A pre-scanning method based on the speed of mobile node in Wireless LAN

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Abstract. Handoff is occurred when a node connect another AP(Access Point). If the handoff latency exceeds 50ms, it can't be used for real time application. But, 802.11 standards consume 350 — 500ms for handoff. So, it is difficult for seamless environment to be used. Lately, To cut down the handoff delay, some pre-scanning schemes have been suggested, in pre-scanning schemes a node has list of pre-scanned APs. When a mobile node disconnect from current AP, the node can connect known AP that have the strongest signal at once. But above method have not considered the moving velocity of a node. In this paper, we suggest a pre-scanning scheme that considers the moving speed. Our scheme dynamically adjust and manage pre-scanning period, hence a node reduce the number of probe message. As a result, the node can save energy. The result is shown by simulation.

Keywords: IEEE802.11, WLAN, Handoff, Scanning period.

1 Introduction

WLAN (Wireless Local Area Network) environment is being built to support to moving human, and a variety of applications based on WLAN are made. In particular Voice over IP (VoIP) application must provide a seamless service when users move to another place. But, the IEEE 802.11 handoff procedure does not ensure QoS (Quality of Service) because it does not support seamless handoff.

Recently, some pre-scanning methods have been proposed to reduce the handoff latency, including SyncScan[3] and DeuceScan[4]. They have focused on reducing the scanning time which occupied about 90% of the total handoff delay. In the pre-scanning methods, MN (Mobile Node) already has the list of APs in order to connect the next AP immediately by pre-scanning APs around the MN. However, they will result in an increase in the number of unnecessary pre-scannings because pre-scanning is performed every 500ms regardless of the moving speed of MN.

In this paper, we propose a pre-scanning method considering the speed of MN to support seamless handoff. Our method dynamically adjusts the pre-scanning period of each AP around MN.

The rest of the paper is organized as follows. In Section 2, we review how the 802.11 handoff mechanisms function and some related works. Section3 describes our algorithm in detail, as well as the potential benefits arising from this capability. We present the simulation results in Section 4. Finally, we summarize our paper in Section 5.

2 Related Work

The IEEE802.11 handoff process consists of three phases (scanning, authentication, re-association).

The scanning phase is the process of finding a neighboring AP by exchanging probe request and probe response messages. The scanning process is classified into active scanning and passive scanning The passive scanning hears a beacon frame that is generated periodically to confirm the presence of AP. This method has the advantage of having low overhead, but has the disadvantage of the greater delay. The active scanning has been proposed to solve disadvantage of the greater delay of the passive scanning. The node broadcasts probe request frame, and waits for probe response. If it does not hear probe response within some time, it performs scanning to move to the next AP. In general, MN selects the next AP with the biggest RSSI (Received Signal Strength Indication) value. The scanning time usually occupies about 90% of the total handoff delay.

The authentication phase is the process of getting permission in order to gain access to AP. The re-association phase is the process of connecting to the new AP.

SyncScan is a low cost technique for continuously tracking nearby base stations by synchronizing short listening periods at the client with periodic transmissions from each base station. APs send beacon frames at time T+d and so on. The MN regularly records the signal strengths of APs on the channels. When a handoff is needed, the MN associates with AP that has the highest RSS. It is not efficient to manage scanning period because all APs do not need to associate another AP.

DeuceScan uses a graph to provide information for making accurate handoff decisions by correctly searching for the next AP and pre-scan approach. However, this scheme does not consider the speed of MN at all.

3 Proposed Scheme

Our scheme dynamically adjusts the pre-scanning period of each AP depending on the speed of MN. In other words, MN performs pre-scanning with different period depending on the speed of MN. When MN moves fast, it scans more frequently since there is a high possibility that MN may escape from the current AP, and needs to handoff to another AP. So, MN has to scan more APs during a given period. On the other hand, if MN moves slowly, it scans less frequently.

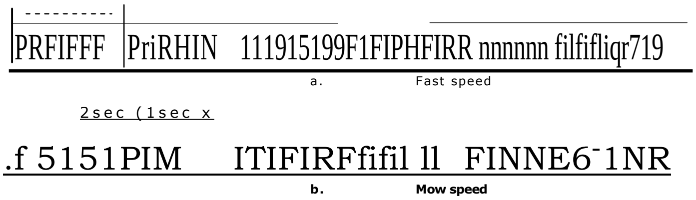


Fig. 1. Pre-scanning with different periods depending on the moving speed in the proposed scheme

The moving speed of MN can be easily obtained using a GPS outside a building. Inside a building, however, the moving speed is calculated using the difference between the previously received RSSI value and the current RSSI value. In this paper, we assume the MN moves inside a building. In our scheme, the scanning period, denoted by T, is given by

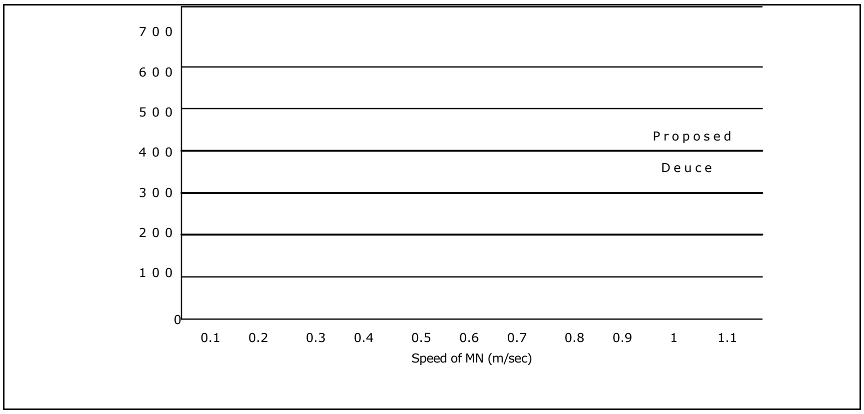
$$T = Maximum[10 \quad j, 1] \qquad (1)$$

where v means the speed of the node, and denotes omission operator. MN scans every 10 seconds when the speed is less than 0.1 (m/sec). As the node moves faster, the scanning period approaches to a maximum value of 1 sec.

4 Performance Evaluation

To evaluate our scheme, simulation base-on NS-2 is performed. Wireless transmission range is assumed to be 30m. We also assume that the time required to waiting for beacon signal on a channel ("ChannelTime") is 20 to 60ms. We assume the mobile station moves following a Gauss-markovian mobility model since it is similar to the mobile pattern of the average person. We compare our scheme with the IEEE802.11 standard and DeuceScan.

Fig. 2 shows the number of scans required in our scheme and DeuceScan when the node moves over a distance of 60m. We can see that our scheme and the DeuceScan require almost the same scan overhead when MN moves fast. When MN moves



slowly, our scheme needs fewer scans without generating the probe messages.

Fig. 2. Scanning period in our scheme and DeuceScan

We can see that our scheme needs a total of 60 scannings and probe messages when the node moves at a speed of 0.1m/sec. Note that the DeuceScan has to perform 600 scans in the same situation. Assuming power used for probe packet transmission is 60uW, MN can save the power of 32,400uW when it is moving from the source to the destination at a speed of 0.1m/sec.

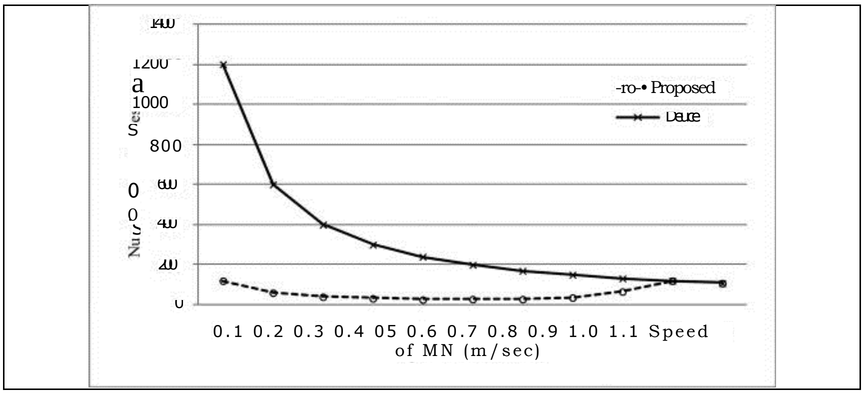


Fig. 3. The number of generated probe messages when the node moves outside the transmission range

Fig. 3 illustrates the number of probe messages generated to find a new AP when the node moves outside the transmission range (30m). We can see a great difference in the number of probe messages between the Deuce and proposed method when the MN moves slowly. But, there is no significant difference when the speed approaches to 1.0m/sec.

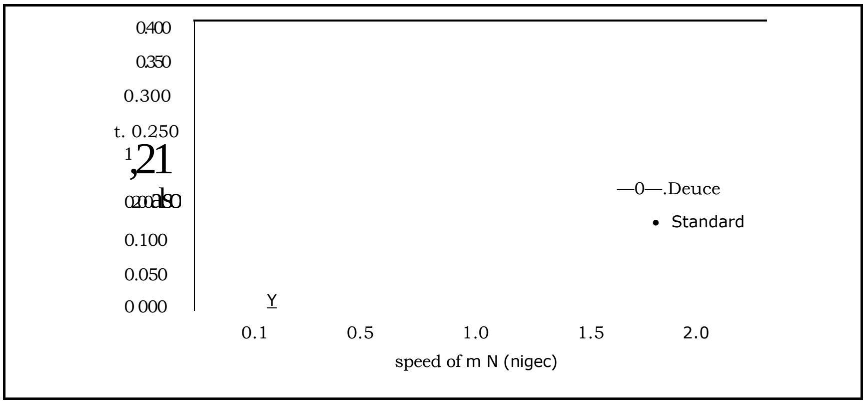


Fig. 4. Handoff latency

In Fig. 4, we can see that our scheme produces a shorter handoff latency delay than the DeuceScan and the IEEE 802.11 standard. This means our scheme is more appropriate to support seamless handoff for mobile multimedia applications.

5 Conclusion

In this paper, in order to support effective handoff for layer-2 in WLAN, we suggest a control scheme of the scanning period. The handoff is an important factor to provide seamless VoIP service and real time streaming service for mobile user. To do this, the handoff delay must not exceed 50ms but 802.11 standards do not guarantee the QOS. Our scheme flexibly manages the pre-scanning period of each AP according to the moving speed. The results of simulation by using NS2 show that the proposed scheme can significantly reduce the layer-2 handoff latency and the number of probe packet and make spare energy.

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