A Study of Information Server over Seamless Service Continuity during Network Handover

Rajina Raj Mohamed

Wireless Communication Cluster

MIMOS Berhad

Kuala Lumpur, Malaysia

e-mail: jina@mimos.my

Abstract—**Mobile devices become more popular nowadays and as they are portable, roaming between heterogeneous networks is essential. With roaming technology, mobile device can perform handover from one network to another network seamlessly. Hence, users may enjoy service on mobile continuously. There are a few approaches discussed among researchers to perform handover for mobile device across heterogeneous network. Most of those existing experiments test bed were built according to the IEEE 802.21 Media Independent Handover standard that is to facilitate a seamless mobility in a heterogeneous network. Information Services (IS) is one of the functionalities in IEEE 802.21 standard for the handover purpose. In this paper, we proposed an experimental test bed setup for seamless video streaming with Information Server in a wireless overlay of 802.11 WLAN. Information Server framework was developed and applied to video streaming application to see the impact of IS over service continuity handover. Results show seamless video streaming service while handoff between two networks and achieved the objective of the study.**

Keywords-IEEE 802.21; Information Server; network handover; heterogenous network.

I. INTRODUCTION

With the proliferation of mobile device, roaming between heterogeneous networks is necessity nowadays. With roaming technology, mobile users can always connected to network services and internet when moving across different access technologies during an ongoing session. Roaming technology can be realized through IEEE 802.21 standard framework that provides Media-Independent-Handover (MIH) [1] to facilitate handover between different networks and different mobile devices.

In IEEE 802.21 standard [2], there is a functionality called media-independent information services which uses Information Database or Information Service (IS) [2] to provide information about neighboring networks surrounding a mobile device. This network information is a combination of several information elements such as Service Set Identifier (SSID), Received Signal Strength Indication (RSSI), Operator Name, Network Type, Encryption Method, Media Access Control (MAC) addresses, etc. Moreover, this network information is structured in such a way that a query/response mechanism can be used to convey the information elements to mobile

devices. These information elements are essential for mobile devices to refer to, in the event of performing seamless handover between heterogeneous networks. Fig. 1 shows an example of handover scenario between WIMAX and Wi-Fi that uses IS applied in network handover. It shows the implementation of IS named media-independent handover function (MIHF) that responsible to assist in handover decision making. It provides detail characteristics and services required by Mobility management entity for mobile phone to handoff from WIMAX to Wi-Fi.

Literature studies proven that by applying IEEE 802.21 approach will assist in handover across heterogeneous networks; but, the key issues are service continuity while handing over between heterogeneous access technologies. Most of the existing works were tackling on the network layer to trigger a handover from one network to other network. However, they were not considering the handover process from application layer to support seamless service continuity during network handover. As such, we developed an IS on application layer to see the impact on seamless video streaming during network handover. The network handover decision is done on application layer and controlled by end users. An IS framework created was applied to video streaming in a wireless overlay of 802.11 WLAN [3]. The end target of the experiment is to see the seamless service continuity of video streaming on mobile phone during handover from one network to another network facilitated by IS. A performance study also was conducted to examine that the objective is achieved. This is a preliminary study and application developed as a proof-of-concept for further research on IS in network handover.

The remainder of this paper is organized as follows. Section 2 describes reviews on several existing IS technologies. Section 3 describes on the system scenario and architecture, experiment setup as well as test results. Finally, in Section 4, the paper is concluded.

II. RELATED RESEARCH WORKS

There are many research works done for network handover that based on IEEE 802.21 standard. Here, we briefly describe some of the existing methods, which are quite relevant to our study. Dutta et al. [4] manipulate service and functionalities in IEEE 802.21 to perform handover between heterogeneous access networks, such as 802.11 [5], 802.16 [6], Code Division Multiple Access (CDMA) [7] and General Packet Radio Service (GPRS) [8]. Experiment result

shows that disconnection time and packet loss during handover can be reduced by applied 802.21-based approach. Usman and Tinku [9] have proposed an extended model for IEEE 802.21 MIH that offers seamless experience to heterogeneous handover in single and multi-hop network scenarios. Research by San-Jo Yoo et al. [10] have proposed a cross-layer based predictive handover architecture and mechanisms that are implemented in IEEE 802.21 media independent handover architecture. Experiment result demonstrated that the proposed method achieved seamless and proactive mobility for various network environments. Mussabir et al. [11] exploited 802.21 Information Services to optimize the Fast Handovers for Mobile IPv6 (FMIPv6) [12]. The proposed mechanism increase the probability of
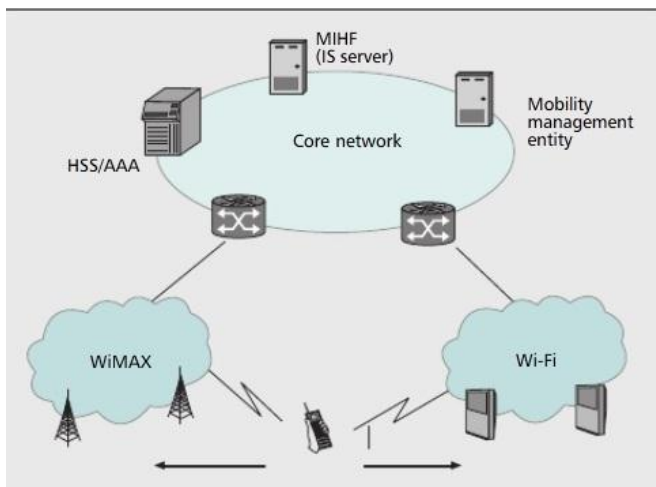

Figure 1. Example of scenario of network handover [3].

predictive mode; so, it reduces the overall expected handover latency in FMIPv6 [12]. Moving-Information-Server (MIS) was proposed by Yaqub [13]. It was implementing in a moving network (e.g. NEMO), where MIS acts both as Reporting Agent (RA) and Information Server (IS). Instead of populating IS repeatedly with redundant network elements, MIS will only store new network elements of available networks. Furthermore, MIS also maintains the updated lists of the known networks mapped with the location information. By using MIS approach, mobile node is capable to know information about the available networks in the geographical domain ahead of time.

III. FRAMEWORK IMPLEMENTATION

A. Framework Scenario

In Fig. 2, we assume that the scenario has taken place in an environment where Bob's mobile device will run a video application and will be attached to one access point or in our case WiFi AP 1. A continuous streaming video will stream from Streaming Server through the Internet cloud to WiFi

AP 1 before finally reaching Bob's mobile device. As Bob moves to different office departments, WiFi AP 1 strength will become weak; therefore; Bob will experience distortion on his video application. In order to cater this issue, IS is introduced to assist mobile device in performing a seamless handover. This could be achieved by allowing Bob's mobile device to query the IS for other available network, which might currently surrounding it. The query could be performed as soon as Bob's mobile device enters the overlapping zone between WiFi AP 1 and WiFi AP 2. When Bob's mobile device receives a response from the IS, it then perform an auto-connect to WIFI AP 2. As a result, the streaming video will remain in a good quality and Bob will not even notice that his mobile device is already connected to a different AP.
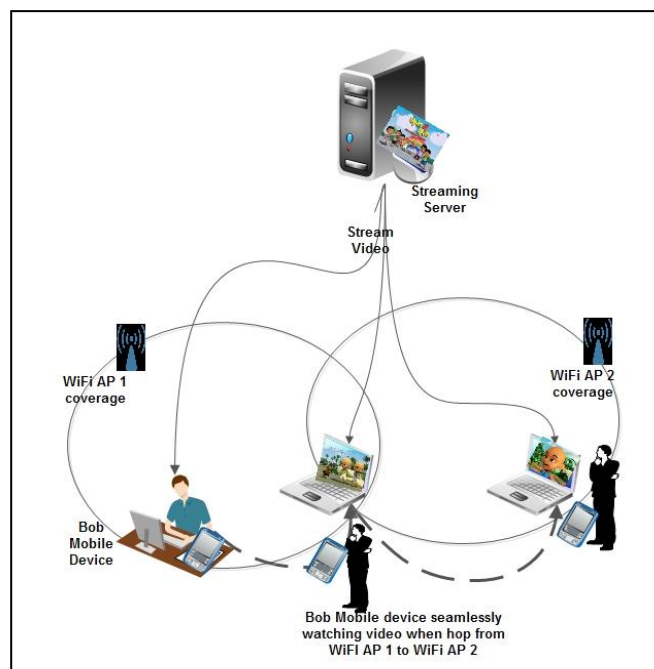

Figure 2. Framework Scenario.

B. Framework Testbed

The testbed used for carrying out our proposed framework is shown by Fig. 3. Testbed component are: streaming server equipped with VLC Media Player as a content server to continuously stream videos; a desktop as IS, one network switch for Internet connection, two access points, and one laptop, as a mobile device. All devices are connected together through network switch. The two APs are used in order to stimulate seamless handover from one network to another. Mobile device is connected to these APs to perform a handover from AP 1 to AP 2. Streaming server and Bob's mobile device are installed with Ubuntu 9.0 while IS is installed with Windows Vista and equipped with MySQL [14]. IS with response and receive message to

device is developed in Java program and interact with MySQL server. The experiment was implemented by streaming server streams the video to Bob mobile device.

Fig. 4 shows the flowchart of our experiment. It starts with Bob watched video on his mobile phone. At certain time, Bob pressed a key on his mobile device to perform handover. Upon key pressing, a message was sent to IS contain query such as; the lists of names of the nearest access points to Bob, their signal strength, the security involved in order to attached to the AP, the AP type (i.e., wireless AP, WIMAX), the operators offering the APs, the access availability (with some charging rate), and finally, their distances from Bob's mobile phone.
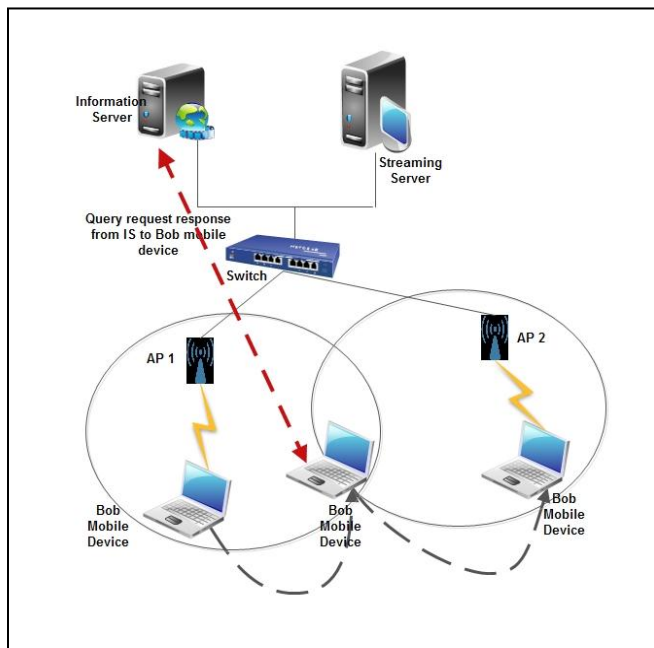

Figure 3.   Framework Testbed Setup.

IS will do a searching and checking and provide Bob with a list of information required. For example, the sorting could be based on the APs signal strength and it's distances from Bob's mobile phone. Consequently, Bob will select an AP with the highest signal strength and nearest distance to him.

In this test experiment, AP 2 is the most eligible candidate. Therefore, Bob will switch his mobile device connection from AP 1 to AP 2 and the video service streams continuously to Bob's mobile phone, without Bob realizes the network handoff by his mobile device.

C.   Testing Methodology and Result

As mentioned earlier, the objective of this experiment is to see the impact of IS in service continuity during network handover. As such, in this experiment, we measure the performance of network handover process from AP 1 to AP 2. According to [2], characteristics of service continuity and seamless are considered by two performance metrics:

- The handover latency should be no more than a few hundred milliseconds
- The QoS provided by the source and target systems should be nearly identical or should not aware the changes to his communication during and after handover.

The process of handover starts from the key pressed on Bob's mobile phone until the mobile is connected to AP 2 and video packet is sent to Bob's mobile phone by AP 2, as shown by t in Fig. 5. Thus, handover time (t) is measured when a key is pressed on Bob's mobile phone.
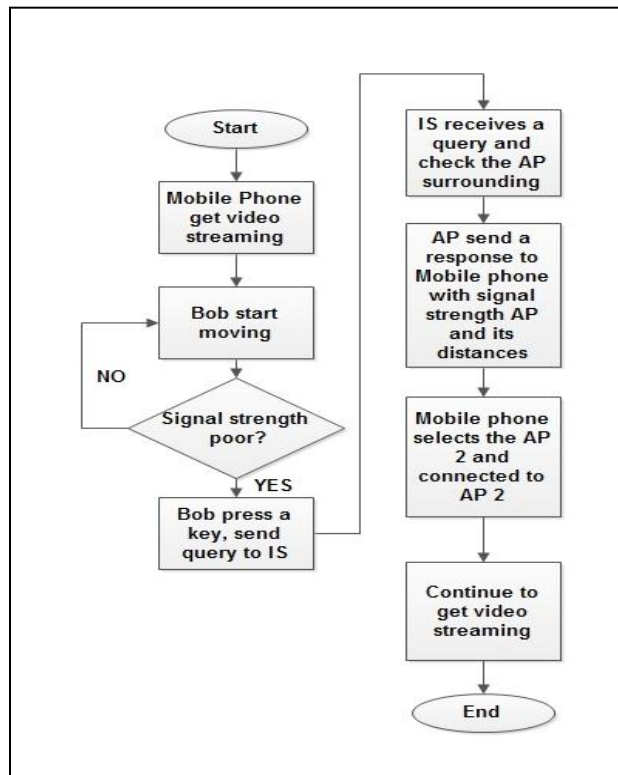

Figure 4.   Flowchart of IS Framework.

Wireshark tool was used to gather and evaluate the data. The number of handover attempted was 20 times to tackle deviation issues. Figure 6 depicts the time taken (in seconds) for seamless network handover from AP 1 to WiFi AP 2 when Bob's mobile device pressed the switching key. Seamless handover took time between 0.017 seconds at attempt number 4 and 14, and up to 0.211 seconds at attempts number 7. A little bit delay at attempts number 7; 0.211 seconds. Allover, the average time taken for all 20 network handover is 0.135 seconds, which can be considered as seamless since the time is very minimum. Moreover, while the experiment was conducted, users did not experience any video distortion; video lagging and also did not even notice/aware that the wireless connection had moved from WiFi AP 1 to WiFi AP 2.
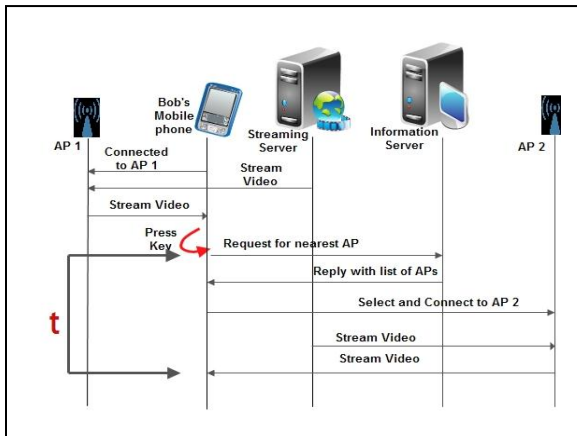
Figure 5.   Framework message flow and timing handover.

I.   CONCLUSION AND FUTURE WORK

This paper presented reviews of several different approaches and implementation method of Information Services (IS) based on IEEE 802.21 standard. As explained in the introduction, IS is one of the functionalities in IEEE 802.21 standard for handover purpose. Information provided by IS will facilitates the handover process between different networks. We developed an IS framework as a preliminary study and applied to video streaming in a wireless overlay of 802.11 WLAN to examine the impact of IS over service continuity during handover. The results obtained from performance evaluation show that the streaming video service is seamless while handoff between two networks thus achieved the objective of the experiment. Since it is still in the preliminary study, there is still missing point that should be considered in future research. The point that should be considered in future research are error handling code and also to be implemented across heterogeneous network.

REFERENCES

[1]   "IEEE Standard for Local and Metropolitan Area Networks – Part 21: Media Independent Handover Services", 21st January 2009J. Clerk Maxwell, A Treatise on Electricity and Magnetism, 3rd ed., vol. 2. Oxford: Clarendon, 1892, pp. 68–73.

[2]   Media Independent Handover for Seamless Service Provision in Heterogenous Networks, George Lampropoulus et al., IEEE Magazine of Mobile Internet Technologies and Application, January 2008, pp. 61-71.

[3]   K. Taniuchi, Y. Ohba, S. Das, M. Tauil, Y-N Cheng, A. Dutta, D. Baker, M. Yajnik, and D. Famolari, "IEEE 802.21: Media Independent Handover: Features, Applicability and realization", IEEE, vol. 7, 2009, pp. 112-120,doi: 10-1109/MCOM.2009.4752687.

[4]   A. Dutta, S. Das, D. Famolari, Y. Ohba, K. Taniuchi, T. Kodaman, and H. Schulzrinne, "Seamless Handover across Heterogeneous – An IEEE802.21 Centric Approach", http://www.cs.columbia.edu/~dutta/research/wpmc-final.pdf [Retrieved: August 2012]

[5]   "802.11-2012- IEEE Standard for Information Technology-Telecommunications and Information Exchange between Systems Local and Metropolitan Area Networks", http://standards.ieee.org/findstds/standard/802.11-2012.html [Retrieved: August, 2012]

[6]   "IEEE 802.16™: Broadband Wireless Metropolitan Area Networks (MANs), http://standards.ieee.org/about/get/802/802.16.html [Retrieved: August 2012]

[7]   "CDMA Technology"
  http://www.cdg.org/technology/cdmatechnology.asp [Retrieved: August, 2012]

[8]   "GPRS", http://www.gsma.com/aboutus/gsm-technology/gprs [Retrieved: August, 2012]

[9]   Usman Javaid and Tinku Rasheed, "Media Independent Handover in heterogenous Multi-hop Mobile Networks", Proc. IEEE The 20th Annual IEEE International Symposium on Personal, Indoor and Mobile Radio Communications(PIMRC09), IEEE Press, Sept. 2009, pp. 588-592.

[10]   San-jo Yoo, David Cyper, and Nada Golmie, "Timely Effective handover Mechanism in Heterogenous wireless Network", Wireless Personal Communication, February 2010, pp. 449-475, doi: 10.1007/s11277-008-9633-8

[11]   Qazi Bouland Mussabir and Wenbing Yao, "Optimized FMIPv6 Handover using IEEE802.21 MIH Services", Proc. IEEE MobiArch '06, IEEE Press, 2006, pp. 43-48, doi: 10.1145/1186699.1186713

[12]   FMIPv6, http://fmipv6.org/ [Retrieved: August 2012]

[13]   Raziq Yaqub, "Network Discovery Through Moving Networks-Information-Server", Proc. IEEE Communications and Networking in China, 2006, pp. 1-4.
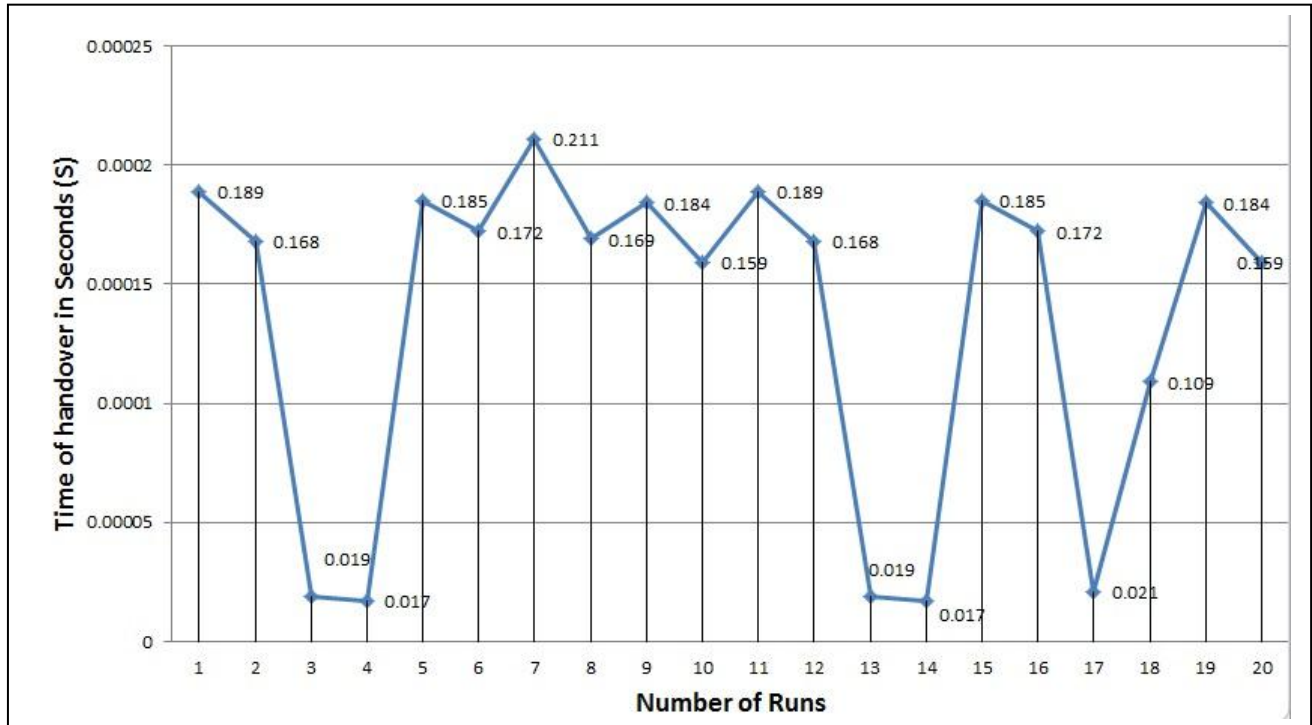
[14]   MySQL , www.mysql.com. [Retrieved: August, 2012]

Figure 6. Result of Handover Time