Reducing the Latency of IEEE 802.11 MAC Layer Handoff using Virtual Access Point

Jyoti Sachan

Amity University
Block – J2, Ground Floor,
Amity University Campus
Sector-125, Noida – 201 303 (UP)

Prof. Anant Kr. Jaiswal

Amity University
Amity Campus
H-Block, Sector 44,
Noida- 201301, Uttar Pradesh

Abstract— **Wireless networks based on IEEE 802.11 have seen rapid growth and deployment in the recent few years. In the fast growing wireless technology, continuous connectivity which allows user mobility and maintains network utilization is one of the most important requirements. So, IEEE 802.11 handoff is a critical issue in communication. Handoff occurs when a mobile station with a communication in progress changes it's associated AP from one to another in the WLAN with fixed access points (APs). A seamless handoff is possible only for a data traffic, which is not affected much by the handoff delay. So, it's very important to minimize the handoff latency because the active communications of a MS (Mobile Station) are interrupted before the handoff completes. So, the IEEE 802.11 MAC (Medium Access Control) protocol recommends an active scanning mode for the handoff process. As we know the entire delay time of a handoff is divided into three parts that are probe delay, authentication and re-association delay time. In this paper we are investigating a well known handoff scheme to reduce the IEEE 802.11 handoff latency and address the possible issues that arise when applied to the vehicular scenarios. Our main objective is to reduce the probe delay to develop faster handoff schemes because probe delay occupies most off the handoff delay time. So, in the proposed model, we reduce the latency of handoff in wireless LAN by using a highly reliable scanning scheme which can be implemented with the current IEEE 802.11 channel scanning procedure. We are also providing a better solution to the inter ESS domain handoff problem.**

Keywords— IEEE 802.11, fast handoff, probe delay, latency, ESS domain.

I. INTRODUCTION

As we can see that one of the most striking changes in the recent use of technologies has been the explosive growth in the use of IEEE 802.11 wireless networks for the internet and local network access. As WLANs support mobility with the high speed information access, IEEE 802.11 WLAN is being widely accepted in different-2 environments. Many wireless multimedia and peer-to-peer applications, such as VoIP and mobile video conference, are developed on WLAN. These multimedia applications make the handoff problem more important since they all require good quality of services.

IEEE 802.11 specifies the two modes: ad-hoc mode and infrastructure mode. In infrastructure mode, IEEE 802.11 network is composed of fixed APs (Access Points) and many mobile stations associated with each AP. For IEEE 802.11 MAC operation, the handoff occurs when a mobile host (MH) moves its association from one access point to another. During this handoff process, MH are not able to send (or receive) data frames to (or from) its current associated AP because of the change of its working channel (frequency). Besides, in order to find out the associate with a new AP, messages are exchanged between the mobile stations (MS) and the access points (APs). As the communications of a MS are interrupted before the handoff completes; latency is involved in the handoff process. It's very important that the process of handoff should be performed without unacceptable disruption of ongoing sessions.

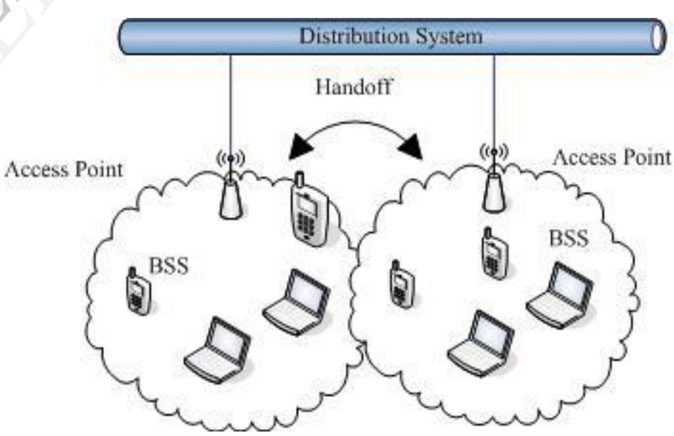

Fig: 1 A handoff scenario

Handoff scenario in IEEE 802.11 wireless LAN is shown in figure 1. Once a mobile station moves out of the range of an access point, then handoff process is initiated. This is usually triggered by the received signal strength of a station falling below the handoff threshold. At this point of time, the mobile station breaks its association with the current access point and starts the process of handoff to find the new AP to associate with.

ISSN: 2278-0181
Vol. 2 Issue 2, February- 2013

According to the IEEE 802.11 standard, to scan the channels for APs, we have two methods- passive and active. Passive scanning involves the reception of the beacon frames by the client in each and every channel and active scanning involves active determination of each channel status by sending probed. Once the best Access Point is identified; the mobile station authenticates and re-associates with the new AP.

In the proposed system, we reduce the IEEE 802.11 MAC Layer Handoff latency. To solve this problem, we will find out all the adjacent access points having better signal strength b y selective scanning technique. In this scanning technique, the mobile host will find all the active APs by using received signal strength indicator. After scanning process, mobile station will start the pre-registration process to register all the mobile station with the selected APs. The previous handoffs scheme can only solve the problems of inner ESS domain handoff, but cannot effectively solve the inter ESS domains handoff because the handoff between two ESS domains involves network layer operations. But in this paper, we are also providing the solution of this problem.

2. BACKGROUND AND RELATED WORK:

2.1 Background-

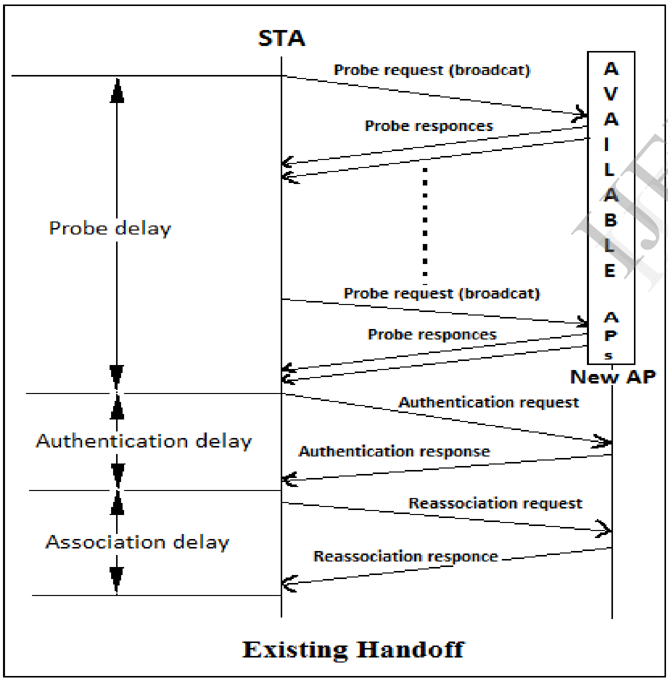

Fig (2)

.

This figure shows the IEEE 802.11 handoff procedure. The handoff process can be divided into three main phases: (I) Discovery (II) Re-authentication (III) Re-association.

In the discovery phase, we find out all the potential APs within its radio range, the mobile station tunes into each predefined channels and listen for the beacon frames. From the beacon frames, mobile station creates the list of the APs. A mobile station shall operate in either passive scanning or active scanning mode. In the active scanning mode, apart from listening to the beacon frames (i.e. passive scanning mode), the station sends additional probe broadcast packets on each channel and receive responses from APs.

The re-authentication phase involves re-authentication and re-association to all the selected APs. This phase is used by the mobile station to establish its identity with the AP that wishes to communicate with.

Re-association phase can be conducted by exchanging request and response messages between the current associated and the next associated AP.

2.2 Related Work- There have been several previous attempts to reduce the latency of IEEE 802.11 handoff.

Arunesh et al. [9] have showed that the probe delay contributes almost 90% to the total handoff latency varies depending on the environment, parameter selection and hardware capabilities.

To reduce the probe delay, Kim et al. [10] discovered a selective channel scanning method using neighbour graph (NG) approach.

Wang and Bao [14] used the same concept and proposed the approach called mobile AP to determine the best time to trigger the handoff. In this approach, the handoff is made by the AP instead of the mobile stations.

Vivek Mhatre et al. [11] also proposed the similar approach that uses the concept of continuous monitoring of neighbouring APs. In this approach, the mobile station continuously monitors the link quality of all the Access Points operating on the mobile station's current channel as well as the neighbouring access points operating on its overlapping channel through beacon signal strength measurement.

Previous analysis on IEEE 802.11 MAC layer handoff by Arunesh et al. [9] shows that re- association delay contributes 15.37 ms to the overall delay of handoff. Reducing the re-association delay when IAPP is applied, Arunesh et al. [9] proposed an approach called context caching by using neighbour graph (NG). Their major contribution is to propagate the STA security contexts proactively to the next potential Access Points in order to eliminate the IAPP latency during re-association.

Kishore Ramachandran et al. [13] proposed a similar approach called the make-before-break algorithm. In this approach, the STA uses two radio cards to gather neighbouring information through periodic probing. Similarly, the functions of the two radio cards are switched for data communication and probing.

Ishwar Ramani et al. [12] discovered a more practical handoff mechanism called Sync-Scan that makes use of scanning time synchronization. This mechanism uses a special type of beacon frame to be periodically broadcast by the APs in order to identify themselves to the stations in range and to synchronize the service state information with all the currently associated stations. The timing of beacon broadcast on each channel is synchronized between the stations and the APs so that the stations can efficiently identify all the neighbouring APs by regularly switching to each channel; this method minimizes the time it losses communication with its own AP.

3-PROPOSED MODEL:

In this proposed model, we discover a better scheme for IEEE 802.11 handoff. In this model, we are using virtual Access Point and neighbours graph to reduce the handoff detection time and also providing solution for inter ESS domain authentication during IEEE 802.11 MAC handoff. As the maximum time of handoff is occupied by the probe delay, hence it is crucial to reduce the probe delay. This phase of IEEE 802.11 MAC handoff is known as scanning or searching for access points in the range. First, we will find out the adjacent access points having better signal strength, by selective scanning technique. In this scanning technique, the mobile host will find out the entire good signal APs among all through received signal strength indicator (RSSI). After completing the scanning process, the mobile host will start the pre-registration process. In this process, the mobile host will be associated with all the selected access points. Now the virtual access point will work between the mobile host and all the registered access points. All the authentication details will be provided to the virtual access point (AP) before the communication starts. Figure (3) will better show the working of propose model.

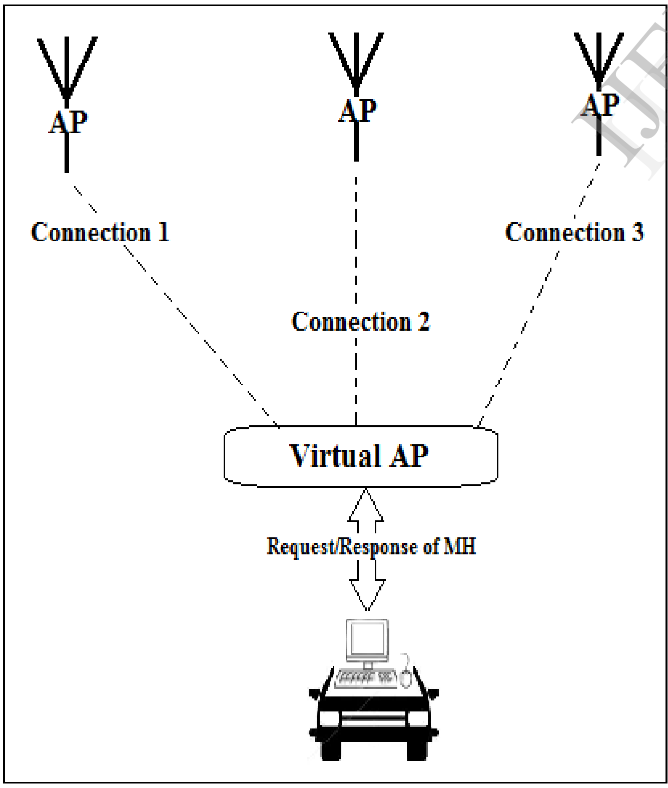

Fig (3)

After the successfully complition of scaning technique, the virtual access point will broadcast the authentication messages to all the selected APs. After receiving the response from the access points the virtual AP sends the re-association messages to each and every AP and wait for response. Once the mobile station wants to access the network, it will send the request to the virtual AP and then, virtual AP will send the request to all connected APs.

Another problem arises when the mobile station moves into other ESS domain explain in fig (4).

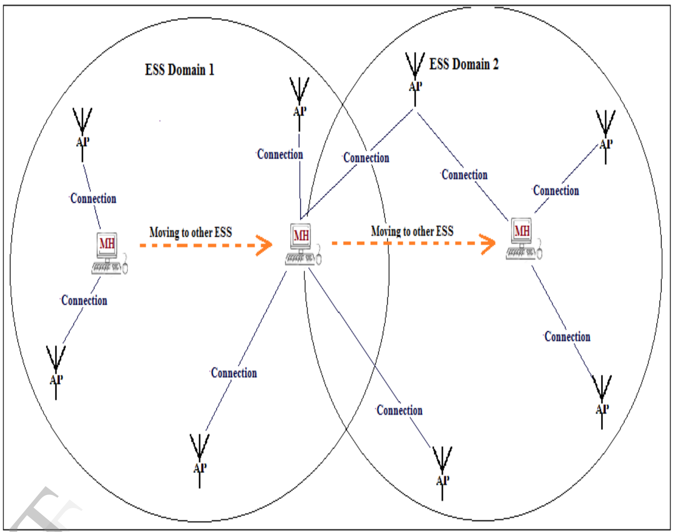

Fig (4)

4- METHOD USED:

A number of handoff techniques have been proposed to reduce the latency of IEEE 802.11 MAC layer handoff. Here, we are using the following technique.

1 Scanning technique:

Here we are using the selective scanning method. In this method, the virtual access point will find out the entire better signal access points in the range of its network. We will find out better strength APs with the help of Received Signal Strength Indicator (RSSI). This is very important that all the access point (AP) must stay in the range for long time because it reduces the effort of scanning again and again.

2 Authentication:

In this authentication process, we require all the authentication details of wireless networks (ESS domains) where we can move. Without the proper authentication details, the virtual access point is not able to connect with any AP. Once we will get all the authentication details, the virtual AP will broadcast authentication messages to all selected access point (APs).

3 Re-association:

Re-association is the last step of IEEE 802.11 handoff. Here, in this phase of handoff, we can start our communication. During the communication, the virtual access point uses the buffer. Buffer will store the request and response. Buffer will provide the data when the connection will change. It initializes automatically at the completion of request and/ or response cycle.

5-Conclusions:

One major challenge of IEEE 802.11 wireless communication is to minimize the latency of handoff. In the handoff process, the probe delay is the main contributor to the handoff delay. So, in this paper, we proposed a simple scanning model for the IEEE 802.11 MAC layer handoff. The proposed model decreases the probe delay in the noisy environment. With the help of this model, we can minimize the handoff latency time. It helps to communication properly without interruption. We also provided the solution of inter ESS domain problem.

REFERENCES

[1] Yuh-Shyan Chen; Chung-Kai Chen; Ming-Chin Chuang; "DeuceScan: Deuce-Based Fast Handoff Scheme in IEEE 802.11 Wireless Networks" Vehicular Technology Conference, 2006. VTC-2006 Fall. 2006 IEEE 64th .

[2] Ping-Jung Huang; Yu-Chee Tseng; Kun-Cheng Tsai "A Fast Handoff Mechanism for IEEE 802.11 and IAPP Networks " Vehicular Technology Conference, 2006. VTC 2006-Spring. IEEE 63rd .

[3] Zhao Li; Lizheng Fu; Ke Xu; Zhenyu Shi; Jianping Wu "Smooth Handoff Based on Virtual Interface in Wireless Network " Wireless and Mobile Communications, 2006. ICWMC '06. International Conference.

[4] Rebai, A.R.; Rebai, M.F.; Alnuweiri, H.M.; Hanafi, S. "An enhanced heuristic technique for AP selection in 802.11 handoff procedure " Telecommunications (ICT), 2010 IEEE 17th International Conference.

[5] Haider, A.; Gondal, I.; Kamruzzaman, J. "Dynamic Dwell Timer for Hybrid Vertical Handover in 4G Coupled Networks" Vehicular Technology Conference (VTC Spring), 2011 IEEE 73rd.

[6] Berezin, M.E.; Rousseau, F.; Duda, A. "Multichannel Virtual Access Points for Seamless Handoffs in IEEE 802.11 Wireless Networks" Vehicular Technology Conference (VTC Spring), 2011 IEEE 73rd.

[7] Dwyer, J.; Bridewell, H.; Nguyen, N.-Y.; Jasani, H. "Impact of handoff delay on RADIUS enabled 802.11 WLANs " Southeastcon, 2011 Proceedings of IEEE.

[8] Li-Hsing Yen; Hung-Hsin Chang; Shiao-Li Tsao; Chia-Chi Hung; Chien-Chao Tseng "Experimental study of mismatching ESS-subnet handoffs on IP over IEEE 802.11 WLANs " Wireless and Optical Communications Networks (WOCN), 2011 Eighth International Conference on.

[9] Arunesh, M, Minho, S & William, A, "An empirical analysis of the IEEE 802.11 MAC layer handoff process", SIGCOMM Computer Communication Review, vol. 33, no. 2, pp. 93-102, 2003.

[10] Kim, HS, Park, SH, Park, CS, Kim, JW & Ko, SJ, "Selective Channel Scanning for Fast Handoff in Wireless LAN using Neighbour Graph", The 2004 International Technical Conference on Circuits/Systems Computers and Communications (ITC-CSCC2004) Japan, 2004.

[11] Vivek, M & Konstantina, P, "Using smart triggers for improved user performance in 802.11 wireless networks", Proceedings of the 4th international conference on Mobile systems, applications and services, Uppsala, Sweden, 2006.

[12] Ramani, I & Savage, S, "SyncScan: practical fast handoff for 802.11 infrastructure networks", INFOCOM 2005. 24th Annual Joint Conference of the IEEE Computer and Communications Societies. Proceedings IEEE, pp. 675-84, 2005.

[13] Ramachandran, K, Rangarajan, S & Lin, JC, "Make-Before-Break MAC Layer Handoff in 802.11 Wireless Networks", IEEE International Conference on Communications, 2006. ICC '06. , pp. 4818-23, 2006.

[14] Wang, J & Bao, L, "Mobile Context Handoff in Distributed IEEE 802.11 Systems", International Conference on Wireless Networks, Communications and Mobile Computing, pp. 680- 5, 2005.