Service Discovery Mechanism for Service Continuity in Heterogeneous Network

S. Mansor[1,a], N. S. Kamal Basha[2,b], S. R. Muhamat Dawam[1,c], N. R. Ali[1,d], and S. J. Elias[,1,e]*

[1]School of Computer and Mathematical Science, Universiti Teknologi Mara, Kedah, Malaysia
[2]School of Computer and Mathematical Science, Universiti Teknologi Mara, Shah Alam, Selangor, Malaysia
[a]*shaifizat@kedah.uitm.my,* [b]*shahniza@tmsk.uitm.edu.my,* [c]*srafidah129@kedah.uitm.my,* [d]*norrash@kedah.uitm.my,* [e]*shamsulje@kedah.uitm.my*

Abstract – *The service discovery process would greatly boost the ability of service lookup to realize the similar services across different platforms. As mobile devices are able to support more than one interface in a single device, the ability to use application services continuously with minimal interruptions becomes a major challenge. Service discovery limitations and future requirements mobile services are presented. To provide a seamless services, an adaptive approach of dynamic service discovery in future mobile environment is proposed to assist the service discovery process smoothen the service discovery and consumption of services.* **Copyright © 2015 Penerbit Akademia Baru - All rights reserved.**

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1.0 INTRODUCTION

With the fast-changing mobile landscape and convergence in all aspects of telecommunications, interoperability is important for any technology to succeed. Telecommunication has become an essential parts of people technology's demand. Services such as voice call, conference call, video on demand, video streaming and video conferencing are becoming parts of user's daily activities. This application requires a high quality service, particularly for voice call session and real time sessions. Consequently, the existence of many wireless access technologies such as Global System for Mobile Communication (GSM), Third Generation (3G), Fourth Generation (4G), Worldwide Interoperability for Microwave Access (WiMAX), Wireless Fidelity (WiFi), are emerging to satisfy the user's requirement to provide anywhere and anytime access to the Internet [1].

Mobile users in today's world are mostly mobile for almost 24 hours a day and involve in communication while they are travelling. Spending most of the time a day in mobile mode will make them to travel across different types of network technologies. Thus moving in and out into a restricted coverage area become a big challenge in order to sustain the always on services throughout the multiple access technologies.

Finding a relevant services that match the mobile user requests remain the major problem [2-4]. Some major causes may include constraint of mobile services, and the inherit complexity of heterogeneous networks. To ensure the scalability of future generation mobile environment

framework, this research will propose enhancement techniques on service discovery approach across heterogeneous wireless network.

The remainder of this paper is organized as follows. In section II, some related works is presented. In section III, limitations of service discovery is described and a proposed solution is presented in section IV. Finally section V includes conclusion and future work recommendations.

2.0 SERVICE CONTINUITY FOR HETEROGENEOUS NETWORK

The proliferation of the Next Generation Networks (NGN) such 4G and other existing wireless technologies such as GSM, UMTS and WiFi, should be interoperable with other communication to sustain the always on connection to the mobile users. The dramatically increase the numbers of smart phone users nowadays [18] urged the technology to work smarter in delivering an equivalent services throughout multiple network.

For example, when a mobile user is moving away from the current point of attachment, the mobile user has to search for a new network connections. A current services, ie. Voice services may no longer be available and new similar services will be discovered. The choice of using the new discovered services is not only actuated by its availability, factors like price, performance, security and user preference become a major cause to use new services.

Today's heterogeneous environment is continually growing. Almost all mobile users are equipped with multiple access technologies. This will allow the mobile users having an access to various types of services and thus improve the service discovery process based on several factors such as user preferences, pricing and security issues.

Through the circuit switched domain ie. Global System for Communication (GSM), the mobile network the user able to access the most dominant services such as voice and SMS services [10], [23]. In addition, WLAN 802.11 is another type of wireless access technologies that enable the user to access the Internet services via IP network or home network with a lower rate or free of charge. When mobile user register with a GSM network is using a telephony services ie. voice call services, it may or may not search for a similar services in order to retain the ongoing call while traveling across different platforms. The challenge in this research is how the mobile user will look for a service discovery process in order to improve the service discovery usability and quality of service.

3.0 RELATED WORKS

Service discovery protocol within heterogeneous wireless networks has been an active research and have various similarities and differences [19]. However some of the protocols are not suited for distributed, energy constraint wireless heterogeneous network as these require explicit multicast packets for service discovery frequently in addition to the multicast control packets.

Voice is a simple utility service, yet sustain successively to both mobile operators and phone users. It has been a killer application to mobile networks for decades. Voice over IP (VoIP) was created so as to give access to voice communication in anywhere around the Voice over IP (VoIP) technology suppresses the alternating silence periods of voice calls and increases bandwidth utilization through efficient multiplexing of voice calls. Most VoIP users are now critically searching the pipeline for services that will allow them to conveniently make free or

cheap calls using their mobile phones at anytime and anywhere. By dialing a mobile number to map other mobile number to a unique IP address users need not to register any service using IEEE 802.11 technology. VoIP is becoming an attractive communications option for consumers. Given the trend towards lower fees for basic broadband service and the brisk adoption of even faster internet offerings, VoIP usage should only gain popularity with time.

Over the years, many researchers have focused on the optimizing service discovery approaches to enable them usable in mobile environments. Those aspects of service discovery approaches include syntactic matching that access the requested services based on the particular words form the user's query [5], [6], behavior based matching such as category matching or keyword matching [7][8], semantic reasoning matching to allow efficient reasoning on context information[9], [11], context aware discovery for a better and accurate service provision [2] [5], [12]–[15] and other nonfunctional description based approach that includes QoS and service user data based matching [6], [16]–[19]. Although they have been many research efforts related to several aspects of service discovery, the researchers focus is not covering the aspects of service discovery in heterogeneous environment.

4.0 LIMITATIONS ON CURRENT SERVICE DISCOVERY MECHANISM

Despite the research efforts that have focused on service discovery, many more limitations with respect to mobile environments remain, including the following:

- Existing service discovery approaches does not take into consideration the support that peers able provide in mobile domains.

- Service discovery performance lack in terms of robustness and scalability since the limited open architecture design.

- Capabilities of mobile user to make decision for service discovery on their own such as user experience and satisfaction, user preferences and device features that must be consolidated in mobile environment are limited, thus it affects the level of mobile users satisfaction which is very important factors.

- Resource constraint are not taken into account in several service discovery approaches that may exist in mobile domains. These providers have limited resources to the mobile environment, for example, perform semantic matchmaking quickly and efficiently.

- Existing service discovery approaches are not able to detect the varieties of signal quality over wireless channel. Thus the services are unable to identify the service discovery to promptly respond and adapt appropriately to such context change.

- In a mobile environment, selecting services that are located in physical proximity, perhaps belonging to the same home network, for instance, can reduce network traffic and, as a result, reduce costs. Identifying services that provide this selection priority is currently not available in existing approaches.

- Keyword based service discovery is ineffective in retrieving the most relevant services to a specific request, while semantic-based discovery is resource service discovery.

The following table summarized several current well known of Service Discovery Protocol capability and limitations.

Table 1: Comparative Service Discovery Protocol on Service Continuity Architecture [22]

	UpnP	Jini	SLP	Salutation	Web services
Capable of handling different services with same names without confusion	No	Partially fulfilling if 128 bit service id is remembered	No	3.2.1 No	No it is handled manually
Capable of services with multiple names in multiple languages	No	Yes by attributes of a service	Partially supporting	No	No
Allow the introduction of any service anytime by anybody	No.	Partially With registering with LUS	Partially Supporting for local domain but not globally	No Salutation manager responsible for registration	No UDDI is authority for publish a service
Efficient	Partially fulfilled With cache its fast but when primary proxy fail it's not efficient	Partially If unicast address is known	Partially Fast when directory agent is not used	NO	No
Error-free	Yes	Yes By Leasing	Yes	Yes	Yes UDDI contains the description
Sound	Partially fulfilled	No	No	Partially With salutation manager	Partially

5.0 FUTURE SERVICE DISCOVERY REQUIREMENT IN MOBILE ENVIRONMENTS

Service discovery is a very important mechanism in preserving the mobile user mobility across heterogeneous mobile environment. Through service discovery process, a mobile user can continuously use the services provided although he/she moving around in different types of wireless network. The two sections below describe the future requirement of service discovery and present the proposed solution of the service discovery framework.
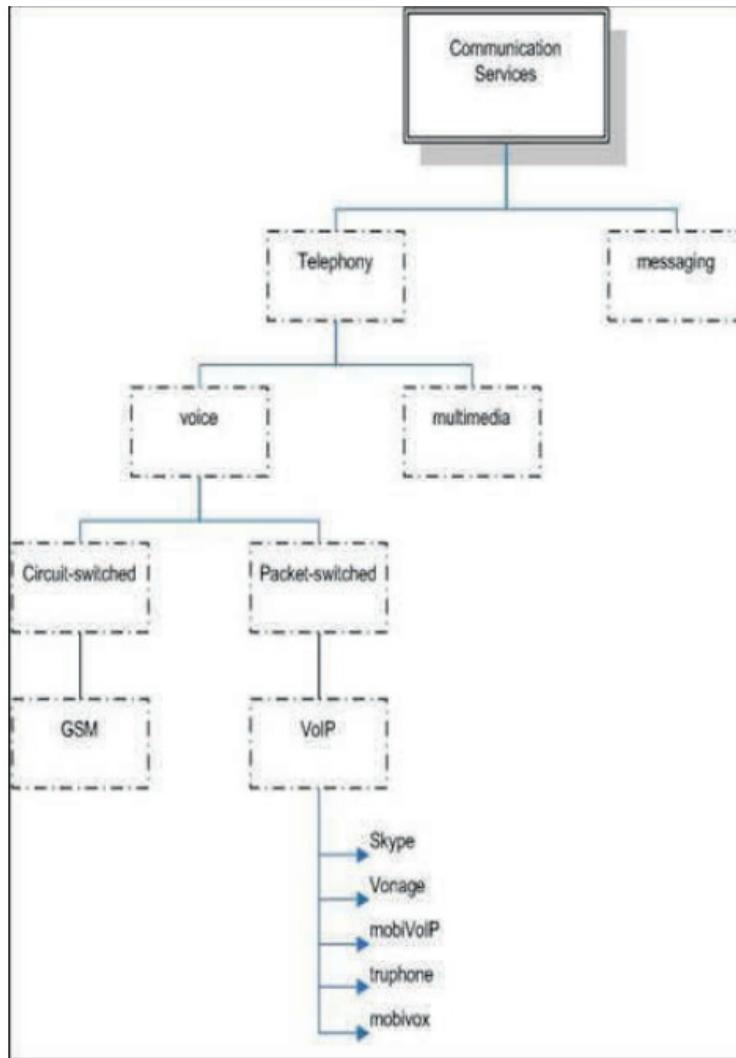
Figure 1: Service Discovery Classification [17]

As per Figure 1, communication services can be classified into two categories which are telephony and messaging. The telephony is classified into two which are voice and multimedia. Under voice classification, there are circuit-switched and packet-switched. GSM is an example of voice telephony using circuit-switched while Voice over Internet Protocol (VoIP) is an example of voice telephony using packet-switched. Under the VoIP classification, there are types of services listed which are Skype, Vonage, MobiVoIP, Truphone and Mobivox. All the services under VoIP classification will be listed and user may choose which one that match with their requirement during service discovery. However, in having the listing of the services there are some factors that need to be considered such as the size of the listing as well as the quantity of the listing. If the listing consists of so many services it will increase the size and the quantity of the classification and may result inefficiency in service discovery process.

5.1 Future Service Discovery Requirements in Mobile Environment

Searching for a discovery is a crucial mechanism in heterogeneous network to realize the process of service discovery. The process must be dynamic enough to handle the incompatible issues of realizing the ongoing services from one network to another. To ensure these features,

several requirements for service discovery in mobile environment should satisfy the following requirements:

- In mobile environment, the frequent transfer process of the terminal mobility will cause the inaccessible services and lead to the failure of binding information. The service discovery process should be able to handle smoothly in finding the same services aor any equivalent services to support seamless services.

- Due to the instability of the provider's mobility, the active user must ensure that the service discovery techniques are keeping up to date.

- With the characteristics of current newer mobile user of that equipped with multi interface, the service discovery mechanism must be compatible with the device capabilities to realize the mobile services.

- In enabling the service provisioning in mobile user, service discovery must incorporate user preferences and personalization to smoothly make the smart decision of service discovery process.

- Due to the resource constraint environment, mobile users may experiencing supporting a limited services. The service discovery procedure should be able handle the service discovery accordingly.

5.2 Proposed Solution of Service Discovery Framework

5.2.1 Scenario 1- Deterioration of Received Signal Strength in Existing Connection

The first scenario explained about an active mobile user using telephony service while on the Network 1 ie. GSM network. As a mobile user moves away from the current point of attachment and approaching the new detected point of attachment, the current received signal strength (RSS) of the active network becomes deteriorated. As the signal detection becomes weaker the mobile user might search for an alternative connection link in order to preserve the ongoing voice call services. To realize the service mobility, mobile user has to make a smart decision to change the connection link due to several reasons.
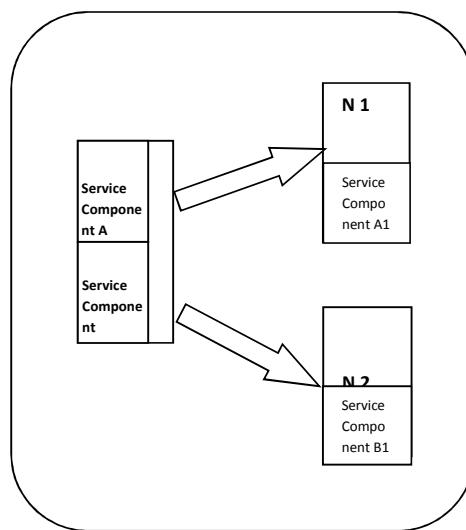
**Figure 2:** Service discovery diagram due to signal deterioration

Several parameters need to be considered in order to ensure the successful service discovery in a new registered network and maintain service quality and service implementation availability. Fig. 2 below explained service discovery between two different types of network.

This research will produce a service discovery model based on the explained scenario above. The service discovery process will be based on the searching for a compatible services in a new detected environment. An adaptive fuzzy decision making algorithm will help the above process to smoothen the service discovery and consumption of services.

5.2.2 Scenario 2 - Service Discovery Model When an Overlapping Network Having a Similar Received Signal Strength

In the second scenario, the situation occur when an active mobile user who is currently using a telephony service under the GSM service provider moving from one place to another. After crossing a certain point of attachment the active mobile user discovers a new network coverage ie. WiFi network. This situation occurs when the two overlapping networks which are GSM and WiFi both are having a similar signal strength with an acceptable rate. Thus the mobile user has to make a smart decision to whether using the existing telephony services under the GSM network staying at the current connection or searching for a new service discovery in an adjacent network coverage to transfer the services.

To realize the service discovery, an appropriate technique should be used to evaluate the network candidate based on mobile user requirements and preferences of users, device and applications, charging mechanism and personalization. In addition to traditional prioritized scheme, a multi attribute decision making approach will be presented in this section in order to make the better decision.
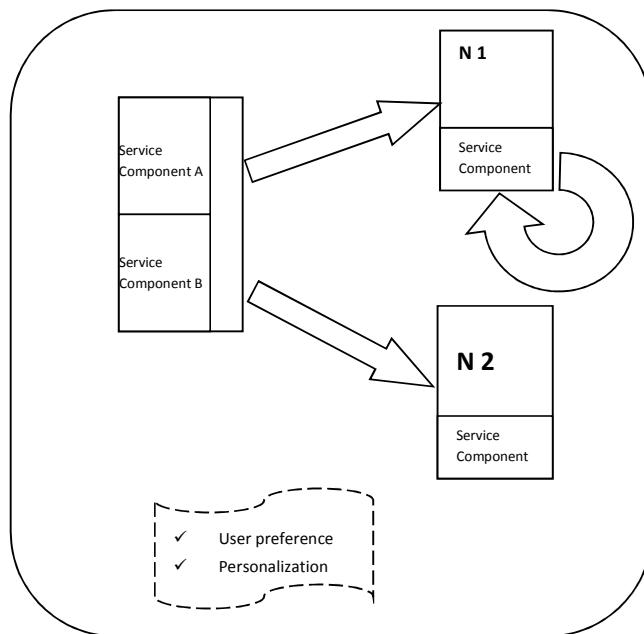
Figure 3: Service mobility of mobile user having a similar received signal strength from two overlapping network

4.0 CONCLUSSION AND FUTURE WORK

The blend of user preference and personalisation in service discovery has made a significant progress in various application. A lot of service discovery model, methods frameworks that employ different approaches have been proposed to improve user's experinece in service discovery matching. The limitations of current service discovery and future requirement for a better services were introduced and discussed and finally pointed out some possible challenges. This research is hope able to help beforehand the discussion of the service discovery process and more specific work will be presented.

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