Malaysian Journal of Mathematical Sciences 10(S) February: 423–430 (2016)
Special Issue: The 3^{rd} International Conference on Mathematical Applications in Engineering 2014 (ICMAE'14)

MALAYSIAN JOURNAL OF MATHEMATICAL SCIENCES

Journal homepage: http://einspem.upm.edu.my/journal

Cost Investigation of Multihoming-based Scheme to Support Mobility Management in NEMO

Shayla Islam*[1], Aisha-Hassan A. Hashim[1], Mohamed Hadi Habaebi[1], and Mohammad Kamrul Hasan*[1]

[1]*Department of Electrical and Computer Engineering,International Islamic University,Malaysia*

E-mail: iium19612@hotmail.com, aisha@iium.edu.my, habaebi@iium.edu.my, hasankamrul@ieee.org

ABSTRACT

Network Mobility Basic Support Protocol (NEMO BSP) is an augmentation of Mobile IPv6 in which a frequent notification are required to update current location of the Mobile Router (MR) to maintain Internet connectivity during inter handoff through preserving the Binding Updates (BU). It might be designed in a high speed train, car as well as aircrafts with a vast range of consigned IP backbone. Nevertheless, NEMO BSP inherits some of the shortcomings like higher handoff latency with packet loss and fails to ensure seamless handover. Moreover, a longer time is required to complete inter Handoff for mobile environment,which may cause performance degradation for the applications are mainly Voice over IP (VoIP), video streaming that running on Mobile Network Nodes (MNNs). This consequence is particularly considerable in wireless environment. As a result, it can be retain seamless Internet connectivity through using multiple network interfaces in NEMO. In this paper, a general overview on existing multihoming-based scheme in NEMO is given in an integrated manner. Furthermore, it estimates Cost Ratio (CR) through numerical analysis in order to support mobility management.

Keywords: Network Mobility Basic Support Protocol, Mobile Router, Mobile Network Nodes, Location Update Cost

1. Introduction

In recent times, to support mobility management of the intact network is the most important issue due to movement of the MR among different subnets. Hence, NEMO BSP has been proposed by the NEMO working group to continue the global reach ability of each node inside the mobile network Devarapalli and Thubert (2005),Yoo and Su (2009),Chen and Chao (2010),Slimane and Abdelmalek (2010). Nevertheless, in case of inter handoff of MR among different access networks, the transmission delay increases due to bypass the packets via each Home Agent (HA) of MR. Thus, increase tunneling overheads as well as location update costPetander and Seneviratne (2006), Kuntz and Noel (2008), Kuntz and Noel (2013), Lin and Labiod (2007), Slimane and Abdelmalek (2012).Various schemes have been proposed which concerning the multihoming-based inter handover scheme in NEMO. Despite the fact that, the existing schemes have a long convergence time during inter handoff that increase LUC. The rest of the paper is structured as follows: Section 2 gives an elementary concept on existing multihoming-based scheme in NEMO. Furthermore, estimation of Location Update Costs (LUC)through qualitative analysis are presented in section 3 and section 4. Finally, in section 5, the conclusion of the paper is presented. Research steps are summarized in figure 1.

2. Background

The concept of making use of a single address introduces the hazard of network failure leading to Internet connection shut down. This occurs only if that specific single interface link fails and no options are remained to continue the connectivity. Nevertheless, with the introduction of multihoming technique users are able to switch between multiple interfaces. It aims to improve the entire Internet connectivity as well as widens the reliability of network applications. Multihoming enlarges the area of application and protocol for fulfilling the exigent aims namely reliability, load sharing, and ubiquity and distribution Kuntz and Noel (2013), Li and Cho (2009). Multihoming can be classified into site multihoming and host multihoming Sousa and Curado (2011) as illustrated in figure 2 and figure 3. The perception of layer 3 multihoming in NEMO is recommended to provide the session continuity at the time of movement among multiple access routers since the architecture of the NEMO network is complicated. The NEMO must retain several tunnels among MR and HA with applying multihoming technique. However, using a single Internet service provider, it is unattainable to achieve load sharing, and ubiquity. Therefore, connecting NEMO via several interfaces become significant for assuring continuous Internet connectivity at any time in any place Slimane and Abdelmalek

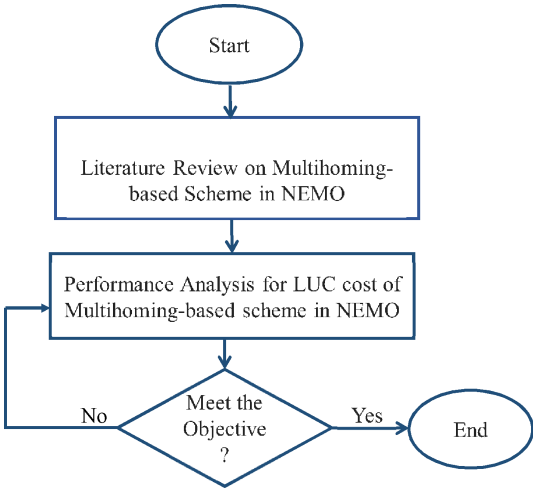

Figure 1: Summarizes the research steps

(2012).

The Shim6 protocol is a host-centric approach which offers a technique to add the context with a recently obtained address. This is attained by the exchange of Update Acknowledgment as well as Update Request (UR) control messages. Shim6 can identify a session with any of its own IP addresses. The chosen address is called the Upper-Layer Identifier (ULID). The address used to locate a node is called locator. When any of MR or HA or both of them are already Multihomed, an established Shim6 context maintain the reliability of bidirectional tunnel between them. If the tunnel is already established in between MR as well as its HA, the MR in NEMO which are Shim6-capable might build contexts with distant MR for receiving the similar multihoming advantages as any host positioned in the Home Network. By integrating the concepts of the Shim with PMIPv6 (Shim with PMIPv6) protocols, an advanced Multihoming support scheme has been proposed in Lin and Labiod (2007). According to Shim with PMIPv6, every interface inside a Multihomed MN gets linked to the LMA domain individually. So, the LMA does not require differentiating among a vertical handover as well as the initial attachment. Additionally, the suggested scheme makes use of Shim Locator Preferences (SLP) in order to support a flow mobility with concurrent Internet connectivity through different access technology during inter mobility handoff. However, the implementation of these proposals with PMIPv6 in NEMO stills an active research area.

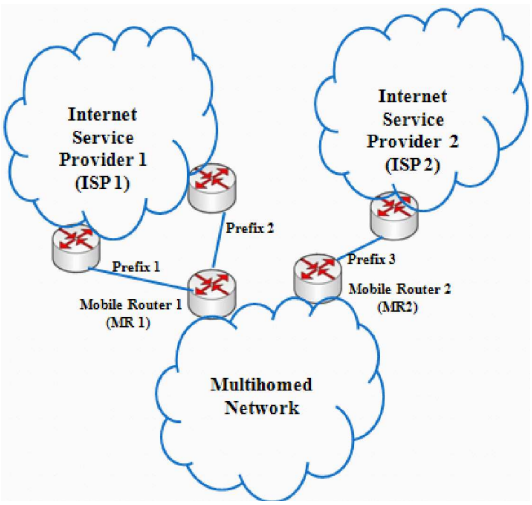

Figure 2: Site Multihoming

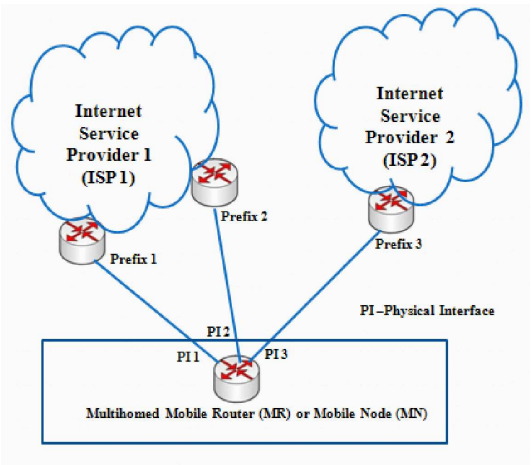

Figure 3: Host Multihoming

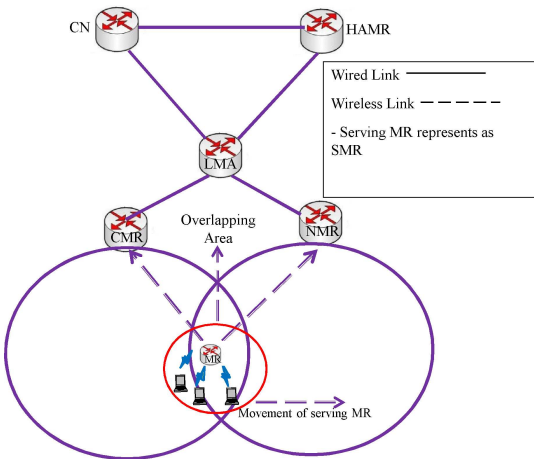

Figure 4: Reference Scenario

3. Cost Investigation

In this part, a location update cost scenario (shown in figure 4) is formulated in order to identify the performance of the multihoming based scheme and NEMO BSP protocols. Initially, Random Waypoint Model Devarapalli and Thubert (2005)is used to calculate Cell Residence Time (CRT) of the MR among different access technology. Afterwards, the result is analyzed in sec. 4.

In multihoming-based scheme, some extra signaling messages are interchanged in between Current MR (CMR)and New MR (NMR), while the MR resides at overlapping area between the CMR and the NMR. CMR and NMR are functioned as Access Router(AR) in this paper. The concept of LMA (Local Mobility Anchor)is applied in multihoming-based scheme. When the MR with LFN enters into a LMA domain, the LUC for the MR can be calculated using following methods Makaya and Pierre (2008).

$$\Phi_L = \alpha_{MR} \times \frac{(\beta_M \times \varphi_{Inter}) + (1 - \beta_M) \times \gamma_{Intra}}{\Phi_{TMR}} \tag{1}$$

In the above equation, φ_{Inter} and γ_{Intra} refers to signaling message for Intra and Inter mobility LUC for multihoming- based scheme respectively.

Table 1: Parameters for Cost Investigation

Parameters	Value
Number of the serving MR α_{MR}	20
Number of Correspondents node	1
The cell residence time of the MR Φ_{TMR}	120sce
Processing cost at LMA	12

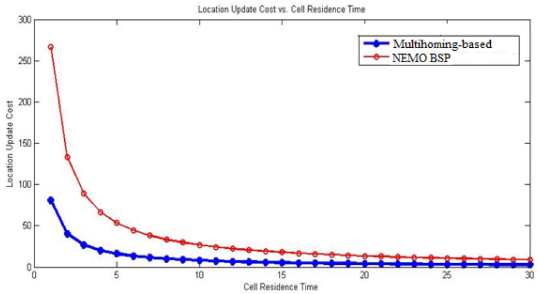

Figure 5: Location Update Cost vs. Cell Residence Time

4. Result Analysis

According to figure 5, the variation of LUC with average CRT is revealed through equation. The LUC of the MR should be lower if the longer the MR remains in a current cell the lower the location update cost. Usually, handoff occurs recurrently if cell residence time decreases. Therefore, with the recurrent movement of the serving MR, it becomes essential for it to notify its HA. As a result, increases the LU cost in NEMO BSP. Conversely, in the multihoming-based scheme as LMA concept is being introduced among the network, it becomes needless for the serving MR to update its HA for every movement. This considerably decreases LUC. Hence, it is summed up that for multihoming-based scheme, it is required less LUC as the CRT is increased. In addition, it is also demonstrated that the cost of multihoming-based scheme increases where as it is below the cost for NEMO-BSP. Moreover, the total scenario of the dependency of number of serving MR is plotted in figure 6. It is summarized via analyzing the figure 5 and figure 6 that, the ratio of the cost is declining when the MR is under 8 that indicates improved performance. Likewise, the cost of multihoming-based scheme diminish by 72when the MR is set to 4. Parameters that are used for cost investigation are shown in Table 1 Makaya and Pierre (2008), Hossain and Ivancic (2011).

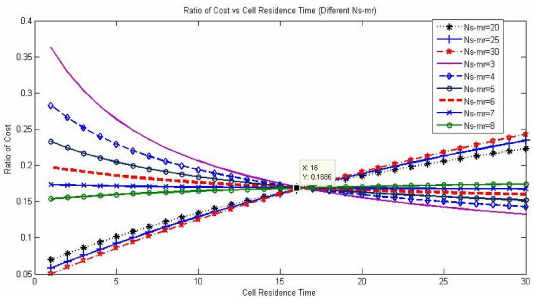

Figure 6: Ratio of Cost vs. Cell Residence Time

5. Conclusion

Producing extra location update cost is one of the important issue in NEMO environment to support mobility management. The main effort of this paper is to explore current multihoming based schemes in NEMO to have a better understanding of the comparative benefits with drawbacks of these protocols with the qualitative advancement.

Acknowledgments

A special thanks to the Research Management Center (RMC), International Islamic University Malaysia and the government of Malaysia, through Ministry of Education (MoE) for the education sponsorship.

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