Outline of the report

1. Detail explanation of the simulation
2. Comparison between SDN solution and standard mobile IP (the two graphs)
3. Introduction to the LLDP protocol
4. Screenshot of flow table (before and after movement of node from one AP to another)

Introduction

The main goal of this project is to develop an SDN based protocol for mobile IP. To achieve this target we have used link layer discovery protocol (LLDP) as an enabler of network dynamics monitoring. In our protocol, we use LLDP to dynamically update the SDN controller about the location of mobile nodes. The SDN controller then installs and updates flow rules in each switch (e.g. eNodeB) in the network so that mobile nodes can continue to send and receive packets from their new location.

In order to compare the performance of the SDN based protocol with standard mobile IP, we also developed a simulation in C++ programming language for the mobile IP protocol using OMNeT++ framework. Having simulation model for both the SDN based protocol and standard legacy mobile IP provides us with the means to compare the performance of both protocols.

Link Layer Discovery Protocol (LLDP)

The Link Layer Discovery Protocol (LLDP) [1] is created to allow device and topology discovery by announcement of required information. It operates based on two processes called *LLDP transmit timer* and *LLDP receive*. The LLDP transmit timer periodically transmit information on enabled devices while the LLDP receive process listens for information and update LLDP databases. In LLDP, information about peer node over each port is saved in a database called PTOP MIB. The messages in LLDP follows a format called type-length-value or TLV. Each LLDP message contains four mandatory TLVs, these are-

1. Chassis ID TLV
2. Port ID TLV
3. Time to live TLV and
4. End of LLDPDU TLV

In addition to the above, and LLDP message can contain additional TLVs. For more information on LLDP protocol readers are encouraged to see RFC 2922 [2].

Implementation of SDN solution for mobility

We have used Mininet-WiFi and Floodlight SDN controller to implement the SDN solution for mobility. An SDN controller application is developed in Java programming for the Floodlight SDN controller. The operation of the application is divided into two processes as listed below-

1. Topology database update using LLDP
2. Flow table update according to topology database

Firstly, the SDN controller app runs a module to periodically send LLDP messages out all the ports of the SDN switches. The controller then receives these packets via other switches. From these messages the SDN controller is able to construct the topology database and detect any change in the topology as per the LLDP protocol specifications.

Secondly, the topology information discovered by LLDP module is used to install flow rules in the SDN switches. Whenever a mobile node moves from one AP to another the SDN controller will detect its new location by receiving an LLDP message at the new AP. The SDN controller will use this new location to update flow entries destined to this mobile node.

Simulation for Legacy Mobile IP

We couldn't perform legacy mobile IP experiment on Mininet because Mininet is a simulator for SDN. Therefore we have used OMNeT++ simulation framework to measure performance of legacy Mobile IP. In the legacy mobile IP simulation devices are divided into following categories-

1. Corresponding node (CN) which is a fixed host at the core network
2. Home agent which is a router
3. Router which is another router that can act as foreign agent
4. WiFi AP
5. Mobile Host which is a host with customizable mobility

Experiments

In order to compare the performance of the SDN based solution with legacy mobile IP we have performed a number of experiments. In each experiment we have considered three scenario-

1. Legacy mobile IP
2. SDN solution with single controller
3. SDN solution with multiple controller

In the first experiment we have measured congestion in the network for the above scenario with load for each mobile node increasing from 0 to 200 Mbps and observed packet loss. The result is given in the following graph-

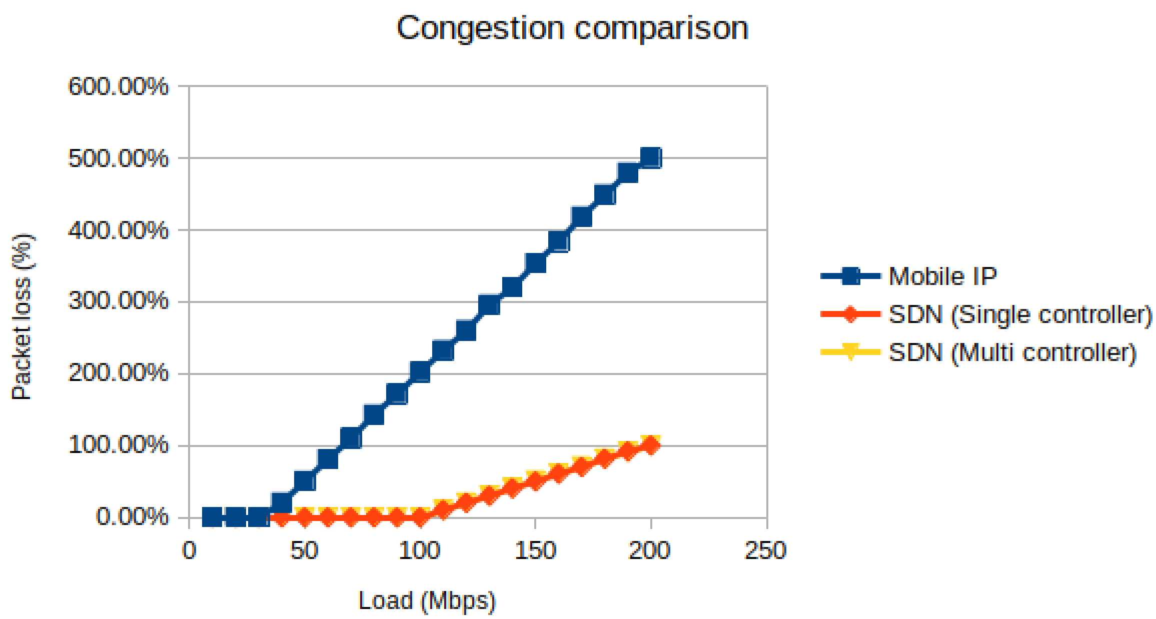

Fig. 1 Comparison of Congestion

In the second experiment we have measured delay in the network for the three scenario with load for each mobile node increasing from 0 to 200 Mbps and observed packet delay. The result is given in the following graph-

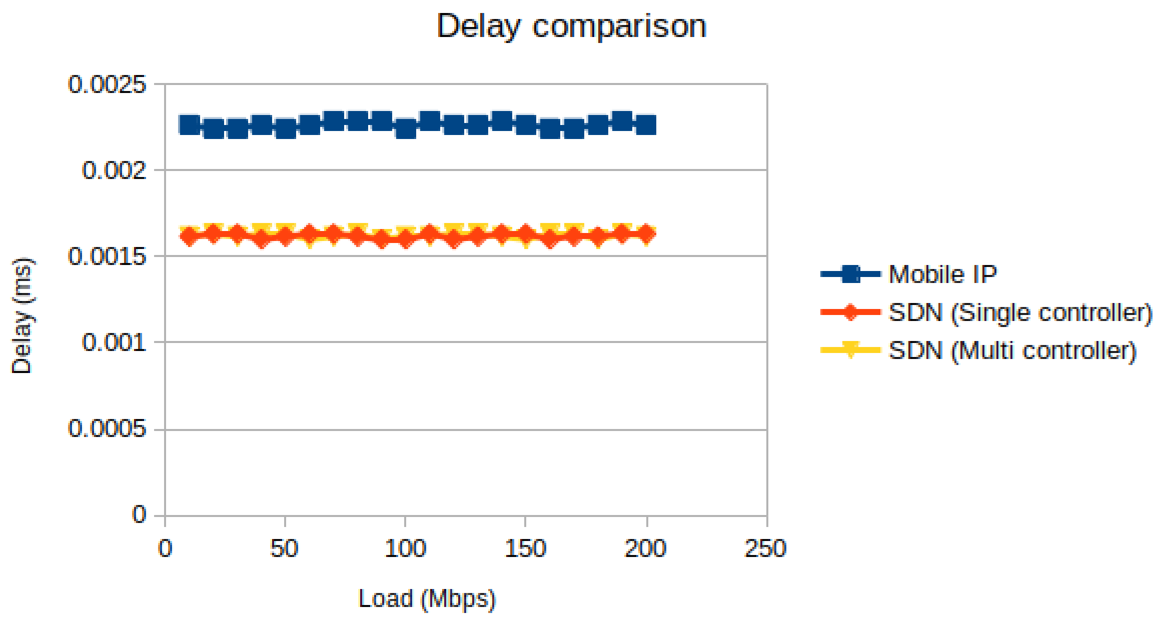

Fig. 2 Comparison of Delay

In the third experiment, we move a mobile node in mininet wifi from one access point to another and observe flow tables of all the SDN switches before and after the mobility event (i.e. movement of the mobile station sta2 from ap2 to ap3).

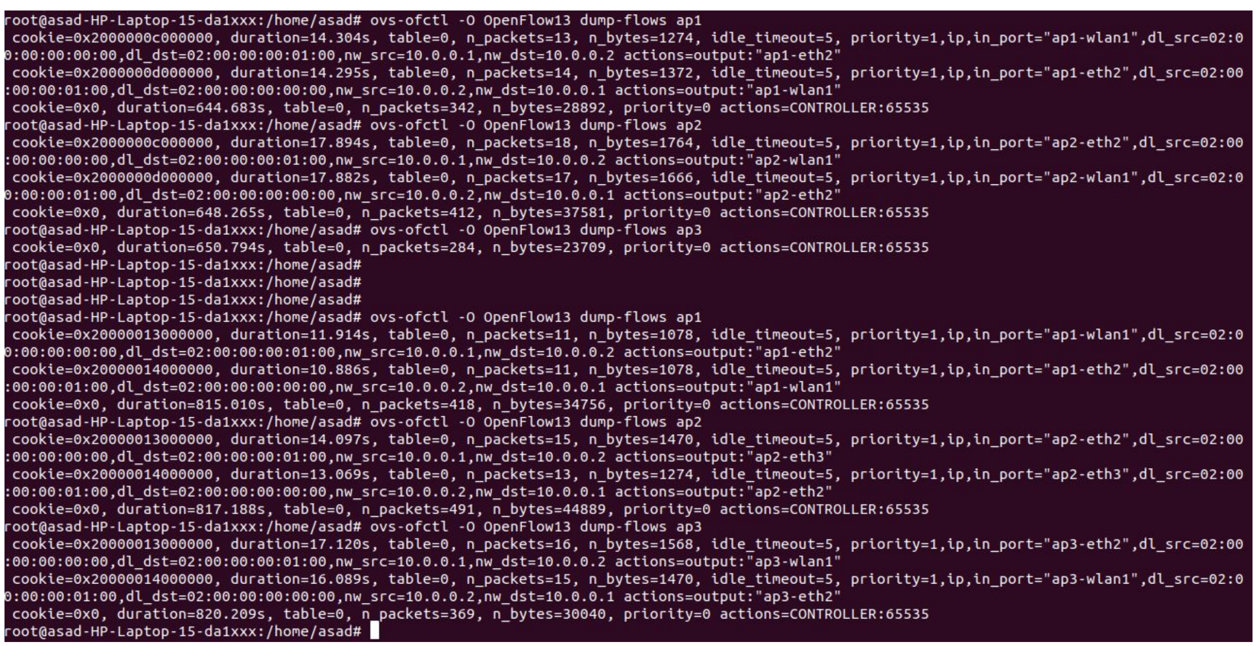

Fig. 3 Observation of flow table changes upon mobility event

References

[1] Congdon, P., 2002. Link layer discovery protocol. *RFC*, *2002*.
[2] Bierman, A. and Jones, K., 2000. RFC 2922. *Physical topology MIB*.