Multi-channel and multi-modal interactions in e-Marketing: Toward a generic architecture for integration and experimentation

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Abstract

Multi-modality is a domain which is study since several years in HCI area. In this paper, we approach this domain under a new point of view, those of the e-Marketing, and so in an industrial framework. Thus, we investigate real issues of E-Marketing with well-known technical in HCI. The multi-modal notion can be compared to the multi-channel one used in e-Marketing. That's why a part of our work is dedicated to define and describe what is behind the terms of multi-modal and multi-channel in the E-Marketing area.

Our collaboration with the Cité Numérique, a subsidiary of the 3 Suisses International Company, a large group of Direct Marketing, carries out us to consider real issues. This collaboration also led us to study concrete scenario in real situations, at large scale.

1 Introduction

In collaboration with 3 Suisses International, a large group of e-Commerce, we are studying multi-modality and multi-channel in HCI and direct marketing areas. We want to manage these two areas with unique software architecture.

According to the definition of the e-Commerce given by (Holsapple & Singh, 2000) "*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*", knowledge management is a key problem and users must be seen as customers, considering a relationship with the organization. In this context, several sources of knowledge will be used. This knowledge will have to be often update and will be persistent.

In order to illustrate what is a multi-channel interaction, we can take a simple scenario: a customer buys some goods via an interactive voice server with his cellular phone and the customer lost the connection during the payment phase. For the organization, this break inhibits a potential sale. Retrieving the previous coherent state of the transaction is an important challenge. Any available channel can be used to achieve this goal. That will avoid customer's frustration.

We have derived a theoretical framework (Chevrin, Derycke & Rouillard 2003) in order to describe such interactions and present a generic software architecture based on four "interfaces" (see Figure 3). They are interfaces to four knowledge domains corresponding to four different systems:

1. The decomposition of the functional kernel in several e-Services. In this area, an interactive e-Service is viewed as a collection of user similar tasks which are grouped in manner to have sense for user's activities, and maintains coherence from the business and marketing rules and management viewpoint.
2. The coupling and uncoupling of channels/modalities. The knowledge appear in the need of rules for determine the best coupling according to the interaction context.
3. The management of the interaction personalization. For example, with the user's profiles, etc. and more generally, the interaction context.
4. The relationship with the Customer Relationship Management (CRM) system.

Thus, our challenge is to propose a robust and flexible technological platform for intermediation with both multi-modal and multi-channel interactions dedicated to integration and experimentation. We have already implemented several prototypes ((Rouillard 2002), by example) which help to understand issues about constraints with this kind of interactions.

Our experience and investigations show that multi-channel and multi-modal interactions are difficult to manage and generate many issues. Furthermore, our researches must follow strict rules and constraints derived of e-Commerce strategies. Current technological solutions are not adapted for companies dealing with direct marketing advanced scenarios. Each channel is managed independently of each other and the integration of channels is not really effective.

Our proposal is supposed to solve several of these important issues:
- multi-channel and multi-modal interactions,
- intentional or unintentional breaks in transactions,
- interaction flows grouping (and ungrouping),
- devices adaptations (both control and data flows),
- integration of many channels (respectively modalities) for multi-channel (respectively multi-modal) interaction coherence.

Such as shown in (Derycke, Rouillard, Chevrin & Bayart, 2003) a solid bridge between e-Marketing , on one hand, and HCI, on the other hand, must be thrown, if we want to bring interesting software architecture that satisfy simultaneously constraints of these two domains. That led us to consider several things:
- A theoretical effort to formalize the domain and give a predictive framework to our works.There is a complexity due to the number of possible devices to couple, the variety of the interaction modes, the richness of the networks, etc.
- Reconsider multi-modality from a "business" point of view. Here, a relation between multi-modality and multi-channel must be done. Of course, a definition of what are modality and a channel (but also multi-modality and multi-channel) must be given.
- Do propositions of generic software architecture dedicated to this kind of interactions. We will present briefly our idea about this framework.
- To design and to implement limited prototypes to support our investigation.

2 Toward a characterisation of multi-channel and multi-modal interaction

2.1 Theoretical framework summary

In [4] a presentation is done for a theoretical framework for the characterisation of multi-channel interaction in e-Marketing. Two points of view are considered on the multi-channel interaction. These two points are two theoretical fields related to "media":
- An "information theory" approach, where, according to the works of Shanon and Pierce, channels are characterised by ours intrinsic properties, such as their power of symbolic representation, the media richness, and the appropriateness between the task and the user.
- An approach more focused on interaction where channels are used in complexes cognitive process between engaged people, more or less directly, in a joint activity.

This theoretical framework is necessary because of the combinatory: when we coupled some channels/modalities, the complexity increases and it is difficult to predict future behavior and user's acceptation.

. Even if several combinations of these channels/modalities make no sense, it appears more and more marketing scenarios, which take benefit of some new innovative combinations (for example: voice via call-centre and SMS (Short Message Service), or phone interaction during co-browsing, etc.), which can bring much added value.

There are two problems here:
- First, the term channel is ambiguous and can represent anything according to the context. That's why we define it more precisely.
- Second, what are the relations between multi-channel and multi-modal approaches of the intermediation?

2.2 Our works about the intermediation between channels, and communication rules

Generally, channels are seen like suppliers of several media (text, image, and voice) supported by different technologies that imply access of different networks and protocols. But we want to go ahead, by building a channel ontological model.

Figure 1 gives our simplified view of the taxonomy built. These four domains are in strong interaction; they establish some constraints on the composition and, of course, on the intermediation.

They are some characteristics that allowed representing interaction knowledge according to four axes:

- The networks and access protocol level with its constraints and norms (see part [1] on Figure 1).
- The "physical" parts such as hardware and software (see part [2] on Figure 1). This one can be supported by existing proposals such as CC/PP (W3C, 2004).
- The interaction mechanisms knowledge: semiotic aspect, ergonomic, HCI design, conversational aspect with the grounding (Chevrin et al. 2003), adequacy to the tasks/medias… (see part [3] on Figure 1).
- All the information related to the user (profiles, etc.). The data linked to him/her will be provided, in part, by the CRM systems (see part [4] on Figure 1).
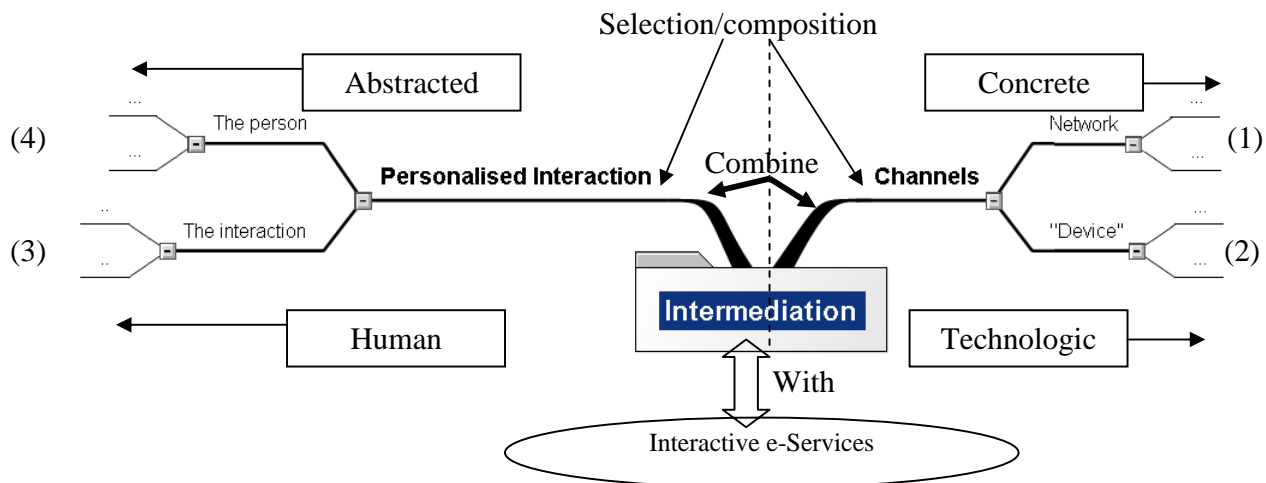
Figure 1: Premises of an ontological model of channel

Figure 1 gives our built taxonomy simplified view about intermediation between channels and personalised interaction with interactive e-Services (Chevrin, Derycke & Rouillard 2005). These four domains are in strong interaction; they establish some constraints on the composition, and so, on the intermediation.

For this ontological model of channels, we could work on past studies such as (Obrenovic, Starcevic & Devedzic, 2003) and (Calvary et al., 2003). In these studies, the authors described a multi-modal ontological model with a combination between textual and audio messages. We want go far and propose an ontological model of the coupling of voice and text.

In this intermediation model, two others knowledge domains are not represented here. They are:
- Marketing strategy such as these managed by CRM systems.
- The knowledge of services and products offered.

2.3 What about multi-channel and multi-modal interaction?

These two terms are closed. Indeed, within a reference framework, such as CARE (Nigay & Coutaz, 1997) to compare multi-channel and multi-modal, we can understand that there is no tight border between multi-channel and multi-modal. The difference is in the temporal granularity of the different channels/modalities coupling.

In fact, the coupling degree of these channels/modalities from the interaction viewpoint can vary from loosely coupled (each channel is used in different episodes and for different user tasks) to highly coupled where two channels/modalities, for example, are used in quasi real time for the achievement of a particular user activity, in a synergic mode. In this last case, in HCI, this is called multi-modality (Fink & Kobsa, 2000), (Papazoglou, 2003). Nevertheless, Sharon Oviatt (Oviatt et al., 2003), has show in a pragmatic way, that a too high degree of coupling is not appropriated to a good usability. Moreover, in our point of view, the user is a customer.

Thus, according to us, multi-modality is on application level while multi-channel is on application domain level. This is due to the temporal granularity levels, which are distinct.

Our challenge is to take into account this temporal difference to manage the multi-channel and multi-modal interactions in a continuous way. To jointly study multi-channel and multi-modal, we have chosen to compare them on a reference framework. CARE (Nigay & Coutaz, 1997) will be used to do these comparisons in order to identify

some links between these two areas. CARE properties describe multi-modality view by the user from the system, so in output.

- The *Equivalence* notion is the fact that the user or the machine can have the choice between several modalities to formulate a particular utterance. A user can have the choice between either pronounce the word "next" or click on the "next" button with his mouse. For a customer, this could be, for example, a choice during the payment. He can call an employee of the company, send a cheque by mail, or simply enter his banking card number via the Web. There is no difference between the two domains at this level.

- *Complementarity* consists to transmit different messages representing the constituents of a same utterance on several modalities. The understanding of the utterance requires, here, a fusion between the different messages transmitted through the different modalities. For example, the system says vocally: "the result of your request is:" and lists a whole of answers on the screen. More preciously, a multi-channel example could be a customer, which receives a MMS (Multimedia Messaging Service) containing an URL he can click, via his web browser, if he wants to take knowledge of the week's promotions. In this case, there is a fundamental difference between multi-channel and multi-modal. Indeed, the granularity between couplings is different in the two areas. In multi-modality, temporality must be close instead of multi-channel, where coupling temporal granularity could be loose.

- *Assignment* consists to always use the same modality for a particular type of utterance and not use them for other utterances types (exclusive specification). It is the case of a user, which would always uses either voice or text to do a define task. It must also be a customer that always uses the web to fulfil his (virtual) basket and always the phone (via an employee of the company) to pay with his banking card. There is no difference between the two areas in this case.

- *Redundancy* consists to transmit a same message via different modalities. As a rule, the analysis of an utterance transmit through one of the modalities is enough to have all the semantics information driven by this utterance. For instance, a user receives the result of a request vocally through speakers and textually through the screen. For a customer, this could be the reception of a SMS and an e-mail of order confirmation (that contain the same information). There is no difference between the two areas in this case.

From this comparison, it appears that the two domains (multi-modality and multi-channel) are near. The differences appear at a temporal level. Indeed, in multi-modality, the interaction has a short life cycle, at the level of the seconds, or even the milliseconds. In multi-channel, it is different: an interaction can last a small period of time (one second) or a longer time (one minute, one day, one month, etc.). When there is a temporal non parallel (sequential) interlacement of modalities/channels, there is no fixed frontier between multi-channel and multi-modal, but rather continuity. When an interaction between channels is strongly synchronised, we will consider it as multi-modal.

Progressively, with the temporal grain thickening, we will shift toward multi-channel. Moreover, in multi-channel domain, the interaction can de interrupted and can be resumed later. In the domain of multi-modality it is not the case. In multi-modality, the interaction needs to be continuous and not accept interruptions.

In fact, multi-channel is a term coming from direct marketing area (for our study). Moreover, the goal of this concept is to touch more easily, more last and more efficiently the customer. So multi-channel serves, here, to built a "good" relationship with the customer.

3   Business use and multi-modality/multi-channel

3.1   Opportunities in e-Marketing

Multi-channel's field is well-known of the direct marketing, or interactive marketing, fields. Indeed, it is possible to buy via point of sale, phones, post mail, Minitel (in France), more recently via voice answering machine, Internet (Web, e-Mail), and even mobiles devices. Each channel will be specialised and some of them will have their own offer (for example, web and paper catalogue are two distinct offers).

Moreover, a channel will not be necessarily dedicated to the product or service sale, but could also serve to disseminate advertising, information, etc. The Figure 2 shows a graphical representation of multi-modal and multi-channel frontier.
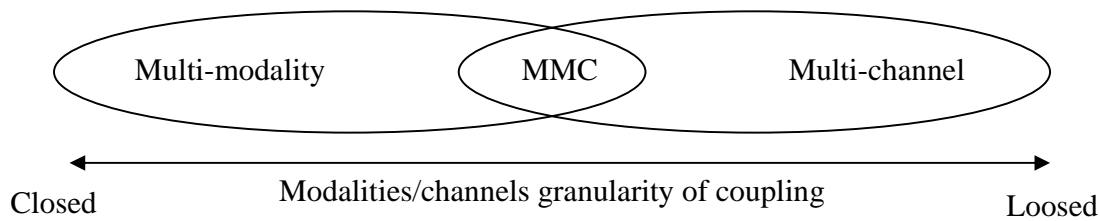
Figure 2: continuity from multi-modality to multi-channel

MMC (Multi-modal and Multi-channel) consists of the overlapping area between multi-channel and multi-modal. There is no difference between the two terms (it is the case when the modalities properties are *Redundancy*, *Assignment* or *Equivalence* from the CARE point of view).

The boundary between multi-modal and multi-channel is not easy to perceive and it is difficult to decide if a situation is purely a multi-modal one, a multi-channel one, or a mix of the two. For several cases, the models that we dispose are not enough expressive. Our challenge is to conceive a technical platform for intermediation, which will manage multi-modality and multi-channel interactions together. These interactions will have to be seamless for the end-user.

3.2 A representative scenario

Thus, there is a new point of view of multi-modality, which opens several opportunities in e-Commerce framework. In order to justify this idea, a relevant scenario is presented in the lines below. You can imagine a customer of a Direct Marketing group, which walk near of an "intelligent" advertising terminal of this group. Then, thanks to geolocalisation potential, customer receives a SMS (Short Message Service) on his cellular phone. This message (SMS) contains bar code represented by a tag, several information describing that he can have 15% of reduction on his next order, and a phone number for more details. Then, he phones the group with the phone number given in the message and asks for more information. An employee of the company says him that he can have 15% of reduction on his next order if he asks a delivery in a relay, this to use the bar code.

This customer decides to buy several articles on the web site of the group. He chooses the option delivery in his favorite relay, and payment to the delivery.

Few days later, he receives a SMS, which indicates that her/his parcel is arrived at the relay. Then he goes to this relay. The employee of the company uses the bar code on the SMS to make the invoicing, and the customer profits of the 15% of rebate.

This scenario is adapted from a real use case. A same mechanism is used in Japan, but the client takes a photo of a tag on a paper catalogue.

We are convinced that SMS, EMS (Enhanced Message Service), MMS, etc. have real interest for e-Commerce. Indeed, this kind of message can be efficient for some services with added value. Imagine a DVD, "Lord of the ring" for example, sells for a price X. A SMS campaign will be launched (on people that agree). These SMS will ask to the customers if they want to buy this particular DVD or not. The confirmation will be send by SMS. This is a simple case, because the product is a pre-sold product, i.e. we do not need to present it to the customers.

You can imagine a more complex scenario.
A customer has ordered 15 days ago with several articles of which a shirt that was not in stock. So, the delivery is done without this shirt. Later, when the shirt is again available in stock, the customer receives a SMS that asks to him if he wants to receive it. Here the problem is more complex for two raisons:
- The product is not any more pre-sold, it needs to be described.
- In this case, the problem is not to launch a campaign on a whole of voluntary customers, but to manage a re-entry in stock alarm.

That is an extremely carrying scenario with important potential.

4 A generic software architecture for multi-channel intermediation

Our technological platform provides four interfaces corresponding to the four main interfaces with its environment. An interface represents a knowledge domain. Another interface makes the supervision of the four others. Figure 3 shows our generic architecture in a schematic way.
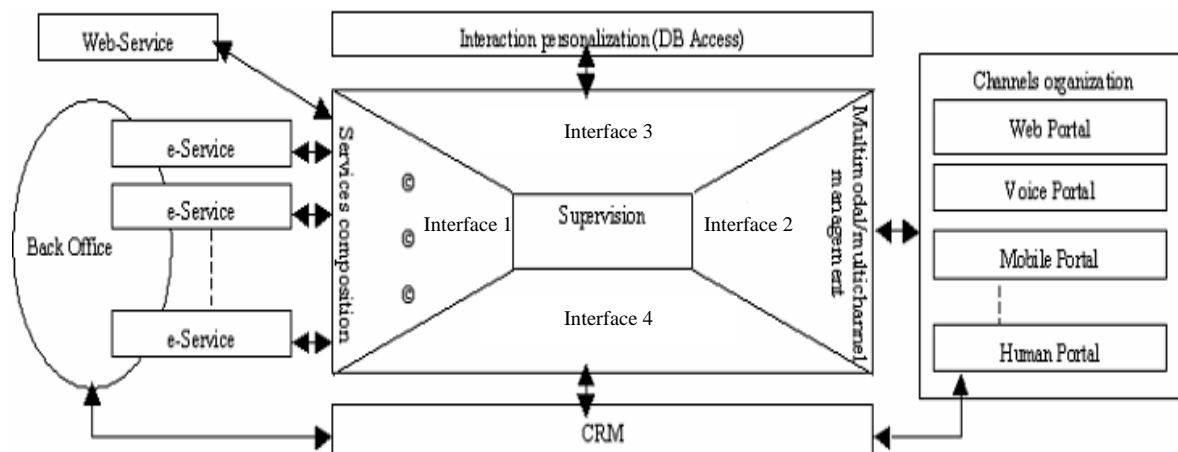
Figure 3: global view of the generic architecture of UMR (Ubiquitous Marketing Relationship)

In this paper, only the interface 2 is interesting for us. Nonetheless the three others will be briefly presented:

Interface 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.

Interface 2: provides all the adaptations and interfaces to the different kind of channels. It is the interface, which interests us in this contribution. 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 (Fink & Kobsa, 2000) with the Web group by the virtue of the VoiceXML standard. In this case the client is a telephone set either fixed of 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 (SMIL 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.

Interface 3: is the support of the adaptation model to the interaction context. It is close to the approach 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 (Rouillard 2003). This is not described in this paper.

Interface 4: is the support of both the interface and the interaction model of adaptation to the Customer Relationship Management system. This will not be developed here.

In this paper, we focus on the interface 2 of this software architecture. This part is complex and generates management interaction flow issues. Coupling and uncoupling several channels implies interaction flow

coordination and synchronization, in order to keep coherence. We approach this point in the next section. For more information on this generic architecture and the more "e-Services" level see (Chevrin et al. 2003) and (Chevrin et al., 2005).

5   A First prototype

## 5.1   Overview: Experiences with other prototypes

We have begun to experiment some multi-modal prototypes since several years (Rouillard, 2002), (Rouillard & Derycke, 2002). This kind of work allows pointing some real multi-modal application issues, such as flow interaction difficulty both within fission and fusion, which, naturally, must be done at runtime. Direct application of our works to the e-Commerce area shows other preoccupations, like, for example, that it is important to consider the end user first as a customer. This section deals with a new prototype, which solves some issues pointed above in this paper.

5.2   Presentation of one of our limited prototype

The prototype that we have implemented is a product sale simulator via web, phone, or WAP. Two important concepts can be presented here:
-    The session: It contains some not completed operations (tasks).
-    The tasks (e-Services (Chevrin, Derycke & Rouillard, 2004)): A user can realise several tasks in a same session. In direct marketing, a task can be an order, in e-Learning it will be for example the fact of filling a questionnaire…

Thus, this prototype allows the management of several types of issues. First, a data persistence mechanism (memory) assures the recovery of an interaction in a seamless way for the end-user when a voluntary or involuntary break arrived. Moreover, the task restarts where it has been interrupted. Then, the system manages the interaction flow fusion, i.e. that the customer can used several channels (modalities) to accomplish its tasks. It is the system, which must synchronise and "merge" data for the customer, in a seamless way. The Figure 4 shows an example of what we can do (in multi-channel terms) with this prototype.
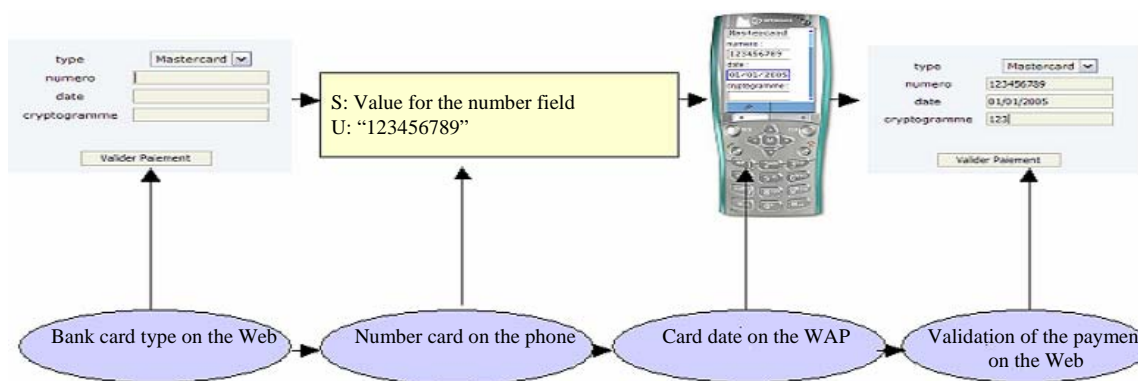
Figure 4: Example of using multi-channel prototype with phone, Web, and WAP

This example is not really realistic, but it shows technical aspects of our works: A customer does a task of payment via our application. He/she begins by filling the first field via the web channel. He/she fills the second field with the voice channel. The third field is filled on the WAP channel. Finally, the customer comes back on the web channel to validate the payment. The application put all the data of the different channels together to make a coherent set of information. In this case, our application does an interaction flow fusion. As seen above, the system is supposed to decompose inputs and outputs interaction flows, but actually, this prototype only manages interaction flow fusion with a limitation in the granularity of the channels coupling; and the interaction flow fission is not managed, here.

5.3   Performing perspectives of this scenario

The implementation of this prototype has permitted to understand several issues. For example, there are multiple identifications during breaks. The studies about communication networks, such as (Van Thanh, Vanem, Tran Dao &

Tore, 2002) could be a solution to this in the future. These works consider all the devices of an user and homogenise the networks use.

Then, we have seen that temporal granularity is an important aspect during the coupling and uncoupling of channels/modalities. Even if the technological aspect can be achieved, developers have to keep in mind ergonomics and usability issues (Nielsen, 1993).

Finally, the link between tasks process (we detail our e-Services approach in (Chevrin et al., 2004) and (Chevrin et al. 2005)) and channels composition is a difficult issue to manage.

6   What are interaction flow fission and fusion issues?

These issues involve three types of management:
- The management of the interaction continuity. For the end-user, the interaction must be seamlessness.
- The management of both data and control flow coordination in order to maintain coherence into the interaction with the end-user.
- The management must be done by a dedicated system, which can be opportunistic and automatic. It will be interesting to propose a kind of generic software, in order to supersede our previous ad hoc prototypes (Derycke et al., 2003).

6.1   The interaction flow fusion

The fusion can arrive during both input and output interactions. In fact, the flow coming either from the user or from the system will be composed, on the fly. This composition must be coherent and the interaction must keep a sense. That's why a robust synchronisation is needed.

A famous input interaction flow fusion example is the Bolt's well-known illustration (Bolt, 1980) with his "put that here" paper. Information coming from voice and those coming from mouse movements will be composed to form global coherent information, which can be used by the system.

In e-Commerce, there is a problem of interaction flow fusion. Let's have an example. A customer fills its basket, validates it, and wants to pay by phone. Then he phones to an employee of the organisation, in order to pay, with its banking card, and last, he consults his e-mail to see if his order has been well registered.

All information coming from each channel must be associated with the other to stay coherent. The difficulty of the fusion is to keep this coherence during all the interaction. For that, high-quality synchronisation and powerful coordination are necessary.

6.2   The interaction flow fission

Like fusion, fission can arrive during both input and output interactions. In fact, the flow coming either from the user or from the system will be decomposing. This decomposition must be coherent and the interaction must keep a sense. Robust synchronisation will be made, such as in the case of fusion.

An example of output interaction flow fission could be this one seen in the case of *complementarity* in the CARE properties seen above (fission of Text To Speech synthesis and textual display).

Like for the fusion, fission is a large issue in multi-channel, particularly for e-Commerce. The reason is the same: synchronisation and coordination of the different parts of the interaction flow is necessary to keep coherence during this one. If this difficulty is not correctly satisfied, there is a high risk to lose potential sales.

7   Conclusion and comparisons with other approaches

In this paper, we showed how multi-modal and multi-channel approaches could be exploited in the E-marketing domain. We work both in HCI and Direct Marketing through collaboration with a large Direct Marketing group: 3 Suisses International. In this way, we are confronted to real problems that this organisation has to face (for example: how to keep and maintain information concerning a client which communicates with the organisation across different channels such as phone, traditional mail, e-mail, SMS?).

Thus, we carry a new glance on multi-modality in HCI with a realistic use. Our studies lead us to model applications supporting many channels and many modalities within the same interaction. We tried to understand this relationship through interactions across multi-channels and multi-modalities in a particular framework applied to E-Business.

Moreover we do a parallel between these two terms. According to our investigations, we think that there is not tangible frontier between them, but rather a continuity based on an increasing temporal granularity (multi-modal

toward multi-channel). We are convinced that the potential of multi-channel is not used yet and stay to be exploited in many areas (E-Business, E-learning, etc.).

Concerning multi-modality, different solutions are already available, such as Kirusa (Kirusa, 2002) or SmartKom (Wahlster, Reithinger & Blocher, 2001). In multi-channel domain, solutions are often based on ad hoc channels juxtaposition (Derycke et al., 2003). Some solutions could be found for the technical part: X+V language (supported by the W3C) for instance allow using XHTML and VoiceXML for the same application. But it is not possible, until now, to use those channels in an interesting multimodal way (only sequential actions are available and not parallel actions, such as speaking while pointing, for example).

Deployment of some prototypes showed several issues, similar to those pointed by (Lard, Sedogbo & Bisson, 2004), which we probably solved with the implementation of more sophisticated prototypes. We will based on our UMR architecture (Chevrin et al., 2004), (Chevrin et al., 2005), itself based on our theoretical framework (Chevrin et al. 2003) and on an ontological model of channels that we will explain in another paper.

Our ultimate challenge is not to compete with existing CRM system, but rather to implement a generic platform, which manages multi-modal/multi-channel interactions in order to study new uses and to find solutions to real issues coming from the e-Business area. It will be interesting to couple and uncouple channels on the fly, for example, according to information taken from the context of the interaction (task, user profile, etc.).

Implementation will be based on a multi-agents platform. Agents approach has been previously used in several multimodalities works, such as OAA (Open Agents Architecture) (Moran, Cheyer, Julia & Martin, 2004). That's why we have chosen the Jade framework (Jade, 2004), a Multi-Agents System platform, for the implementation part.

8   Acknowledgements

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