Service Personalization for Unified Messaging Systems

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Abstract
In the last two years a variety of concepts for service integration and corresponding systems have gained momentum. On the one hand, they aim for the interworking and integration of classical telecommunications and data communications services, such as telephony, voicemail, fax, e-mail, paging, etc. On the other hand, they are focusing on universal service access from a variety of end user systems, including both, fixed and mobile terminals. Such concepts or systems are designated as unified messaging. Most of the technical problems, resulting from the service integration, have been solved during the last years. However, service personalization is still an insufficiently solved problem of today’s unified messaging systems. Different services have to be personalized in different ways.

This paper will investigate, how different services could be personalized in a unified way. Therefore, several services, which are offered nowadays by unified messaging systems, will be analyzed. In the second part of this paper, a generic approach for service personalization will be given. For illustrating the introduced approach, the last section describes a first realization.

Keywords: Unified Messaging, Universal Message Access, Universal In-box, Media Conversion, Content Analysis, QoS, Service Integration, Service Interworking, Customer Service Control, Rule based Service Personalization, Personal Mobility, Personal Communication, Location-aware Applications.

1. Introduction

Today’s communications environments are still characterized by the usage of several services. Each of them needs to be accessed in a specific way. For example, a user has to employ two different devices if he wants to make a phone-call and to send a fax. The more services a user wants to employ, the more devices or applications he has to operate on. There is almost no way to handle a certain telecommunication service with a terminal which is not designed for it. E.g., it is not possible to read email with a mobile phone. To overcome this restriction, a new category of telecommunication service solutions has gained momentum in the last years. Under the catchword “Unified Messaging”, these solutions have the aim to fulfill the vision of integrating different communication services [Nam97, Gre97]. The usage of different services should be possible in the same way.

The idea for such solutions is based on recent developments in the area of personal communications featuring information at any time, at any place, in any form. That means, a user should be able to handle several kinds of telecommunication services independent when, where, and on which way he wants to do that. The idea behind these systems is to provide a user with a unified access to all services he has subscribed to. Additionally, unified message delivery should be possible. To achieve this, different approaches are chosen by vendors [Vdm99]. The “one-stop-shopping” principle is mostly used to model a unified message-box. All messages (phone-mail, fax, email, etc.) will be stored into one box which could be accessed via a WEB-client or a Graphical User Interface (GUI). Another new approach tries to integrate message processing as well as synchronous communications, where all communication parties have to be involved at the same time. That enables Intelligent Network [Mag96] like scenarios (e.g. number portability, dynamic routing, call forwarding, etc.).

In the following, the term “unified messaging system” will be used synonymously to describe a system which integrates different kinds of services in order to achieve universal access to them.

A very prerequisite for a unified messaging system is the capability to adapt one telecommunication service to another one. Thus, a service which should be delivered to a specific terminal could be adapted to fit the addressed terminal’s specific demands. For instance, such an adaptation is used nowadays to read out facsimiles on telephone lines. The original facsimile will be adapted via an Optical Character Recognition (OCR) and a following Text-to-Speech (TTS) conversion. The result (an audio stream) will delivered via a telephone line. Today, adaptation processes like this can be applied to many telecommunication services. The processing power of computers limits possible adaptation processes only. Some of them would need more computing power than available today (e.g. real-time adaptation from one video format into another one).

The second prerequisite is to harmonize different kinds of terminals or applications through the integration of several functionality into one terminal. The occurrence of a great variety of multifunctional handhelds or palmtops is a first step in this direction. Small devices, able to communicate wireless with both, the telephone networks and the Internet, open a new dimension of ubiquitous computing. If a user wants to reach any another person, he has no longer to ask himself: Is it possible to reach the other one? The only decision he has to make is how he wants to
communicate with the other person. If he requests a service the addressed terminal is not able to handle, this service will be adapted to the addressed terminal. As mentioned before, the adaptation will be processed inside the communication system (transparent to both the caller and the callee). [Vdm99]

The integration of several legacy services in office computers is another approach to harmonize terminals. Especially, the Computer Telephony Integration (CTI) plays an important role in this context. Office computers will be additionally equipped with telephony or fax hardware. The software, necessary to use this hardware, could be integrated in already existing applications. Besides this, new kinds of applications will be possible. So called “Pop-Up” application for service centers are able to react to different callers displaying related information. Generally, it could be stated that the integration of legacy telecommunication services into office computers will lead to more flexible communication environments.

The third prerequisite relates to the new telecommunication services which will be introduced day by day. It has to be possible to integrate new services into an existing unified messaging system after its installation. Information retrieval agents, information push services, news on demand, electronic commerce, and IP-Telephony are only some examples of new services which should be possible to integrate. The most of the actual unified messaging systems support only the major telecommunication services: telephony, fax, email, and paging. They are designed as closed systems, which are unable to extend with new kinds of services. A system with open interfaces, able to adapt to new services was introduced in [Vdm99]. It demonstrates, that it is feasible to add new services to an existing unified messaging system.

The fourth prerequisite is the service personalization, however the most of today's unified messaging systems do not face it. In this context, service personalization means the capability to customize different services to user specific preferences. This comprises features like call and time dependant routing, user screening, call forwarding, automatic message response, service dependant call processing etc. For instance, a user should have the possibility to configure for whom he wants to be reachable at which time. Furthermore, a user should be able to set the Quality of Service (QoS) he prefers for service delivery. This could not be done with parameters like jitter, delay, bandwidth, or other traditional parameters of network based QoS. Only the system itself has to care about that QoS. A customer of a unified messaging system wants only to deal with parameters he could understand. The new user-friendly kind of application based QoS will be characterized in terms of arising costs or intelligibility of the delivered service. [Pfe97]

This paper will analyze different kinds of services and service architectures to find out common features for service personalization. The analysis will be done, because the most of today’s unified messaging systems do not pay attention to the possibilities each service offers. The common features, which are discovered, will be used to design a first approach for a generic service personalization. Therefore, this approach will include an extendable generic user profile, as well as an algorithm how this user profile has to be evaluated. The result of the evaluation will contain exact instructions, how a specific service has to be processed for a certain user. For the configuration of the profile, users will be supported by graphical applications. The given approach will show, that future telecommunication environments will no longer be characterized by the usage of different services. Instead, such environments will be characterized by the way users customize subscribed services. This will only be done by means of reachability, privacy, cost, and application based Quality of Service. The underlying services will become almost transparent for the customers.

This paper is organized as follows. The 2nd section will investigate services, used today in unified messaging systems, to find out offered capabilities. Especially, the features of service personalization provided by these systems should be analyzed. Section 3 focuses on future trends for communication environments. Different examples for future service personalization will be given. In the 4th section, these capabilities will be structured and an approach for a generic profile for service personalization will be introduced. To illustrate the introduced approach, section 5 will show a first implementation which customizes different kinds of services in a unified way.

2. Service personalization in today’s unified messaging systems

This sections will investigate different services which are offered by today’s unified messaging systems. Common features of service personalization will be used later to define a generic approach for customizing unified messaging systems.

2.1. Telephony (PSTN/ISDN)

Today’s digital telephone networks are based on centralized switching centers with associated switching logic. A customer of a telephone service is able to customize this service logic by means of reachability. He could configure how an incoming call should be handled on different conditions (e.g. no answer, line busy, permanent forward). For these cases the user could define call forwarding rules (i.e. if the line is busy, forward the call to number xyz). Private Branch Exchanges (PBX) extend the forwarding capabilities with definitions for caller groups, to which a customer can forward his calls. They can also react to the calling line identification of the callee to forward the call dynamically. Unified messaging systems, which are on the market today, do not use such functionality. Telephony is only employed for voicemail support. Customers can have personal numbers for their automatic answering machines. The recorded announcements will be stored either for later access or forwarded by email to a predefined email account. [UMS]
2.2. Fax

Fax services are very similar to telephony services, the same transmission network and the same logic are used. Therefore, the same service methods of personalization could be applied to fax services. Additionally, new fax devices provide users with functionality like pager notification, automatic printout, automatic call forwarding, or forwarding by an email. Unified messaging systems provide this forwarding and notification capability, too. It could be customized by selecting a certain email account, a pager number, or a default printer. [UMS]

2.3. Email

Nowadays, electronic mail (email) is the most customizable messaging technology. It is possible to do both, customizing the message transfer and the software which receives the messages. Emails could be automatically forwarded, rejected, replied, or left untouched on different conditions. Theses conditions are evaluated in a special way. The content of an email will be analyzed to decide how it should be processed for the user. It is possible to execute special applications on email arrival, which are able to react to user preferences. The content analysis is a powerful tool for the provision of intelligent filters (Spam Filter, Trouble Ticketing Filters). This functionality could also be used to enhance email environments with a user-friendly service personalization. For instance, a customer could define, “if an email from person X, with an attached image larger than one megabyte, and the word “Fun Stuff” in the subject field reaches me, delete it automatically and respond to the originator with an unfriendly comment”. The most message based services could be customized similar to email. The processing of emails comprises four steps:

- the detection of an incoming email
- the analysis of this email
- the evaluation of the user preferences
- the execution of any kind of action (e.g. the message forwarding)

Almost all current unified messaging systems do not face this capabilities. In most cases email is only used as a unifier or meta-format for different services, because of its ability to transport different kinds of attachments. Some systems provide special graphical frontends which could be customized to react to incoming emails with special actions. [UMS]

2.4. Paging

This service could be used with mobile phones (using a Short Message Service) or with special wireless paging devices. The service itself provides hardly any customizable features. But, value added services (e.g. wake-up notification, or trouble ticketing systems, personalized news), which use paging, could be customized in a flexible way. The main information, necessary for such services, is when, what, and for whom a message should be delivered. Today’s unified messaging systems employ this kind of notification. Nearly all occurring events could be notified this way to a certain user. [UMS]

This section has shown that the basic services, supported by unified messaging systems today, will be neither customized as much as possible, nor as much as necessary. The underlying technologies offer much more capabilities for customization. To make unified messaging systems more flexible and more user-friendly, the shown capabilities should be taken into account. Based on these capabilities, a general framework for customizing unified messaging systems will be build.

3. Future Trends in Service Personalization

In this section, different future trends for service personalization will be discussed. The sources of these trends are parts of recent researches in the area of personal communications and parts of standardization processes which are in progress.

3.1. Information at any time, any place, in any form

The vision of information at any time, at any place, in any form is not that new. Recent research activities [Dec97] have investigated in that vision. In the last year, also the market has adapted that slogan to promote its offers. It has already been shown [Pfe97], that it is feasible to deliver any kind of information to any kind of terminal. To enable such an application, conversion processes have to be integrated in communication systems. These conversion processes could be used for the automatic service delivery and for the remote access to stored messages. In both cases, the conversion processes adapt a certain kind of message to the terminal the customer uses. The question which has to be answered is: Is it possible to customize conversion capabilities in a user-friendly way?

Two systems should be introduced which are capable of customizing conversion processes. The first one is the intelligent Personal Communication System [Pfe98] which has successfully demonstrated automatically configured conversion processes. These processes will be only instantiated under the scope of given user preferences. All user preferences necessary for the service delivery are stored in a rule based customer service profile. Rules define conditions on which several actions have to be processed. Examples for conditions, the system takes into account, are:

- from whom the message is sent,
- at what time a message has been received by the system,
- the terminal a user is currently registered at, or the location a user is currently located in,
- the quality of service (application based QoS) which should be delivered,

It should be mentioned, that in some cases only a notification is possible (e.g. if an image should be delivered to a mobile phone). But in the future, this restriction could be overcome by the usage of artificial intelligence in conversion modules which are capable to do intelligent content analysis and conversion.
- the format the message is coded in (i.e. JPEG image or ASCII text), or
- the type of messaging service, the message is transported by (i.e. fax or email).

Some actions, the system defines in relation to conditions are:
- forward to a certain terminal,
- forward to a certain location,
- forward to a certain user,
- force a specific service for service delivery (e.g. fax),
- forbid a specific service (e.g. phone call),
- force a specific format of the message (e.g. JPEG image),
- forbid certain kind of terminal (e.g. no mobile), or
- replay to the originator of the message with a prerecorded announcement.

This set of conditions and actions provides a powerful environment for service customization. If a message has been received, it could be delivered similar to the process given in 2.3. The message will be analyzed and the result will be compared with user’s conditions. If any condition matches, the associated action will be performed. Unless a condition matches, the system has to process the service without user preferences.

The second system, which is currently under development, is the Advanced Profile Manager (APM) [Cam]. The APM is embedded into a system that realizes the Virtual Home Environment [VHE], which is one part of the Universal Mobile Telecommunication Systems [UMTS]. In the APM project, it should be illustrated how Mobile Agent Technology [Bre98] could be employed for service customization. Therefore, the APM acts similar to the rule based environment described in the iPCSS. If a message should be processed, the APM of the callee will be evaluated to find out how the message has to be delivered. A specialty of the Mobile Agent Technology (Migration) enables the “on demand” installation of user applications at the called user’s equipment [Arb98]. This technology makes it easier to adapt services. That means, both, the service and the devices, could be customized employing mobile agent technology.

Both introduced systems make it possible to customize incoming services in a very comfortable way, but outgoing services can not be customized. A generic service personalization framework for unified messaging systems must be able to handle outgoing services, too, because today’s unified messaging systems support this kind of services. Some examples for useful scenarios are given below:

- a user wants to write an email with his mobile phone therefore he has to force the outgoing service email
- a user wants to send a prepared fax at a specific time therefore he has to force a certain time for sending
- a user wants to use a certain service provider (i.e. to could enable least cost routing) therefore he has to force a certain provider access

These examples could also be modeled in rules which contain conditions and actions. When a customer is initiating a service request, this request has to be compared with the conditions he has defined. In the case a condition matches the request, the service initialization has to be done in consideration of user’s predefined actions.

3.2. Mobility

Another trend in telecommunications is mobility. This means terminal mobility as well as personal mobility. Terminal mobility could be achieved by small devices a user could always carry. For supporting personal mobility, a user must have the possibility to register himself at any kind of telecommunication equipment. So, a system could face this registration to deliver different kinds of communication requests to the terminal the user is registered at. An extension of this approach is the registration at locations. A system, which supports location registration, must have knowledge about the communication capabilities at different location. If a user is registered at a certain location, the system itself has to choose one of the terminals at that very location for the message delivery. That registration could be automated by using automatic location technologies [Zel98, War97]. E.g. a user can wear a little infrared sender which could be detected by a receiver. If a user is detected by any receiver, he will be registered automatically. An approach, how such a system could be realized, is described in [Pfe98].

4. Customer Service Control for the next millennium

Different trends for service customization have been shown in the last sections. Now, these trends should be combined to apply them to unified messaging systems.

4.1. Analysis of incoming service requests

The analysis of a service request is a prerequisite to handle it in a user predefined manner. The information, necessary for the message processing, could be found out only by an analysis of the incoming message. Therefore, two different kinds of analyzing service requests should be taken into account.

4.1.1. Service related analysis

This kind of analysis relates to the special characteristics each service has. It has to be evaluated which persons are the calling party and the called party. Additionally to that, the time and the expected costs will be determined. Service specific implementations have to be employed, to find out this information. For instance, the mapping of telephone numbers to logical representations of customers will be done by a piece of software which is able to deal with telephony services.

4.1.2. Content related Analysis

After finding out the service related information about a communication request, the message has to be

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transmitted is analyzed\(^1\). A simple rule could be applied to the content related analysis. The more information the analysis is able to find out, the more flexible the service customization could be done. Therefore, each kind of upcoming technologies for content analysis should be taken into account. This comprises technologies like:
- automatic speech recognition,
- optical character recognition,
- language detecting (including automatic spell checking),
- digital image evaluation (including pattern recognition), and
- automatic text search (text robots).

All information, collected by the analysis, will be used to find out how a certain message has to be processed. This leads to the relationship between the content analysis and the parameters a customer should use for its predefinitions. New kinds of technologies for analyzing messages will extend the parameters of service customization. A very simple example for applying content analysis is the textual pattern matching in the subjects field of emails. If this field contains a specific word (pattern), a predefined action could be executed.

The advanced technologies mentioned above will also help to realize the application based QoS which has been introduced. Especially, the intelligibility of a certain message could be analyzed to enable a useful service delivery. I.e., a user could have the possibility to block messages which are arriving in a language he is not able to understand. Or, he can force the processing of such message by automated translation processes [UNL]. For future telecommunication environments, these kinds of content analysis will produce new value-added services (only one idea is the retrieval of images by speaking into a telephone “find some nice pictures with a horse on it and send it to me using email\(^2\)").

### 4.2. Rule based Customer Service Control

The rule based concept, which was given in section 3, will be used as basis for the following discussion. A customer describes his preferences for different services in rules. He could have as many rules as he wants. Each rule consist of two parts, a condition and a list of actions. The list of actions enable to react to communication requests with several different actions.

#### 4.2.1. Conditions

Conditions define on which circumstances a specific communication behavior is demanded by the customer. Summarizing the sections 2 and 3 it has to be stated, that the most important conditions are destination related, originator related, time related, service related, contend related, and QoS related. Hence, these five categories should be used to describe conditions in general. Destination and originator related conditions face from which user, or terminal, or location a message comes in or should be delivered to. Time related conditions describe the time a message comes in or the time a message should be delivered. These conditions are defined very flexible to comprise periodic events (e.g. send every second day at 6 p.m. a fax). With service related conditions a user can customize what kind of service he wants to process facing his preferences. The content related and QoS (application based) related conditions describe all characteristics which can be determined by the employed content analysis. The more intelligent this analysis is, the more parameters could be used for content oriented service customization. These conditions could also be applied to incoming and outgoing messages. A customer can react to the special content or QoS of an incoming message or he could force a certain kind of outgoing message handling, related to a certain content or QoS.

#### 4.2.2. Actions

The way, how a communication request should be handled, is described in actions. The different kinds of actions, which will be used in the following, are also derived from the sections 2 and 3. Three different kinds of actions can be identified, the destination related actions, the service related actions and the content and QoS related actions. The destination related actions comprise each kind of forwarding or redirection instruction to other customers, terminals, or locations. Both, forced forwards and forbidden forwards are possible, to include or to exclude possible destinations explicitly. Service related actions are capable to force or to forbid any kind of service or format. This feature can be used to write an email which will be send as fax, because the customer forces the outgoing service fax. The content and QoS related actions enable even better service customization. Different types of content can be forced as well as forbidden. It will be possible to send a fax, written in English, which will be converted to Spain, because Spain was forced for outgoing messages. Such examples illustrates very well that today’s unified messaging systems are still at the beginning of being customizable or user-friendly.

In section 2.1 a special behavior of PSTN / ISDN systems was shown. They are capable to react to the state the addressed terminal has (e.g. busy, don’t answer). A similar functionality is also applied to actions. Five different states are defined which should be taken into account before executing any action:
- normal – no special state has occurred (default case)
- busy – the callee already uses the addressed terminal and the terminal is not able to deal with a new communication request more
- don’t answer – the addressed terminal is able to serve the communication request, but the addressed user is absent or does not want to answer that request
- not registered – the system could not locate the addressed customer
- error – in all cases of failures

\(^1\) Of course, this is only possible for store-and-forward services. Synchronous services will only be analyzed by the service related analysis.

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Each one of these five states is associated to a certain action. A set of these five actions is called action record. Therefore, a complete rule contains one condition and a list of action records.

The list enables the execution of several actions on one condition (e.g. a fax could be forwarded and a notification about that could also be delivered).

4.2.3. Evaluation

Up to now, the rules which are the basis for the customized service processing are described. Now it will be shown, how a communication request should be evaluated.

If a communication request is signaled to a unified messaging system, this request will be analyzed as discussed in 4.1.1 and 4.1.2. The results of that analysis will be used to evaluate the rules defined by the addressed customer.

Rule by rule will be evaluated until one rule is found which matches the requested service. In this context, matches means, that all parameters, specified in the condition of a certain rule, correspond to the service request.

- it is the same service,
- it is the same time,
- it is the same content,
- etc.).

If a rule matches the request, the corresponding normal action of that rule will be performed¹. After that, the system tries to deliver the service as specified in the normal action. Nothing else has to be done in case of success. If the service could not be delivered to the predefined destination, the system has to react to this by performing one of the actions busy, don’t answer, or error. Which action will be performed in such situations depends on the reason why the normal service delivery was not successful.

5. First realization

In this section, a first realization of theoretically results, described in this paper, will be introduced. The main idea is to realize a service personalization framework which could be applied to several systems. Therefore, some decisions for the design of a prototype will be discussed now.

Because the most unified messaging solutions are based on distributed systems, the framework has to be

¹ There is only one exception. If the addressed person is not registered at a location or terminal the not registered action will be performed. If this action is not specified in the matching rule, the normal action will be performed. The further processing is for both not registered cases similar to the normal case.
accessible from different host computers. To solve this problem, the system is based on a middleware platform. The platform which was chosen for the realization of the framework is a CORBA [OMG98] based implementation. Therefore, for the communication between different components the Internet Inter ORB Protocol (IIOP) is used.

5.1. Influencing Systems

Although, the implementation should be used by several unified messaging systems, up to now only two systems use the prototype. The first one is the iPCSS (see section 3) which does not use the entire functionality. Because it is not able to deal with outgoing calls, this functionality is not used.

The second system, which employs the prototype, is described in [Vdm99]. It is a unified messaging system which faces incoming and outgoing service requests by applying content analysis to them.

These two systems have influenced the work on the prototype of the service personalization. They have shown which capabilities state-of-the-art technologies offer and how they could be applied to real systems. With the help of these two projects the possibility to realize a prototype for different systems has been shown.

5.2. Customer Service Control Server

The implementation of the service personalization framework is divided into two parts, the Customer Service Control Server and the Customer Service Control Client. At first the Customer Service Control Server is described.

The server is responsible for the handling of service personalization data related to several customers. Additionally to that, it is able to evaluate service requests. Therefore, it contains a database in which the data of personalization is stored, and a logic which performs the evaluation. The database is structured as shown in figure 1. It is implemented in C++ classes (see figure 1 for class hierarchy). The evaluation, which uses the database, is realized by corresponding member functions of the database’s C++ classes. The entire server is implemented using Microsoft’s Visual C++ 6.0 and Rogue Wave’s Tools.h++ Professional 8.0 library package. Tools.h++ enables comfortable programming with its powerful base classes. Moreover, it is available for many operating systems, so the implementation is kept portable. The used CORBA implementation is IONA’s ORBIX 2.3 [Iona98].

5.3. Customer Service Control Clients

Sections 3 and 4 have shown that it is possible to customize services in manifold ways. To make customers familiar with these new kind of customizations, different applications are necessary. Plain applications, able to customize simple forwarding scenarios, will be the first step. A higher level of customization requires that users are more familiar with such systems. Therefore, three kinds of Customer Service Control Clients are planned. The multiple choice based client requires nearly no practice. A user has only to choose out of pre-configured rules. The rule based client enables the configuration of simple rules supported by pre-configured templates for conditions and actions. An example for an action template is: “Forward the message by fax to my secretary and notify me by a SMS”. The advanced rule based client enables a user to configure all parameters which are contained by the Customer Service Control. For instance, content related conditions could only be described in this kind of application.

All applications will be implemented using the programming language Java. The used CORBA implementation on client side is IONA’s ORBIXWEB 3.0. All clients could be executed either as a stand-alone application or as an applet running in a web-browser. Figure 2 shows the first implementation of a rule based client. It illustrates very well the two parts of a rule, the condition and the action record.

The five actions could be customized or left untouched. Actions which have not been customized (e.g. not registered in the second rule in figure 2) will be executed with default values if the corresponding state occurs (e.g. busy).

5.4. Adapting other Systems to the Customer Service Control

While the server should be used from different systems, the data-structures are designed for easy understanding. Nearly all parameters are typed as strings, so that it is possible to cast different syntaxes into such parameter. If a system wants to employ the Customer Service Control Server it has to adapt its representations for users, terminals, locations, etc. This could be applied to the communication between a unified messaging system and the Customer Service Control Server. Therefore, the rest of the unified messaging system could be left unchanged. The only point which has to be checked carefully is the semantic of the adapted data-structures. The syntax or the structure could be mapped, but if the semantic is different in two systems one system has to refine it.

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6. Conclusion

This paper has presented a short overview about services offered today by unified messaging systems and how these services could be personalized. The presentation has shown, that customers of future telecommunication environments will demand more flexibility in using several services, as well as in customizing these services. The usage of different services should be possible in the same way. Transferring these demands to service personalization, it is stated that today’s unified messaging systems support customers insufficiently.

Based on state-of-the-art technology it is possible to design a generic framework for service personalization. This framework could be applied to different systems. An approach which is designed to achieve this has been shown in this paper. Based on this approach, a first realization of a Customer Service Control has been illustrated. This realization represents a rule based service personalization framework which could be easily extended to fit future service demands.

7. References


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