

# **Multi-Dimensional-Personalisation for the online and offline world**

Steffen W. Schilke<sup>1,2</sup>, Udo Bleimann<sup>2</sup>, Steven M. Furnell<sup>1</sup> and Andrew D. Phippen<sup>1</sup>

<sup>1</sup> Network Research Group, University of Plymouth, Plymouth, United Kingdom

<sup>2</sup> Institute of Applied Informatics Darmstadt (aida),  
University of Applied Sciences Darmstadt, Germany  
e-mail: steffen@schilke.net

## **Abstract**

During the dot com era the word “personalisation” was a hot buzz word. With the fall of the dot com companies the topic has lost momentum. As the killer application for UMTS is not yet identified the concept of multi-dimensional-personalisation (MDP) could fill this spot. Based on the location, the interest and the location of the user a recommendation of online content as well as offline events shall be offered to the user. At the right time, at the right place the right information or service will be offered. Instead of having to request this information this new service concept would proactively provide the information and services.

## **Keywords**

Internet, Personalisation, Personalization, Location Based Services, Mobile Systems, Recommendation, UMTS

## **1. Introduction**

“Personalisation” has been a hot term during the dot com era. In 1999 at a Gartner Group symposium it was predicted that “... by 2003, nearly 85 percent of global 1,000 Web sites will use some form of personalization (0.7 probability)” (Abrams et al., 1999). It seems that this prediction did not come true. Through the meltdown of the dot com companies lot of the hype went bust. Nowadays personalisation is seen in a broader context known as an “Adaptive Interface”. The first two levels (i.e., conceptual and semantic level) shall represent the personalisation (the other two levels are called syntactical and lexical – adapted from Foley et al., 1990).

This paper will introduce the next generation of a personalisation approach which goes beyond where most personalisation projects have gone before. Besides the personalisation efforts the location of the user will be taken into account. In addition a temporal dimension will be considered. These shall be considered to be the main dimensions used or applied for this new personalisation approach hence the name “Multi-Dimensional-Personalisation” (MDP). Other issues have to be taken into account and will be mentioned later.

First it will be shown how the terms have been defined and have been used. Their relationship and samples of the application of these approaches will be presented. Then it will be presented how the new approach will go further and allows to combine the dimensions interest of the user, the location and the time for recommending and presenting the right information or service proactively. The approach will allow to offer personalised views on information and services in the online as well as the offline world. It goes further then allowing a user to have one specific site personalised and extends this approach to all participants (online as well as

offline). One of the key issues is to organise information in a way that a system can use it to support the user and pass a selection / recommendation of it to the user, depending on the active user model / personality.

## **2. Dimensions for Personalisation**

The proposed system applies three main dimensions which are the interest (where personalisation is usually based on), location and time. It is necessary to show the relationship to previous approaches to be able to full show the extended reach of this idea.

The first dimension is interest which is the main factor used for personalisation nowadays. The interests of the user are taken into account to present the information or services the user should be interested in. It is based on various information from the user, from his past user behaviour, different filtering techniques and recommendations based on these data.

The second dimension is the location of the user which allows to extend the reach of this approach from a desktop bound application to the mobile world, i.e., not only online information and services but also events and services from the offline world can be taken into account. This makes it necessary to take the end user device and its capabilities into consideration. The device might have a low bandwidth connection or other technical limitations.

The third main dimension is the time. This dimension can be applied in different ways. The system could synchronise with the schedule of the user to recommend events which fit the (future) schedule of the user. Another application could be to apply the knowledge of a timeline in a curriculum of a degree programme to be able to recommend information or events which suite the progress of the student. From the perspective of a marketing approach this dimension could be used by evaluating the behaviour of the user (e.g., the daily way to and from work) to offer, e.g., a happy hour special or a concert in a bar which fits the usual time the user passes a certain location.

Additionally the user might want to have different “personalities” which allow him, e.g., to switch between a private or business profile. Besides the context the user should be able to define a kind of “Mood” or “Situation” (user model / personality) which acts as a kind of threshold or prioritisation, e.g., to prevent to be disturbed during an important business meeting. In the next sections the definitions of the terms will be presented and extended to fit the new “Multi-Dimensional-Personalisation” approach.

### **2.1 Personalisation**

"...the Web is ultimately a personal medium in which every user's experience is different than any other's". (Schwartz, 1997). The term can be defined that it "... is the task of making Web-based information systems adaptive to the needs and interests of individual users, or groups of users. Typically, a personalized Web site recognizes its users, collects information about their preferences and adapts its services, in order to match the users' needs." (Pierrakos et al., 2001). In 1998 the idea of an adaptive Web sites was defined as sites which "...automatically improve their organization and presentation ...". (Perkowitz and Etzioni, 1998). Pierrakos et al. (2003) stated that "One way to expand the personalization of the Web is to automate the adaptation of Web-based services to their users.". Kahabka et al. (1997) defined "The aim of personalisation is to select data whose content are most relevant to the user from a greater

volume of information and to present them in a suitable way for the user.". For the Internet community or industry "Personalisation is increasingly considered to be an important ingredient of Web applications. In most cases personalization techniques are used for tailoring information services to personal user needs.". Personalisation "... is done automatically based on the user's actions, the user's profile, and (possibly) the profiles of others with 'similar' profiles" (Mobasher et al., 2001).

Personalisation should not be mixed up with customisation. Customisation usually deals with the appearance of a web site (e.g., colours, fonts or the appearance of the site, i.e., which information goes where - i.e., how information will be displayed), i.e., "In customization, user controls and customizes the site or the product based on his/her preferences" (Mobasher et al., 2001). A summary by Allen et. al. states "On the Web, the difference between customisation and personalisation usually comes down to who is in control of the content." (Allen et al., 2001). For the customisation the user is in control of the appearance and not in control of the content. The user usually can only control which and where to place a certain content by customising (e.g. my.yahoo.com). Nowadays there are groups referring to personalisation and customisation as "interface adaptation" instead.

Unfortunately the most Personalisation systems are mainly driven by a kind of one dimensional approach. This is expressed by a statement from Abowd and Mynatt (2000) which states that "Most context-aware systems still do not incorporate knowledge about time, history (recent or long past), other people than the user, as well as many other pieces of information often available in our environment.". In this statement one issue is left out as the system could use information about the future of the user by actively using information from a diary or schedule.

Common sense leads to the thought that only a system which is offering the most relevant information for the user in a given situation (e.g., determined by location, time, interests of the user, ...) will be more successful than any other system offering only a standard view on the information. In addition it seems necessary to expand the reach even further from the online to the offline world.

This is where the new concept called Multi-Dimensional-Personalisation (MDP) can provide significant benefits to the user. It is an approach to support the user to cope with the massive information overflow. The online world as well as the offline world provide a vast array of opportunities, information (a.k.a. as content) and services or events for the user. The main problem nowadays is to get the right information at the right time at the right place and in the right format.

## **2.2 Location**

Mobility became a buzz word like personalisation. It has to be taken into account that "mobile distributed environments applications often need to dynamically obtain information that is relevant to their current location" (José and Davies, 1999). The "... location awareness is a key factor for mobile commerce's success, because it can contribute to a system's ease of use in many ways." (Zipf, 2002). Bob Egan, Vice President Mobile & Wireless, from the Gartner Group has said that "The Internet will not be successfully translated to the mobile world without location awareness which is a significant enabler in order to translate the Internet into

a viable mobile economy ...". Unfortunately "... the current design of the Internet does not provide any conceptual models for addressing this issue" (José and Davies, 1999).

As stated above the location can be an important parameter which is necessary to offer the user the appropriate information or services. Even when used from a desktop system it can be necessary to provide location information to successfully use the offer of a web site. E.g. a price comparison web site allows the user to search a DVD from a catalogue and request a price comparison which includes the shipping information. In order to do so the system needs information about the location of the user to identify the shipping costs from each shop.

### **2.3 Time**

This temporal dimension has not been recognised much in earlier approaches. One well known scenario is a TV guide web site which offers information on TV shows ahead of time by combining the interest of the user with a given time frame. Other examples are an event guide or a database with "Calls for Papers". The time dimension is an important component for this approach as it allows to track the typical behaviour of the user together with the location dimension. Extending the reach into the future is possible by using the schedule and appointments listed to offer information about events which will happen around another event in the "neighbourhood" of this location. This is especially true if you consider offline events.

It seems obvious that the dimension time does not make sense applied alone. It is usually used directly or indirectly combined with one or both of the other dimensions.

### **2.4 Application examples of the different dimensions**

"My Yahoo!" is a mixture of customisation and personalisation whereas Amazon has a personalisation system for book recommendations which is depending on the user's profile and the purchasing patterns of user's with a similar purchasing and interest history. Personalisation of book recommendations has been performed in the past by the bookshop staff which remembers the preferences of the customer and proactively offers books which should suite the taste of their customer.

My Yahoo! "... is a customized personal copy of Yahoo!. Users can select from hundreds of modules, such as news, stock prices, weather, and sports scores, and place them on one or more Web pages. The actual content for each module is then updated automatically, so users can see what they want to see in the order they want to see it. This provides users with the latest information on every subject, but with only the specific items they want to know about." (Manber, 2000). It allows an user to customise his page depending on his interests. Some of the personalisation happens "... inside the modules. For example, users can choose which TV channels they want to include in their TV guide in addition to which local cable system they use." (Manber, 2000). By choosing the local cable system a second dimension location will be included by considering the TV interests and the location of the user. A similar approach was taken in the PTV project. "The basic idea behind PTV [Personalised Television] is the 'online personalised TV guide'. That is, PTV is a television guide, listing programme viewing details just like any other guide, but with one important difference, the listed programmes are carefully selected to match the viewing preferences of individual subscribers. In short, every subscriber sees a different guide, a guide that has been carefully constructed just for them, taking account

of their programme preferences, their preferred viewing times, and their available channels. Crucially, PTV can inform users about programmes that they may be interested in watching." (Smyth et al., 1998).

### **3. Multi-Dimensional-Personalisation concept**

"Most context-aware systems still do not incorporate knowledge about time, history (recent or long past), other people than the user, as well as many other pieces of information often available in our environment." (Abowd and Mynatt, 2000).

Multi-Dimensional-Personalisation (MDP) is an approach to support the user to cope with the massive information overflow. The online world as well as the offline world provide a vast array of opportunities for the user. The main problem nowadays is to get the right information at the right time at the right place and in the right format. There are the main dimensions time, interest and location and the minor issues like bandwidth (GPRS, HCS, UMTS, LAN, WLAN, ...), format / medium (from plain text format to rich media formats depending on the client, available bandwidth or hardware), priority (how important is an information) and cost (costs associated with information or an event). Besides these dimensions and issues there are security concerns ("Big Brother") which have to be considered. As mentioned before the main dimensions for such a new personalisation approach are :

- The time dimension is comparable to a calendar or schedule. The user has a certain repeating behaviour or plans some trips ahead. The MDP would build up on this information and would allow a permission based recommendation taking into account the interest of the user and the location of the user. This would allow to recommend future events as well as events which fit the regular schedule of the user.
- The location dimension takes the "moving" pattern of the user into account. Regardless if the user is using a desktop PC, a notebook, a mobile device like a PDA or smart phone he will be "somewhere". Either at home, at work or on the road there always will be interesting things or information related to this user. Regardless if the online world or the offline world is the source of the information there is a location component to it (i.e., "where" it is). Combined with the other dimensions it is possible to offer recommendations "just in time" at the right place. Even planing ahead in time would be possible. Reoccurring moving patterns of a user can be tracked and used for recommendation based on the users location.
- The interest dimension (a.k.a. as "personalisation" in prior approaches) is covering what the user is interested in. This can range from business or commercial interests which are related to the job or studies to purely private interests like hobbies or information about, e.g., diseases.

Minor issues as mentioned above can be taken care of during the implementation of the system, issues like, e.g., bandwidth of the communication, technical capabilities of the device used to participate, ... . It seems that in existing systems and in previous work or literature such an approach has not been taken before. There are usually the two main approaches interest and location used in such existing personalisation systems. The interest based personalisation is

usually using filtering techniques like content filtering, collaborative filtering, rule based filtering, content mining, monitoring of the surf behaviour or by selection of interest topics through the user for the personalisation or recommendation to the user. These methods have to be extended to be applied in the multi-dimensional-personalisation context and has to be taken into account for the proof-of-concept or implementation phase. The user shall be provided "... with the information they want or need, without expecting from them to ask for it explicitly" (Mulvenna et al., 2000). Besides this the Content and services should be "... actively tailored to individuals based on rich knowledge about their preferences and behaviour." (Hagen et al.,1999). Nielsen writes on his web site that the "... bottom line is that for enabling Smart Personalization techniques the application needs to recognize individuals, not computers" (Nielsen, 2002). By taking this into account and considering that personalisation usually happens only on one web site or within a portal (e.g., in an intranet) the requirements should be clear. This new approach proposes services which will provide the user with the possibility to use his profile across all participating web sites. As Schafer et al. writes "One classification of delivery methods is pull, push, and passive" (Schafer et al., 2001). In order provide good services for the user it shall be an interactive solution providing the result of the multi-dimensional-personalisation in form of a proactive push to the user. This requirement was described, e.g., in (Chavez, 1998) that "an optimal assistant provides the required information autonomously and independently, without requiring the user to ask for it explicitly". The user shall get "... the right information at the right time and place - with minimal interaction" (Chavez, 1998).

The location based approach is nowadays mainly used for mobile devices like mobile or smart phones. In such scenarios the information is mainly used to navigate the user to an service or information provider. This is connected to a certain need or demand of the user (e.g., a pizza restaurant, a hotel or such things). This is mainly an "on demand" scenario, i.e., the user requests / pulls the information and has to select "what" he wants. The location based personalisation provides the "where" information for the "what". As far as the literature research has shown there is no system proposed which really combines this two dimensions in a personalisation engine. At the current state there is no approach known to the author which combines the third dimension time with the two other main dimensions. There are some approaches to combine the dimensions time and interest, e.g., in form of an interactive TV guide, i.e., a recommendation engine for TV shows. Another issue is that there are no real approaches known to the author which tries to bridge personalisation between the online and the offline world.

#### **4. Research outlook**

In order to deploy the multi-dimensional-personalisation approach the building blocks have to be established. To do so the single components have to be combined to offer this service. The classification of the interest is an important issue for the personalisation. A meta-hierarchy approach for the controlled vocabulary which describes the interest has to be investigated. The interest shall be gathered from the user as well as be collected from the user and usage behaviour of the user (e.g., by evaluating the web usage, favourites, web searches, output from recommendation systems, ...).

The geographical and temporal behaviour is another important issue for the multi-dimensional-personalisation. This is an specific issue as data protection laws can cause problems in certain countries. One solution is to store the profile anonymously and pass this data without a real reference to the participating and requesting server. A Microsoft white paper stated this problem that "People are not in control of the technology that surrounds them. We have important data and personal information scattered in hundreds of places across the technology landscape, locked away in applications, product registration databases, cookies, and Web site user tracking databases." (Microsoft, 2001). By providing an open interface and data security a cross platform and cross web site personalisation could be achieved. In order to use the geographical information about the user the devices used have to be capable to gather data about its location. Possible technology scenarios are GPS / Galileo, location information via the mobile phone service provider (e.g. GSM cellular location, CellID, observed time difference of arrival (OTDOA), ..., i.e., location information about a cell where the device is located). Whereas the location is important for the geographical recommendation the temporal dimension has to be considered as well. In combination with the location, e.g., the daily way from and to work can be identified. Future events would have to rely on a combination of time and location in a schedule (e.g., two weeks holiday in Las Vegas from the 13<sup>th</sup> of January or a business trip from the 11<sup>th</sup> to London). One issue for this is an extended calendar event description in digital form which not only gives information about the date and time but also gives information about the location (e.g., the iCalendar extension SKiCAL which allows to describe an event including location and time). Additionally it should cover a form of classification of the topic of the event in order to map it to matching interests.

In order to reduce the payload on the used device, regarding bandwidth and storage, a multi-tier architecture has to be defined which allows the system to work even with low bandwidth devices like a standard smart phone.

This new approach of a personalisation engine which extents its reach from the online world towards the offline world seems to be very promising as it connects the separated worlds. As the users interests would be considered in conjunction with their location, even when they are on the road (i.e., a roaming user profile). The system could provide a new convenience for users world wide. By considering the regular / daily schedule and prescheduled events in the calendar the MDP system is able to look ahead to recommend interesting events. The service would not only be applicable to the user. In addition it gives opportunities for service providers, marketing and learning providers. Especially in the life long learning field a school could suggest to a busy student presentations and workshops along its daily and future schedule even when he is away from his "home" location. In this scenario the time dimension applies twice. Once in the schedule of the user and once in the progress along the timeline for the curriculum / study programme.

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