with bidirectional communication .

Suppose the same client is participating in a load-reduction program, the retailer might want to know the load reduction as it occurs, in which case the communication from the customer's meter to the retailer needs to be either much more frequent or based on a system that permits the retailer to poll the customer's meter at any time. This second approach requires a meter with multiple communication ports that can send dynamic-pricing and load-reduction programs. The metering communication system needs to move data and instructions between the customer and its retailer, and perhaps automatic-control systems will be needed to answer to time-varying prices. The answer to these situations brings us to reflect what should be the better structure to support these requirements. An e-Business structure

is no doubt, but what type of structure could better improve this B2C platform.

The answer stills in the model presented in the second hypothesis of the market model in section 2, Fig.1 supported by the UML specific model presented in fig. 2 the electricity retail model. This is also supported by the Baligh-Richartz effect where the reduction of number of contacts improves trade efficiency and reduces its associated costs as shown in (Wigand, 2003). Mediation overtakes the incompatibilities between the buyers and the sellers and focuses the attention on the transaction.

3.3 Security requirements

Any kind of web transaction to be successful must be secure, surveys indicate the most important factor that influences an online purchase is the security of that transaction (Malek, 2004).

An issue of great importance is the security of the B2C market, from both sides, the access to the market and the information exchanged are significant values to preserve. On the contrary to other electronic markets the break of the security market not only affects the information but also an huge amount of resources in a directly or indirectly way. An intruder that violates the system could unbalance the market values, and as a consequence the electrical system is affected as all the framework that support it. Brownouts and blackouts can occur affecting all the population served by that market. The structure presented must answer to the basics security parameters, authentication, confidentiality, integrity, non-repudiation in all the online transactions exchanged in this market.

Specifically the first step from the point of view of the market operator is to be sure that the markets participants are who they said to be, to do so an authentication process must be required.

After this process the market operator must have means to ensure the confidentiality of the information exchanged. An encrypted end-to-end method will increase the reliability of the security system.

Non-repudiation is a grant that ensures the responsibility of all market participants, and consequently push them to take measures for their security systems.

If besides the above measures an attack succeed the market security system must have means of recovery.

Besides the generic security issues there are some specific of this type of market. As said above it is allowed that clients could change between electricity providers but it is necessary to prevent unfair jumps between retailers without the financial situation resolved. Each time a new contract is settled, the verification must be granted by the ISO, certifying the availability of these new contract parameters for the physical structure of the electrical system.

4 DISCUSSION

As we analysed above, retailers are necessary in any type of electricity market structure and in the near future their presence will be more essential. The natural evolution of the electricity industry and Internet technologies will bring a electricity web retailer market for costumers with dynamic tariffs. It makes sense they will have such a market, where the client could choose between different type of electricity prices, bundle of products and services. Price is usually a main parameter to make a choice, but there are other services that retailers could associate over the electricity they provide and the necessary metering. Other types of energy are common to be bundle like fuel and gas, remote control of interrupted loads, remote energy audits, advising and giving support to new and efficient equipment are some of the services that an electricity retailer could offer. In fact Great Britain is starting an electricity client retail market with several competitors (about 38), from the client side more than 100.000 per week change from suppliers (Heath, 2004). Market efficiency is also supported by retailer web auctions where savings range from 3 to 8% (Wigand, 2003).

5 CONCLUSION

The paper proposed a new electricity retail market model, on a B2C web platform to clients with dynamic price. In this model, a client could choose between retailers (and the associated products and services) that belong to this e-market. Besides metering, billing, and remote tariffs control, retailers provide remote services like energy audits, energy management programs.

Price spikes at the wholesale market where the cause of many brownouts and blackouts. In the first phase of deregulation, prices at the final client change once or twice a year. Retailers have to support financially these oscillations. The model proposed makes possible to solve this problem and

creates efficient answers in the market. This way it's possible to better control demand and it's resources.

The wholesales markets are trading for some time and already tested, while retail e-markets are only making the first steps. The Web is the right platform for these markets, as for retailer e-procurements programs. Some issues are raised for futures improvements in retailer models, such as the clients segmentation, could be stratified in several ways, by power, by consumption, by economic sector. Usually three types are at the top of this hierarchy, industrial, commercial and domestic clients. As the influence of on-line auctions grows, customers are more likely to learn about the potential savings that can be reaped through aggregated purchasing via a centralized, low-cost procurement channel.

We could talk in a second generation of deregulation where market concentrate an international electricity retail purchasing system, which intention is to save money and electricity to both sides of this web market, retailer and the final costumer, as said before a win-win relation. Efficiency is achieved by the competition among retailers to keep and acquiring costumers. As a result of this market web structure operational and product costs are reduced.

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