Some issues for the Modelling of Interactive E-Services from the Customer Multi-Channel Interaction Perspectives

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Abstract

We are involved in research on new interactive systems for e-Commerce, especially in the B-to-C perspective. These works are in the crossroads of HCI and e-Services area. So, we have studied existing researches about web services, which appear insufficient for our needs. First of all, we explain the complexity of the interactive systems for direct marketing. Then we discuss about the design of generic architecture for rich interactions in B-to-C and we give a definition of our interpretation of e-Service. Finally, we propose an analysis of the models and protocols for the e-Services.

1. Introduction

We are involved in research on new interactive systems for e-Commerce, especially in the B-to-C perspective. But our interest is also for the field of application such as e-Learning and e-Government. Our main experiences are in the design of interactive services, which benefit from new channels for interaction, due to the rapid spreading of wireless phone and data devices, and to the development of intelligent communications networks and middleware, enabling emergence of ubiquitous computing.

In co-operation with an important Direct Marketing company, we are working in two directions for the design of future multi-channel flexible interactive services:

- A direction centred on the complex interactions allowed by the right combination of channels or/and interaction modalities (i.e. language vs. direct manipulation). The coupling of these elements is done dynamically, depending on the user contexts and marketing rules [5].
- A direction centred on the global architecture of the information and communication systems. Effectively most of the customer channels (for example Web or Audiotel) have been designed case by case and relatively independently. Their convergences were only effective by their connections to a common back office system. The needs for a re-factoring have been accelerated by several factors: convergences of legacy systems either through the uses of ERP or deployment, in the organisation or through the supply chain, of EAI solutions, and evolution of the business rules with requirements for flexibility and for more dynamic relationships (or affiliation) with third parties, for cross-selling for example. But the convergence at the customer interaction level is still lagging in spite of use of Customer Relationship Management systems (e-CRM). It seems for us that an approach in the spirit of Service Oriented Architecture (SOA) or Computing (SOC) could be an elegant way to solve this problem [20] [13].

This contribution is focused on the interaction that our two research directions have shown from our first investigations and developments. The design of an experimental technological platform for multi-channel and multi-modal intelligent interaction have leaded us to reveal some issues about the modelling and design of e-services, that current proposals, such as those of the Web services suite [21] are not satisfactory for our purposes. Our analysis is situated at the crossroad of three disciplines: Human-Computer Interaction (HCI), marketing and distributed systems.

2. The complexity of interactive systems for Direct Marketing

2.1 About Direct Marketing and E-Commerce

In direct marketing focused on the individual customer, whatever her/his location, it is not true that development of e-Commerce means the exclusive use of the Web channel. Indeed there are already well-established relationships with the customer through a diversity of communications channels (or medium) such as Call Centres for phone, Audiotel and videotext servers, Web, WAP, e-mail, SMS…
Nevertheless, Direct Marketing companies have also developed some forms of personalised relations with their customers, and some are going toward a One-to-One marketing strategy [14]. This has been amplified by the support of the personalisation processes into e-Commerce solutions where, thanks to new technologies [6], it is more easy now to apply this kind of personalisation, not only based on the direct knowledge of the customers (through her/his passed purchases or actions and from direct filing of some forms) but also indirect knowledge, for example by inferring from user interactions through the HCI. Our view of the e-Commerce reflects the central place of the knowledge about the customer not only as a user of the interface, with his/her preferences and skills, but also as a long term customer relationship, in order to augment or to maintain her/his loyalty or fidelity. We are closed to the definition of the e-Commerce given by [7] “E-commerce is an approach to achieving business goals in which technology for information exchanges enables or facilitates execution of activities in and across value chain as well as supporting decision making that underlies those activities”. In putting emphasis on the decision process, informed by knowledge learned from the past relations and interactions with the customer, those authors shown also, that this knowledge management process is central. All the relationships can be seen as an “evolutionary learning relationship” where both the parties (seller and customer) co-operate, more or less, in order to maintain a mutual understanding of the transaction and to achieve their respective satisfaction.

2.2 Complexity of a multi-channel and multi-modal customer relationship approach

There are a lot of possibilities in the combination of interaction electronic channels to support a transaction relationship between a customer/user and the different parts of the value chain. By channel we mean different medium (text, image, and voice) supported by different technologies which implies different network accesses and protocols. This will be illustrated later.

Of course not all the combinations of these channels make sense, but it appears more and more marketing scenarios, which take benefit of some good innovative combinations (for example: voice via a call-centre and SMS, or phone interaction during web co-browsing). The degree of coupling of these channels from the transactions viewpoint can vary from loosely coupled (each channel is used in different episodes and for different user tasks) to highly coupled where two channels, for example, are used in quasi real-time for the achievement of a particular user activity, in a synergetic mode. In this last case, in HCI, we speak about multi-modality [5] [11]. This trend is fostered by new proposals for the Web standards, issued by the W3C consortium, such as VoiceXML for voice interaction [23] or multi-modal web [24].

The studies of isolated uses of channels, or of more rich scenarios implying several channels for a same transaction, have shown that the temporal logic of these transactions, in term of elementary task composition, is different considering the channel, or the combination of channels, used. For example the identification of the customer must be done first, before all others actions, in the case of the Audiotel, but it can be delayed to the payment phase in case of a Web interaction. In the integration of the different channels accesses and management systems into a “seamlessness” infrastructure, these differences, into the automation of the actions, would be taken into account. This should be reflected into the dynamic composition of e-Services supporting group of user activities or tasks.

3. The design of generic software architecture for rich interactions in B-to-C

3.1 An overview of a technological platform for experiments

From our previous experiences of developing and experimenting some Ad Hoc designed prototypes [5] using the potential of multi-channel and multi-modal interactions, we have start to design and implement a more generic and open architecture in order to have more flexibility in the composition of innovative
scenarios for interactive marketing, and their experimentation and evaluation. Our aim is not to compete with large solutions provided by important software companies in the domain of e-CRM or of e-Commerce technological platforms.

Our technological platform, under development, provides four facets corresponding to the four main interfaces with its environment followings two main axis.

A facet is an API, which represents four knowledge domains. An API makes the supervision also and manages the four other.

- First axis of the Figure 1, horizontal, is the main one and corresponds to the information flow and control relatives to the transaction and management of the “dialogue” with the customer/user. It goes from e-Services, which provide an abstraction and a clear delimitation for all the functions handled by the value chain, from the user technological environments with their different interfaces of the telecom networks.

- Second axis, vertical, is relative to all the operations of transformation –filtering, enriching, and formatting– of the information flow, in order to provide personalisation, either in relation with the user context, technological environments and profiles, or in relation with the marketing rules managed by the e-CRM system.

Facet 1: contains the model of adaptation to the e-Services. In terms of HCI architecture it can be seen as the functional kernel, the Model in the well-known MVC pattern. It serves to interface the e-Services for interaction, with a common level of abstraction and its related language, and to assure the composition and intertwining of the e-services, in a way, which depends of the nature, and the history, of the relation with the customer. We will elaborate more on this facet in the following.

Facet 2: provides all the adaptations and interfaces to the different kind of channels. We have identified five main groups of channels depending on their underlying technologies, networks accesses and rules of use:

* The web group which is mostly handled by a Web portal and some proxy mechanisms (for example for real-time co-browsing, or adjunction of videoconferencing) and extended by functions or components such as community or forum management systems. In this case the client is a classical Web browser and some adaptation of contents and layout for PDAs.
* The “voice” group which handles all the functions relative to speech recognition and speech synthesis and of the phone protocols (supravocal keying, etc.), which can be coupled [5] with the Web group by the virtue of the VoiceXML standard. In this case the client is a telephone set either fixed or mobile.

* The wireless mobile phone group, which handles gateways for I-Mode, WAP, SMS…In, this case the client is a mobile phone with some extensions provided by the telecom operator such as more powerful data links than GSM (i.e. GPRS, EDGE, UMTS...). Of course this group can share some information servers with the web group.
* The broadcast channel group: due to the digitalisation of most of the broadcast medium (TV, FM radio, etc.) it appears an opportunity to use them into e-Commerce systems. This will be developing in the future with the potential of rich media delivery (SMILE and MPEG4 standards), of streaming servers and narrow casting over the Internet, and provision for controlling the quality of services over the networks.
* And finally the human channel group, which is the interface with a multimedia call-centre: direct phone calls, e-mail reading and answering handled by human agents with the assistance of the e-CRM systems. It must be remember that, depending on the intelligence of the solutions, which are deployed, SMS and e-mail inward and outward messages can be proceed either by human agents or intelligent software agents.

Facet 3: is the support of the model of adaptation to the contexts of interaction. It is closed to the approached done for the adaptive support of mobile or ubiquitous interactions and the handle of client multiple interaction platforms. For that purpose some abstract interaction description languages have been proposed such as UIML or PlasticML [17]. This is not described in this paper. We want just only mention that, depending on the marketing rules, this facet can offer the possibility to personalise by the user herself not only the interface she wants for interaction but also the composition of services she wants to use (self-service). Telecommunication providers already plan this for the future Intelligent Networks where subscribers will be enable to compose their bouquet of services [15].

Facet 4: is the support of both the interface and model of adaptation of the interaction to the Customer Relationship Management system. This will not be developed here, but it must be recalled than CRM systems are more and more open, not only in terms of technologies with the benefit of Web Services adoption, but also in terms of modularity and semantic interoperability. We know also that there is no a clear delimitation between some functions of our proposed experimental system and those provided by the e-CRM systems. We see actual systems of CRM, already in operation in the enterprises, as legacy systems that must be integrated into our architecture.

3.2 Introducing an e-Services approach: our definition and argumentation

First of all it appears that the word “e-Services”, or even “services” is still confused and have different meaning for different communities. We agree with Baida
et Al [1] that a least three perspectives on e-Services must be understood in order to provide a shared terminology for e-Services: a business science one, a computer science and an information science one, in their case. In our case, our aim is to introduce an HCI science perspective, that, same as the information science, can give a bridge between business and computer sciences, because it takes seriously into account the customer viewpoint, as an interface user but is a customer-oriented design approach where usability is one of the key factor for the success of the business, and also the technology viewpoint. It must be also understood than we privilege the business and marketing perspective, over the technologies one.

In business science: an e-Services can be defined as “the provision of services over electronic network” [18] where electronic networks have an assumption larger than Internet, and including wireless networks, Kiosks, ATM… This shift of paradigm for the e-Commerce toward the service-focused paradigm is justified because it is a more customer-oriented approach, allowing more efficient and effective satisfaction of the market needs, in a more competitive way. For Rust and Kannan [18] this is achieved trough “uses of two ways dialogues to build customized services offerings, counting on knowledge about the customer to build strong customer relationships”. This is the same strategy than those developed in the One-to-One marketing. We retaine from these analysis that: 1) Services must be dynamically composed either by system initiative inferring from knowledge about the customer (a learning relationship [14]) or by the customer/user, who can be seen by extension as a co-producer of the service (self-services [26]); 2) The scope of an e-Services approach of e-commerce is to extend the upstream and downstream channels of an organisation in direction of its customers, or users, in an information orientation, flows of information and controls, and that channels are not only the Web or even the pure Internet.

In computer science: the definition of what is an e-Service, or even service, is strongly influenced be the movement around the Web engineering and the development of a lot of Web services related standards. And most of the time it is used as a synonym for Web services. In [1] one of the definitions mentioned is “loosely coupled, reusable software components that encapsulate discrete functionality and are distributed and programmatically accessible over standards Internet protocols”. We can agree with this definition if the standards mentioned can be enlarged to those, for example, of the wireless phone ones. We can observe that the support of upstream and downstream channels, aforementioned, is sometimes categorised in computer science as “information-providing service”.

In HCI science: concept of e-services is not now very mature, and there are many definitions. The definitions oscillate between the business science and computer science viewpoints. With the Web centric approaches, of most of the user interfaces for e-Commerce, it is clear that the emphasis is also on the Web services viewpoint, where the traditional separation of concerns, a good design pattern, that exists in HCI software development - separation of the functional kernel (the Model) from the presentation (the View), and from the dialog control (the Controller) - is kept. Of course this question, about abstraction of Web services for user interaction, will be more acute in the case of connection of Web portal to Web services, using standards protocols in the WSIA suite. In our case our definition of e-services from an interaction with the end-user viewpoint (in the following “interactive e-Services”) could be specialisation of previous one: an interactive e-services is viewed as a collection of user similar tasks which are grouped in manner to have sense for his/her activities, and maintains coherence from the business and marketing rules and management viewpoint. This is closed to the use of specific design patterns for the design of the user interface in e-Commerce [23].

![Figure 2: Relation between E-Services](image)

![Figure 3: Adaptation to the MVC model](image)

![Figure 4: Adaptation of the MVC model for several ESI](image)
Our first investigations for the re-factoring of the value chain in e-commerce for direct marketing have distinguished of several examples of basic interactive e-Services:

**E-catalogue**, which is used for the search and selection of products to buy. It could be basic online catalogue with simple search tools, for example by products categories, or more intelligent one based on recommending systems and “tribes” behaviour;

**E-order** is the filling of “caddy” or order forms, and the payment tasks with the various possibilities and possible credits negotiation;

**E-tracking** is dedicated to the interaction with the various actors of the supply chain (in what stage is the delivery of my ordered products?);

And some others e-services such as, **e-registration, e-claims** top handle all the customers complaints, **e-communities** to have contact with other customers to share experiences about uses of the products or services, and **e-profile** in order to provide the way for the customer/user to customise his/her interface, to give information and preference for the different networks and interaction devices uses...

These interactive e-Services are only examples, and we could give another, as the domain of e-banking, etc.

### 4. Analysis of the models and protocols proposed for the e-Services

#### 4.1 The Web engineering approach: the Web services suite

The development of Web technologies has produced a rapid increase of new standards proposed by different consortiums such as W3C, OASIS, etc. [21] [12] Web services appear as a new paradigm for e-business. A Web service is a self-describing, self-contained, modular application over the Web. Mainly it is viewed as a standard interface, and a life cycle, to favour communication between distributed applications.

The Web services are composed, and this composition is connected to the final user, if required, through one of the specific application, also a web services, dedicated to the end-user interaction management. It means than the embedded web services do not need to understand and manage the dialogue with the end users. For us it seems that complex multi-channel interactions require something in the middle between “interaction ignorant” web services, and user interface informed web services. At this stage of investigation we call them Interactive Web Services. Same as in the Web Portal special case, the proposal can be seen as a layer above the already recognised standards, especially the trio WSDL, SOAP and UDDI. Our interest is also about the proposals relative to the composition, aggregation or orchestration of web services. In front of the entire composition languages proposal, and of their overlaps, the situation seems confuse for us. However service-oriented composition, such as those proposed in the Business Process Execution Language for Web Services (BPEL4WS), Web Services Conversation language (WSCL) or Web Services Choreography Interface (WSCI) could be on interest for us. Nevertheless we observe:

* First, the realisation of the composition specified in one of the aforementioned languages is left to the developers. In most of the design this is achieved through the use of a workflow system which leads to the problem of matching between the patterns specified in these composition languages an those find in the workflow approach [22] and that the composition is mostly done as the design stage and cannot be easily change a run-time due to the lacks of flexibility of workflows. This has been sometimes overcome by the use of multi-agent technologies.

* Second, that these composition languages allow uses of conversational compositional patterns, in conjunction with the hierarchical one, such as shown for BPEL4WS by [9]. But this mix is not so easy at the implementation level by the limit of workflow systems. Several works [2] [3] have proposed new approaches for the support of web services composition focused on the conversation patterns and modelling, which give more flexibility and dynamicity in the composition at the run-time. These works also point the lacks of the composition languages from this viewpoint.

Our requirement for a description language for Interactive e-Services invocation and composition is slightly different of those of the Web services mainstream, because the needs for dynamicity is different: in the case of Web services standards (WSDL & UDDI) the aim is the possible discovering at run time of an e-Services, answering to a particular need (rent a car for example) with possibility for brokering of services. Although in our case, in a first stage, there no real needs for e-services discovering of the fly, even the external e-Services are well known at design time due to affiliation rules of marketing and needs to keep consistent the end-user dialogue, but fine grain composition is required at run-time in an opportunistic way.

The requirement for a dynamic adaptation of the composition of Interactive E-Services, in relation with the channels compositions and interactions, leads us to consider the design of a complementary Interactive Web Services description language and a composition mechanism based on a conversational pattern focused on dialogue with the user, through multi-channel interactions. This is investigated through the study of two approaches that aim to give an abstract level between the e-services and the interaction engine: the web portal one and the “Ubiquitous Interactor” one [10].

#### 4.2 Surface integration for the end-user interaction: the web portal approach

A portal mostly represents the aggregation of either content from diverse sources, both inside and outside...
(distant or not) or of functions, such as email, calendaring, etc. For that matter presentation is an important issue of portal. This portal must provide both a single consistent interface across diverse content and function and a common user interaction model and API which new applications can build on. Moreover, a portal must provide different levels of personalisation, like, for instance, allowing different classes of users to have different levels of privileges. Nevertheless, integration of content, application or services into portals has been task that requires significant custom programming effort.

In this area, “WSIA and WSRP are new web services standards that enable businesses to create user-facing, visual, end interactive web services that organizations can easily plug-and-play into their applications and portals” [16]. Web Service for Remote Portlet (WSRP) and Web Service for Interactive Applications (WSIA) are specifications provided by OASIS consortium. WSRP focuses the improving of presentation-oriented web services interoperability and WSIA addresses the interactive web services interoperability. A WSRP web service is plugged into a portal without programming and constitutes thus a standard remote portlet. This kind of solution could be adapted for our issues, but WSRP still remains presentation oriented. And we can differentiate two kinds of web services (Figure 5):

- The presentation-oriented web services. This solution allows suppliers to manage the presentation of their services.
- The data-oriented web services. In this case, we want to consume and process data from the portal (source IBM)

For example, an organisation wants keep its own graphical chart and its visual design. This approach enable to plug web services into portals without programming effort, via proxy portlets, they define as abstract portlets that can received any presentation-oriented web services. Moreover, WSRP includes “markup fragmentation” mechanisms, which allow adapting data presentation for several markup languages such as XHTML and HTML in the current version. In the future, standards like WML for WAP, VoiceXML, and cHTML, for iMode are also considered. In spite of the interest of this solution for lot of portal applications, this is not adapted to ours issues. Indeed, we want to hold dialogue integrity and the continuity for a long duration of the interaction over various channels. Thus, presentation-oriented web services go too far for our needs.

- The data-oriented web services, is more close to our concern. In this case, web services receive requests and return data objects encoded in XML documents in the response. This approach allows the portal operator to make its own presentation of the web services. In our case, we want to consume and process data from services, so it is already a better solution. However, this approach is not enough interaction oriented. Thus, WSRP allows only surface integration where e-services aggregated don’t collaborate directly, and are not aware of the “state of affairs” of the others. This is the reason why our investigation led us to have interest in other works like [10]. It is the object of the next section.

From the HCI viewpoint it means that the two approaches of WSRP don’t satisfy clearly the separation of concerns between models, dialogue controllers and presentations, and than, in spite of possibility of generating several interaction mark-up languages, it is too dependant of a visual web interaction.

5. Some protocols for interaction service

As we discuss in the last section, our works are interaction oriented, thus, interactive e-services must be described in this way. So, we need an e-service modelling language interaction oriented for describe services at a high level of interaction. In this area, several studies emerge since few years. Here we will discuss about ISL (Interaction Specification Language) by [10] and WSIA.

5.1 “Ubiquitous interactors” with Interaction Specification Language (ISL)

In this way, [10] proposes ISL (Interaction specification language) in order to describe both services and services interactions. ISL is different from WSDL (Web Service Description Language) that is at a more low level, and represents the activity in a static view that doesn’t take into account the nature of the contents exchanges for interaction with the end user. Thus, [10] proposed eight interaction acts (“abstract units of user-service that contain no information about modality or presentation”) for describe most of possible interactions.

In the ubiquitous interactors approach, there is an interaction engine, which is device specific and service independent. This engine allows presenting device specific information. We can see that in Figure 6.

At the opposite this work has no direct links with the web services movement and no compatibility with the
stacks of standards provided by the W3C or OASIS for example. The services considered are mainly those related to document accesses.

5.2 Proposal: WSXL and WSUI

Interaction management behind services and applications user-oriented is become a current research subject. Several standards emerge from diverse works. Two languages, WSXL (Web Service eXperience Language) [8] and WSUI (Web Service User Interface) from the technical committee WSIA, supported by OASIS have appeared to supplement WSRP in the WSIA suite.

Interaction management behind services and applications user-oriented means, on one hand, that user can access directly to the services by a simply browser, and on the other hand, the association management and the assembling of services by different intermediaries before interaction with the end user is done.

The elaboration of this specification is based on two scenarios:
- The multi-channel access to the web services by users (PC, PDA, cellular phones, etc.).
- The web services aggregation in a single page by a distribution channel intermediary (such as portal).

WSUI and WSXL specifications try to define an abstract XML representation of the web services presentation and of user interaction with it. This allows a simplification of the aggregation and association of web services, and also simplifies their adaptation to the access mode (that it could even be done automatically).

We think that the flexibility about the interaction between services and user is not sufficient for our works. Indeed, contrary to ISL, WSXL is too channel dependent.

These approaches are not sufficient for our purposes. Few ideas about our works for performed the lack of these solutions can be given.

5.3 Our proposal for the specification of ESI

We need to define a solution that is channel independent and both service and interaction aware for the e-Service. A grammar needs to be develop, which describe service independent of content and device, and both services and users oriented interaction. This can be based on a taxonomy or an ontological model of multi-modality which describes the basis task model of each e-Service. We have started from the [25] proposal described in UML. In this way, a combination of e-Services will be able to do according to users profiles, channels used, a stat of the interaction and also CRM that represent both direct marketing domain constraints and knowledge.

Our challenge is to propose an XML compliant ESI specification language, which is still under development. Several elements about it such as simple eight primitives see in [10] will be implemented. Of course, we want to be interaction oriented, i.e., an end-user can interact with it. That's why; input tag must have attributes, as “type” that describes type of media used during interaction, like text, voice, etc. Moreover, interaction flow must be managed between ESI. Indeed, ESI can exchange data and controls during the interaction and the difficulties appear about the services composition. Figure 7 Shows an ESI schematisation. Due to the dynamicity of ESI composition, input and output must be abstracted. Requirement is the result of the current interaction and the effect must affect the future interaction. Presentation of this formalisation will presented in details in the conference.

6. Conclusion

New emerging standards for Web services and new service-oriented design approaches are great opportunities for the re-engineering of current e-commerce solutions in order to provide a better multi-channel support, and a better customer relationship through more flexibility, and possibility for self-services. Multi-channel and multi-modality in the customer/user interactions are difficult challenges from the HCI design viewpoint, and lead to new constraints for the re-engineering of the value chain, in a services oriented approach. This requires that most of the e-Services constituting the assets of the (virtual) organisation must be mediating by specific interactive e-Services, and that the composition is done dynamically, and in an opportunistic way regarding the marketing rules. This is enforced by the use of best practices and design patterns, already known in the field of HCI, such as separation of concerns exemplifies through the controller pattern and the MVC framework.

This more HCI view of what is an interactive e-Services, and how it can be interfaced, shows the limits of current proposals, even those which are already presentation-oriented such as those related to the Web portals. This work about description and interaction languages for interactive e-Services is in progress starting from the critics presents here, and we will provide more elaborate results for the workshop.

Our activity, about description and specification of interactive e-Services, is part of the design of a generic software architecture for experimentation of rich multi-channel and multi-modal interactions if the framework of e-Commerce B-to-C, taking benefit of the potential of the ubiquitous computing and mobile interaction devices. The need for high flexibility at different levels
from interactive e-Services composition, to personalisation and channel dynamic choice and combination has push us to choose a distributed multi-agent system (a MAS) in the technological platform, to realise the central part of the architecture presented in figure 1. This choice of MAS has already shown its potential either in the design of more flexible workflow systems, running in a peer-to-peer mode, or in the field of support of multi-modality in the HCI field. But the rational for this choice and the selection of the technologies for the MAS is out of scope of this paper.

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8. BIBLIOGRAPHIE


