10-2006

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## Recommended Citation

Victor A. Clincy and Padmaja Mudiraj. 2006. The future leading mobility protocol: Mobile IPv4 or mobile IPv6? J. Comput. Small Coll. 22, 1 (October 2006), 197-203.

# THE FUTURE LEADING MOBILITY PROTOCOL - Mobile IPv4 OR Mobile IPv6?*

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## 1. ABSTRACT

Mobile computing has become an important area of computer networking and is expected to play a fundamental role in the ubiquitous access of Internet resources in the future. In recent years, we have seen increasing demand from end-users to access network resources from anywhere and at anytime from all kinds of devices. A greater degree of connectivity is almost becoming mandatory in todays business world. In addition, mobility of end-users is placing further requirements on network systems and protocols to provide uninterrupted services. Mobile network protocol such as Mobile IPv4 has emerged as one of the promising solutions capable of providing uninterrupted connectivity. It allows the users to roam beyond their home network while still maintain their own home IP address. Similarly, Mobile IPv6 is the protocol that deals with the mobility for the IPv6 nodes. This protocol allows an IPv6 node to be mobile, and arbitrarily change its location on the IPv6 Internet while still maintaining its existing connections.

We have done a study of the MobileIP technology, and the components that support this technology. We investigated the impact of mobility on the performance of voice and video conferencing applications over Mobile IPv4 and Mobile IPv6. Through this paper, we have made an attempt to identify the strengths and weaknesses of the two mobility protocols and discover which protocol leads the future generation Internet.

This paper is organized as follows. The first part briefly overviews the two mobility protocols (Mobile IPv4 and IPv6). The second part describes the basic scenarios of the network model that are required to conduct such evaluation,

followed by the results of the simulation. Final part describes the conclusion of our study.

## 2. OVERVIEW OF MobileIPv4 And MobileIPv6

As mentioned before, MobileIP allows the users to roam beyond their home network while maintaining their own home IP address. The major components involved in a MobileIP network are mobile node, home agent, and foreign agent. This technology has three major phases which include agent discovery, registration, and tunneling (Leary & Roshan, 2004). In the agent discovery phase, the mobile node determines whether it is connected to the home or foreign network. If it is connected to the foreign network, then it acquires the care-of-address and this is done during the registration phase. Once the mobility binding is created, all the packets that are addressed to the mobile node will be tunneled by the home agent and will be sent to the foreign agent to which the mobile node is connected. The foreign agent then sends the packets to the mobile node.

The Mobile IPv6 protocol was introduced to minimize the interruption in service experienced by IPv6 mobile node as it changes its point of attachment to the Internet. Without such a mechanism, a mobile node cannot send or receive packets from the time that it disconnects from one point of attachment to the time it connects to a new point of attachment and registers a new care-of address

## 3. PACKET FORWARDING TECHNOLOGY

A mobile node will have two addresses. The first address is the home address which is visible to all other users, and the second address is the care-of-address which is only visible to the home agent. This is a temporary address assigned to the mobile node, and this address is never known or used by other users or applications. Mobile IPv4 and Mobile IPv6 protocols share similar ideas, but their implementations are somewhat different. The packet forwarding technology used in each of these protocols is described below.

### 3.1 Mobile IPv4 Data Delivery

In the mobile IPv4 data delivery, the foreign agent is responsible for assigning a care-of-address to the mobile node, and forwarding the packets to it. The foreign agent assigns the care-of-address dynamically. It shares the same IP address between many mobile nodes as per their requirements. All the packets destined to the mobile node will be encapsulated/tunneled by the home agent and sent to the foreign agent. The foreign agent then decapsulates the packets and send them to the mobile node.

### 3.2 Mobile IPv6 Data Delivery

The mobile IPv6 data delivery works in a similar way as mobile IPv4 delivery. If the correspondent node is Mobile IPv6 compatible, then the data packets are sent directly to the mobile node's location on the IPv6 network. And if the correspondent node is not Mobile IPv6 compatible, data packets are sent to the mobile node's home address. The home agent then intercepts the data packets and tunnels them using IPv6-over-IPv6 tunneling to the mobile node's care-of address. The data packets include a new routing extension header that contains the mobile node's home address.

## 4. CONFIGURATION OF THE NETWORK USED FOR THE SIMULATION

The objective of this model is to assess the strengths of the mobile IPv6 protocol and analyze how the mobile IPv6 protocol overcomes the weaknesses the mobile IPv4 protocol. The simulation is divided into two different scenarios. The first scenario is a wired MobileIP network and the mobility protocol used is mobile IPv4. The second scenario is a wireless mobile IP network and the mobility protocol used is mobile IPv6. To study the performance of the network, the simulation model must consist of the following main components

- *Traffic Generating Sources:* Depending upon the requirements for the simulation, the source hosts are configured to run a video conferencing, and voice conferencing applications.
- *Traffic Receiving Destinations:* Each of the destinations host is configured to satisfy the request made by the source stations. For example, a destination host called "fserver" is configured to receive voice/videoconferencing traffic.
- *Network Topology*: For the MIPv4 scenario, the network topology consists of a home agent, foreign agent, mobile node, correspondent node and the server (see figure 1). The network model for the second scenario consists of two wireless clients who act as mobile client and correspondent node. Each of the wireless clients is configured to run voice and video applications. Each of these clients is configured with a home agent. Two other routers act as anchor points of communication when these mobile devices travel to foreign networks (refer to figure 2).

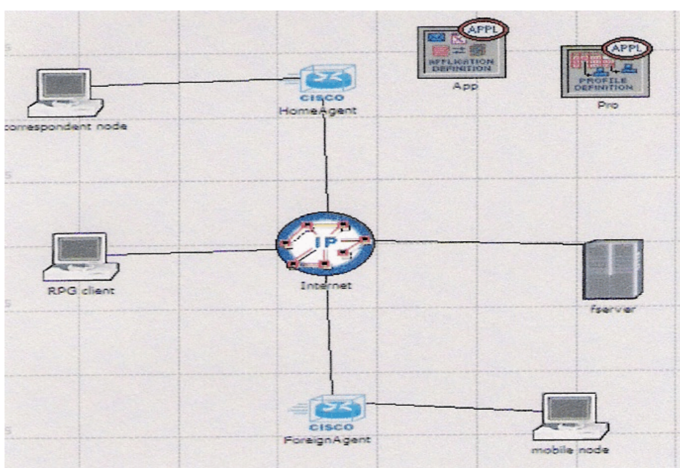


Figure 1: MobileIPv4 Network model

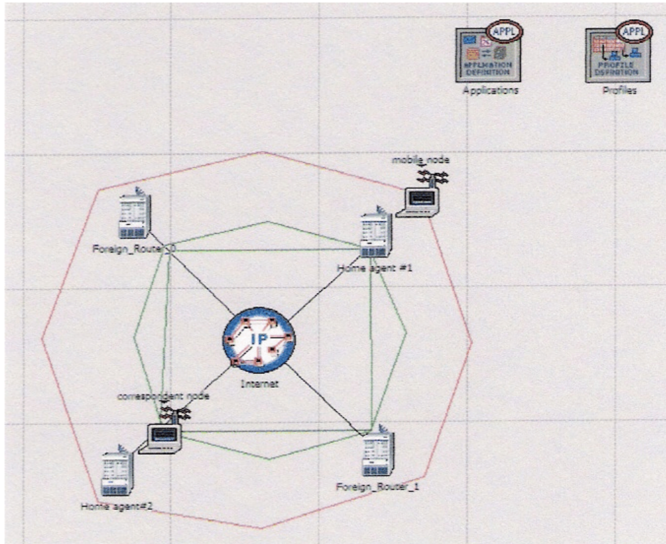


Figure 2: MobileIPv6 Network model

## 5. RESULTS OF THE SIMULATION STUDY

With the network model described in the previous section, the performance can be evaluated using different criteria for different applications. The metrics we have used to assess the performance of these protocols is the end-to-end delays. Figure 3 shown below displays the tunneled traffic sent and received for the mobile IPv4 scenario. Figure4 represents the tunneled traffic sent and received for the mobile IPv6 scenario. The blue graphs represent the tunneled traffic sent and red graphs represent the tunnel traffic received. In the case of the mobile IPv4 protocol, there is some variation in the traffic sent and traffic received. The variation implies that the packets have been lost. But for the mobile IPv6 scenario, the traffic sent and received is almost same which implies zero packet loss.

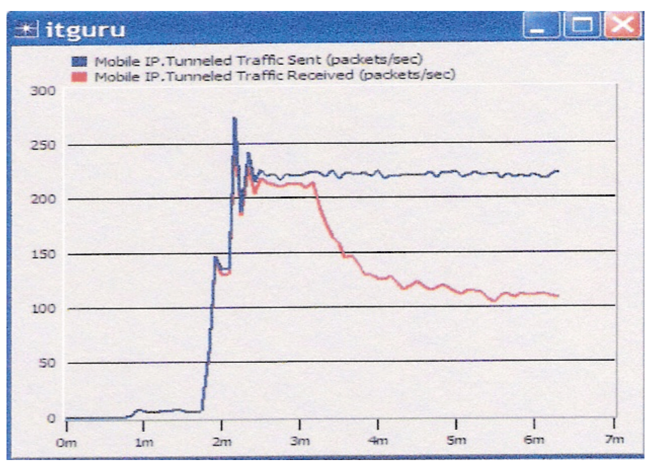


Figure 3: MobileIPv4: Tunneled traffic sent versus received

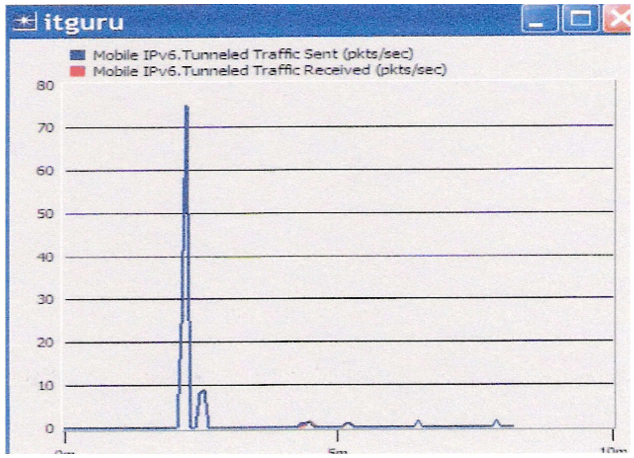


Figure 4: MobileIPv6: Tunneled traffic sent versus received

Figure 5 shown below displays the amount of video conferencing packet end-to-end delays and figure 6 displays the amount of voice packet end-to-end delays. Both the figures indicate high delays for the mobile IPv4 scenario (red line) when compared to that of the mobile IPv6 scenario (blue line). In the case of the mobile IPv4 scenario, the packets do not reach the mobile node directly. The home agent tunnels the packets and sends them to the foreign agent. The foreign agent then forwards the packets to the mobile destination. Moreover, the Foreign Agent scheme creates an additional overhead in processing the packets because it shares a single IP address between many mobile nodes dynamically. The delays are increased as a result of the increase in the processing overhead (refer to figure 5 and 6). Where as in the case of mobile IPv6 scenario, the packets will be sent directly from the correspondent node to the mobile node. There is no foreign agent to act as an intermediary between the home agent and the mobile destination.

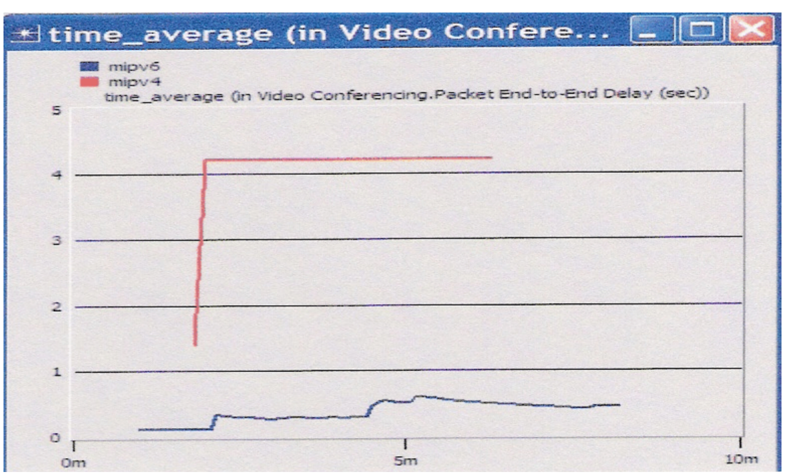


Figure 5: Video Conferencing Packet End-to-End Delays

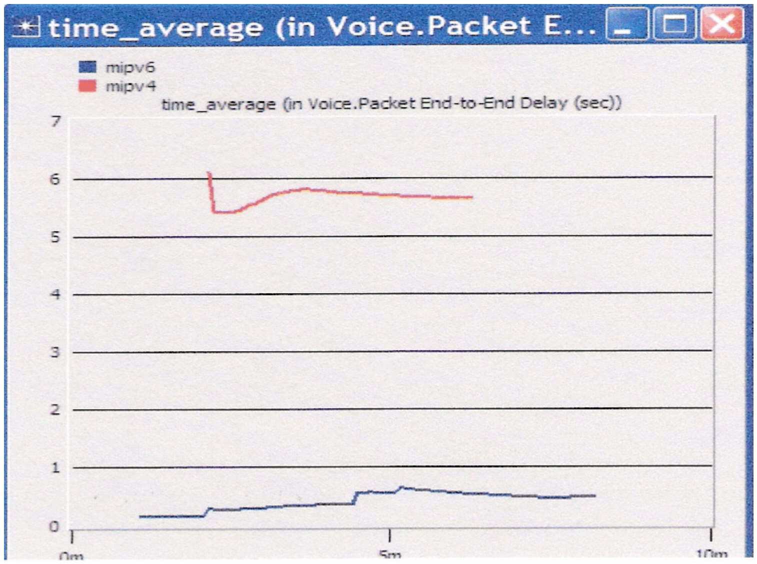


Figure 6: Voice Packet End-to-End Delays

## 6. CONCLUSION

From the results of the simulation (see section 4), we found that the mobile IPv6 protocol is more efficient than the mobile IPv4 protocol. The difference in the the processing overhead in each of the protocol's packet forwarding technology created difference in the performance of the protocls. Below is a breif description of the drawbacks of the mobile IPv4 protocol and how the mobile IPv6 protocol overcomes the drawbacks of mobile IPv4.

The major drawback of the mobile IPv4 is the triangle routing problem. Consider a case where the sending node and the mobile node are on the same network, and the sender wants to send packets to the mobile node. Instead of sending the packets directly to the mobile destination, the sending client sends the packets to the mobile node's home address. So, the packets travel all through the Internet and reach the home netwrok. The home agent then tunnels the packets and sends them back to the mobile node's care-of-address. Therefore the packets travel round and finally reach the same netwrok from where they were sent. This is called as triangle routing. The Routing Optimization technique deployed into the mobile IPv6 specification overcomes the problem of triangle routing particularly when the mobile node roams in a distant foreign network. According to the route optimization, the packets directly travel from the correspondent node to the mobile node without detouring to the home network. Route optimization eliminates the transmission delays associated with bidirectional tunneling and is needed to provide sufficient performance for time-sensitive traffic, such as Voice over IP (VoIP). It also ensures that the shortest communications path will be taken. The route optimization technique eliminates congestion at the mobile node's home agent and home link.

The overall differences between the mobile IPv4 protocol and the mobile IPv6 protocol are listed below (Introducing mobile IPv6 in 2G and 3G mobile networks, n.d):

- Unlike mobile IPv4, the mobile IPv6 has no Foreign Agents
- Route Optimization technique is the strength of mobile IPv6 which lacks in mobile IPv4

- The mobile IPv6 uses Neighbor Discovery to find link addresses of neighbors whereas the mobile IPv4 uses Address Resolution Protocol (ARP).
- In order to discover the home agent address, the mobile IPv6 protocol uses anycast addressing and returns a single reply to the mobile node whereas the mobile IPv4 uses a directed broadcast approach and returns separate replies from each Home Agent.
- In case of the mobile IPv6 protocol, the mobile nodes obtain care-of-addresses through stateless address auto-configuration whereas the mobile IPv4 uses agent discovery.

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