ROTIO+: A Modified ROTIO for Nested Network Mobility

Ansuman Sircar[1], Bhaskar Sardar[1], and Debashis Saha[2]

[1] IT Dept, Jadavpur University, Kolkata
ansuman.sircar@tcs.com, bhaskargit@yahoo.co.in
[2] MIS Group, IIMC, Kolkata
ds@iimcal.ac.in

Abstract. The NEMO Basic Support (NBS) protocol ensures session continuity for all nodes in a moving network by maintaining a tunnel between Mobile Router (MR) and its Home Agent (HA). The NBS protocol, however, suffers from sub-optimality problem in routing, which gets amplified as the level of nesting increases [4]. The ROTIO [5] is a route optimization scheme for nested NEMO that restricts the number of tunnels to two thereby alleviating the pinball routing problem to a great extent. In this paper, we propose ROTIO+, a simple but practical extension of ROTIO scheme, to further reduce the number of tunnels to one in nested NEMO. In ROTIO+ scheme, the MR uses two binding updates (BUs): one to its HA and the other to the Top Level Mobile Router (TLMR). In the BU to its HA, it provides both the Care of Address (CoA) and Home Address (HoA) of the TLMR. Under normal circumstances, the HA routes all packets for the MR to the CoA of the TLMR. When the QoS decreases beyond a threshold i.e. the TLMR is changing the point of attachment, the HA sends the packet to the HoA of the TLMR. Thus, the scheme limits the number of visits to HA to one for a nested network and also has a fall back scheme when the TLMR changes point of attachment. The results show that it is an effective solution for route optimisation problem in nested NEMO.

Keywords: NEMO Basic Support protocol, MIPv6, Route optimization, ROTIO, Nested NEMO.

1 Introduction

The proliferation of mobile computing devices such as Mobile Telephones, Personal Digital Assistants (PDAs) and Laptop computers has created the need for continuous Internet connectivity through IP layer. In a vehicle, a group of such mobile computing devices move together as a unit, forming a moving network. This is popularly known as Network Mobility (NEMO) [1]. A simple example is being that of a person carrying a PDA and a Laptop while travelling in a car. Managing the mobility of such devices, known as Mobile Hosts (MHs), is possible using Mobile IP (MIP) (e.g. Mobile IPv6 (MIPv6) [2]) protocols. However, this would require all MHs to be MIP capable and be able to process a storm of control packets to perform MIP functions. Moreover, all MHs within a moving network may not be sophisticated enough to run such

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mobility support protocol. These problems are addressed by the NEMO working group with the Internet Engineering Task Force (IETF).

In NEMO, a network segment or subnet can move and attach to arbitrary points in the routing infrastructure. This moving network can only be accessed via specific gateways called Mobile Routers (MR) that manage its movement. To ensure session continuity for all nodes in the moving network, the IETF proposed the NEMO Basic Support Protocol (NBS) [3]. In the NBS protocol, each MR has a Home Agent (HA) where it resides when it is not moving. Since the MR is a part of the home network, the mobile network has a Home Address (HoA) belonging to the set of addresses assigned to the home network. This HoA remains assigned to the MR even when it is away. When the MR is attached to a foreign network, the MR acquires an address from the visited network, called the Care of Address (CoA). The connectivity with the MR is established through a bi-directional tunnel between the MR and its HA, known as MRHA tunnel, using the bind between the HoA and the CoA. This tunnel is set up when the MR sends a successful Binding Update (BU) to its HA, informing the HA of its current point of attachment. All communications to the moving networking has to be routed through the HA of the MR via the MRHA tunnel to reach the foreign network (i.e. the CoA) where the MR is currently residing. Thus, the MR can provide accessibilities to its own Mobile Network Nodes (MNNs), which are attached to its ingress interface that has its own network prefix.

In order to provide Internet connectivity, a MR can either connect to an Access Router (AR) or to another MR, which in turn is connected to Internet. This property of MR, whereby it attaches to other MRs, results in formation of a nested NEMO. In a real life scenario, this can be envisioned as a Personal Area Network (PAN) accessing Internet via MR of a car on a ship, which in turn contains a mobile network of larger scale with its own MR as show in Figure 1. This nested network of MRs is a simple

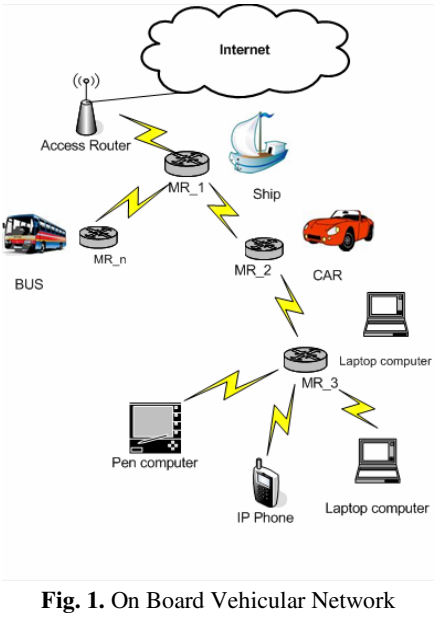

Fig. 1. On Board Vehicular Network

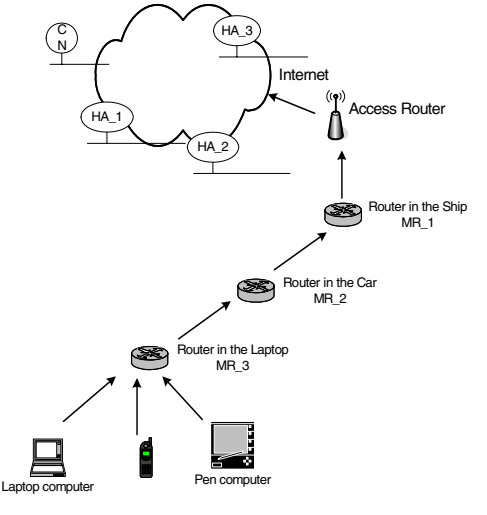

Fig. 2. Nested Mobile Network