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SDN based Heterogeneous Wireless Network Handoff using Active and Scanning Links

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Abstract. This paper proposes SDN (Software Defined Network) based Heterogeneous Wireless Network Handoff using Active and Scanning Links. It improves transmission speed by using multi RAT (Radio Access Technology) terminal and OpenFlow switch. In order to avoid scan operation disturb communicate operation, each of Network interfaces perform scanning and communicating, respectively. It can reduce handoff latency by mobile node makes multiple links with APs (Access Point) and OpenFlow switch control packet flow. It works through Scanning link prepare next association in advance before disconnecting current connection.

Keywords: SDN, Multi RAT, OpenFlow, Handoff

1 Introduction

As the recent growth in mobile device usage, mobile traffic is currently the most important traffic on the Internet. Current Internet and user access network is in dealing with tremendous mobile traffic, efficiently and effectively [1]. However, wireless network environment in which mobile device operates is not stable, especially about moving device.

For these reasons, this paper proposes SDN based Heterogeneous Wireless Network Handoff using Active and Scanning Links. SDN can help a developer agile and programmable networks that operate dynamically [2]. Proposed technology use SDN to using network interfaces at the same time and control flow of packet between an application server and mobile.

This paper contains problem of traditional handoff, composition, operation process, and the effect of proposed technology.

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2 Existing Research and Problem

2.1 Traditional Mobile Network

In traditional wireless mobile network, a mobile node keeps only one link connected with an access point. Because the mobile node uses a single interface, the previous link must be disconnected before connecting with a new link for associating with other AP during handoff

2.2 Traditional Handoff Sequence

In traditional technology, one network interface performs whole phase of a handoff including disconnecting previous connection, reconnecting to other AP, and scanning surrounding APs.

The process of handoff starts from checking whether the link is disconnected or not. If the link is disconnected, a mobile node makes a connectable AP scan list and finds best AP to communicate. If there is a proper AP, a mobile node tries to connect with it. If not, the mobile node repeats scanning and find alternative AP. This process makes a connection gap between disconnection and reconnection. Handoff decision occurs after mobile node cannot communicate with current AP. It decreases connection quality by keeping low-quality connection.

This paper contains problem of traditional handoff, composition, operation process, and the effect of the proposed technology.

3 Proposed Scheme

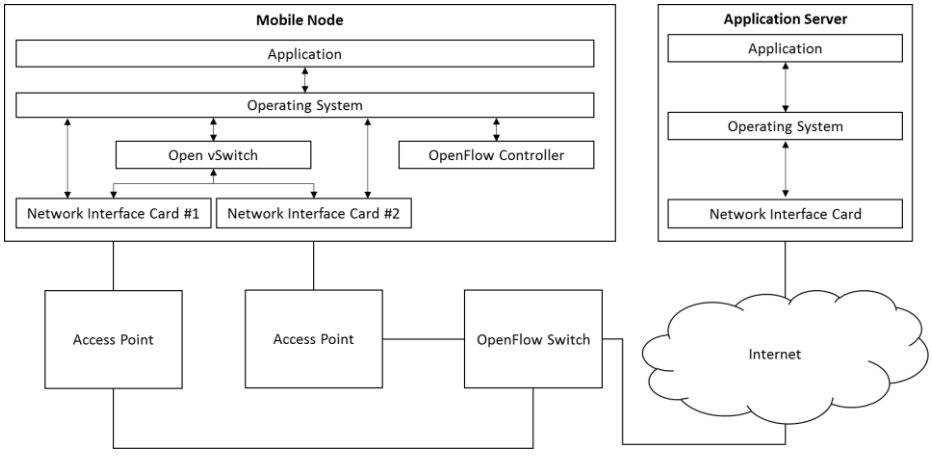

Fig. 1. Proposed mobile network and device structure

3.1 Proposed Mobile Network

Figure. 1 shows proposed wireless mobile network. Mobile node has two network interfaces. Each interface can be connected to different AP at same time. It is possible by using Open vSwitch in a mobile node [3]. Mobile node use one interface for communicating and another interface for scanning better AP. In this paper, communication interface is called Active Link and scanning interface is called Scanning Link. This way of interface management make the scan operation of Sensing link does not disturb the communicate operation of Active link. It reduces handoff latency by prepare new link with Sensing link. OpenFlow switch is located between server and mobile node. It helps this reducing handoff latency through control flow of packet.

3.2 Proposed handoff Sequence

Proposed handoff sequence is composed of three phases. First phase is Booting phase. Second phase is Normal phase. Last phase is Handoff phase.

When mobile node is turned on, Booting phase starts the initialization process. Active link sends 802.11 association requests to AP and receives 802.11 association response from AP. If it is necessary, the mobile node can be allocated IP (Internet Protocol) address by sending DHCP (Dynamic Host Configuration Protocol) message.

Normal phase starts after Booting phase. The Connection of Active link is established between mobile node and application server. Sensing link scans surrounding APs and compares it with Active link continuously. If sensing link finds better AP than Active link, it moves on Handoff phase.

In Handoff phase, Sensing link sends 802.11 association request to found AP and receives 802.11 association response from that AP. Through this message, mobile node and application have newly established connection. Next, Active link sends 802.11 disassociation message to old AP and releases previous connection. Two Interfaces switch name and role. OpenFlow switch updates flow table and send packets to the new link. The mobile node return to Normal phase and repeats this process.

4 Performance Evaluation and Analysis

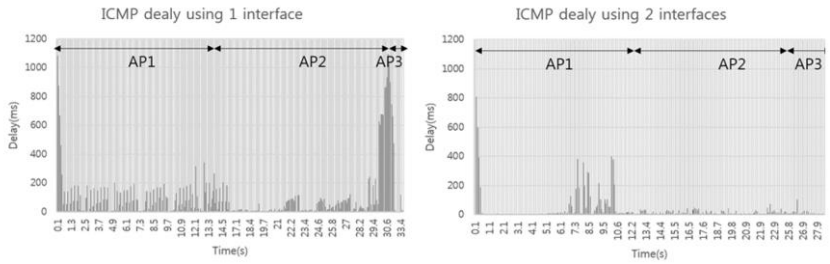

Fig. 2. (a) ICMP delay of mobile node using single interface. (b) ICMP delay of mobile node using dual interface

The experiment uses one mobile node and three APs installed at a distance. The mobile node moves from AP1 to AP2 to AP3. The handoff threshold sets -70dB so as to handoff occurs on the proper position. Figure. 2(a) and Figure. 2(b) is the graph of the experiment using different interface number. Figure.2(a) is ICMP (Internet Control Message Protocol) Message delay on the mobile node using one interface and Figure.2(b) is using two interfaces. On handoff time, graph has the highest value. It can interpret two ways. First, there is a blank area caused by the handoff process. Second, The RSS (Received Signal Strength) is so low that signal can't be delivered right at that time. Both graph show increase of ICMP delay. But, absolute value of increasing value of 2 interfaces graph has much lower than 1 interface graph. In Figure. 2(a), the highest value is over 1000ms. But it doesn't over 400 in Figure 2(b).

5 Conclusion

This paper suggests how to reduce the delay time during handoff by utilizing the two interfaces. The process using two interfaces is network independently performed. Thus, it is possible to graft and use easily. Also, through continuous scanning, the mobile node can access to another AP before quality degradation.

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