

Chapter 12

Extended Mobile IPv6 Route Optimization for Mobile Networks in Local and Global Mobility Domain

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ABSTRACT

Network mobility (NEMO) route optimization support is strongly demanded in next generation networks; without route optimization the mobile network (e.g., a vehicle) tunnels all traffic to its Home Agent (HA). The mobility may cause the HA to be geographically distant from the mobile network, and the tunneling causes increased delay and overhead in the network. It becomes peculiar in the event of nesting of mobile networks due to pinball routing, for example, a Personal Area Network (PAN) inside a vehicle. The authors propose an Extended Mobile IPv6 route optimization (EMIP) scheme to enhance the performance of nested mobile networks in local and global mobility domain. The EMIP scheme is based on MIPv6 route optimization and the root Mobile Router (MR) performs all the route optimization tasks on behalf of all active Mobile Network Nodes (MNNs). Thus, the network movement remains transparent to sub MRs and MNNs and modifies only MRs and MNNs leaving other entities untouched and is more efficient than the Network Mobility Basic Support protocol (NEMO BS). The authors carried out an extensive simulation study to evaluate the performance of EMIP.

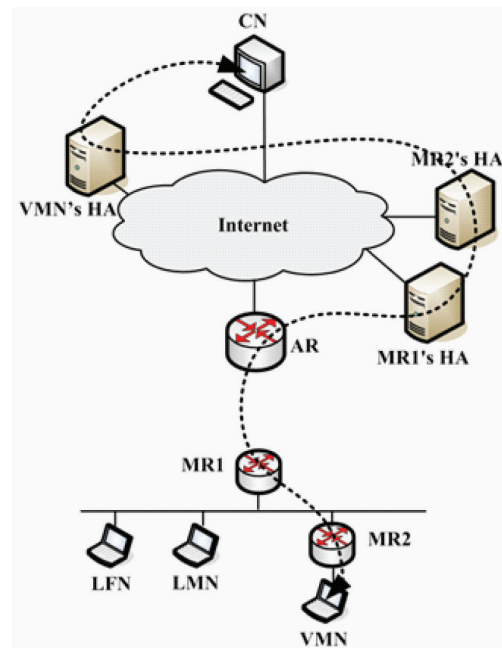
DOI: 10.4018/978-1-4666-0119-2.ch012

INTRODUCTION

Network mobility arises when an entire network of IPv6 nodes moves as an entity and changes its point of attachment to the Internet topology, e.g. people inside a vehicle accessing the Internet (Lach, Janneteau, & Petrescu, 2003). The NEMO working group developed NEMO BS (Devarapalli, Wakikawa, Petrescu, & Thubert, 2005) for mobility management of mobile networks by extending host mobility support protocol, Mobile IPv6 (Johnson, Perkins, & Arkko, 2004). Applying Mobile IP in the mobile network context results in poor performance with very high delays and overhead (Perera, Sivaraman, & Seneviratne, 2004). By introducing an entity named MR, NEMO BS enabled mobile network preserve communication with other nodes, while changing their point of attachment to the Internet. NEMO BS supports three kinds of nodes attached to a mobile network (Ernst & Lach, 2007), Local Fixed Node (LFN), Local Mobile Node (LMN), and Visiting Mobile Node (VMN). The basic concept is for each MR to have a HA, and use bi-directional tunneling between the MR and HA to preserve session continuity when the mobile network moves. The MR will do the necessary handoffs and all the devices attached to the MR can get mobility services without perceiving any movement.

Using MR-HA tunneling for packet transfer, NEMO BS results in triangular routing problem similar to Mobile IPv6 without Route Optimization (RO). Moreover, in the event of nesting of mobile networks, it has a pinball routing problem (Ng, Thubert, Watari, & Zhao, 2007), since all packets sent between source and destination node are forwarded via the HAs of all the MRs. Figure 1 shows the pinball route between the Correspondent Node (CN) and the VMN. It suffers from increased latency and packet size as an extra IPv6 header is added per level of nesting. Thus, NEMO BS supports session continuity but does not use Mobile IPv6 capabilities enough, specially

Figure 1. Pinball routing



Home Address (HoA) option and type 2 routing header to perform RO.

As next generation networks are expected to support real time multimedia applications that are highly time sensitive, not only the handover latency of mobile networks but also the end-to-end delay should be kept under certain values. The handover latency can be minimized using techniques such as one proposed in (Prakash, Verma, Tripathi, & Naik, 2009). Therefore, one of the major issues in network mobility is RO. RO techniques are required to handle the end-to-end delay between communicating peers which directly affects QoS. The high delay may cause TCP like protocols to suffer since TCP throughput is heavily dependent on Round Trip Time (RTT) between communicating peers, and the packet overhead may cause packet fragmentation required to fulfill the PMTU value.

The objective of this paper is to develop a RO mechanism that can effectively avoid the longer path bypassing the HAs, with apparent gain in terms of QoS and scalability. Moreover,

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