

Effects of fixed and roaming CN on MIPv6 networks

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Abstract

Mobile Internet protocol version 6 (MIPv6) is a protocol that allows mobile nodes (MNs) to remain accessible while moving in the IPv6 network, providing users with a form of transparency in spite of the mobility. Mobile networks consist of different nodes such as the MN, correspondent node (CN), home agent (HA), foreign agent or router (FA or FR) and mobile router (MR). One of the vital nodes in a mobile network is CN, a node that communicates with the MN. In the future, in times of need, for instance, during wars, disasters or natural hazards, an MN may require the services of a CN in order to roam. In this paper, we analyse the effect of fixed and roaming CN on MIPv6 networks. The results show that, with a fixed CN, the delay variation performance, end-to-end delay and packet received are better than having a roaming CN in the mobile networks. This requires the attention of researchers, especially when all the communicating nodes (i.e., MN and CN) are roaming in the mobile networks to reduce the delay and packet drop, especially during the handover process.

Keywords: MIPv6, fixed CN, roaming CN, MN, HA and FA.

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1. Introduction

In order to support the end user's mobility, the Internet Engineering Task Force (IETF) has introduced a new protocol known as MIPv6, which enables a mobile node (MN) to move from one network to another, without the establishment of new sessions in the Internet [1, 2]. When an MN establishes a session with the corresponding node (CN) while moving from one network to another without using MIPv6, a session between a CN and MN will be interrupted and a new one will be created. MIPv6 supports an MN to configure Home Address (HoA) and acquire Care of Address (CoA) when in a foreign network [3]. The MN informs its HA or previous FA of the new address when reaching out to the new foreign network in order to maintain their communications session [2].

In the current MIPv6 networks architecture, the CN and MN node communication is based on a client-server model in which the CN is considered as a fixed server while the MN is mobile. For instance, a CN may be a server like youtube.com servicing video streaming to MN through the Internet. In contrast, there may be some scenarios in which a CN will be needed as a mobile server, such as in times of disasters, military operations, etc. When CN is used as a mobile server, a central point, which is mobile, may be required to communicate with other points during disaster or military operations. Due to the increase in occurrence and the fast and rapid nature of the responses in these scenarios, the need for CN as a mobile server will be vital in the near future.

In this paper, two models were analysed, a mobile network with a CN with a fixed cable connected to the router and a CN roaming in the mobile network. These models were analysed when route optimisation was enabled and when it was not. The results obtained from the route optimisation and non-route optimisation models were then compared. In each model, three performance parameters (delay variation, end-to-end delay and received packets) were used to observe the effects of these models on the MIPv6 networks.

2. Mobile IPv6 Networks and Operations

2.1. Mobile IPv6 Networks

Mobile networks are sets of subnets or single nodes connected to the Internet through mobile routers (MRs) that change their anchor points (access router) over the Internet. A mobile network consists of the following nodes: MN, CN, home agent (HA), foreign agent or router (FA or FR) and mobile router (MR). The CN is a node that is in communication with an MN. The CN can be mobile or stationary. Therefore, the terms MN and CN are used to refer to any end nodes located within the mobile network and any nodes communicating with one another. The HA is a router in the home network that is used for assigning HoA to MN and tunnelling packets to deliver them to a new address of MN when found outside the home network. FA represents the network where the MN is temporarily attached. It is configured and assigned as a CoA to an MN [4, 5].

2.2. Mobile IPv6 Operations

The MIPv6 network is a network that supports a node to move from its home network to another network. MIPv6 was designed to allow nodes to be reachable and keep the connection ongoing while moving to other locations to meet the topological requirements of being transparent to the upper layers. The MIPv6 nodes are (normally) assigned to two IPv6 addresses: HoA and CoA. The HoA is given to nodes when they are at home networks, and are used for reaching out to the MN with a steady session of communication, while hiding the IP layer mobility from the upper layers. Keeping HoA of MN permanently is advantageous, because all the CNs will communicate with the MN through HoA without indicating or showing the current MN position [6]. Therefore, the packets are routed to MN regardless of whether the MN (is) at its home network or otherwise. However, if the MN is not at its home network, then the HA must forward all the packets to the CoA of the MN [7].

When the MN is away from its home network, the CoA is used to reach it. The CoA address is formed based on the prefix of the foreign network. The CoA is obtained by stateful or stateless means [7]. When routing optimisation is enabled due to movement of MN to another network and address configuration, the MN informs its HA and CN about those changes via Binding Update (BU) messages. BU contains information about CoA and HoA of the MN. This BU's information from the HA and CN must be stored to allow HA and CN to forward packets directly to MN CoA [2].

3. Related Works

There are few studies carried out in relation to the effect of node roaming or fixed nodes on the MIPv6 network in the Internet. Most of these studies of the past decade are focused on route optimisation and handover of MIPv6 networks. With route optimisation, great performance improvement has been archived [8, 9]. However, this is not conclusive; either the improvement in performance can (only) be obtained if all end nodes (CN and MN) are roaming, or MN is roaming and CN is fixed.

According to [10], mobility of CN causes a degradation effect on the performance in an MIPv6 environment, because of frequent handoffs. For this reason, researchers have proposed a new scheme for Mobile IPv6 called Intelligent Mobile IPv6 (IMIPv6) that minimises the handoff delay caused by the movement of MN and CN. In their study, they compared the existing MIPv6 with the proposed IMIPv6 in a simulation. The results indicate that IMIPv6 significantly reduces the overhead signalling costs and packet loss during handoffs.

In [11], a mobility model was proposed that takes into consideration MN as well as the CN, especially when MN and CN are in foreign networks. It is obvious that real-time applications such as video conferencing and voice need faster re-establishment of broken connections because of their frequent exchanging of network access points. The proposed model was efficient as the nodes change the network access point frequently because of the high mobility, and result in less packet loss and faster handoff. In addition, the model makes best use of the available bandwidth, which is a sensitive parameter in wireless networks.

Several studies have also considered notions such as handover, route optimisation and mobility efficiency. For instance, in [12] a delivery mechanism was proposed to reduce the initiation time of handover, thus reducing the handover latency. In addition, the designed mechanism reduced the overlap of coverage between adjacent cells. Choi *et al.* [13] proposed an efficient network mobility support scheme with the direct Home Network Prefix (HNP) assignment to reduce the location update cost and packet tunnelling cost.

Schmidt and Wählisch [14] investigated the topological impacts of continuous support on efficient mobility in the MIPv6 hierarchical environment. In their model, during handoff MN does not depend on the roundtrip time of binding with HA or CN. They suggested MIPv6 improvements for a continuous handover for avoiding bidirectional multicast communication. Zohra *et al.* [15] conducted an analytical study of IPv6 mobility management and its handover performances. The results collected can be used to analyse and identify the characteristics and performance indicators of the proposed mobility. This can facilitate decision-making for development of a new mobility management protocol in the mobile network.

4. Network Model and Configuration

In our study, we created a network model with a fixed and a roaming CN with two scenarios (when route optimization is enabled and when it is not). The roaming CN model network consists of two foreign routers (FRs) (FR_1 and FR_2) and HAs (HA_A and HA_B). It also has two MNs, MN_1 and MN_2. MN_2 was considered as the roaming CN with HA_B as its HA and MN_1 with HA_A as its HA as shown in Figure 1.

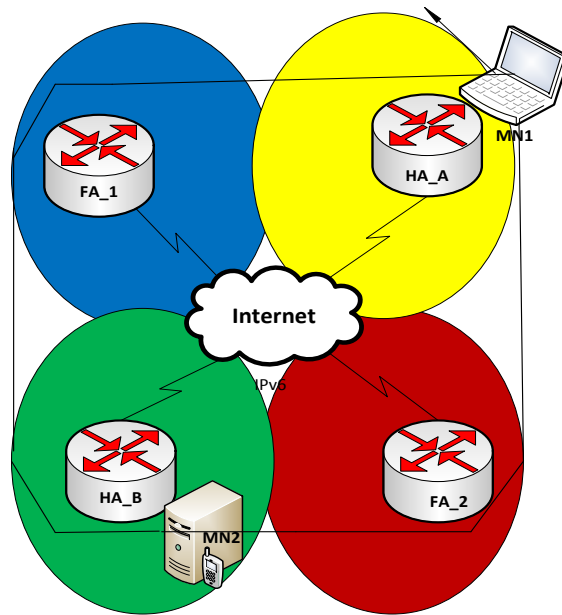


Figure 1. Network model with roaming CN

The fixed CN network model consists of two FRs (FR_1 and FR_2), one HA (HA_A for MN_1) and a normal router (R_1 connecting CN) with a single MN (MN_1) and fixed CN as shown in Figure 2.

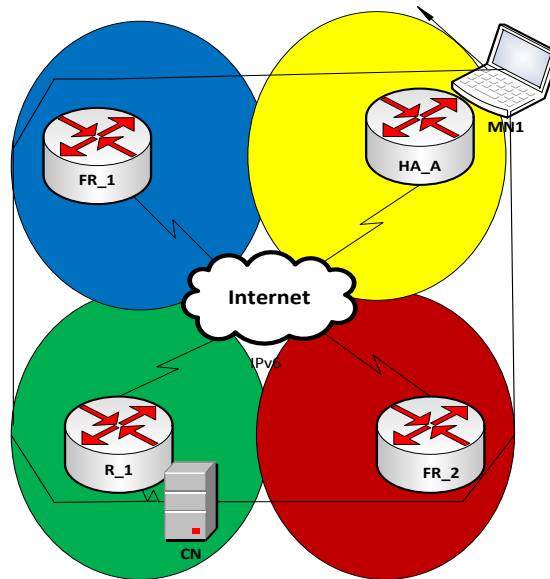


Figure 2. Network model with fixed CN

5. Network Model and Configuration

In this study, a simulation was performed in the OPNET Modeller version 14.0. Three performance parameters (delay variation, end-to-end delay and received packets) were selected for video conference application (lightweight video conference). Performance of fixed and roaming CN topological scenarios were compared for each of the above parameters when a route optimisation was enabled and when it was not. The following section explains the obtained results.

5.1. Delay Variation

The difference in end-to-end delay in one-way direction of the video conference is represented here. Figure 3 shows a delay variation of a video conference application in a network with fixed and roaming CN when the route optimisation was enabled. Within 300 sec of simulation time, delay variation of a fixed CN was equal to 0 while that of a roaming CN had a slightly increased value of 0.003 sec. From 300 to 600 sec of simulation time, the delay variation was approximately the same for all the scenarios. However, after 600 sec of simulation time, the delay variation started to jump up to a high value in the fixed CN scenario, showing a small value of delay variation compared to a roaming CN scenario. This shows that if a route optimisation is enabled, there will be a huge difference in delay variation when a CN is roaming and when it is fixed.

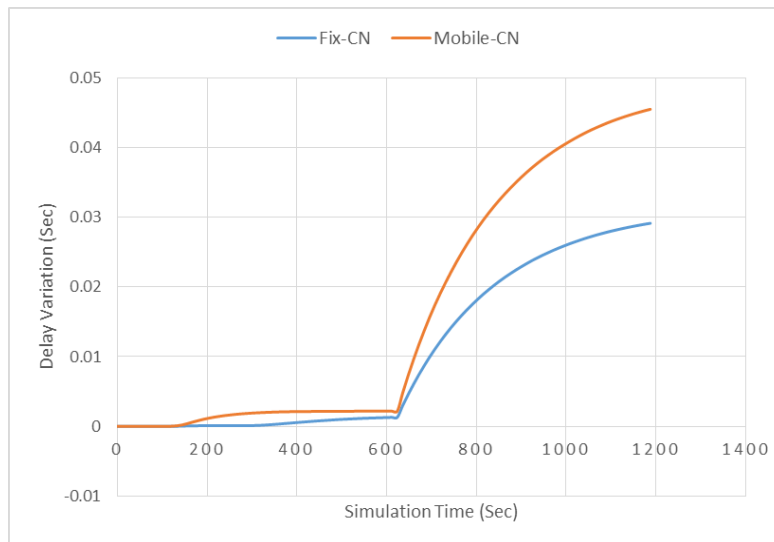


Figure 3. Delay variation for video conference when route optimisation is enabled

Figure 4 shows a delay variation of video conference application when no route optimisation is enabled. It is clear that after 150 sec of simulation time, the delay variations for these two scenarios were different. However, the difference in delay variation was minimal and approximately the same for the entire simulations.

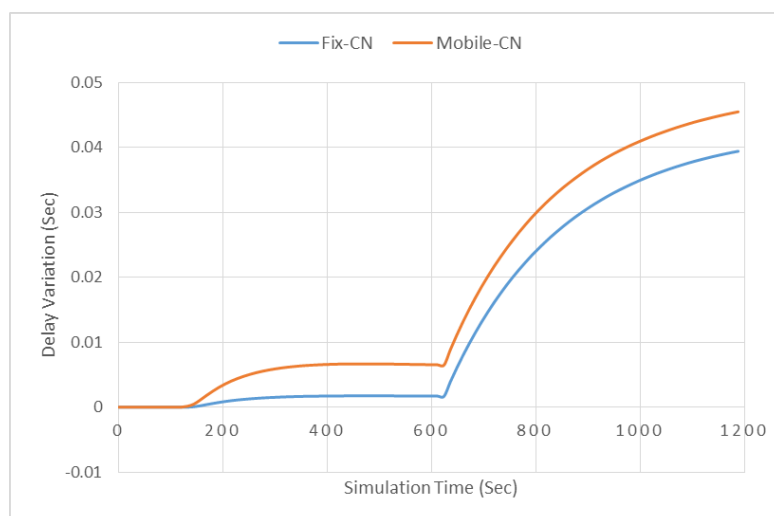


Figure 4. Delay variation for video conference when no route optimisation enabled

5.2. End-to-End Delay

In this part, the end-to-end delay for the video conference application in fixed and roaming CN is shown. The time taken by a packet from the sender to the receiver is referred to as end-to-end delay. Figure 5 shows an end-to-end delay for fixed CN and roaming CN when route optimisation was enabled. With both MN and CN roaming, the end-to-end delay was better due to the fact that at some point the CN and MN were closer to each other. With route optimisation enabled, the packets are sent directly to each other without passing through an HA, which makes the end-to-end delay minimal in some cases. With a fixed CN, an end-to-end delay is minimal at one moment during the simulation time when the MN is passing near the fixed CN. The roaming CN has the advantage of reduced end-to-end delay when roaming near the MN when route optimisation is enabled.

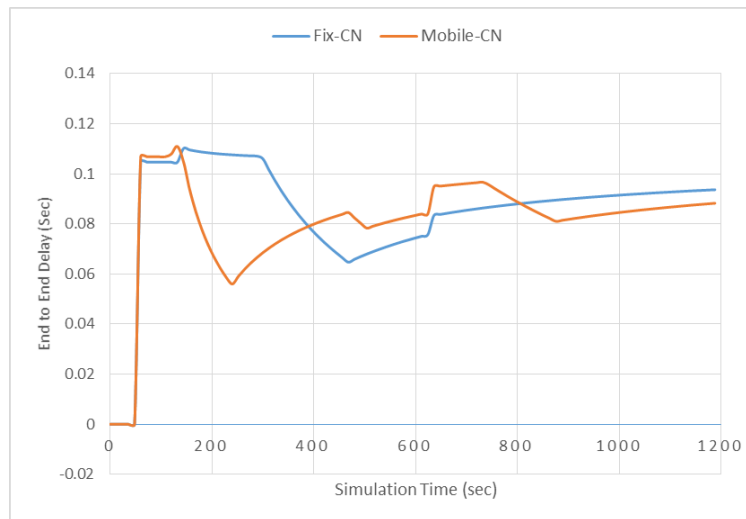


Figure 5. End-to-end delay for video conference when route optimisation is enabled

Figure 6 shows end-to-end delay for roaming and fixed CN scenarios when no route optimisation is enabled. End-to-end delay for roaming was higher when compared with the fixed CN scenario. The end-to-end delay was higher even when the MN and CN were near to each other, because the packets first have to pass HA before tunnelled to MN or CN. In a scenario of fixed CN, only packets tunnelled are carried on the MN node side. This feature reduces end-to-end delay to a desirable degree.

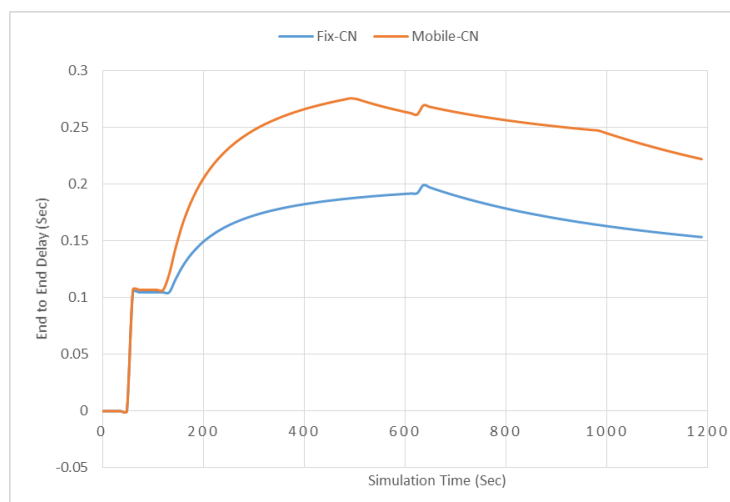


Figure 6. End-to-end delay for video conference when no route optimisation is enabled

5.3. Packet Received

The number of packets received for video conference application is discussed in this part. In Figure 7, packets received when route optimisation is enabled for fixed and roaming CN scenarios were compared. From the results, no packets drop during the communication between MN and CN except when MN or CN has to do the handover process. It is clear that the two nodes where roaming packets drop during handover process was high compared to a fixed CN scenario where packet drops during handover process occurred only on the MN side. However, when both nodes perform the handover process, no packets were received on either side of the nodes and the packet drop was severe.

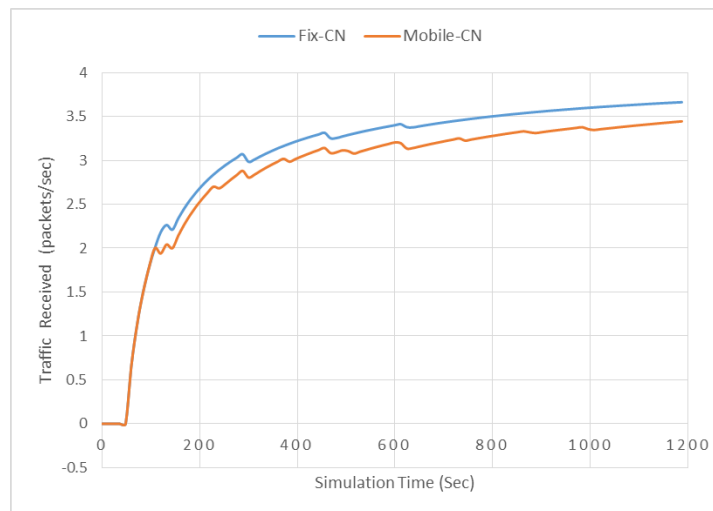


Figure 7. Packet received for video conference when route optimisation is enabled

Figure 8 shows packets received for video conference when no route optimisation was enabled for roaming and fixed CN scenarios. As explained above, with roaming CN, packet drop is more during the handover process. As the hosts were not communicating directly as was the case with route optimisation enabled, the packets had to pass through HAs first, which in some cases increases delay. However, the packet drop when no hosts performed the handover process reaches to the maximum, as in the case of route optimisation enabled.

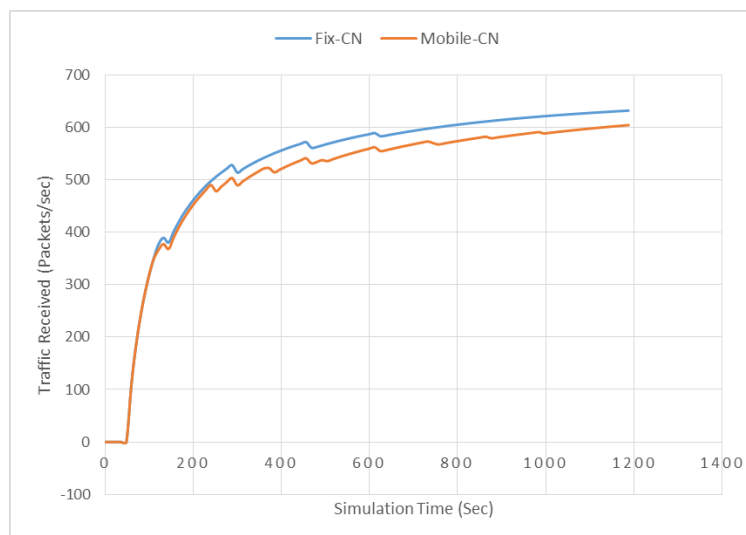


Figure 8. Packet received for video conference when no route optimisation is enabled

6. Conclusion

In this study, we evaluated the effects of fixed and roaming CN on MIPv6 networks when route optimisation is enabled and when it is not enabled. Our results showed that, a roaming CN has a negative impact on the performance of the mobile network, except in the end-to-end delay when route optimisation is enabled. The good performance of end-to-end delay was achieved with a roaming CN due to the fact that MN and CN were directly communicating with each other because they were near to each other. In this duration, the end-to-end delay was reduced significantly. The delay variation and packets received, especially during the handover process, were due to the mobility of CN and MN. In fact, this should be the main indicator that researchers should consider when considering mobility deployment of CN.

References

- [1] Tripathi, A. K., Radhakrishanan, R., & Lather, J. S. (2014, February). Impact of wireless link delay on handover latency in Mobile IPv6 environment. In *Issues and Challenges in Intelligent Computing Techniques (ICICT), 2014 International Conference* (pp. 424-428).
- [2] Perkins, C. (2011). *Mobility support in IPv6*. Access Date: 7 July 2017. <http://www.rfc-editor.org/info/rfc6275>
- [3] Adibi, S., Naserian, M., & Erfani, S. (2005). Mobile-IP MPLS-based networks. In *Electrical and Computer Engineering, 2005, Canadian Conference* (pp. 168-171).
- [4] Bernardos-Cano, C. J., Soto-Campos, I., Calderón-Pastor, M., von Hugo, D., & Riou, E. (2005). Nemo: Network mobility in ipv6. *IPv6 More than A Protocol*, 6(2), 36-44.
- [5] Montavont, N., Noel, T., & Ernst, T. (2004). Multihoming in nested mobile networking. In *Applications and the Internet Workshops, SAINT 2004 Workshops International Symposium* (pp. 184-189).
- [6] Giust, F., Bernardos, C. J., & De La Oliva, A. (2014). Analytic evaluation and experimental validation of a network-based IPv6 distributed mobility management solution. *IEEE Transactions on Mobile Computing*, 13(11), 2484-2497.
- [7] Baddi, Y., & El Kettani, M. D. E. C. (2014). Multiple active cores-based shared multicast tree for mobile IPv6 environment. In *Information Science and Technology (CIST), 2014 Third IEEE International Colloquium* (pp. 378-383).
- [8] Toshniwal, S. V., & Barbudhe, V. K. (2016). Mobile IPV6 Route Optimization. *International Journal of Engineering Science*, 1, 3575-3580.
- [9] Lee, K., Park, J., & Kim, H. (2003). Route optimization for mobile nodes in mobile network based on prefix delegation. In *Vehicular Technology Conference, VTC 2003-Fall. 2003 IEEE 58th* (pp. 2035-2038).
- [10] Saxena, P. C., & Jasola, S. (2006). Performance of intelligent Mobile IPv6. *Computer Standards & Interfaces*, 28(6), 737-751.
- [11] Kumar, M., & Jaffery, Z. A. (2012). A new mobility model for multimedia networks. *IJCSNS*, 12(9), 107-116.
- [12] An, Y. Y., Yae, B. H., Lee, K. W., Cho, Y. Z., & Jung, W. Y. (2006, April). Reduction of handover latency using MIH services in MIPv6. In *Advanced Information Networking and Applications, 2006. AINA 2006. 20th International Conference* (Vol. 2, pp. 229-234).
- [13] Choi, J. I., Seo, W. K., & Cho, Y. Z. (2015). Efficient network mobility support scheme for proxy mobile IPv6. *EURASIP Journal on Wireless Communications and Networking*, 2015(1), 210-215.