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An Experimentation with Simulating Mobile IPv6 (MIPv6) in NS-3 to handle User Mobility

1. INTRODUCTION

sets up the tunnel after receiving BA. We have defined new functions to send and receive mobility related signaling messages such as *SendMessage()* and *Receive()*. The *Receive()* function uses new handler functions *BAHandle()*, *HoTHandle()* and *CoTHandle()* to process received signaling messages. The *BList* object of *MIPv6MN* class is updated with the information such as home agent address, lifetime, BU state, CoA, HoA etc. In the similar way the *MIPv6CN/HA* classes handle the mobility messages and update the *BCache* object. All mobility messages are demultiplexed by the *MIPv6Demux* class and forwarded to the proper handler class of the *MIPv6MN/CN/HA* classes.

Figure 1. MIPv6 Classes

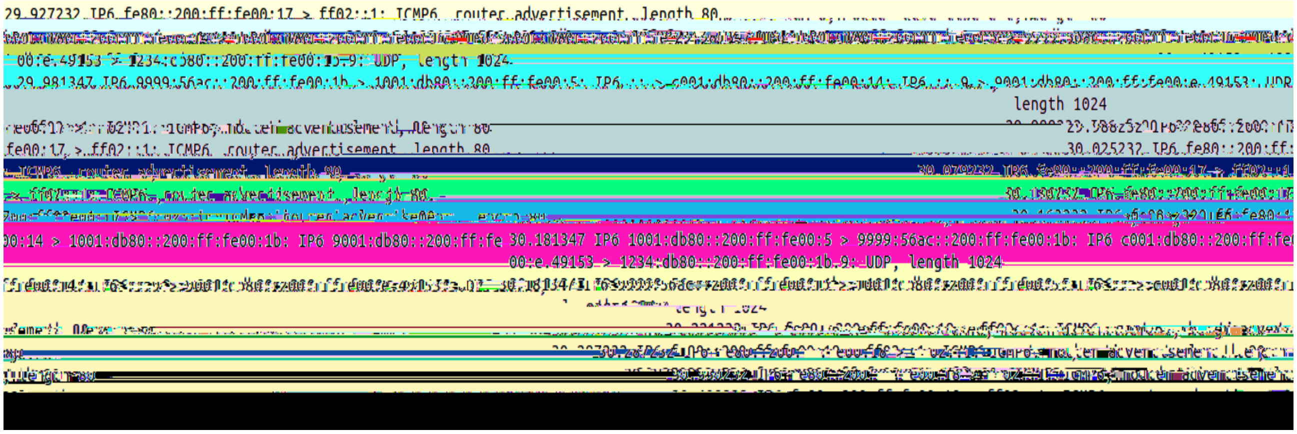
The *Ipv6MobL4Protocol* and *Ipv6TunL4Protocol* classes use same *Receive()* function to handle mobility messages and data packets respectively. The *Receive()* function of *Ipv6MobL4Protocol* class forwards the mobility message to the corresponding *Receive()* function of the *MIPv6MN/CN/HA* class while the *Receive()* function of *Ipv6TunL4Protocol* class receives data packets from the *Ipv6L3Protocol* class.

We have defined a new class, *TunNetDevice*, by inheriting *NetDevice* class to enable IP-in-IP encapsulation de-capsulation of packets and transmission over physical interface of a node. The helper classes *MNHelper*, *HAHelper* and *CNHelper* classes define overloaded *install()* method to allow the users to install MIPv6 in a node.

To process data packet for MN to HA direction, *Ipv6SourceRouting* class is used to determine the outgoing tunnel net device and encapsulate the packet. This encapsulated packet is then passed to *Ipv6L3Protocol*. The HA uses *Ipv6TunL4Protocol* class to de-capsulate the packet and sends it to the CN. In the similar way, the packets from the HA are routed to the MN's CoA. To implement route optimization, we use m_NewRouteCallback method of Ipv6L3Protocol class which changes the destination address to MN's CoA.

5. Simulation Results

This section reports preliminary results to verify the correctness of our implementation. Figure 2 shows the simulation environment. For the wired links, we have used data rate and link delay of 100 Mbps, 20 milliseconds respectively. For the wireless links, we have used date rate and link delay of 11 Mbps, 10 milliseconds respectively. The CN and the MN runs an echo client server application based on UDP. The PCAP trace file is used to measure the handover performance of MIPv6. Figure 3 and 4, shows the handover packet trace at the MN. The MN sends the last packet to the CN through AR1 at t=30.181347 second. The MN receives RA from AR2 at t=30.221232 second and starts address configuration process. At t=31.350586 second, the MN sends a BU to its HA and receives corresponding BA at t=31.592070 second. Then the MN starts receiving packets through AR2 at t=31.794587 second. Then the MN sends HoTI and CoTI packets at t=31.592070 second and t=31.712474 second respectively. The MN receives HoT and CoT packets at t=31.712474 second and t



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29.927232 IP6 fe80::200:ff:fe00:17 > ff02::1: ICMP6, router advertisement, length 80
 00:e.49153 > 1234:db80::200:ff:fe00:1b.9: UDP, length 1024
29.981347 IP6 9999:56ac::200:ff:fe00:1b > 1001:db80::200:ff:fe00:5: IP6 > c001:db80::200:ff:fe00:14: IP6 9 > 9001:db80::200:ff:fe00:e.49153: UDP
                                                                                                                    length 1024
fe00:17 > ff02::1: ICMP6, router advertisement, length 80                                                          30.025232 IP6 fe80::200:ff:
00:14 > 1001:db80::200:ff:fe00:1b: IP6 9001:db80::200:ff:fe 30.181347 IP6 1001:db80::200:ff:fe00:5 > 9999:56ac::200:ff:fe00:1b: IP6 c001:db80::200:ff:fe
                                                            00:e.49153 > 1234:db80::200:ff:fe00:1b.9: UDP, length 1024
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