

# User adaptive media selection based on agent communication

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By spread of Internet, we become to use several of communication such as email, ICQ, VoIP etc. But as become convenient to use, user must be aware of variety of information regarding the media and partner user. The forecast is that this problem grows larger and larger as new media are brought in the expanding communications network. In this research, we suggest an agent MIA (Media Integration Agent) that manages the information instead of user. The MIA is an agent that obtains situation of user, and dynamically exchanges addresses and tendency of using medias in form of vCard. By use of this, user can choose better communication media. Accordingly seamless communication environment that user doesn't have to be aware of various information is formed.

## 1. Introduction

Today, people utilize various communications media. Telephone, facsimile and postal mail are used in the real life. In the network, applications include e-mail and ICQ. However, difficulties exist in order to effectively employ each of the media and make proper use of the multiple media. The user must be aware of the variety of information regarding the media and the partner user of the communication, which is listed below, and pick out the appropriate media to be applied.

- Information on the media
  - specific address information for each of the media
- Information on the communicating partners
  - available media for the partner
  - tendency or preferences of the media for the partner
  - optimum media at the time of the communication

Although the acquisition and the selection of such information could be partly supported by the proprietary functions specific to each of the media in the existing communications environment, the functions are quite insufficient in terms of the integrated multi-media environment. The forecast is that this problem grows larger and larger as new media are brought in the expanding communications network.

Therefore, it is necessary to supplement the communications environment with the facilities that help the human users by understanding and interpreting, or assisting the user to interpret, the information on the media and the partner users.

To solve these problems, the authors are constructing a new communications environment by innovating the Media Integration Agent (MIA) and the UniAddress, which is a unique identifier to an MIA and a user of the MIA. The MIA is an agent that holds the information about the media and the communicating partners. With the MIA and the UniAddress, the human users are released from dealing with the low-level data such as media-specific proprietary address of the partner so that the communication media can be utilized more efficiently.

## 2. Information needed to make proper selection of the media

### 2.1 Information that the user must remember

As discussed in the introduction, the user must know two kinds of information to determine which of the media is the most useful when commencing a communication: information on the media and information on the communicating partners. This

section analyzes each of the information.

### **2.1.1 Information on the media**

Each of the media has specific addressing schema. A unique address must be given to a user in the schema to identify the user. For example, a telephone user must know the telephone number, and an e-mail user must know the e-mail address, of the communicating partner, in order to use the media. Although what the media user wishes to do is to 'call X', the user must 'push the number of X' in fact. Managing all kinds of such media-specific addressing for each of the media is a big burden for the users.

Intelligent telephone terminals or e-mail client software have own user database functions. With the help of the database, the user may not have to be aware of the address of the partners. However, these functions are very specific to each of the media. If a person wants to make use of multiple media, the following problems emerge:

- Certain address information for a user in a database for one of the media may not be in other databases of different media.
- Even one exists in another database, a separate search must be initiated for the same user.

For example, if you are reading an e-mail and need to make a telephone call to the originator of the mail, your e-mail client cannot handle the request. Even if the e-mail address is stored in the database of the e-mail client software, the telephone number for the address might not be there. You have to search a telephone directory for the telephone number.

### **2.1.2 Information on the communicating partners**

The optimal communications media vary from time to time depending on the external situation because people who are committed to multiple media may utilize them differently. For instance, one would prefer 'to be reached by phone from 9 to 5; via fax or e-mail otherwise' and another may 'accept only e-mail except for urgent cell phone'.

Thus the optimum media at the time of the communication can be resolved by evaluating the following information:

- (a) Available media to the originator
- (b) Available media to the recipient
- (c) Recipient's tendency or preferences for the media
- (d) Contents of the communication

Of the above information, the originator may easily understand and select (a) and (d) but (b) and (c) are hard to obtain. Typically, the user either acquires and remembers information on (b) and (c) by experience, or asks the recipient when necessary. It takes time and it is cumbersome either way, which makes great trouble for the users.

### **2.1.3 Functions required for the communications environment**

The above analysis reveals that the following functions are requested to the communications environment in order that multiple media be effectively utilized:

- To get the available media and preferences for the media of the communicating partner.
- To integrate the addressing information for each of the media so that the communications can be made independent of the media type and without having to touch the details.

In the present communications environment, the media data described in section 2.1.1 are separately exchanged by individual users. The obtained data are also independently managed by the remembrance of the users or the discrete media clients. This research aims to formulate a communications environment that enables the users to efficiently make proper use of the multiple media. To do so, a mechanism has been introduced that integrates the media information (section 2.1.1) and user information (b) and (c) (section 2.1.2) as an object, which is interchanged between the user agents that control the object.

## **3. The communications environment supported by UniAddress and MIA**

The following two points characterize the concept of the communications environment supported by UniAddress and MIA, which are proposed in this research:

- The agents administrate media information (address

and preferences) for the users.

- The human user communication is backed up by the multi-agent communication that dynamically exchanges media information.

The logical model of the communications environment consists of three layers: agent space that is populated by the MIA, real space, and the media space that comprises of media in the network. [Fig. 1] The UniAddress is a unique object name that corresponds to an MIA. UniAddress is exchanged with the users either in the real space or in the media space by one of the media. UniAddress identifies the communicating partner by pointing to the partner's MIA.

The MIA is an avatar of the human user in the agent space. MIAs interchange data such as available media to the user, address in a media scheme and media preferences. This is to assist the users to decide which media to employ, based on the information that the agent has acquired. The MIA looks in the MIA Search Server for the current location of the partner agent of the communication with the UniAddress key. It also verifies the communicating partner if the sender MIA of the media information knows the UniAddress of the destination MIA. Now, the human user initiates the communication with the following sequence in this environment:

- (a) The user designates the partner of the communication to the MIA.
- (b) The MIA lists up all available media by consulting with the partner's MIA.
- (c) The MIA prioritizes the available media that it gathered in step (b) according to the latest circumstances and presents them in order to the user.
- (d) The user assigns the media.

#### 4. Related activities

Concerning the problems of this research area, other activities include vCard and address retrieval with LDAP. The relationship of this research with them is discussed below.

##### 4.1 Information exchange with vCard

In the area of Personal Data Interchange (PDI), the

common format has been standardized for the electronic card that is targeted to exchange information such as name and affiliation and media addresses between the users, known as vCard.

With vCard and vCard-savvy applications, it is possible to unitarily manipulate the address information regardless of the specific media that the communicating partners use. However, the standard properties of the vCard contain only static data of addresses or available media, similar to the regular business cards. Therefore, it is impossible to dynamically provide the users with the available media and media preferences at the time of the communication. Another problem is that there is no prescription for informing the partners the change on the field data in a vCard.

While the communications environment based upon this research recommends standard vCard for the data exchange for the static media, it extends the vCard specification by introducing the own extended properties (property names that start with 'X-') that describe dynamic information required to choose which media to use at the time of the communication. Since the UniAddress is guaranteed to be unique, it is always doable to get the latest data from the MIA when any field has changed on the vCard.

##### 4.2 Address retrieval with LDAP

E-mail clients such as Microsoft Outlook or Netscape Communicator offer services that utilize LDAP to look

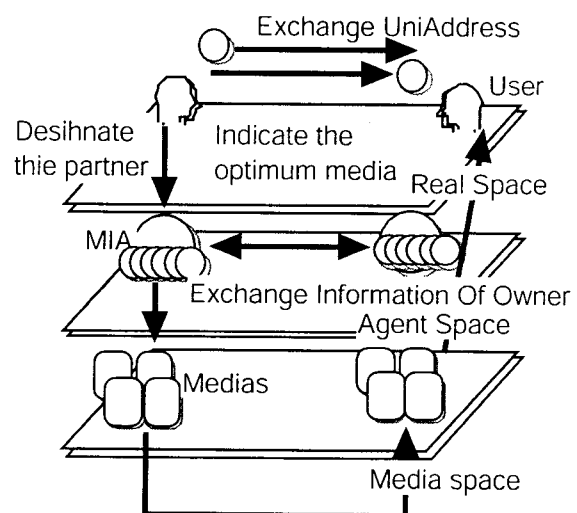


Figure 1. Model of Communication Environment

for the mail address. However, only globally available addresses that the general public may access can be registered with LDAP. This is because Outlook and Communicator do not take advantage of setting the access control to the information based on the user certification.

In this proposed communications environment, private information such as address and telephone number, which public access should be restricted, can be safely dealt with because only UniAddress is known to the human users and the actual media data exchange is conducted by the delegated MIAs specified by the UniAddress.

## 5. Prototype of the communications environment based on the MIA

Based on the model presented in section 3, the authors have implemented the prototype of the MIA system. The system is written in Java. The agent communication conforms to the FIPA standard.

### 5.1 System configuration of the communications environment

The communications environment of UniAddress and MIA consists of the components shown in [Fig. 2].

#### 5.1.1 UniAddress

The UniAddress is a unique object name that corresponds to an MIA. The MIAs can start communicating when the human users have exchanged the UniAddresses.

#### 5.1.2 MIA

The MIA is an agent that manages the following information: (1) communication address of the owner user for each of the media and preferences of the owner for each of the media; and (2) UniAddresses of other users and static media information, which can be described within a standard vCard.

The MIA has the functionality (1) to dynamically collect the communications addresses of the partner for each of the media and the preferences of the partner in terms of time for the media; and (2) to assist the owner user to utilize the media based upon the acquired information in step (1) and the current situation of the

owner. The internal model of incarnation will be discussed in the next section.

#### 5.1.3 Media Evaluator

The Media Evaluator is a mechanism that receives media invocation request from the MIA and execute the application programs to use each of the media. The Media Evaluator is in fact a collection of the particular Evaluator Modules that fit to the particular media. Users can plug-in a new Evaluator Module that can call the cherished application of the user for the media to set up one's accustomed environment. It is also feasible to extend the communications environment by adding a new Evaluator Module to the Media Evaluator when a new media has been introduced.

#### 5.1.4 Media

The media in the figure are application programs that correspond to the actual media: i.e., e-mail client application, fax application etc.

#### 5.1.5 MIA Search Server

The MIA Search Server furnishes a directory service that registers the information for the UniAddress of the MIA and the location of the MIA in the agent space (in FIPA terms, GUID [Global Unique Identifier] of the agent). By querying the Search Server, MIA can be identified even if it has moved in the agent space.

### 5.2 Model of incarnation of MIA

The MIA consists of the following elements:

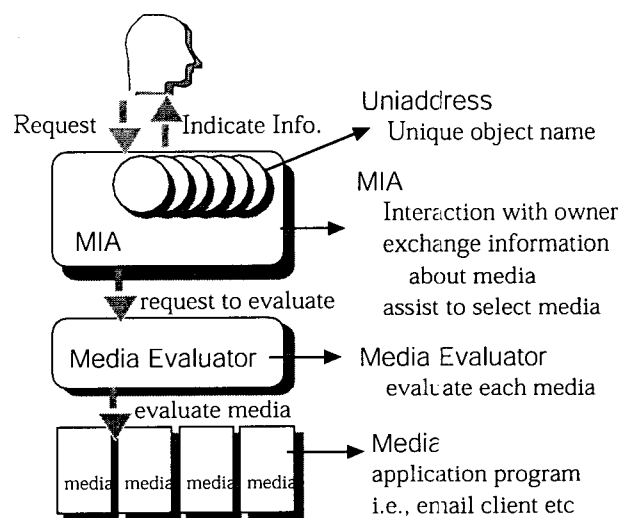


Figure 2. System configuration of the communications environment

### 5.2.1 Address Communication Agent

This agent communicates with the partner MIA to exchange data on the address and the preferences for the media. The information that the agents exchange upon the communication changes dynamically depending on the situation of the users such as the current location and the available media.

### 5.2.2 User Agent

This agent is responsible for the interactions with the human users. The User Agent processes the following transactions depending upon the user's method on the communication:

- (a) The user requests the MIA to start the communication.

The User Agent negotiates with the MIA of the communicating partner to identify the optimum media and present the media to the user.

- (b) The user directly manipulates one of the media.

The User Agent translates the symbolic names and the other media's address to the canonical address specified in the current media schema. For example, if the user enters the real name or telephone number to the e-mail application, the User Agent automatically converts that data to the e-mail address.

If the user selects the synchronous media (such as telephone or chat), the User Agent investigates if the media can be adopted and the partner is available for the media. If not, the User Agent proposes the alternative, possibly asynchronous, media to the user.

### 5.2.3 Media Preferences Agent

This agent observes the media utilization tendency of the user (phone, e-mail, fax and so on) and accumulates the information on date, time, day of the week etc. and

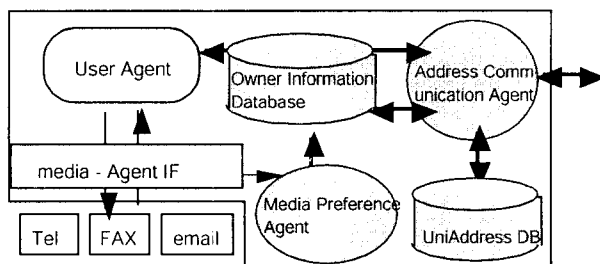


Figure 3. Model of incarnation of MIA

send the data to the Owner Information Database.

### 5.2.4 Owner Information Database

This database manages the information on the addresses for each of the media for the owner of the MIA and the data transferred from the Media Preferences Agent. It also generates the media preferences from the data and administrates the preferences.

### 5.2.5 UniAddress Database

This database manages UniAddresses interchanged between the users, and the address information and preferences for each of the media that the Address Communication Agent has gained. Whether a UniAddress is stored in this database or not makes the certification criteria for sending a sensible information to another user.

## 6. Conclusion

This paper has proposed UniAddress and MIA to construct an effective communications environment that is composed of a large number of media. In the proposed environment, the agents control the media and the user information, which otherwise users must manage by themselves, and the agents assist the decision of the users. The authors plan to evaluate the prototype system.

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