A DECISION MECHANISM FOR PROCESSING MULTIMODAL SERVICES IN FUTURE GENERATION NETWORK

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ABSTRACT

Communication technologies, old or new, are pushing the development of telecommunication industry. Thus, technically performing a multimodal service session (eg. one end is involved with data while the other end is with multimedia) is no longer a problem. People are gaining interests in managing these multimodal services by considering the choice and preference of users. This research brings in a four-option decision mechanism to intelligently process a multimodal service and may ensure a successful and friendly communication session for two reasons. Firstly, this mechanism provides four extra options for a service that may fail in current communication systems. After three extra tries, the service session will most probably succeed. Secondly, the user make decisions themselves by setting the rules of how to make proper decisions in advance.

1. INTRODUCTION

The emerging Next Generation Network (NGN) is expected to incorporate all the existing networks via comprehensive four-level architecture. These four levels include the access level, the transport level, the control level, and the application/service level [1].

This convergent network is also desired to provide network users with all types of services anywhere and anytime. In other words, no matter what the initial type of a service is, the NGN users are able to use the service at any type that matches their most handy communication terminal. For example, a deaf person may answer a voice call by text messaging on Internet messenger [2].

Much research has been conducted on the access and transport levels of the NGN hierarchy to realize a seamless conversion between different service types, such as text-to-speech [3], speech-to-text [4], voice over IP [5], or IPTV [6]. Yet few of them are focusing on how to manage a multimodal service with different service types at the two ends of a service session.

Moreover, when a service reaches a user, he/she must accept whatever type of the service that is available for him/her at the moment. However, the determined choice of a service type by the network may not greatly satisfy network users because the users may prefer to order their own service.

Thus, the focus on service performance and service management in a multimode-service environment needs moving up to the control and application/service levels of the NGN architecture, getting closer to the users themselves.

In our research, a mechanism for applying intelligence on network is proposed for Future Generation Network (FGN), which is beyond the generally speaking NGN in terms of service performance and service management.

In the FGN, the intelligence mechanism sits between the application/service level and the network users. It is able to do part of a job for the users during a communication session as well as provides an interface for the users to make their favorite services.

In this paper we will first define the network intelligence in the FGN in section 2. Then in the following section 3 we will depict a decision mechanism of processing multimodal services. This mechanism plays an essential role in the future network intelligence. Finally, we analyze Mr. Smith's communication life in section 4 in order to understand how the decision mechanism positively affects a modern person's life.

2. FUTURE NETWORK INTELLIGENCE

We envision applying intelligence on the FGN so the network will be able to deal with part of a job for the users and help the users process their services in a friendly manner.

To endow the network with the intelligence abilities, we establish a virtual person in the network to take over part of the task of a real person during a communication session. We assume the virtual person has the abilities of intelligence that a real person has. That is to say, the virtual person is able to behave like a real person in communication sessions.

In the real world, a network user has his/her individual personal profile, such as his/her current communication status as well as his/her social relations with other users. Accordingly, the virtual person will completely reflect the

communication situation of the real person. It is able to represent the real person in terms of personal information and present communication status. Also it is able to relate to other virtual people via the social relations of real people.

The procedure of a complete service session in the FGN can then be described as the followings.

When starting a service, the service initiator first connects to the virtual initiator. The virtual initiator negotiates with the virtual receiver on whether the real receiver is able to receive this service session for that moment. If the receiver is technically available (such as being with proper and free terminal) at the proper time, a successful service session between the initiator and the receiver is set up.

However, if the virtual receiver finds that the real receiver is not available, it will further search its socially related parties on whether other people are able to help with the service. After the virtual receiver finds a competent, reliable, and available virtual assistant receiver, it authorizes the virtual assistant receiver to handle the service after successful negotiation. A link will then be set up between the virtual initiator and the virtual assistant receiver.

After these virtual people have eventually finished all the events of searches, negotiations, and choices, the network indicates the final receiver (the one who is finally decided to receive the service) to receive this service session and communicate directly with the initiator.

In the entire procedure of setting up and running a service session in the FGN, only two real people are involved in the service session, namely, the initiator and the final receiver. The rest work such as looking for and setting up an appropriate connection between two appropriate people is conducted by the network intelligence.

3. DECISION MECHANISM

For the easier view and realization of the FGN intelligence in a technical way, we describe the network intelligence as the functional entities in Figure 1 using a vertical orientation of the NGN architecture.

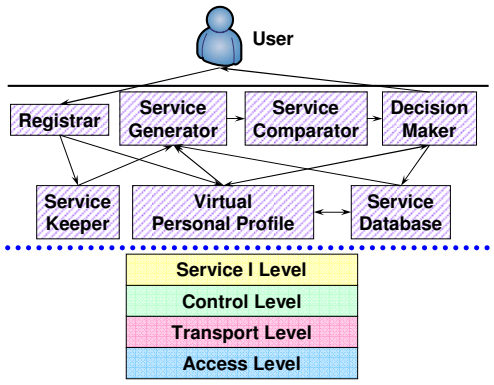

Figure 1. Functional design of future network intelligence.

An intelligent service management shows up when one of the FGN functional entities makes decisions on how to deal with a temporarily failed service according to the users' service requirements, current communication status, and social relations with other communication users.

In the following we will introduce the procedure of performing a service by using this intelligence mechanism and understand the task of each functional entity.

When a service comes from the initiator, the Registrar first checks its authenticity and then divides it into three parts. The first part is the service characteristics and the requirements on each characteristic. The second part is the initiator's personal communication information. The last part is the receiver's personal communication information.

Then, the first part of service characteristics is sent to the Service Keeper, while the initiator's information and the receiver's information are respectively sent to the Virtual Personal Profiles (VPP) of the initiator and the receiver.

After that, the Service Generator generates two types of virtual services. It combines the service characteristics and the initiator's information to generate an "original service"; meanwhile it combines the same service characteristics and the receiver's information to generate a "new service".

Once the two services are ready, the Service Comparator will compare them on service characteristics. 1) If the "new service" CAN meet the requirements of the "original service", the Decision Maker will set up a service channel between the initiator and the receiver. A successful service session is performed. 2) If the "new service" CANNOT meet the requirements of the "original service", the Decision Maker has to make its own decisions then. These decisions are made according to the communication information of the initiator and the receiver.

Four optional decisions are available. The first is to ask the permission of the initiator on whether to immediately deliver a service with less satisfied performance; the second is to postpone the service and wait till the communication status of the receiver changes to be available; the third is to find an assistant receiver to assist the receiver with this service; and the fourth is to learn how to deal with this type of service from other experienced users. These four options are explained in details as the followings.

Option 1: The Decision Maker first checks with the virtual initiator whether the "new service" is acceptable for the initiator. If the initiator requires reasonably on service characteristics, the "new service" is acceptable and a service session is set up. If the "new service" disagrees with the initiator, the Decision Maker will take the second option.

Option 2: The Decision Maker checks with the virtual initiator on whether it agrees to postpone the service until the initiator's communication status becomes available. For example, a user becomes contactable when one's physical location changes from a subway without signals to a road with signals. If the virtual initiator decides to postpone the service, a complex service package composed of the service

characteristics, the initiator's information, and the receiver's information will be temporarily kept in Service Database.

The Service Database will then contact the receiver's VPP at regular times. Once the virtual receiver's communication status changes to be available for this service, the Service Database will immediately send the service package to the Service Generator. Two services, one for the initiator and one for the receiver, will be generated and compared again to see whether a service session can be set up. It is noted that the virtual receiver's personal information can be updated by the real receiver's actions in other service sessions. For example, the receiver's communication status can be updated when he/she initiates another service session.

Option 3: If the virtual initiator demands the service to be carried out as soon as possible, the virtual receiver will check its social relations on whether other users are able to take over this service. If a proper virtual assistant receiver is found, the virtual receiver will authorize the virtual assistant receiver to carry on the service for it. The virtual assistant receiver must accept the invitation to this service session.

The virtual initiator and the virtual assistant receiver then start the same negotiation procedure as that between the virtual initiator and the virtual receiver described above. If the virtual assistant receiver is proven to be qualified for this service, it will start to communicate with the virtual initiator.

Option 4: If the service is new to the virtual receiver or, in other words, the virtual receiver does not know how to process this type of service, it will then look in its social-relation list for a virtual assistant receiver that has the experience of processing this type of service.

When such a virtual assistant receiver is found, it helps the virtual receiver with the service session by taking the following steps. If the virtual receiver has a higher priority than the virtual assistant receiver and the virtual assistant receiver's communication status is available, the virtual receiver will authorize the virtual assistant receiver to accomplish the service session for it. However, if the virtual receiver is lower than the virtual assistant receiver in priority but is trusted by the virtual assistant receiver, the virtual receiver will learn from the virtual assistant receiver on how to process the service by copying the rules of dealing with this type of service from the virtual assistant receiver.

After having learnt the rules of performing this type of service, the virtual receiver evaluates itself on whether it is able to manage the service on the basis of its current communication status. To do so, the options 1, 2, and 3 need carrying out again.

Finally a real communication will be set up between the initiator and the final receiver, which may be either the receiver or the assistant receiver. If unfortunately one assistant receiver is not able to implement or teach on how to do with the service, the receiver will continue to look for other assistant receivers. Whatever, this decision mechanism reduces the possibility of failure to the least.

4. A LIFE EXAMPLE OF DECISION MECHANISM

An example below will illustrate how to deal with four types of services according to the decision mechanism. The relations of the people in the example are shown in Figure 2, where Mr. Smith is the centric person of all communication sessions and others are in different sessions. All these network users are enabled with future network intelligence.

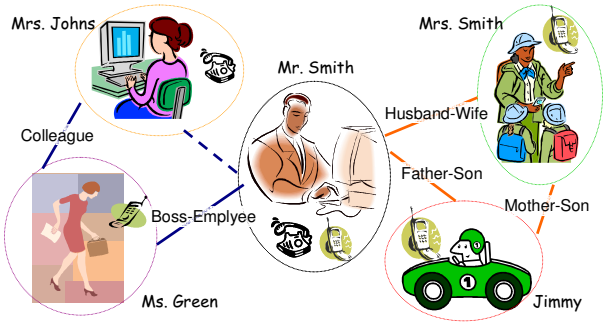

Figure 2. Mr.Smith's communication life.

Mr. Smith is a product manager. He is currently in office and is therefore able to access Internet and any phone.

Mr. Smith's former secretary – Mrs. Johnes – is still helping Mr. Smith with some former business cases. She is currently available to both Internet and office phone.

Ms. Green is Mr. Smith's present secretary. She is busy with an exhibition and thus only accessible by cell phone.

Mr. Smith has a 17-year-old boy named Jimmy. His wife – Mrs. Smith – is a teacher. Both Mrs. Smith and Jimmy have a 3G cell phone that can receive voice and data.

Now we simulate four categories of services that happen to Mr. Smith. After analyzing how to deal with these services, one is supposed to be clear of the intellectual ways of choosing proper service type from the management level.

4.1. Inner family service

Today is Jimmy's birthday. Mr. Smith sends Jimmy a birthday eCard with the pixels of 1024×1024. However, the virtual Jimmy finds that Jimmy's 3G cell can only receive pictures with the pixels of no more than 128×128.

Because the relation of Mr. Smith and Jimmy is Father-Son, the key issue of the service is to reach Jimmy while other issues such as the quality of service are less important. Therefore, the first of the four options (refer to Sec. 3) will be chosen, which is to deliver the service as soon as possible at the cost of an unsatisfied service performance.

To process a service in this way does not change the type of service (data) but diminishes the service performance. Besides, the service transfers between heterogeneous networks (from Internet to wireless network). Howsoever, this way satisfies Mr. Smith to the greatest extent because he would like to convey his best wishes to his son in the first time and does not care of the quality of the service that much.

4.2. Extern family service

An insurance company contacts the Smith family's VPP to make a survey of family safety. The survey is supposed to go to Mr. Smith because he did this before. Yet, Mrs. Smith is also legible for the survey as an adult family member.

The call first gets to Mr. Smith's cell phone but finds out that he is busy. The call will then be forwarded to Mrs. Smith's cell phone. If she answers, the survey is done.

This case shows that a successful service is determined by the communication availability, the social relations, and the learning ability of the expected receivers. In this case, the network looks for the currently available adult member of Smith family one by one although the insurance company operator only phones the Smith family's VPP number once. Moreover, Mr. and Mrs. Smith's social relation ensures that the service is forwarded to a proper family member. Assume the insurance company used to have zero credits in Mrs. Smith's VPP because it never contacted Mrs. Smith before. However, Mrs. Smith trusts Mr. Smith and Mr. Smith trusts the company, Mrs. Smith then naturally trusts and shares her information with the company (option 4 in Sec. 3).

4.3. Normal office service

Mr. Smith sends an Email with NORMAL priority to Ms. Green about a meeting next week. Yet Ms. Green is attending an exhibition and her communication status in her VPP shows both Internet-offline and cell-off. The network will then hang on the Email and wait. If Ms. Green happens to make a call, virtual Ms. Green will find that Ms. Green is available at her cell phone. Then it will switch the status of cell-phone on and send a short message to Ms. Green's cell phone about the content of the Email.

In this case, service execution time is not the most important issue but the content of the service should not be abridged at all, or the quality of the converted service should be no worse than the original service. Thus the option 2 in Sec. 3 of delivering a late service with original performance is preferred. This way, the service is delivered without missing any information and causing any inconvenience.

4.4. Urgent office service

Mr. Smith sends an email with HIGH priority to Ms. Green about delivering a batch of products right now. However, Ms. Green is in the exhibition and she cannot react to this demand right now. The virtual Ms. Green will then search around and finds out that Mrs. Johns is able to help with the service and she is currently online available. The HIGH priority email will then be immediately forwarded to Mrs. Johns and Mrs. Johns finally accomplishes this task.

The option 3 (Sec. 3) of dealing with a service is used in the business case. This way the service can be successfully performed without any delay and with a good service quality.

5. CONCLUSIONS AND FUTURE WORK

This research does not focus on the technologies of converting one type of service into another type. Yet it focuses on the service management of choosing the most appropriate service type to suitably and efficiently deliver a service when multimodal services are needed.

To save a service session that might fail in current systems, the FGN takes further optional actions. These four options are (1) to deliver the service immediately but with a less satisfied service performance, (2) to keep the original performance of the service and wait till the receiver is available for the service, (3) to ask for help from another network user, and (4) to learn from other experienced users.

However, a user does not always have to manually configure a service. An optimal choice is actually preset by the user in his/her VPP and is determined by the user's current communication status and social relations. Thus the virtual user will automatically provide the most appropriate solution for the user.

In the future, two big issues needing considering. One is to figure out a well-organized scientific structure of social relations of communicating people [8]. Thus the choice of how to perform a service may be decided by the network according to people's VPP and service characteristics.

The other issue is to apply the intelligence theory on an IP Multimedia Subsystem testbed [9] and use an experiment to test the theory. If this trial succeeds, the decision mechanism will be able to fit into FGN in principle.

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